PIONEER INVENTIONS

and

PIONEER PATENTS

A lecture on Patent Law delivered to the Senior Engineering Students of Purdue University ot the Classes of '22, '23 and '24 and previous classes

by

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Preface.

Some years ago the author was invited to talk to the Senior engineering students of Purdue University on Patents and Patent Law. A single lecture only was wanted, limited to two hours. It was one of a course of lectures that were intended to give the students some advance information on questions that were apt to arise in the business world which they were about to enter. These lectures were given in a course under the title "Engineering Administration" and included such subjects as Contracts, Labor Problems, Advertising, Ethics, Insurance, Banking Corporations, Specifications, etc. How to present the subject of Patents and Patent Law so that it would instruct as well as entertain was a problem. College students are critical and Seniors no less so than the average. They can go to sleep on, or walk out from a two hour lecture with at least as much freedom as others. Some lecturers have had this demonstrated convincingly, if not to their entire satisfaction.

Patents are the metaphysics of the law and both the law and metaphysics are dry subjects. The combination of them does not help either. Several outlines for the proposed lecture were prepared only to be discarded and the subject laid aside. The subject was recalled when it was noticed that a popular science book described the alphabet as a great invention. This suggested as the basis of the lecture the alphabet, the art of printing, and the steam engine as historical and technical stepping stones, followed by some of the great inventions of the nineteenth century. The U. S. patents issued thereon were used, and some of the leading points of Patent Law were presented in connection therewith. The selection of inventions was confined to those inventions the use of which has been universal and with which everyone is familiar. Those patents were preferred in the litigation of which important questions of Patent Law had been passed on by the courts, and the Patent Law was written up as it had been evolved or applied in connection with each of these inventions.

For the first hour of the lecture the plan was a "ten strike", to borrow an expression of George Ade's. The second hour was easily filled by a statement of what the students would find in practice, the basis for which was well laid by what was said in the first hour. Throughout the whole talk the intention was to teach by example rather than precept or abstract principle.

The lecture has now been delivered four times to as many Senior classes. The first time was to an audience of twenty-five and the last time to over five hundred. The author has been invited to deliver it for the fifth time, this time to the Senior class of 1924. The author was urged to print this lecture by Dean A. A. Potter of the Engineering Schools of Purdue University, and because of the interest of that great educator and the encouragement given by him and his associates and students, he has felt warranted in putting the lecture in book form. A small edition was printed in 1923, which edition was promptly adopted as a text book for a class on Industrial Relations of the University of Minnesota. The book has been thoroughly revised and considerably enlarged, and is now presented in a second edition.

It is believed that the book will interest the engineering profession generally, also manufacturers and inventors, and that it will be of use as an elementary text book in law schools, more especially as an introduction to the study of patent law, and as a text book on economics or industrial relations, and kindred subjects.

The author wishes to acknowledge the valuable assistance received from Dean A. A. Potter, and the appreciation so warmly expressed by the faculty and students of the Engineering Schools of Purdue University.

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Pioneer Inventions and Pioneer Patents

By

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Part I.

The Constitution of the United States provides:

"Congress shall have power to promote the progress of Science and Useful Arts, by securing for limited times to Authors and Inventors the exclusive right to their respective Writings and Discoveries."

In accordance with this provision the Patent and Copyright laws have been passed.

The patent law provides for the granting of a patent on any new and useful invention of an art, machine, manufacture or composition of matter or any new and useful improvements thereof. Here four classes of invention are recognized and an invention to be patentable must fall in one of these classes.

The term "art" in the patent laws means a chemical or physical process, such as a process for making soap or nitro-glycerine or extracting gold, photographic or photo lithographic processes, or the process of tanning leather, or the Bessemer process for making steel. It can even include mechanical processes such as the process of making expanded metal, but will not ordinarily include a result that is merely the function or operation of a machine.

The term "machine" means a combination of stationary and moving mechanical elements adapted to receive power and apply it to a useful purpose. It need not be automatic. Usually the parts move through a regular cycle or cycles of operations and this may be defined as its "mode of operation." These include a steam engine, a dynamo, a typewriter, a lawn mower, etc.

The term "manufacture" means any product made by the art or industry of man which does not fall in the other classes and embodies invention. Barbed wire, expanded metal, excelsior, nails, tacks, tools and implements are examples of manufacture.

The term "composition of matter" means a mixture or chemical combination of materials. Gunpowder and red light are mixtures and nitroglycerine is a chemical combination. But few of the so-called patent medicines have been patented or are capable of being patented.

Anything to be patentable under any of these heads must be new and useful and must amount to invention as distinguished from ordinary mechanical skill.

To patent any of these inventions, the inventor must file an application with the Commissioner of Patents in which he must fully describe the invention and must illustrate the invention with drawings, if it can be so illustrated, and he must claim the invention by pointing out the particular part which is new and patentable, and must also swear that he is the inventor of the invention. If new and useful and the product of the inventive faculty, the Patent Office will grant a patent. In making an invention the mind leaps over a logical barrier.

When the patent issues, it is printed and copies of it are sold by the Patent Office at ten cents each, and the patent as so printed will contain a copy of the drawings and the specification that the inventor has filed in the Patent Office and the claims which the Patent Office has allowed him. The drawings and the specification must show the invention so fully that any one skilled in the art to which the invention pertains, can with the information contained in the patent, practice the invention without further assistance from the inventor. Each patent adds an invention to the world's store of knowledge and makes a permanent public record of it from the time the patent issues.

Design patents are also provided for by the Patent Law. The in-

ventions covered thereby are the creations of the artist and are patentable because they are ornamental and not because they are useful in the ordinary sense.

To the end of 1923 over 1,486,000 patents have been issued by the U. S. Patent Office. To present an elementary introduction to the patent law to the student, the engineer, or business man, which will include a comprehensive survey of even a fraction of these patents is impossible. Such a presentation would confuse more than it would expound or explain.

Patents have been called the metaphysics of the law. This is because they deal with technical subjects in a technical way and are not easily understood. So too the Patent Laws and the Rules of Practice of the Patent Office are not easily understood by people not specially trained therein. In this book a detailed discussion of patents and the patent laws will be avoided and the subject will be presented by means of a few pioneer inventions and the pioneer patents thereon. Nearly everyone is acquainted with these broad inventions and the claims in such patents are broad and simple and easily understood. Taken in connection with the history of the inventions and the litigation thereon, these patents will illustrate what patents should be and what they should not be.

The Alphabet.

The first pioneer invention to be considered is the alphabet. But is the alphabet an invention? Most of us who have had orthodox teaching are apt to assume that the alphabet is as old as the race and that both originated about 6,000 years ago, that it originated with Adam and Eve in the Garden of Eden and was taught to Cain and Abel. This also would lead us to assume that the written language is as old as the spoken language. None of these assumptions are correct. The alphabet is an invention and is probably the greatest invention ever made. Compared with the age of the race it is a very recent invention. It is much more recent than the bow and arrow and the wheel and axle. It is the first and only instrument that connects the written language with the spoken language. It was invented probably by the Phoenicians less than 4000 years ago. They were the first to drop all other written characters and use the alphabet exclusively in their writing. Other languages copied the alphabet from them.

The spoken language grew first. The written language started long after but without the alphabet. The written language first used pictures and then other characters, signs, and symbols to represent the spoken words for objects and ideas. Each spoken word if written at all was written with a picture or character different from every other word. Whatever language was written before the invention of the alphabet was written in crude clumsy characters or pictures that somewhat resemble and were harder to use and harder to understand than the illustrated rebus that we sometimes are in puzzles.

The use of such characters greatly restricted the growth of language and thought. The Chinese written language was originally made up of such characters and some of these characters have persisted in that language till the present time. In the Chinese language the sun is represented by a small circle with a dot in the center ⊙. The rising sun was indicated by this same character with a line under it $\underline{\odot}$. The setting sun by the same character with a line over it $\overline{\odot}$. Man is represented by two lines representing his legs ⋁. For thousands of years all written languages were made up of such characters. There was nothing about the character that indicated the sound of the spoken word that it represented. That was traditional and was handed down by word of mouth. Then some one conceived the idea of using characters to represent the com-

bination of sounds in a syllable, that is, one character to represent the combination of a vowel and one or more consonants. Many of the hieroglyphics of Egypt are characters of this sort. This required enormous numbers of characters to represent the various syllables that enter into words and in the Chinese language there are now over 20,000 of such characters each representing a different syllable. While these syllables each had a phonetic value it was but little better than the characters that represented complete words for the purpose of connecting the written with the spoken language.

Then someone discovered that these syllables were all made up of a few elementary sounds and that all of the composite sounds that are called words could be analyzed into these few elementary sounds. This was the discovery of a scientist and a discovery of the highest order. If the reader does not think so, let him try to pick out the elementary sounds from the conversation of his neighbor or from conversation in a strange language. This discovery was probably made without any reference to an improvement in the written language, just as many abstract scientific discoveries are made now without a practical application and sometimes years elapse before the inventor takes hold and applies these discoveries to a useful purpose by making an invention based on such discovery. However, that is no reason why these discoveries should not be made. Faraday's answer, "Of what use is a baby?" when he was asked of what use were his discoveries, is pertinent in this connection.

Finally an inventor grasped the opportunity and invented written characters that represented these elementary sounds and further invented the idea of arranging them in groups in various orders so that when the letters of a group were sounded collectively and in the order of their arrangement they would produce the sound of a word in the spoken language. Nearly all the words of alphabet languages are spelled phonetically, that is, in the manner above described. There are a few exceptions to phonetic spelling and the simplified spelling urged some years ago was intended to remove some of these exceptions.

It took a genius to recognize this possibility of connecting the written language with the spoken language. He invented the alphabet and put it to use in writing the language and for the first time made a simple direct connection between the spoken and the written language. Assuming that the alphabet had just been invented and applied to the English language and that a U. S. Patent may issue thereon the inventor would proceed as follows to secure the patent. He would first write a specification describing his invention substantially as follows:

"It has been discovered that the elementary sounds of the human voice are comparatively few in numbers. I have invented a series of written characters for representing these sounds which characters are 26 in number and are as follows: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z. These letters may be used to indicate the sound of spoken words heretofore used and to constitute the written word of said spoken word. For such purpose the letters are arranged in the order in which the sounds which they represent have heretofore occurred in such words so that when the letters are sounded collectively and in the order in which they are arranged they will reproduce the sound of the spoken word or make the composite sound which is the spoken word.

"These letters may be used to form all written and spoken words heretofore used by arranging them in the order in which the sounds which they represent have heretofore occurred in such words, so that the pronunciation of the word will indicate the spelling thereof and the spelling of such words as may now exist or may hereafter be formed will indicate the pronunciation thereof."

The inventor of the alphabet would have claimed his invention possibly in the following words:

"I claim the art of writing words by the use of letters each of which has a different elementary sound, which letters when sounded collectively and in the order of their arrangement will make the composite sound which is the spoken word."

He might also have claimed "the art of using characters for the formation of written words, each of which characters represents a distinct elementary sound made by the vocal organs."

Each of these claims give a broad definition or a broad description of the alphabet partly with reference to its makeup and partly with reference to its use and they describe the alphabets of the English language and other languages just as well as they describe the Phoenician alphabet. In other words, they point out the invention, for such is the function of the claim.

The preliminary work in analyzing sounds into elements was done in Egypt and other countries. But none of these countries carried the work far enough. In Egypt especially writing was kept a mystery by the priests and simplification of writing so that it could be used by the masses was against their policy. Hence, they continued to use symbols for words and syllables mixed with the elements of the alphabet.

The Phoenecians may have had the benefit of this preliminary work and again their development of the alphabet may have been entirely original. Assuming that the Phoenecians borrowed the alphabet from the Egyptians, they quickly reduced it to its simplest terms and stripped from it all matter that made it obscure. The religious scruples that affected the Egyptians had no weight with them. If the characters were divine for the priests of Isus they were a convenient instrument to supply the every day wants of the sailors of Tyre. So they made the alphabet complete according to their own ideas and applied it to the writing of their own language and dropped all other symbols. In other words, they completed the invention, reduced it to practice, gave it to the public and put it to use. They made it a practical success and used it in their every day business.

The Phoenecian alphabet had only consonants. The Greeks improved upon it by adding vowels. This is the usual course in making inventions. It is seldom that one inventor or set of inventors can carry an invention to completion or exhaust the possibility of improvements.

The English alphabet is not a complete and perfect instrument. It duplicates some sounds and omits others. C and K, G and J, S and Z, F and PH are largely duplicates of each other and X has practically the same sound of KH, KS or GZ. It omits characters for many vowel sounds or variations in vowel sounds which must be left to memory. The Greek alphabet has diphthongs which the English alphabet omits. Such irregularities account for the differences in the number of characters in the alphabets of the various languages and shows how habit frequently blocks the road to improvement.

The Phoenicians were a commercial people and their sailors and merchants went to all parts of the world which they could reach by ships and they carried their alphabet with them. The invention was carried to every nation bordering on the Mediterranean Sea and to even more distant territory and each of these countries quickly adopted the alphabet as the basis of its written language. In this way the use of the alphabet spread. Each country adapted it to its own language. The number of letters in the alphabet varied. The Phoenician alphabet had 22 letters, Hebrew 20, Greek 24, Latin 23, English 26. The sounds represented by these letters were largely the same for the human voice is practically the same the world over and the alphabets all contained sub-

stantially the same invention, for each of the letters of an alphabet represented a different elementary sound and all the letters of an alphabet represented all the sounds which the voice would make in speech.

All these alphabets in other languages would have infringed the patent granted on the Phoenecian alphabet, assuming that a patent could have been issued on the original invention. The later alphabets in other languages might have been improvements on the original alphabet but they would have infringed the claims above specified and tribute could have been levied if such claims had been granted by a government having jurisdiction over all the languages.

The alphabet is easily learned and remembered and it is easy to use. It saves a vast amount of time, expense and mental energy that is wasted by languages that have no alphabet. It simplifies reading, writing and printing and has made the education of the masses possible. It makes possible what would otherwise be impossible. The absence of an alphabet in a language makes printing difficult and makes telegraphy impossible. The Chinaman has never been able to send a telegram in his own language for it has no alphabet. He can use the telephone and talk Chinese but in telegraphing the practice in China is to translate all Chinese messages into English and send them in the Morse code. At the receiving station they are translated back into Chinese and delivered. The telephone is adapted to all languages because it transmits speech or sounds and can transmit both elementary and composite sounds but the telegraph is not so adaptable for its signals are based on the alphabet.

The Illiad and Odyssey of Homer were not reduced to writing until after the alphabet had been carried into Greece and until after it had been improved upon and assimilated, or probably later than 550 B. C. For several hundred years before that time these poems existed only in the memory of the bards. Without the alphabet these poems would never have been recorded and would probably have been lost. It is possible that in other languages other gems of literature equally great once existed that were lost because there was no alphabet for recording them.

With the invention of the alphabet, the real mental development of the human race began. The alphabet has contributed more to the development of the human race than all of the inventions that were made by the human race prior to its invention and for a long time thereafter. The human race has been on earth over five hundred thousand years and possibly for many times that period. Yet the alphabet was invented less than four thousand years ago. These figures show how very slow man has been in making inventions in any except modern times.

Under the U. S. Patent laws there is no room for the patenting of such an invention as it does not fall within the four classes prescribed by the law. It is cited as an illustration of a great invention and as an illustration of an invention that cannot be patented although it is properly called an art.

If the art of printing had been invented first and the alphabet had been invented to supplement it and carry it into effect the alphabet might have been claimed in connection with the invention of printing. This is what happened in connection with the Morse telegraph patent for Morse not only invented telegraph instruments by which signals were transmitted and recorded but also invented an alphabet of dots and dashes by which the signals were expressed. Of this more will be said later.

Printing.

The next important invention to be considered is the invention of the art of printing. This invention was made less than five hundred years

ago in Germany and we will say that John Gutenburg of Mainz was the inventor.

If he had applied for a United States patent he might have said in his specification:

"I have invented the art of printing in the practice of which I have made a separate metal type for each letter of the alphabet and for each of the other characters used in writing, such as numerals, punctuation marks, etc. Each type has a character formed thereon by a raised or a sunken surface. A separate matrix is made for each type and a great number of type can be cast from each matrix. These type are grouped alphabetically, or numerically, etc., all the type of one letter or character being kept together for convenience. These type can be assembled in any order that may be desired to form words and sentences suitably spaced apart and punctuated and when so assembled, the surfaces of the type showing the characters will occur on a single plane. These type surfaces can then be coated with ink and a sheet of paper can then be pressed on the inked surfaces and the ink carried thereby will adhere to the paper and make an impression of the characters of the type so assembled. The letters will appear negative and in negative order in the type and positive and in positive order on the printed paper.

"After the type have been used for the purpose of printing a suitable number of impressions, they may be distributed under their proper classification and may then be re-assembled in another order to make other words and sentences for the purpose of making another set of impressions.

"The type with the alphabetical and other characters formed thereon are shown in the drawings which are submitted herewith."

The inventor might have claimed as follows:

"I claim the use of movable type each having a raised surface formed thereon corresponding to a letter of the alphabet and other characters used in writing and capable of making a separate distinct impression of that letter or character on any substance."

He might also have claimed as follows:

"The use of movable type each having a raised surface formed thereon, one for each letter of the alphabet, which type can be assembled to represent words and from which an impression of such words can be made on some other substance."

Either of these claims would cover the old hand form of composition but perhaps neither of these claims would specifically cover the line of matrices assembled by the Mergenthaler Type Setting Machine and the line of type cast thereby. Yet, Gutenburg's invention of the art of printing was broad enough to include or lay the basis for the work of the linotype or type casting machine and he would therefore have been entitled to a claim broad enough to cover it as follows:

"I claim the art of casting type by the use of a matrix. I claim the art of making impressions by movable type."

These claims would have covered the Mergenthaler machine.

The foregoing claims on the alphabet and the art of printing fairly illustrate what patent claims are and the difference between broad and narrow claims and the need of claiming an invention in every possible way.

So far the printing press has not been mentioned as a part of the art of printing. It was a separate invention and an important step in the development of the art as we see it in retrospect, but the art of printing was made up of a number of inventions each of which was patentable in itself. These separate inventions can be listed first, as movable type, second, the hand setting of the type, and third, the taking of an impression from the type by hand without a press just as the printer now takes a proof by hand from type, fourth, the casting of type in a matrix and

fifth, the printing press. It is quite probable that the casting of type in a matrix and the use of a printing press was not arrived at until many years after the preceding steps had been taken. Yet the art of printing was a complete invention when movable type were made and set up and an impression was taken from them by hand.

When Gutenberg invented printing he did not show his invention to the public but kept it as a trade secret although not for long. He soon lost his trade secret and this is how it happened: The first book that Gutenberg printed was the Bible and when he had printed the first edition (about 1450), his partner, John Faust, went to Paris to sell the books. He sold his first copy to Charles VII of France. The book was greatly admired. Every one thought it was copied by hand and marveled at the evenness and uniformity of the letters. It must have taken a wonderfully steady hand to copy it and must have been the work of a life time, so every one thought, for every letter was clear and distinct, not a blot or an error was found anywhere. The King paid 750 crowns for it.

Some days later the archbishop called and the king showed him the Bible. The archbishop said at once that it was much like the one he had recently bought. He sent for his copy and compared them. To their astonishment they found that they were exactly alike page for page, line for line and word for word. They could hardly believe their senses so contrary was this to their ordinary experience with books. Then they found that others had copies just like theirs which further increased the mystery. Finally they traced the books back to John Faust and John Gutenberg and the clergy at once accused them of having sold themselves to the devil. The monks and friars had copied all books by hand up to this time and they joined in denouncing Faust and Gutenberg for their occupation was threatened by this mystery. To save their lives Faust and Gutenberg had to show how the books were copied by printing and thus the secret got out and soon spread to all countries. But the printer never forgave the clergy for causing the loss of their secret and by way of contempt he called a blot a monk and a blank a friar and by way of glorifying the devil he called the printer's boy by that name. These terms have been used in the trade ever since. Their use has a connection with the loss of a valuable trade secret that has been of vast benefit to the whole world. It has been the most valuable invention ever given to the human race. Printing would have been impossible without the alphabet, and would have been impractical without the development of paper. This great invention was therefore, dependent on two prior inventions. This is frequently the case with inventions.

Steam Engine.

The next important invention was the invention of the steam engine which was the greatest invention of the 18th Century and was made less than one hundred and sixty years ago. First Newcomen invented a steam engine in 1705 that used steam at a pressure but little above the pressure of the atmosphere. It developed power only by condensing the steam in the engine cylinder and forming a vacuum therein. The atmospheric pressure then moved the piston into the vacuum so formed. This condensation chilled the cylinder which had to be heated again by the steam admitted for the next stroke. In 1762 Watt added the separate condenser which was kept cold while the cylinder was kept hot. This stopped the waste of heat and made the engine efficient. In 1802 Trevithick added high pressure steam so that the piston was worked with both pressure and vacuum. This development was greatly delayed by the lack of our modern machine tools of capacity and precision. Good castings were hard to make. For years it was impossible to bore cylinders accurately and the

steam leaked past the piston. In the absence of good plates, boilers could not be built that would stand the pressure. But finally these difficulties were overcome and efficient engines and boilers were made and English coal and power were put to work in factory production.

Incidentally some of these things worked for good. Newcomen's engine leaked between the cylinder and piston and being an upright engine he put water on top of the piston to seal the joint. Some of the water leaked through into the live steam and where it did he found that the steam condensed quicker and more effectively than when he depended on the chilling of the surface of the cylinder alone. So he invented the jet condenser. The valves in the Newcomen engine had to be worked by hand and a small boy was so employed on one engine, but he wanted to play marbles instead of attending to such monotonous work and he fastened the valve handles to the walking beam by strings in such a way that they opened and closed automatically after the engine was once started. Real valve gear then followed as a matter of course.

Watt's first engines were for pumping water out of mines, and did not produce rotary motion for it was not needed. He later intended to produce rotary motion by a rotary steam engine. Then he invented the connecting rod and crank to convert the reciprocating motion of the piston into rotary motion of the shaft only to find that Pickard had patented it before him. Watt then invented his sun and planet motion to turn the power shaft. This was used for a time but with the expiration of Pickard's patent this motion has become obsolete.

James Watt secured an English patent in 1769, No. 913, entitled "Watt's Method of Lessening the Consumption of Steam and Fuel for Fire Engines," and in the specification of this patent he set forth the principles of his invention so briefly and clearly that the reader will recognize that they underlie the operation of the steam engine of today and show that Watt was a master mind in steam engine work.

In this specification Watt refers to his engine as a fire engine and this must not be confused with the fire engines that are used in the fire department for putting out fires, but is an engine that is driven by fire which generates steam that is used under pressure in the engine cylinders.

Watt's patent specification reads in part as follows:

"My method of lessening the consumption of steam and consequently fuel in fire engines, consists of the following principles:

"First: That vessel in which the powers of steam are to be employed to work the engine, which is called the cylinder in common fire engines, and which I call the steam vessel, must, during the whole time the engine is at work, be kept as hot as the steam that enters it; first by enclosing it in a case of wood, or any other materials that transmit heat slowly; secondly, by surrounding it with steam or other heated bodies; and thirdly, by suffering neither water nor any other substance colder than the steam to enter or touch it during that time.

"Secondly: In engines that are to be worked wholly or partially by condensation of steam, the steam is to be condensed in vessels distinct from the steam vessels or cylinders, although occasionally communicating with them; these vessels I call condensers; and, whilst the engines are working, these condensers ought at least to be kept as cold as the air in the neighborhood of the engines, by application of water or other cold bodies.

"Thirdly: Whatever air or other elastic vapor is not condensed by the cold of the condenser, and may impede the working of the engine, is to be drawn out of the steam vessels or condensers by means of pumps, wrought by the engines themselves or otherwise.

"Fourthly: I intend in many cases to employ the expansive force of steam to press on the pistons or whatever may be used instead of them,

in the same manner in which the pressure of the atmosphere is now employed in common fire engines. In cases where cold water cannot be had in plenty, the engines may be wrought by this force of steam only by discharging the steam into the air after it has done its office.

Fifthly: Where motions around an axis are required, I make the steam vessels in form of hollow rings or circular channels, with proper inlets and outlets for the steam, mounted on horizontal axles, like the wheels of a water mill; within them are placed a number of valves that suffer any body to go round the channel in one direction only; in these steam vessels are placed weights, so fitted to them as entirely to fill up a part or portion of their channels, yet rendered capable of moving freely in them by the means hereinafter mentioned or specified. When the steam is admitted in these engines between these weights and the valves, it acts equally on both, so as to raise the weight to one side of the wheel, and by the reaction on the valves successively to give a circular motion to the wheel, the valves opening in the direction in which the weights are pressed, but not in the contrary; as the steam vessel moves round, it is supplied with steam from the boiler, and that which has performed its office may either be discharged by means of condensers or into the open air.

"Sixthly: I intend in some cases to apply a degree of cold not capable of reducing the steam to water, but of contracting it considerably, so that the engine shall be worked by the alternate expansion and contraction of the steam.

"Lastly: Instead of using water to render the pistons and other parts of the engine air and steam tight, I employ oils, wax, rosinous bodies, fat of animals, quick silver and other metals in their fluid state."

The last claim which covers various expedients in packing the piston with the cylinder is a curious side-light on the inaccuracy with which cylinders were bored and the inaccuracy with which pistons were fitted to the cylinders. This appears from the following which is taken from the ninth edition of the Encyclopaedia Britannica, Vol. 15, page 152, under the subject of Machine Tools:

"James Watt, for instance, in 1769, was fain to be content with a cylinder for his 'fire engine' of which, though it was but 18 inches in the bore, the diameter in one place exceeded that at another by about $\frac{3}{8}$ of an inch; its piston was not unnaturally leaky, though he packed it with paper, cork, putty, pasteboard and old hat."

After the development of the steam engine came the invention of the locomotive, and the Bessemer process for making steel, all of them inventions of the 19th Century, the Bessemer process being, it is believed, the greatest invention of the 19th Century, the steam engine being the greatest invention of the 18th Century. These were English inventions and were covered by British patents. We need not go into claims on these inventions but will presently refer to claims which have been granted in the United States patents on other inventions now in common use.

It is again pointed out that the human race has been on this earth for over five hundred thousand years. It used over ninety-nine per cent of that time before it invented the alphabet and it used ninety-nine and nine-tenths per cent of that time before it invented the art of printing. Both of these inventions are therefore of recent origin and the golden age of mechanics has been literally crowded into the short space of time which has passed since the invention of the steam engine and has been more especially crowded into the last fifty years of that time since machine tools were produced and made available for manufacturing.

In the United States up to the end of the year 1922 over 1,440,000 patents were granted. Of these about 98,000 were granted before the

year 1870. In the fifty odd years beginning with 1870 about 1,300,000 patents have been granted in the United States. Over 500,000 British patents have been issued in the same time and correspondingly large numbers have been issued by all other countries. So that in the last fifty years about 4,000,000 patents have been issued in the various countries of the world and in all of the countries before the last fifty years the total number of patents granted was probably less than 200,000.

The invention of the alphabet made possible the real mental development of the human race. It laid the basis for the art of printing. The invention of the art of printing made possible the education of the human race and the invention of the steam engine, and various other forms of power development that have come since that time have made possible the raising of the human race from poverty or slavery to freedom and civilization and even luxury.

Every patent issued adds to the store of human knowledge and educates and elevates the race. Every patent issued is a public asset given without expense to the community. The inventor is compensated for a short time only out of a permanent profit which the invention creates. The public gets the most of the profit or saving or wealth arising from inventions. A small part only is given to the inventor. The inventor is the benefactor of the public and the advantages and luxuries which we have on every hand afford abundant evidence of the debt which civilization owes to its greatest patron, namely, the inventor.

The development of the human race by invention has been wonderfully summarized by the late Robert H. Ingersoll in a Thanksgiving sermon published in the Dresden Edition, Vol. 4, from page 160 of which the following is quoted:

"It is a long road from the savage to the scientist—from a den to a mansion—from leaves to clothes—from a flickering rush to the arc light—from a hammer of stone to the modern mill—a long distance from the pipe of Pan to the violin—to the orchestra—from a floating log to the steamship—from a sickle to a reaper—from a flail to a threshing machine—from a crooked stick to a plow—from a spinning wheel to a spinning jenny—from a hand loom to a Jacquard—a Jacquard that weaves fair forms and wondrous flowers beyond Arachne's utmost dreams—from a few hieroglyphics on the skins of beasts—on bricks of clay—to a printing press, to a library—a long distance from the messenger, traveling on foot, to the electric spark—from knives and tools of stone to those of steel—a long distance from sand to telescopes—from echo to the phonograph, the phonograph that buries in indented lines and dots the sounds of living speech, and then gives back to life the very words and voices of the dead—a long way from the trumpet to the telephone, the telephone that transports speech as swift as thought and drops the words, perfect as minted coins, in listening ears—a long way from a fallen tree to the suspension bridge—from the dried sinews of beasts to the cables of steel—from the oar to the propeller—from the sling to the rifle—from the catapult to the cannon—a long distance * * * from slavery to freedom—from appearance to fact—from fear to reason."

Thanks to the inventor, the human race has traveled all this distance and an even greater distance, for it must be remembered that this summary was written 25 years ago, and some of the inventions which have contributed to these remarkable results have been patented in United States patents, and particular ones of these United States patents on pioneer inventions will now be considered and discussed with reference to the inventions they disclose and cover and the features and principles of patent law that they embody or their history may illustrate.

The patents selected cover inventions that are widely used and with which the public generally is well acquainted.

4 Sheets-Sheet 1.

S. F. B. Morse,

Printing Telegraph.

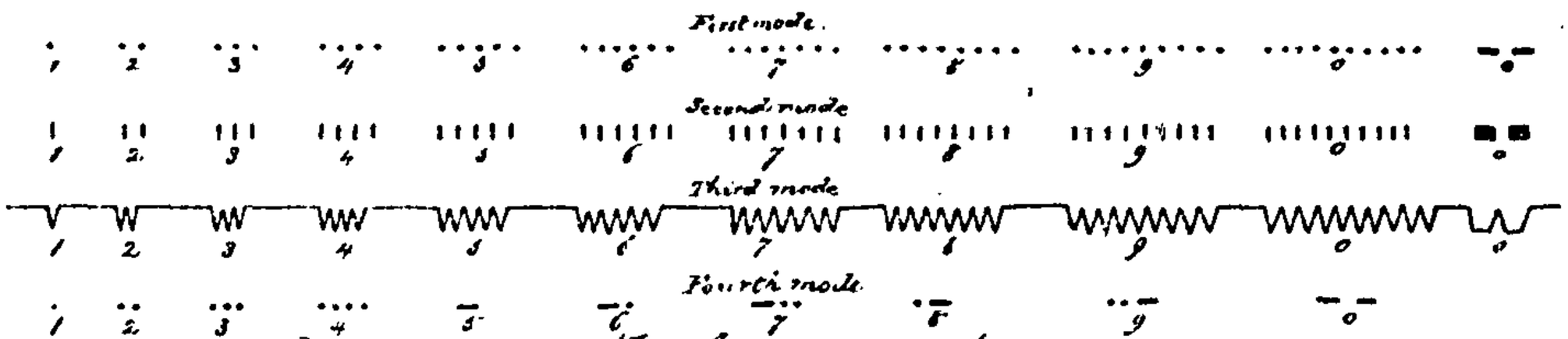
No 117.

Reissued June 13, 1848.

The System of Signs.

Example 1st

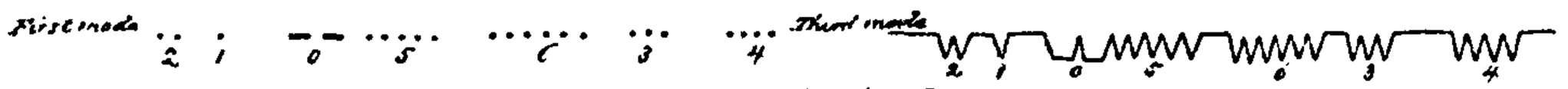
1st For Numerals.



Example 2d

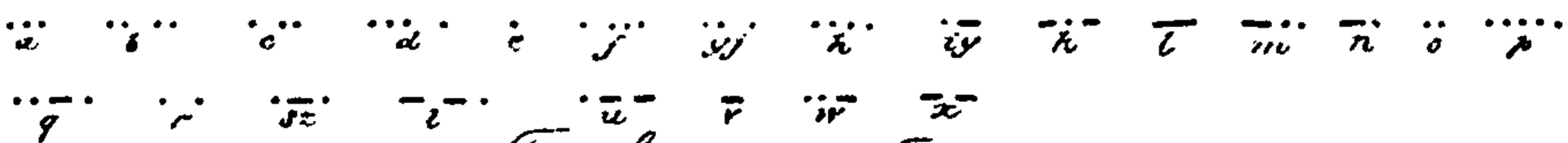
For Compound Numerals.

Showing the numerals combined together



Example 3d.

2d For Letters



The System of Type.

Example 4th

4th For Numerals.

Fig. 1.

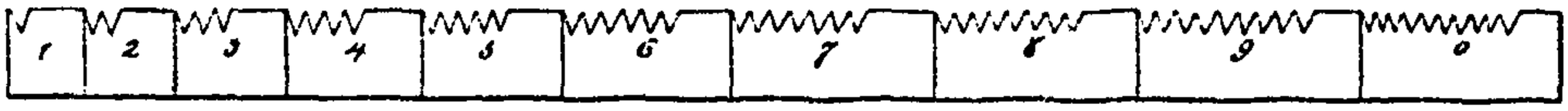
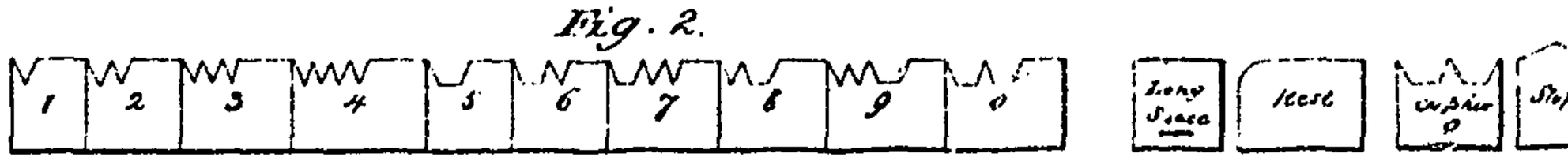
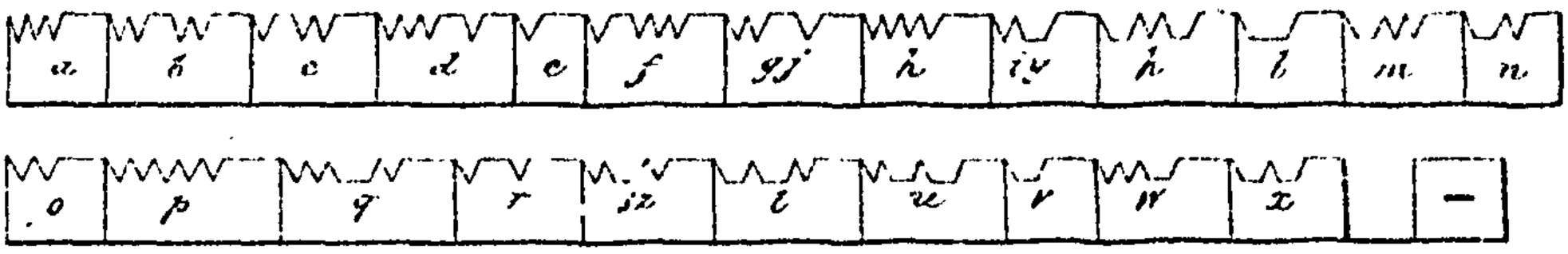


Fig. 2.



Example 5th

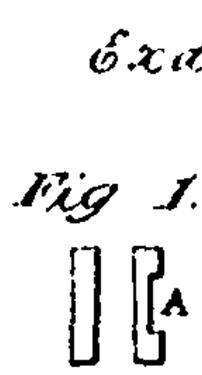
2d For Letters



Example 6th

Type for Circular Portrule.

Fig 1.



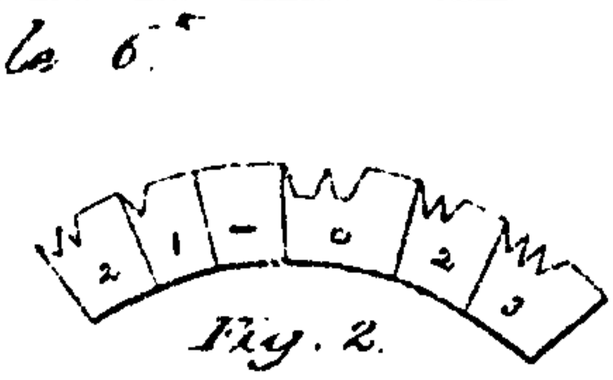


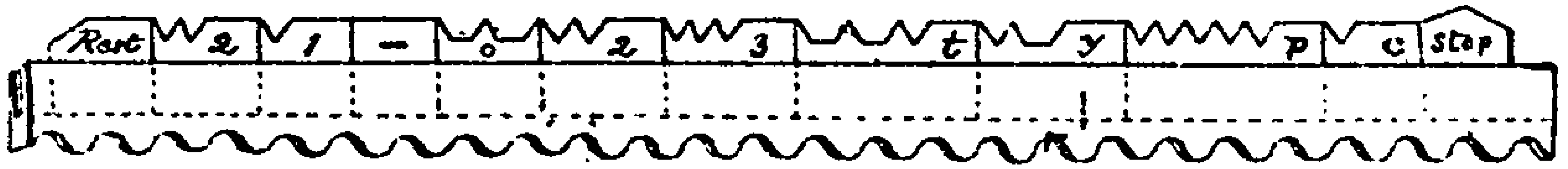
Fig. 2.

Fig. 3.

The System of Mechanism.

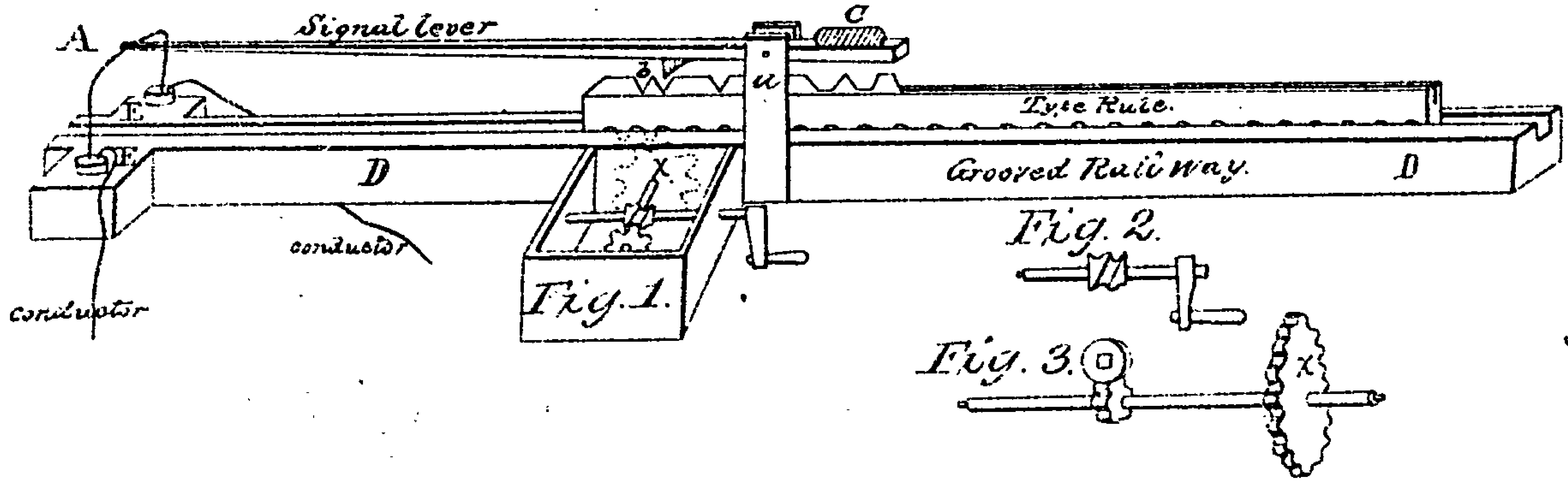
Example 7.

Type Rule.



Example. 8.

Straight Port Rule.



No 117.

S. F. B. Morse,

Printing Telegraph.

Reissued June 13, 1848.

4 Sheets, Sheet 2.

S. F. B. Morse,
Printing Telegraph.
Reissued June 13, 1848.

No. 117.

Example 10

Register

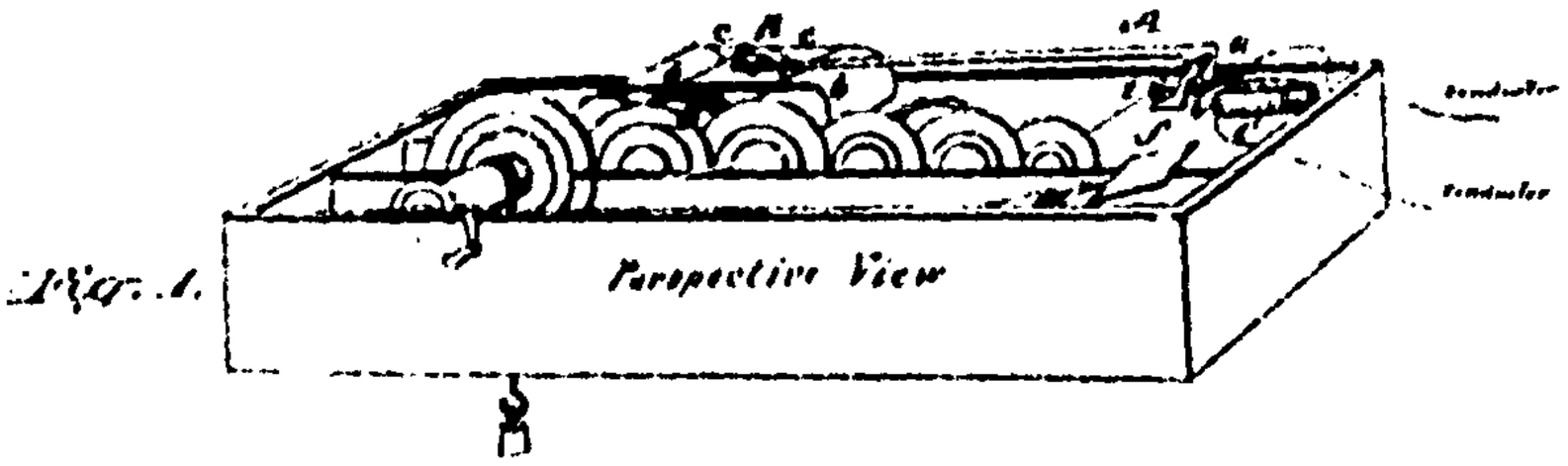


Fig. 1.

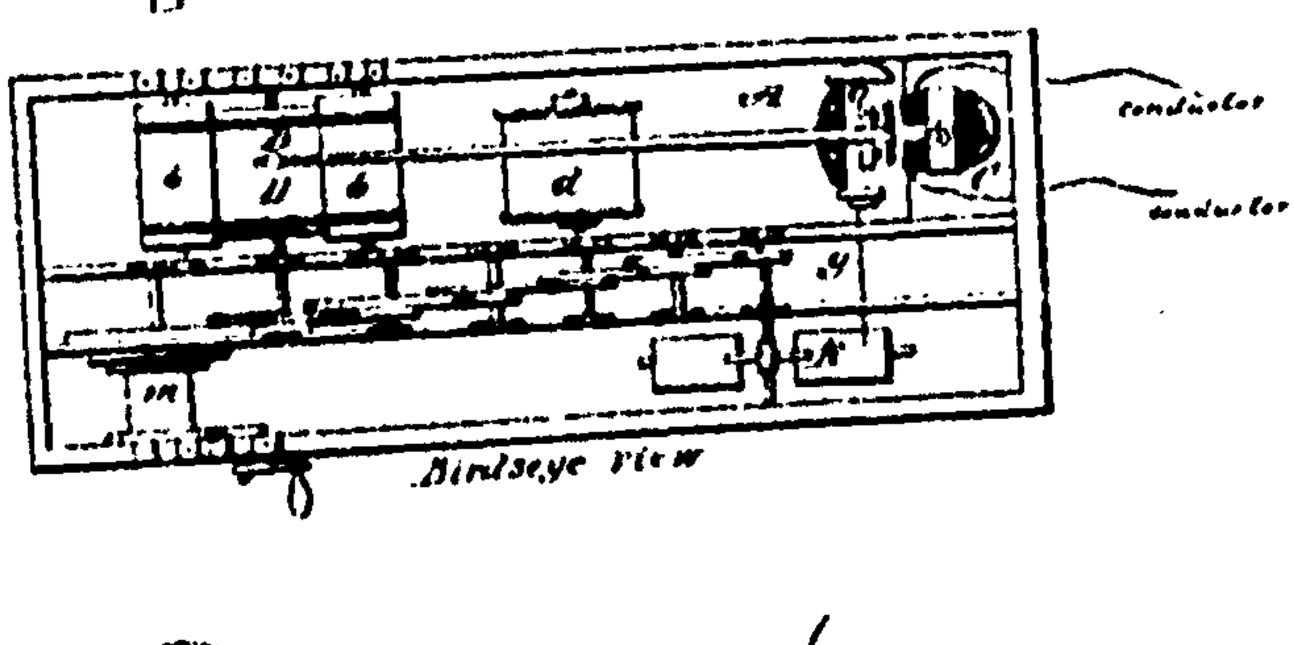


Fig. 2.

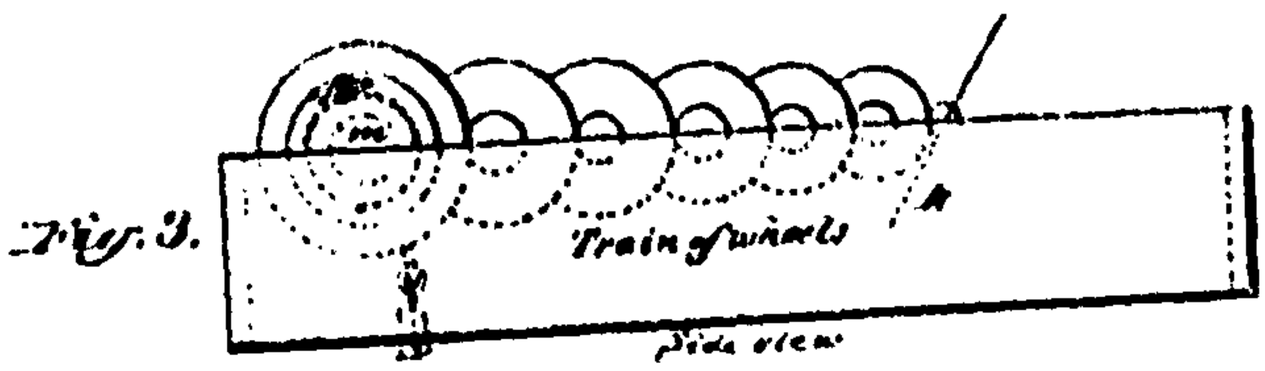


Fig. 3.

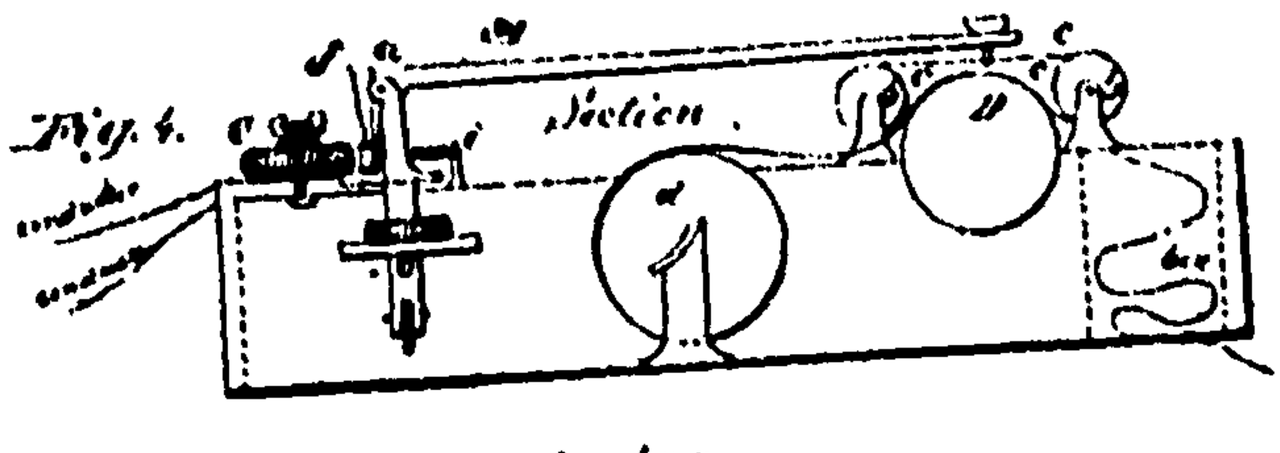


Fig. 4.

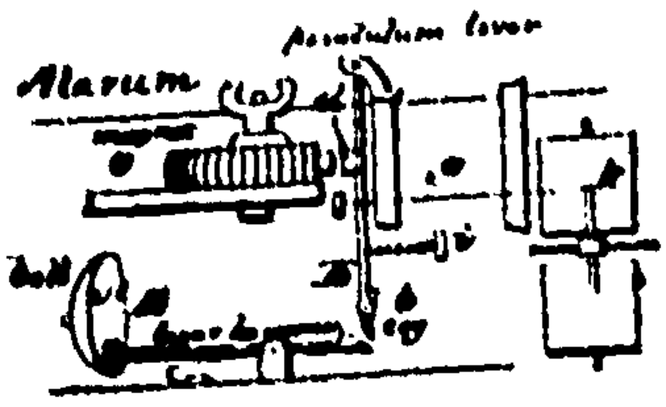


Fig. 5.

No 117.

S. F. B. Morse,
Printing Telegraph.
Reissued June 13, 1848.

4 Sheets, Sheet 4.

Example, II.

Fig: 1.

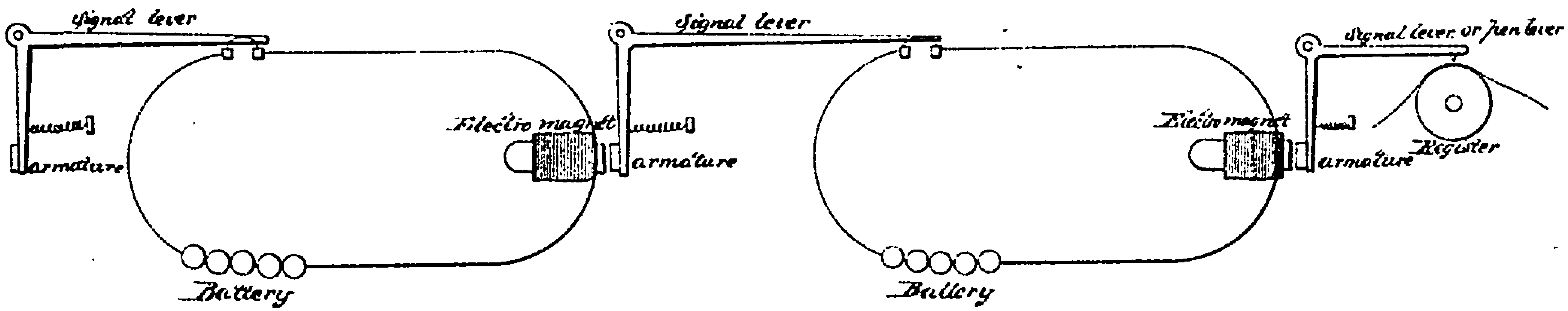
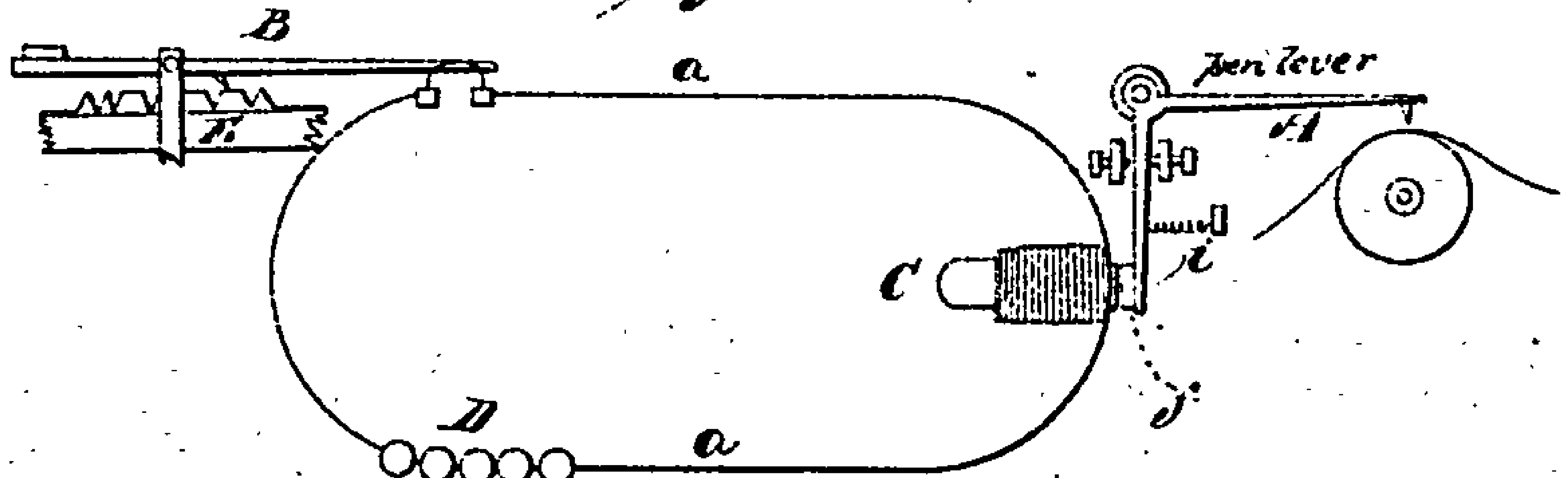


Fig: 2.



UNITED STATES PATENT OFFICE.

S. F. B. MORSE, OF POUGHKEEPSIE, NEW YORK.

IMPROVEMENT IN ELECTRO-MAGNETIC TELEGRAPHS.

Specification forming part of Letters Patent No. 1,647, dated June 20, 1840; Reissue No. 79, dated January 15, 1846; Reissue No. 117, dated June 13, 1848.

To all whom it may concern:

Be it known that I, SAMUEL F. B. MORSE, now of Poughkeepsie, in the county of Duchess, in the State of New York, have invented a new and useful apparatus for and a system of transmitting intelligence between distant points by means of electro-magnetism, which puts in motion machinery for producing sounds or signs, and recording said signs upon paper or other suitable material, which invention I denominate the "American Electro-Magnetic Telegraph;" and I do hereby declare that the following is a full, clear, and exact description of the principle or character thereof, which distinguishes it from all other telegraphs previously known, and of the manner of making and constructing said apparatus and applying said system, reference being had to the accompanying drawings, making part of this specification, in which—

Examples 1, 2, and 3 show my system of signs, consisting of a combination of dots and spaces, and of dots, spaces, and horizontal lines, intended to represent—example 1, signs for numerals; example 2, signs for compound numerals; example 3, signs for letters; all which signs may also represent words or sentences. Examples 4, 5, and 6 are specimens of the form of type used for regulating the imprinting of the signs. Example 7 is the type rule; example 8, apparatus for connecting and breaking the electrical or galvanic circuit. Example 10, Figure 1 is a perspective view of the registering apparatus; Fig. 2, a top plan; Fig. 3, a side elevation of the train of wheels moving the paper and regulating its motion; Fig. 4, a sectional elevation of the registering-lever and parts appended thereto; Fig. 5, alarm apparatus. Example 11 is a diagram showing the relative positions of the different parts of an approved form of apparatus, including a combination of circuits.

Prior to my first application for a patent it had been essayed to use the currents of electricity or galvanism for telegraphic purposes, either by decomposition or the action or exercise of the deflective force of a current upon a magnetized bar or needle, which decomposition or deflection required to be noted by ocular inspection at the instant the sign was made.

By my invention the intelligence can be transmitted and imprinted on paper or other suitable substance without requiring the aid of any person at the station to which the communication is transmitted, so as to be read at any time thereafter. My apparatus for this purpose consists of two principal parts or combinations.

The first part consists of a galvanic battery or any known generator of galvanism or electricity, a galvanic or electric circuit composed of any known conductors of electricity, a port-rule and signal-lever or other contrivance for closing and breaking the circuit, all in combination with an electro-magnet or device by which the motive power of the electric or galvanic current, which I call "electro-magnetism," may be developed and applied to give motion to other machinery for the purpose of marking or imprinting intelligible characters, signs, or letters at any distances. The conductors may be suspended in the air upon posts or otherwise, or buried in the ground, being always well insulated at the posts or in the ground. This combination is illustrated in the annexed drawings in example 11, Fig. 2, where D indicates the battery; *a a*, the circuit; E, the port-rule; B, the signal-lever, and C the electro-magnet.

The new parts and the operation of this portion of my apparatus I thus further describe viz:

At any convenient point in the circuit (generally near the generator) a break is made in the conductor, and the two ends thereof are immersed in mercury-cups, as shown in the drawings at E E, Fig. 1, example 8. To connect the circuit I employ an inverted U-formed piece of metal or other proper connector, A, suspended over the mercury-cups E E on the end of a horizontal lever, denominated in said drawing the "signal-lever," whose fulcrum is at *a*, so that when the connector A is dipped into the cups the circuit is completed. Between the fulcrum and connector A there is affixed to the under side of the lever, and projecting downward, a triangular tooth, *b*, which bears on the upper surface of the types about to be described, and is raised or lowered by them.

The lever may be counterbalanced by a weight or its equivalent, as at C, to make it move easily.

is used to close and break the first circuit. The second circuit has an independent battery, and may be used to work a register or other apparatus for registering, or to close and break a third circuit, or both, and thus by a combination of circuits the requisite power can be obtained at any distances *ad infinitum*. This combination is shown in example 11, Fig. 1.

It will be observed that my vocabulary system of signs or secret writing by cipher can be conveniently used in communicating by this telegraph, and any mode of closing and breaking a circuit may be adopted, the object being to do so at proper intervals.

Having thus fully described my invention, I wish it to be understood that I do not claim the use of the galvanic current or currents of electricity for the purpose of telegraphic communications generally; but

What I specially claim as my invention and improvement is—

1. Making use of the motive power of magnetism when developed by the action of such current or currents, substantially as set forth in the foregoing description of the first principal part of my invention, as means of operating or giving motion to machinery which may be used to imprint signals upon paper or other suitable material, or to produce sounds in any desired manner for the purpose of telegraphic communication at any distances. (The only ways in which the galvanic current had been proposed to be used prior to my invention and improvement were by bubbles resulting from decomposition and the action or exercise of electrical power upon a magnetized bar or needle and the bubbles, and the deflections of the needles thus produced were the subjects of inspection, and had no power, or were not applied to record the communication. I therefore characterize my invention as the first recording or printing telegraph by means of electro-magnetism. There are various known modes of producing motions by electro-magnetism; but none of these had been applied prior to my invention and improvement to actuate or give motion to printing or recording machinery, which is the chief point of my invention and improvement.)

2. The employment of the machinery called the "register" or "recording-instrument," composed of the train of clock-wheels, cylinders, and other apparatus, or their equivalents, for moving the material upon which the characters are to be imprinted, and for imprinting said characters, substantially as set forth in the foregoing description of the second principal part of my invention.

3. The combination of the machinery herein described, consisting of the generator of electricity, the circuit of conductors, the contrivance for closing and breaking the circuit, the electro-magnet, the pen or contrivance for marking, and the machinery for sustaining and moving the paper, all together constituting one apparatus or telegraphic machine, which I denominate the "American Electro-Magnetic telegraph."

4. The combination of two or more galvanic or electric circuits with independent batteries, substantially by the means herein described, for the purpose of obviating the diminished force of electro-magnetism in long circuits, and enabling me to command sufficient power to put in motion registering or recording machinery at any distances.

5. The system of signs consisting of dots and spaces, and of dots, spaces, and horizontal lines, for numerals, letters, words, or sentences, substantially as herein set forth and illustrated, for telegraphic purposes.

6. The system of signs consisting of dots and spaces, and of dots, spaces, and horizontal lines, substantially as herein set forth and illustrated, in combination with machinery for recording them, as signals for telegraphic purposes.

7. The types or their equivalent and the type-rule and port-rule, in combination with the signal lever or its equivalent, as herein described, for the purpose of closing and breaking the circuit of galvanic or electric conductors.

8. I do not propose to limit myself to the specific machinery or parts of machinery described in the foregoing specification and claims, the essence of my invention being the use of the motive power of the electric or galvanic current, which I call "electro-magnetism," however developed, for marking or printing intelligible characters, signs, or letters at any distances, being a new application of that power of which I claim to be the first inventor or discoverer.

SAM. F. B. MORSE.

In presence of—
GEO. WOOD,
J. READ BAILEY.

Electric Telegraph.

On June 20, 1840, Samuel F. B. Morse took out his patent 1,647 on "an improvement in the mode of communicating information by signals by the application of electro-magnetism." The original patent contains three sheets of drawings and six pages of specification and claims. It describes a telegraph apparatus on a single circuit, a relay mechanism for extending the circuit, and a telegraphic alphabet. This alphabet with but little change has ever since been known as the Morse code. The patent also shows mechanism for printing this alphabet on paper to make a permanent record. When Morse patented the invention he intended the message to be read from this record and such was the practice for some time after the telegraph was put into use, but operators soon began to read the sounds by ear and the printing mechanism fell into disuse.

Morse's telegraph instruments were very crude, clumsy and cumbersome as compared with the improved instruments adopted a few years later in commercial use. These improved instruments have been kept in use ever since (for sixty years) with but little change.

The Morse patent No. 1647 contained three sheets of drawings and six pages of specifications and claims. Morse surrendered his patent and took instead his reissue patent, R 79, issued Jan. 15, 1846. This patent contained four sheets of drawings and less than three pages of specification and claims.

Later on Morse surrendered this reissue patent and obtained instead R 117 issued Jan. 13, 1848.

The drawings of all these patents are the same except that the second and third patents illustrate relays which are not shown in the drawings of the first patent. For our purpose, it is sufficient to present merely the third patent R 117 in full and reproduce the claims of the first and second patents.

The first patent contained nine claims as foilows:

"1. The formation and arrangement of the several parts of mechanism constituting the type-rule, the straight port-rule, the circular port-rule, the two signal-levers, and the register-lever and alarm-lever, with its hammer, as combining respectively with each of said levers one or more armatures of an electro magnet, and as said parts are severally described in the foregoing specification.

2. The combination of the mechanism constituting the recording-cylinder and the accompanying rollers and train-wheels with the formation and arrangement of the several parts of mechanism, the formation and arrangement of which are claimed as above and as described in the foregoing specification.

3. The use, system, formation, and arrangement of type and of signs for transmitting intelligence between distant points by the application of electro-magnetism and metallic conductors combined with mechanism described in the foregoing specification.

4. The mode and process of breaking and connecting by mechanism currents of electricity or galvanism in any circuit of metallic conductors, as described in the foregoing specification.

5. The mode and process of propelling and connecting currents of electricity or galvanism in and through any desired number of circuits of metallic conductors from any known generator of electricity or galvanism, as described in the foregoing specification.

6. The application of electro-magnets by means of one or more circuits of metallic conductors from any known generator of electricity or galvanism to the several levers in the machinery described in the foregoing specification, for the purpose of imparting motion to said levers

and operating said machinery, and for transmitting by signs and sounds intelligence between distant points and simultaneously to different points.

7. The mode and process of recording or marking permanently signs of intelligence transmitted between distant points and simultaneously to different points by the application and use of electro-magnetism or galvanism, as described in the foregoing specification.

8. The combination and arrangement of electro-magnets in one or more circuits of metallic conductors with armatures of magnets for transmitting intelligence by signs and sounds, or either, between distant points and to different points simultaneously.

9. The combination and mutual adaptation of the several parts of the mechanism and system of type and of signs with and to the dictionary or vocabulary of words, as described in the foregoing specification."

Of the claims of the first patent the fourth and fifth are sufficiently illustrative. The fourth claim covers broadly the making and breaking of the electric circuit for the purpose of making signals. The claim does not say whether the signals are made by sound or by signs, so the claim is broad enough to cover either form of telegraphing and it is significant that both signs and sounds or either of them are specified in the eighth claim and protected Morse when the paper recording strip of his invention was abandoned as unnecessary.

The fifth claim covers broadly the relay of the modern telegraph circuit by which the transmission of signals can be extended over an indefinite distance thru a number of circuits arranged in series, each circuit operating to open and close the next circuit and so on ad infinitum. The first reissue patent contained five claims as follows:

"1. Making use of the motive power of magnetism when developed by the action of such current or currents, as a means of operating, or giving motion to machinery, which may be used to imprint signals upon paper or other suitable material or to produce sounds in any desired manner for the purpose of telegraphic communication. (The only ways in which the galvanic current has heretofore been proposed to be used is by decomposition and the action or exercise of the deflective force of a current upon a magnetized bar or needle, and the decompositions and deflections thus produced were the subject of inspection, and had no power of recording the communication. I therefore characterize my invention as the first recording or printing telegraph by means of electro-magnetism. There are various known modes of producing motion by electro-magnetism, but none of these have hitherto been applied to actuate or give motion to printing or recording machinery, which is the chief point of my invention and improvement).

2. The system of signs consisting of dots and lines, substantially as herein set forth and illustrated, in combination with the telegraph for recording signals.

3. The types and rule, in combination with the signal-levers, as herein described, for the purpose of connecting and breaking the current of galvanism and electricity.

4. In combination with an electro-magnet used for telegraphic purposes, the train of clock-work actuated by a weight or spring for the purpose of carrying the material on which the record is to be made under the registering-pen, substantially in the manner specified.

5. The combination of two or more circuits of galvanism or electricity generated by independent batteries by means of electro magnets as above described."

The second claim is for a system of signals and recording mechanism and while it does not claim the Morse code or alphabet as an invention, it is a step in that direction.

The fifth claim is broadly for the relay circuits. The claims of the reissue patent cannot be said to be an improvement on the claims of the original patent.

Claim 1 of Reissue 79 and Claim 1 of Reissue Patent 117 are too long and ambiguous to be of much value. Both of these claims are limited to the combination of machinery for printing the signals upon paper and therefore were not infringed by the use of Morse's apparatus without the recording features where the operator depended upon the sound and wrote out the message manually.

In Reissue 117 Claims 2 and 3 also include the combination of the printing mechanism and are equally faulty for the same reason.

The 4th claim is broadly for the relay and is well stated.

The fifth claim is broadly for the Morse alphabet and illustrates how an alphabet was recognized as an invention in and covered by a U. S. Patent.

The 6th claim is for the Morse code with machinery for recording the signals.

The 7th claim is on the printing mechanism by which the signals are recorded.

The 8th claim is for the long distance transmission of electric power for the purpose of printing signals, and the claim with but little change could have been made to cover long distance transmission of electric power for any mechanical or electrical purpose.

The 4th and 5th claims of Reissue 117 are the broad and valuable claims of the patent, and the remaining claims in comparison have but little value, except for the purpose of protecting Morse's particular mechanism for transmitting and recording signals.

As Morse telegraphing has nearly all been done by sound rather than by recording mechanism it is obvious that the six claims which are more or less limited to the recording mechanism really sacrifice the best part of Morse's invention which is well covered by the fourth and fifth claims of his original patent, the fifth of his first reissue patent and the fourth and fifth claims of his second reissue patent.

The Morse patent as reissued in 1848 Reissue No. 117 was sued on and the case is reported in Federal Cases 13,043 which gives the decision of the lower court sustaining the patent as valid and infringed and the appealed case is reported in 15 Howard 620, 14 L. Ed. 601. The Supreme Court decision was written by Chief Justice Taney in Dec. 1853, the same judge who wrote the famous Dred Scott decision.

The court held the first seven claims valid and infringed and sustained the injunction thereon, but it held the eighth claim to be too broad and not warranted by law. It appears from Morse's reissue patent No. 117 that an attempt had been made to use currents of electricity for telegraphic purposes by making the electric sparks at the receiving station mark a chemically prepared paper, this causing electro-chemical action or decomposition which left marks on the paper from which the message could be read. The Court objected to Morse having a patent covering an invention which used nothing of Morse's disclosure as the court regarded it, and so the court said as follows:

"We perceive no well-founded objection to the description which is given of the whole invention and its separate parts, nor to his right to a patent for the first seven inventions set forth in the specification of his claims. The difficulty arises on the eighth."

It is in the following words:

"Eighth. I do not propose to limit myself to the specific machin-

ery, or parts of machinery, described in the foregoing specification and claims; the essence of my invention being the use of the motive-power of the electric or galvanic current, which I call electro-magnetism, however developed, for marking or printing intelligible characters, signs, or letters, at any distances, being a new application of that power, of which I claim to be the first inventor or discoverer."

"It is impossible to misunderstand the extent of this claim. He claims the exclusive right to every improvement where the motive-power is the electric or galvanic current, and the result is the marking or printing intelligible characters, signs, or letters at a distance.

"If this claim can be maintained, it matters not by what process or machinery the result is accomplished. For aught that we now know, some future inventor, in the onward march of science may discover a mode of writing or printing at a distance by means of the electric or galvanic current, without using any part of the process or combination set forth in the plaintiff's specification. His invention may be less complicated—less liable to get out of order—less expensive in construction, and in its operation. But yet, if it is covered by this patent, the inventor could not use it, nor the public have the benefit of it, without the permission of this patentee.

"Nor is this all; while he shuts the door against inventions of other persons, the patentee would be able to avail himself of new discoveries in the properties and powers of electro-magnetism which scientific men might bring to light. For he says he does not confine his claim to the machinery, or parts of machinery, which he specifies; but claims for himself a monopoly in its use, however developed, for the purpose of printing at a distance. New discoveries in physical science may enable him to combine it with new agents and new elements, and by that means attain the object in a manner superior to the present process, and altogether different from it. And if he can secure the exclusive use by his present patent, he may vary it with every new discovery and development of the science, and need place no description of the new manner, process, or machinery upon the records of the Patent Office. And when his patent expires, the public must apply to him to learn what it is. In fine, he claims an exclusive right to use a manner and process which he has not described, and indeed had not invented, and therefore could not describe when he obtained his patent. The court is of opinion that the claim is too broad, and not warranted by law."

The court's reasoning is faulty for it wrongly assumes that Morse could have got his patent without disclosing a complete operative invention. But he could not have done so for the law has always required the inventor to make a complete operative disclosure of his invention in his application. This disclosure is always printed as a part of the patent for the information of the public and this disclosure must fit every claim in the patent.

It is very doubtful if this fanciful condition that the court feared has ever been realized or even attempted in practice.

Later in the decision the court said as follows:

"The provisions of the acts of Congress, in relation to patents, may be summed up in a few words.

"Whoever discovers that a certain useful result will be produced in any art, machine, manufacture, or composition of matter, by the use of certain means, is entitled to a patent for it; provided he specifies the means he uses in a manner so full and exact that any one skilled in the science to which it appertains can, by using the means he specifies, with-

out any addition to or subtraction from them, produce precisely the result he describes. And if this cannot be done by the means he describes, the patent is void. And if it can be done, then the patent confers on him the exclusive right to use the means he specifies to produce the result or effect he describes, and nothing more. And it makes no difference, in this respect, whether the effect is produced by chemical agency or combination; or by the application of discoveries or principles in natural philosophy, known or unknown before his invention; or by machinery acting altogether upon mechanical principles. In either case, he must describe the manner and process as above mentioned, and the end it accomplishes, and any one may lawfully accomplish the same end, without infringing the patent, if he uses means substantially different from those described."

The Court did not attempt to apply the well-known doctrine of mechanical equivalents which has been recognized in many decisions since that time by all the courts. This doctrine is to the effect that where the alleged infringer uses means which are the mechanical, chemical or other equivalent to the means disclosed in the patent, the use will be held to be an infringement if the invention is properly claimed. This doctrine is especially applied to the protection of so-called pioneer inventions and the enforcement of so-called pioneer patents.

The court did not see fit to sustain the claim by giving it a narrow construction as was done in the suit on the Selden patent at 184 F. R. 893, where the claim was broad enough to cover either the use of a two cycle engine or a four cycle engine in an automobile. Inasmuch as the Selden patent showed a two cycle engine in the combination and the alleged infringer used a four cycle engine in his car the court limited the claim to include only a two cycle engine and held that the patent was valid but not infringed.

If the eighth claim had been granted in the patent as originally issued, it is possible that the court would have sustained it. Claims equally as broad in other original patents have been sustained by all the courts in later decisions but Morse's delay of eight years after his patent had issued was probably a factor in the decision, although the court did not say so.

Later on the Supreme Court in the case of Miller vs. Bridgeport Brass Co., (1882) 104 U. S. 350; 26 L. Ed. 783, declared broader claims in a reissued patent invalid unless they were applied for within two years from the granting of the original patent. This rule was necessitated because the reissuing of patents had grown into great abuse for a great many patents were reissued with claims covering features that were originally not claimed at all or with broader claims to cover valuable improvements that had been made by others. The market was dominated by the broadened claims of these reissued patents, and the public was forced thereby to pay tribute, although the claims in the original patent were not infringed by the improved apparatus. Many were misled into thinking that products were public property which they could manufacture and they accordingly began to manufacture such products from which they were cut off by the reissuing of the patent with broad claims. In the decision of 1882 the Supreme Court held that the broad claims were invalid unless applied for within two years. This discouraged the reissuing of patents. The effect of the decision of 1882 is shown by the fact that in the next 20 years thereafter the average number of patents reissued each year was less than 100, while in the thirteen years before that decision the average number of patents reissued each year was over 526. This made it dangerous to trust a reissued patent and made it quite necessary to claim the invention fully in the original patent. If

the invention is not properly claimed in the original patent and a mistake has been made, then the reissue of the patent must be applied for promptly if it is to be of avail.

So far as stopping this particular defendant's piracy was concerned the effect of the decision was the same as though all claims had been held valid and infringed. The court enjoined the defendant from further infringing the first seven claims of the patent but, because the eighth claim was not valid in its opinion the court refused to assess the defendant for complainant's costs in the prosecution of the suit.

While the court refused to apply the doctrine of mechanical equivalents to the eighth claim it did apply the doctrine of mechanical equivalents to the first seven claims. It held that the two instruments and systems were the equivalent of each other in the following language:

"It is a well-settled principle of law, that the mere change in the form of the machinery 'unless a particular form is specified as the means by which the effect described is produced' or an alteration in some of its unessential parts; or in the use of known equivalent powers, not varying essentially the machine, or its mode of operation or organization, will not make the new machine a new invention. It may be an improvement upon the former; but that will not justify its use without the consent of the first patentee.

"The Columbian (O'Reilly's) Telegraph does not profess to accomplish a new purpose or produce a new result. Its object and effect is to communicate intelligence at a distance, at the end of the main line, and at the local circuits on its way. And this is done by means of signs or letters impressed on paper or other material. The object and purpose of the Telegraph is the same with that of Professor Morse.

"Does he use the same means? Substantially, we think he does, both upon the main line and in the local circuits. He uses upon the main line the combination of two or more galvanic or electric circuits, with independent batteries for the purpose of obviating the diminished force of the galvanic current, and in a manner varying very little in form from the invention of Professor Morse. And indeed, the same may be said of the entire combination set forth in the patentee's third claim. For O'Reilly's can hardly be said to differ substantially and essentially from it. He uses the combination which composes the register with no material change in the arrangement, or in the elements of which it consists; and with the aid of these means he conveys intelligence by impressing marks or signs upon paper—these marks or signs being capable of being read and understood by means of an alphabet or signs adapted to the purpose. And as regards the second patent of Professor Morse for the local circuits, the mutator of the defendant does not vary from it in any essential particular. All of the efficient elements of the combination are retained, or their places supplied by well-known equivalents. Its organization is essentially the same.

"Neither is the substitution of marks and signs, differing from those invented by Professor Morse, any defense to this action. His patent is not for the invention of a new alphabet, but for a combination of powers composed of tangible and intangible elements described in his specification, by means of which marks or signs may be impressed upon paper at a distance, which can there be read and understood. And if any marks or signs or letters are impressed in that manner by means of a process substantially the same with his invention, or with any particular part of it covered by his patent, and those marks or signs can be read, and thus communicate intelligence it is an infringement of his patent. The varia-

tion in the character of the marks would not protect it, if the marks could be read and understood."

The court made several rulings in this decision which are of interest, and will be referred to.

In answer to the contention that the invention had been previously invented, but not previously patented or published abroad the court said as follows:

"But if the priority of Morse's invention was more doubtful, and it was conceded that in fact some one of the European inventors had preceded him a few months or a few weeks, it would not invalidate his patent. The act of Congress provides that when the patentee believes himself to be the first inventor, a previous discovery in a foreign country shall not render his patent void, unless such discovery, or some substantial part of it, had been before patented or described in a printed publication.

"Now, we suppose no one will doubt that Morse believed himself to be the original inventor, when he applied for his patent, in April, 1838. Steinheil's discovery does not appear to have been ever patented, nor to have been described in any printed publication until July of that year. And neither of the English inventions are shown by the testimony to have been patented until after Morse's application for a patent, nor to have been so described in any previous publication as to embrace any substantial part of his invention. And if his application for a patent was made under such circumstances, the patent is good, even if, in point of fact, he was not the first inventor.

"In this view of the subject, it is unnecessary to compare the telegraph of Morse with these European inventions, to ascertain whether they are substantially the same or not. If they were the same in every particular, it would not impair his rights. But it is impossible to examine them and look at the process and the machinery and results of each, so far as the facts are before us, without perceiving at once the substantial and essential difference between them and the decided superiority of the one invented by Professor Morse."

In answer to the contention that Morse had obtained part of his information from other sources and was therefore not the inventor, the Court said as follows:

"Neither can the inquiries he made nor the information or advice he received from men of science in the course of his researches impair his right to the character of an inventor. No invention can possibly be made, consisting of a combination of different elements of power, without a thorough knowledge of the properties of each of them, and the mode in which they operate on each other. And it can make no difference, in this respect, whether he derives his information from books, or from conversation with men skilled in the science. If it were otherwise, no patent in which a combination of different elements is used could ever be obtained. For no man ever made such an invention, without having first obtained this information, unless it was discovered by some fortunate accident. And it is evident that such an invention as the electro-magnetic telegraph could never have been brought into action without it. For a very high degree of scientific knowledge and the nicest skill in the mechanic arts are combined in it, and were both necessary to bring it into successful operation. And the fact that Morse sought and obtained the necessary information and counsel from the best sources, and acted upon it, neither impairs his rights as an inventor nor detracts from his merits."

Morse's first patent expired in 1854 and was extended for seven years. He had some legal battles in which he was always successful but at great

expense. His U. S. patents netted him less than one hundred thousand dollars. His invention was first put into use between Washington and Baltimore in May, 1844. The money was furnished by the Government and several members of Congress were very pronounced in their scepticism and expressed themselves very sarcastically on the proposal of an electric telegraph. His telegraph was successful at once but the public was slow to patronize it. In 1846 it had been extended to Philadelphia, New York, and Boston. In 1862 it was extended across the continent replacing the pony express. Four years later the Atlantic Cable connected America and Europe. Morse lived to 1872 and saw all the developments which came from his early struggles. It is to be regretted that his financial reward was very moderate compared to the benefit which he gave to mankind and the honors which were heaped upon him and his memory.

The original Morse telegraph instruments were quickly improved into their present form within a short time after the telegraph became a commercial institution. The key for sending and sounder for receiving have remained in use ever since. But little improvement has been made on the essentials of telegraphy as now practiced except in the development of duplex and multiplex telegraphy, automatic telegraphy, stock tickers, etc., all of which use the intermittent electric impulses conveyed over metal wires to convey signals. The telegraph has been supplemented by the telephone and the radio of which more will be said later.

UNITED STATES PATENT OFFICE.

CHARLES GOODYEAR, OF NEW HAVEN, CONNECTICUT, EXECUTOR OF CHAS. GOODYEAR, DECEASED.

IMPROVEMENT IN THE ART OF PREPARING CAOUTCHOUC.

Specification forming part of Letters Patent No. 3,633, dated June 15, 1841; extended seven years; Reissue No. 156, dated December 25, 1849; Reissue No. **1,085**, dated November 20, 1860.

DIVISION B.

To all whom it may concern:

Be it known that CHARLES GOODYEAR, late of the city of New Haven, in the State of Connecticut, did invent a certain new and useful Improvement in the Manner of Preparing Fabries of Caoutchouc or India-Rubber, not known or used by others before his invention or discovery; and I do hereby declare that the following is a clear and exact description of the principle or character which distinguishes it from all other things known before.

The object of this invention is the production of the new manufacture, substance, or product known as "vulcanized india-rubber," (which is also the invention of said CHARLES GOODYEAR, and the subject of another patent bearing even date herewith,) and its peculiarity is in the art or process by which that manufacture or substance is produced. That art or process is conducted as follows:

Native caoutchouc or india-rubber is combined with sulphur, which may be done in various ways well known to the trade before the date of this invention, the most common of which is either by grinding the dry rubber and sulphur together in a machine with heated cylinders, well known for that purpose, until the mixture is reduced to a plastic state, or by dissolving the caoutchouc or india-rubber in its known solvents, the one most commonly used being camphene or spirits of turpentine, and adding to the solution the sulphur in a powdered state. The proportions of the gum and sulphur which are found good in practice are twenty-five parts of india-rubber and five parts of sulphur, by weight, although vulcanization will be produced by using sulphur in various proportions considerably less or more than these. To this mixture other ingredients may be added, among which white lead is one of the best, and which, when combined with the rubber and sulphur in the proportion of seven parts, by weight, materially facilitates the process.

The mixture of india-rubber with sulphur and with other materials was well known before the date of this invention; but no result of any great value was thereby produced until CHARLES GOODYEAR discovered his new art or process, by which an entire change is effected in the properties and qualities of the mixture of india-rubber and sulphur, rendering the substance or material highly and permanently elastic under all conditions of its use, and insensible to heat and cold, and in some measure to the destructive effects of many of the essential oils and acids.

This art or process consists in subjecting caoutchouc or india-rubber, when combined with or in the presence of sulphur, to the action of a high degree of heat, for the purpose of changing or altering its qualities and properties and producing the new substance called "vulcanized india-rubber;" and it may be carried on in a variety of ways, the effect being due to the action of heat, without regard to the particular manner of its application. One of the methods is to place the composition of rubber and sulphur in an oven, and then to heat it up gradually until it attains the temperature necessary to produce the change required, which will be, say, from 212° to 350° Fahrenheit, according to the quantity of sulphur, the size of the mass to be operated upon, the degrees of temperature applied, and the presence of other ingredients in the composition. When the mixture is made in proportions of twenty-five parts of gum, five parts of sulphur, and seven parts of white lead, the temperature of 270° will be usually found the best, and the duration of the process will vary, according to the thicknesses of the mass, from two to six hours, the thinner mass requiring the least time. The same effect may also be produced by using heated cylinders and passing the material in sheets slowly over their surfaces, and in various other ways or methods, which the convenience of the operator may suggest. The heat may be communicated from the place of combustion to the place where the rubber is to be operated on, the only object being to subject the material to the influence of heat for a sufficient time to produce the desired result.

In subjecting the india-rubber to heat, for the purposes described, sulphur may be used or incorporated with or applied to the caoutchouc in a variety of ways, either in a gaseous, liquid, or solid form; but its presence in some form at some time during the application of the heat

is essential to the production of the new manufacture which CHARLES GOODYEAR invented, although it is found that this effect will be produced by the of the very small quantities of sulphur. In practice, however, for most purposes the proportions mentioned in this description will be found sufficiently accurate for good results.

Before the plastic india-rubber (prepared as before mentioned) is subjected to the above-described process it may be molded or formed into any desired shape, and in that shape operated upon and other materials--such as cotton, silk, wool, or leather—may be incorporated or combined with the india-rubber and sulphur, thereby modifying the strength, elasticity, or other qualities of the new manufacture for particular purposes, as it is found that the new substance or product will be produced whenever the essential elements of rubber, sulphur, and heat are used, whether such other materials are incorporated or not.

What is claimed as the invention of CHARLES GOODYEAR, deceased, is—

Subjecting caoutchouc or india-rubber or other vulcanizable gums mixed with or in the presence of sulphur (whether with or without other ingredients) to the action of heat, for the purpose of affecting its qualities or properties, as described.

CHAS. GOODYEAR.

In presence of—
EDW. N. DICKERSON,
JAMES A. DORR.

Rubber.

On June 15, 1844, Charles Goodyear took out his patent 3633 on vulcanizing rubber, the process of which consists essentially in combining the rubber gum with sulphur by heat. The original patent contained three claims, none of which broadly claimed the invention, in fact he confused the invention by stating that white lead was also an essential part of the combination. The three claims of the original patent read as follows:

1. The combining of the said gum with sulphur and with white lead, so as to form a triple compound, either in the proportions herein named or in any other within such limits as will produce a like result; and I will here remark that although I have obtained the best results from the carbonate of lead, other salts of lead or the oxides of that metal may be substituted therefor, and will produce a good effect. I therefore under this head claim the employment of either of the oxides or salts of lead in the place of the white lead in the above named compound.

2. The formation of a fabric of the india-rubber by interposing layers of cotton-batting between those of the gum, in the manner and for the purpose above described.

3. In combination with the foregoing, the process of exposing the india-rubber fabric to the action of a high degree of heat, such as is herein specified, by means of which my improved compound is effectually changed in its properties so as to protect it from decomposition or deterioration by the action of those agents which have heretofore been found to produce that effect upon india-rubber goods.

On December 25, 1849, Goodyear obtained a reissue of this patent, Reissue No. 156, but in the reissue specification he again emphasized the need of combining the three elements by the application of heat and claimed the invention in the same way. This appears from the claims which read as follows:

"1. The curing of caoutchouc or india-rubber by subjecting it to the action of a high degree of artificial heat, substantially as herein described, and for the purpose specified.

"2. The preparing and curing the compound of india-rubber, sulphur, and a carbonate or other salt or oxide of lead by subjecting the same to the action of artificial heat, substantially as herein described."

From the foregoing claims it will be seen that Goodyear did not correctly claim the important feature of his invention in either his original patent or his first reissue of it. The important feature of his invention was the combination of rubber gum with sulphur by heat. But he did not say so in his claims for either he omitted sulphur as an element or added a third element to the combination thereby making the claim unnecessarily specific. None of these claims would have been infringed by the combination of two elements only, namely, rubber and sulphur joined together by heat.

Thereafter on November 20, 1860, Goodyear again surrendered his patent and took out two reissues, No. 1,084 and No. 1,085, both issued November 20, 1860. Each of these patents contains but one claim. In the first of these reissued patents he claimed the article of manufacture in the following terms:

"The new manufacture called 'vulcanized india-rubber,' which is a combination of india-rubber with sulphur, (whether with or without other ingredients,) chemically altered by the application of heat, substantially as described."

Reissue patent No. 1085 contains the process claim as follows:

"Subjecting caoutchouc or india-rubber or other vulcanizable gums

mixed with or in the presence of sulphur (whether with or without other ingredients) to the action of heat, for the purpose of affecting its qualities or properties, as described."

Reissue 1085 is reproduced herewith. The others are omitted as unnecessary.

In these reissue patents issued about sixteen years after his original patent Goodyear correctly claimed his invention. These claims cover his invention broadly. They should have been made in his original patent but he made the common mistake of failing to state the important feature of his invention for sixteen years after his original patent issued. Under the present patent practice these mistakes and delays would have been fatal to his monopoly.

As an inventor Goodyear had an amazingly hard time of it, was frequently hopelessly sunk in the depths of poverty and was several times imprisoned for debt, in spite of which hardships he pursued his apparently hopeless task with a zeal that was worthy of a great inventor working on a great invention. Several times he thought he had solved the problem of making rubber serviceable commercially but each time his product, after standing up under one set of conditions, failed when those conditions changed. Usually a change in temperature, such as occurred from day to day, was sufficient to ruin the product, a rise in temperature causing the rubber to melt down or draw out of shape and a fall in temperature causing it to become brittle or cracked. Not until he hit upon the idea of combining the crude rubber gum with sulphur in the right proportions with sufficient heat to unify them did he attain success, and even then for a long time he was misled as to the need of white lead as an element of the combination, which finally proved to be unnecessary. All this caused him many years of trouble and expense during which it seemed he was continually struggling against adversity, and after he had perfected his invention he was involved in a maze of litigation that might well have appalled a man of unbounded resources.

In the tenth volume of Federal Cases 32 decisions are recorded in patent suits brought by Charles Goodyear. Probably the most interesting and the most famous one of these suits is Goodyear vs. Day, 5569, Sept. 28, 1852. This case was tried before the Federal Court at Trenton, N. J., in which Court Justice Grier presided. In this case Daniel Webster was one of the attorneys for Goodyear, the inventor and complainant, and Rufus Choate represented the defendant infringer. It is said that Daniel Webster received a fee of $15,000 for his part in winning this case and he left his duties at Washington long enough to earn it because, as he said, he needed the money to pay his debts.

In this, and in other cases in which Goodyear sued for infringement, the infringer attacked the validity of the patent on the ground that the invention had previously been made by another inventor.

Over 4000 printed pages of proofs and exhibits were included in the record.

In the course of his argument Daniel Webster said as follows:

"It is well known that the articles manufactured of gum elastic up to the year 1834 were entirely useless. If they were exposed to the sun, they became sticky; you could not separate them after their surfaces came in contact; and if exposed to the cold, they became hard and rigid. I well remember that I had some experience in this matter myself. A friend in New York sent me a very fine cloak in India rubber, and a hat of the same material. I did not succeed very well with them. I took the cloak one day and set it out in the cold. It stood very well by itself. I surmounted it with the hat, and many persons passing by supposed they saw standing by the porch the Farmer of Marshfield."

In January, 1844, Mr. Goodyear went to Naugatuck, in Connecticut, and started a factory. It would be painful to speak of his extreme want —the destitution of his family, half clad, he picking up with his own hands little billets of wood from the wayside to warm the household—suffering reproach—not harsh, for no one would bestow that upon him—receiving indignation and ridicule from his friends. Here is a letter of his written in a good spirit and cheerful vein, but particularly affecting from that circumstance:

"Debtors' Prison, Boston, Apr. 21, 1840.

"Mr. John Haskins or Luke Baldwin:

Gentlemen: I have the pleasure to invite you to call and see me at my lodgings, and to communicate with my family, and possibly to establish an India Rubber Factory for myself, on the spot. Do not fail to call on the receipt of this, as I feel some anxiety on account of my family. My father will probably arrange my affairs in relation to this Hotel, which, after all, is perhaps as good a resting place as any on this side of the grave.

Yours truly,

CHARLES GOODYEAR."

(See page 213, Leading American Inventors, by G. Iles, Henry Holt & Co. Pub.)

Later in the same argument Daniel Webster said as follows:

"There is not a single question of fact in the case we have said, on which the court can feel the least doubt. We assert that Goodyear is the first man upon whose mind the idea ever flashed, or to whose intelligence the fact ever was disclosed, that by carrying heat to a certain height it would cease to render plastic the India rubber, and begin to harden and metallize it. If there is a man in the world who found out that fact before Goodyear who is he? Where is he? On what continent does he live? Who has heard of him? What books treat of him? What man among all the men on earth has seen him, known him, or named him? Yet it is certain that this discovery has been made. It is certain that it exists. It is certain that it is now a matter of common knowledge all over the civilized world. It is certain that ten or twelve years ago it was not knowledge. It is certain that this curious result has grown into knowledge by somebody's discovery and invention. And who is that somebody? If Goodyear did not make the discovery who did make it? Who did make it? If the other side had endeavored to prove that some one other than Mr. Goodyear had made this discovery, that would have been fair. But they do not meet Goodyear's claim by setting up a distinct claim of anybody else. They attempt to prove that Goodyear was not the inventor, by little shreds and patches of testimony. Here a little bit of sulphur and there a little parcel of lead; here a little degree of heat, a little hotter than would warm a man's hands, and in which a man could live for ten minutes or a quarter of an hour; and yet they never came to the point. There are birds which fly in the air, seldom lighting, but often hovering. Now this is a question not to be hovered over, not to be brooded over, and not to be dealt with as an infinitesimal quantity of small things. It is a case calling for a manly admission and a manly defense. I ask again, if there is anybody else than Goodyear who made this invention who is he? Is the discovery so plain that it might have come about by accident? It is likely to work important changes in the arts everywhere. It introduces quite a new material into the manufacture of the arts, that material being nothing less than elastic metal. It is hard like metal, and as elastic, as pure original gum elastic. It is as great and momentous a phenomenon occurring to men in the progress of their knowledge, as it would be for a man to show that iron and gold could remain iron and gold and yet become

elastic like India rubber. It would be just such another result. Now, this fact cannot be denied; it cannot be secreted; it cannot be kept out of sight; somebody has made this invention. That is certain. Who is he? There is not in the world a human being that can stand up, and say that it is his invention, except the man who is sitting at that table. The learned counsel may prove that A. made a part, and B. made a part, and C. made a part, but A., B., C. and D., and all the rest of the alphabet disclaim this as their invention. I say, therefore, at this hour in which I have the honour to be speaking to this court, that there is not a man on the footstool who pretends this is his invention but one—not a man. Is that not enough? The invention exists. Everybody knows and understands it, and everybody connected in former times with the manufacture of India rubber has been astonished and surprised at it. There have been many respectable witnesses in this case, and the best and most intelligent of them say, after having been engaged in attempts in this manufacture for years and years, losing their time and fortunes, they never heard of or imagined any such thing, as the vulcanization of rubber until Goodyear's invention was made."

With reference to the contention of the defendant that Goodyear was not the first inventor and that he had borrowed from others, the court's decision says as follows:

"The testimony shows that many persons had made experiments—that they had used sulphur, lead, and heat, before Goodyear's patents, and probably, before his discovery. But to what purpose? Their experiments ended in discovering nothing, except, perhaps, that they had ruined themselves. The great difference between them and Goodyear is, that he persisted in his experiments, and finally succeeded in perfecting a valuable discovery, and they failed. It is usually the case, when any valuable discovery is made, or any new machine of great utility has been invented, that the attention of the public has been turned to that subject previously; and that many persons have been making researches and experiments. Philosophers and mechanicians may have, in some measure, anticipated, in their speculation, the possibility or probability of such discovery or invention; many experiments may have been unsuccessfully tried, coming very near, yet falling short of the desired result. They have produced nothing beneficial. The invention, when perfected, may truly be said to be the culminating point of many experiments, not only by the inventor, but by many others. He may have profited indirectly by the unsuccessful experiments and failures of others; but it gives them no right to claim a share of the honour or the profit of the successful inventor. It is when speculation has been reduced to practice, when experiment has resulted in discovery, and when that discovery has been perfected by patient and continued experiments—when some new compound, art, manufacture, or machine, has been thus produced, which is useful to the public, that the party making it becomes a public benefactor, and entitled to a patent.

"And yet when genius and patient perseverance have at length succeeded, in spite of sneers and scoffs, in perfecting some valuable invention or discovery, how seldom is it followed by reward? Envy robs him of the honour, while speculators, swindlers, and pirates rob him of the profits. Every unsuccessful experimenter who did, or did not, come very near making the discovery, now claims it. Every one who can invent an improvement, or vary its form, claims a right to pirate the original discovery. We need not summon Morse, or Blanchard, or Woodworth, to prove that this is the usual history of every great discovery or invention.

"The present case adds another chapter to this long and uniform history. But notwithstanding the indomitable energy and perseverance

with which this attempt to invalidate the patent has been pursued, the volumes of testimony with which it is oppressed, and the great ability with which it has been canvassed in the argument, we are of opinion that the defendant has signally failed in the attempt to show that himself or any other person discovered and perfected the process of manufacturing vulcanized India rubber before Goodyear. We shall give therefore our decree of perpetual injunction."

This was a very well deserved tribute to the inventor by the court.

After Goodyear was dead the executor of his estate brought suit on these reissue patents 1,084 and 1,085 which suit is reported in Federal cases No. 5583 under the name of Goodyear vs. Providence Rubber Co. This case was decided in the November term of 1864. Clifford, one of the best of patent judges, made the decision.

The defendants contended that the patent on the process 1,085 was invalid because the claim was broader than the original invention in that it included not only rubber but other "vulcanizable gums" and the court held that this defense was good. On this point the court said as follows:

"The express terms of the claim make it include not only native rubber when compounded with sulphur and subjected to a high degree of artificial heat, but all other vulcanizable gums, with or without other ingredients. Nothing of the kind is described in any one of the patents granted to the original inventor, nor even in the patent to which the claim is annexed.

"Under the circumstances, I am of the opinion that the claim of this patent is broader than the invention of the original patentee, and consequently that it is void, because it is not for the same invention as the patent which was surrendered as the foundation of the reissue. O'Reilly vs. Morse, 56 U. S. 112."

As the patent contained but one claim this ruling made the patent void. This shows the danger of taking a patent with but one claim in it. Another claim could have been obtained in this patent differing from the patented claim by the omission of the words "or other vulcanizable gums" and such claim would have been patentable and would have been sustained by the court. Or Goodyear might have claimed "subjecting vulcanizable gum mixed with sulphur to the action of heat, etc." The writer does not know whether any other gum can be combined with sulphur to produce a result similar to the vulcanizing of rubber but if such were the case it would seem that Goodyear would have been entitled to a claim that would have covered the combination of any gum with sulphur so long as it produced a similar result or product. In such case it would seem that the various kinds of gums were merely chemical equivalents and that the combination of sulphur with them all would naturally be suggested by Goodyear's invention and should be within the scope of his patent.

The doctrine of equivalents is limited by the rule that the equivalent must not be vague or indefinite but must be well known. Patent No. 317,676 was issued to Sawyer & Mann on May 12, 1885, on an application filed January 9, 1880. This patent threatened to dominate the incandescent lamp art. It claimed an "incandescing conductor of fibrous or textile material." This patent was passed on by the Supreme Court at 159 U. S. 465 40 L. Ed. 221. It appeared from the evidence that there were over 6000 vegetable growths none of which possessed the peculiar qualities that fitted them for use as filaments in incandescent lamps. The Court held that this patent could not be sustained except as to one narrow claim (which claimed a filament of carbonized paper), for to hold otherwise would prevent further investigation. The lamps made under Edison's patent 223,898 issued January 27, 1880, were therefore held not to infringe the Sawyer & Mann patent.

The same rule was applied in Matheson vs. Campbell, 78 F. R. 910, and patent 345,901 for a coal tar dye was held invalid because too broad. The patent assumed that any form of sulpho acid would give the reaction of the invention. It was shown that there were over 100 forms of sulpho acid only a few of which would work in the process to give the desired result. The law is further stated for the Patent Office in x. p. Steinmetz 1916, C. D. page 10, where similar broad claims were denied an applicant.

A broad construction was given to the Goodwin patent 610,861 issued September 13, 1898, on an improvement in a celluloid base for photographic films. Prior to Goodwin's invention celluloid film would always dry or harden with a surface that was like ground glass and was, therefore, not transparent. This made it unsuitable as a carrier for photographic emulsion, because although a negative could be made with it a print could not be made with the negative. The inventor found, however, that by dissolving nitro cellulose in nitro benzole and diluting it with alcohol he could spread the solution out on a suitable surface and after allowing it to set and dry and harden he could obtain thereby a transparent celluloid film. It was found that acetate of amyl could be used instead of the solvent and ethyl acetate, methyl acetate or acetone could be used instead of alcohol as the diluent. Goodwin claimed the invention in the terms of "dissolving nitro-cellulose in a menstrum containing a hygroscopic element and an element that is non-hygroscopic" and in the case of Goodwin Film and Camera Co. vs. Eastman Kodak Co, 207 F. R. 351, the court held that Goodwin's patent covered the substitution of all non-hygroscopic equivalents for the nitro benzole and the substitution of all hygroscopic equivalents for the alcohol and held that the patent was valid and infringed. This decision was sustained on appeal at 213 F. R. 231 where the court said as follows:

"Goodwin being first to make the patented pellicle, is entitled to a fair range of equivalents whether he claims them or not. His specification was addressed to chemists, not lawyers, and he was justified in assuming that a chemist would understand when he said in his original application that he used nitro-benzole or other solvent, that he meant other similar or equivalent solvent, one which would accomplish the same result in the same manner. A chemist knowing the object to be attained, would hardly have selected a solvent which could not accomplish that object. Knowing the properties of nitro-benzole, he naturally would seek an equivalent having similar properties and not one having properties which would defeat the object in view."

Incidentally it may be said that this decision cost the Eastman Kodak Co. several millions of dollars for the infringement of the Goodwin patent.

The decision is in contrast with Judge Clifford's ruling on the claim in Goodyear's reissue patent 1,085.

Judge Clifford, in the same decision, held that the claim in reissue 1,084 covering vulcanized rubber as an article of manufacture was valid and infringed.

The defendants appealed from this decision holding R 1084 as valid and infringed but the complainants did not appeal from the decision holding R 1085 invalid. Therefore, only the patent on the article of manufacture was before the Supreme Court whose decision is reported at 75 U. S. 788; 19 L. Ed. 566. With regard to Goodyear's invention the court ruled as follows:

"The original patent was issued in 1844. The invention has since been covered by a succession of patents, the last of which, the reissues in question, are still unexpired, and are the foundation of this litigation. The discovery was one of very great value. It is a mine of wealth to the possessors. Since the first patent was issued there have been numerous

cases of litigation involving its validity. They were earnestly contested. In every instance the patent was sustained. This litigation was remarked upon by the counsel for the appellants, and it was added that this question is now, for the first time, presented to this court for consideration. It is a just commentary to say that such a litigation is always to be expected in cases like this. There are always those who are ready to gather where they have not sown. The number and ardor of the conflicts is usually in proportion to the value of the prize at stake. The validity of the claim of the testator was never shaken by any adjudication. It has been uniformly affirmed and sustained. If the subject was never brought here before, it was, doubtless, because those who were defeated elsewhere saw no grounds for the hope of a more favorable result in this court. These considerations are very persuasive to the presumption that the claim of Charles Goodyear, the elder, that he was the original and first inventor, is impregnable. If it were not so, we cannot doubt that it would have been overthrown in the numerous and severe assaults which have been made upon it. We have, however, examined the question by the light of the evidence found in the record and in the absence of the adjudications referred to should have had no difficulty in coming to the same conclusion. We entertain no doubt upon the subject."

Further on the court said as follows:

"A patent should be construed in a liberal spirit, to sustain the just claims of the inventor. This principle is not to be carried so far as to exclude what is in it, or to interpolate anything which it does not contain. But liberality, rather than strictness should prevail where the fate of the patent is involved, and the question to be decided is whether the inventor shall hold or lose the fruits of his genius and his labors."

The court sustained the reissue patent 1,084 as valid and infringed and approved the master's award to the complainant of $310,757.72, that being the profit that the defendant had derived from the infringement, as estimated by the master in the accounting.

Hard Rubber.

Goodyear's invention related to the manufacture of soft flexible rubber as we know it which rubber is made by combining from six to twenty parts of sulphur with 100 parts of rubber gum. This does not make hard rubber. Hard rubber was the invention of Nelson Goodyear and was covered by his patent 8,075. In his specification Nelson Goodyear states that he uses twenty-five parts or more of sulphur to 100 parts of rubber gum which makes a product that is hard and stiff. He claimed this invention in his claim in the following language:

"The combining of india rubber and sulphur, either with or without shellac for making a hard and inflexible substance hitherto unknown, substantially as herein set forth."

Ordinarily differences in proportion do not amount to an invention and will not sustain a patent but the invention of hard rubber is a notable exception to this rule for by increasing the amount of sulphur in the composition to a certain extent an entirely new product is formed having different characteristics from soft elastic rubber and this made a composition of matter that was new and patentable for it amounted to an invention.

An illustration of a patent that was declared invalid because it amounted only to a difference in proportion, is found in the Edison patent 802,631 on a Rotary Kiln for Burning Cement Clinker. Before this invention, rotary kilns had been used but they were all short and had small capacity. Edison conceived the idea of making cement in a big way and he therefore got up a tubular kiln that was about 150 feet in length and

he claimed a kiln that was over 100 feet in length and a kiln that was substantially 150 feet in length and a kiln the length of which was approximately 25 times its internal diameter. This patent was declared invalid at 208 F. R. page 20 and 218 F. R. page 895 because it claimed merely a difference in degree or proportion over previous kilns, altho such previous kilns had never exceeded over 60 feet in length.

A difference in proportion or degree was recognized as patentable in Patent No. 835,120 issued to Sulman et al. on Ore Concentration. Previous to Sulman's invention oil had been used in separating the fine particles of metal from the rock with which it existed in the ore and with which it was mixed by pulverizing the ore. The amount of the oil that had been used in previous processes was from 2% to 300% of the whole weight of the ore treated. The cost of the oil made all these previous processes prohibitive. In Sulman's invention oil was used in quantities ranging from .02% to .50% of the ore treated and the oil preferably used was oleic acid with water, and with or without other oils or liquids. Oil has an affinity for metal but does not have an affinity for quartz or other elements of the ore. Oil would therefore coat the metal particles but this would not cause the metal to float in water, even if used in large quantities. This was where previous processes had failed. Sulman discovered that by mixing with the pulverized ore a small quantity of oil that would froth and by agitating the mixture with air, bubbles would form in the thin oil coating on the metal particles. These bubbles would make the grains of metal float on the water in a froth, leaving the tailings in the bottom of the tank. This froth was a combination of metal, oil, and air, and was skimmed off and the metal was recovered from it.

Claim 5 of Sulman's patent read as follows:

> "The herein-described process of concentrating ores which consists in mixing the powdered ore with water, adding a small proportion of oleic acid amounting to 0.02-0.5 per cent on the ore, agitating the mixture until the oleic acid has been brought into efficient contact with the mineral and has formed a froth therewith, and separating the froth from the remainder by flotation."

In passing on this patent the Supreme Court in the case of Minerals Separation, Ltd., vs. Hyde, 242 U. S. 261, held that the patent was valid, although in one respect the invention consisted in using a smaller quantity of oil than was used in prior processes. This was merely a difference in degree, but it was accompanied by a difference in result, namely, that on agitation air bubbles would adhere to the particles of metal coated with this oil and cause them to float in the froth, which was new.

The court also held that the inventors named in the patent were the real inventors although the actual discovery that resulted in the patented invention was made by an employee of theirs, who made the analyses and the observations which resulted in the discovery. This reaffirmed the doctrine originally stated in Agawam vs. Jordan, 74 U. S. 583, that the employee who assisted the inventor in carrying out his invention was not the inventor of the contributions that he made to the independent inventions of the employer, but that such dependent inventions belonged to the original inventor who caused the work to be done, and could be claimed by him as part of his invention.

In 250 U. S. 336 the Supreme Court with regard to this same patent held that where the defendant used oil in quantities of more than one per cent of the mass of ore being treated he did not infringe the patent, but the decision states that there was evidence to the effect that if oil was used by defendant in quantities slightly exceeding one per cent after January 9th, 1917, through the rest of the year, it would have involved a loss of over a million dollars in increased cost of oil and in diminished recoveries.

Sheet 1
3 Sheets

E. Howe, Jr.

Sewing Machine.

No. 4750 Patented Sep. 10, 1846.

Fig. 1

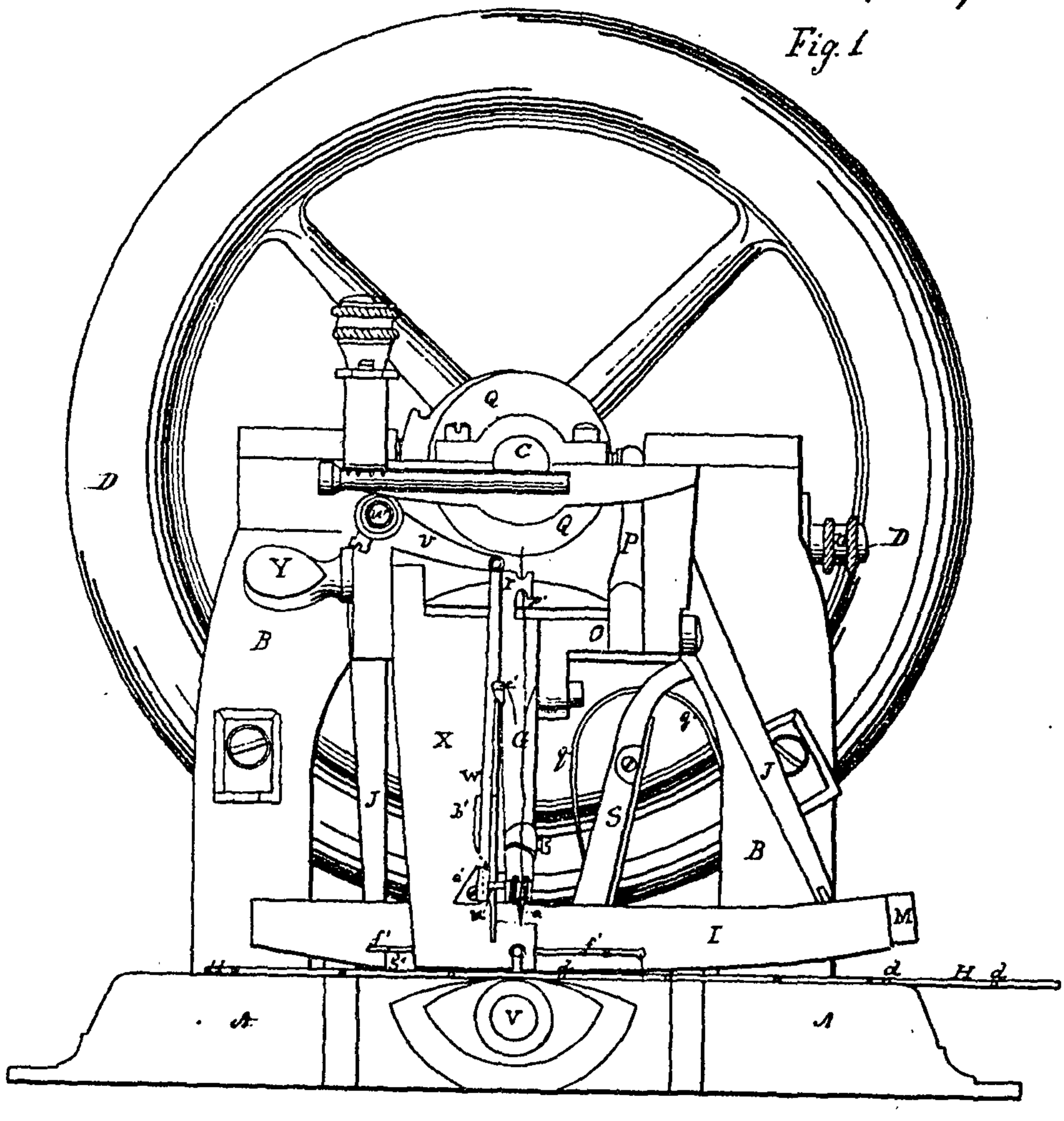


Fig. 4.

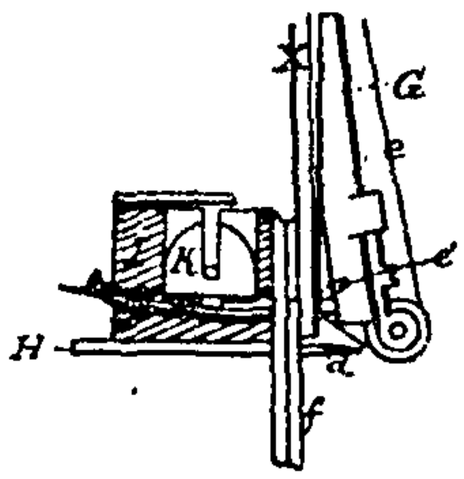
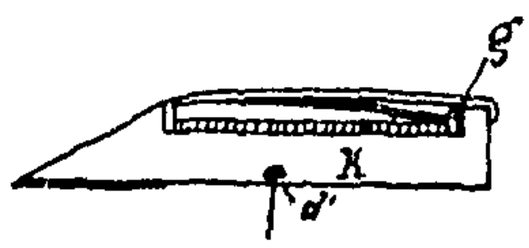


Fig. 7



Sheet 2
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E. Howe, Jr.

Sewing Machine.

No. 4750 Patented Sep. 10, 1846.

Fig. 2

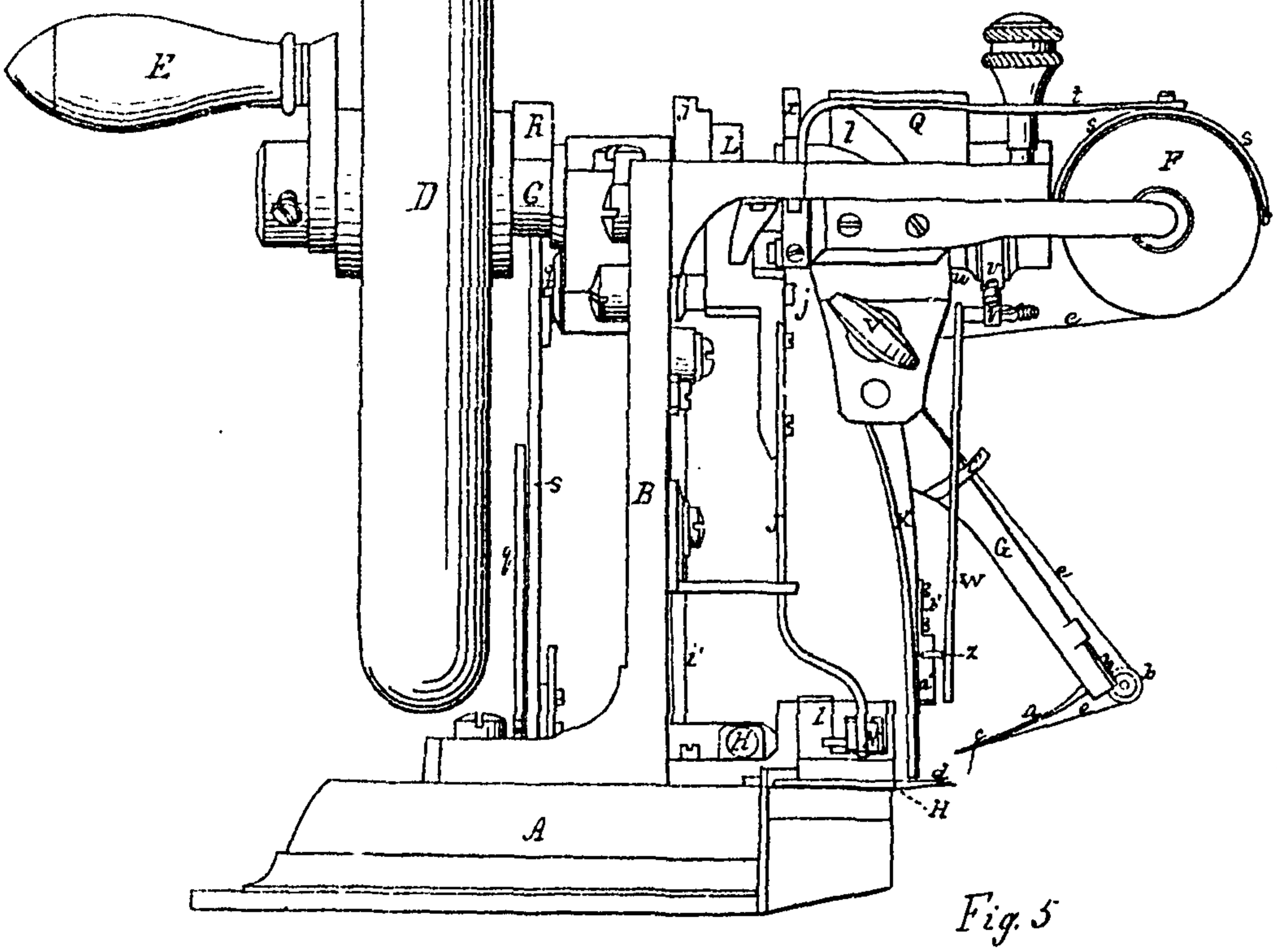
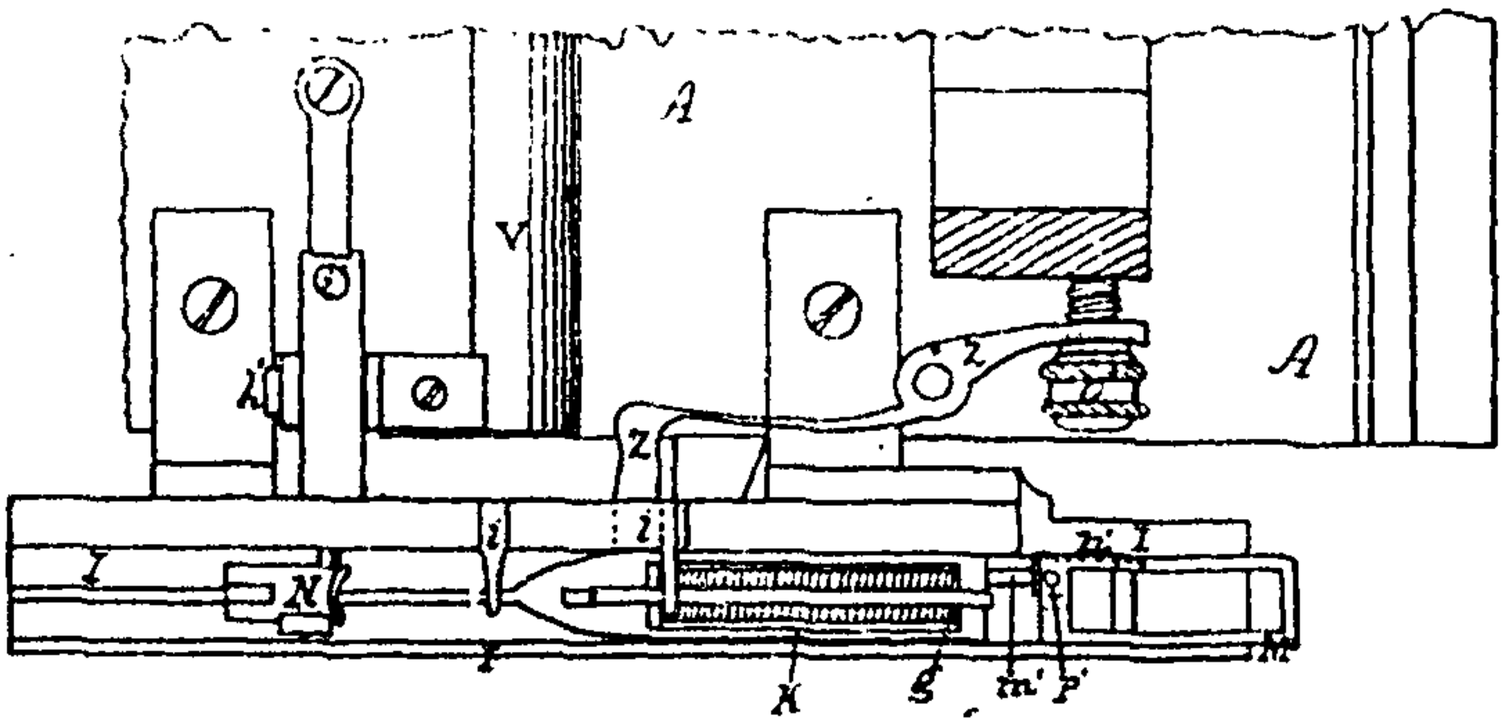


Fig. 5



Sheet 3
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E. Howe, Jr.

Sewing Machine.

No. 4750 Patented Sep. 10, 1846

Fig. 3

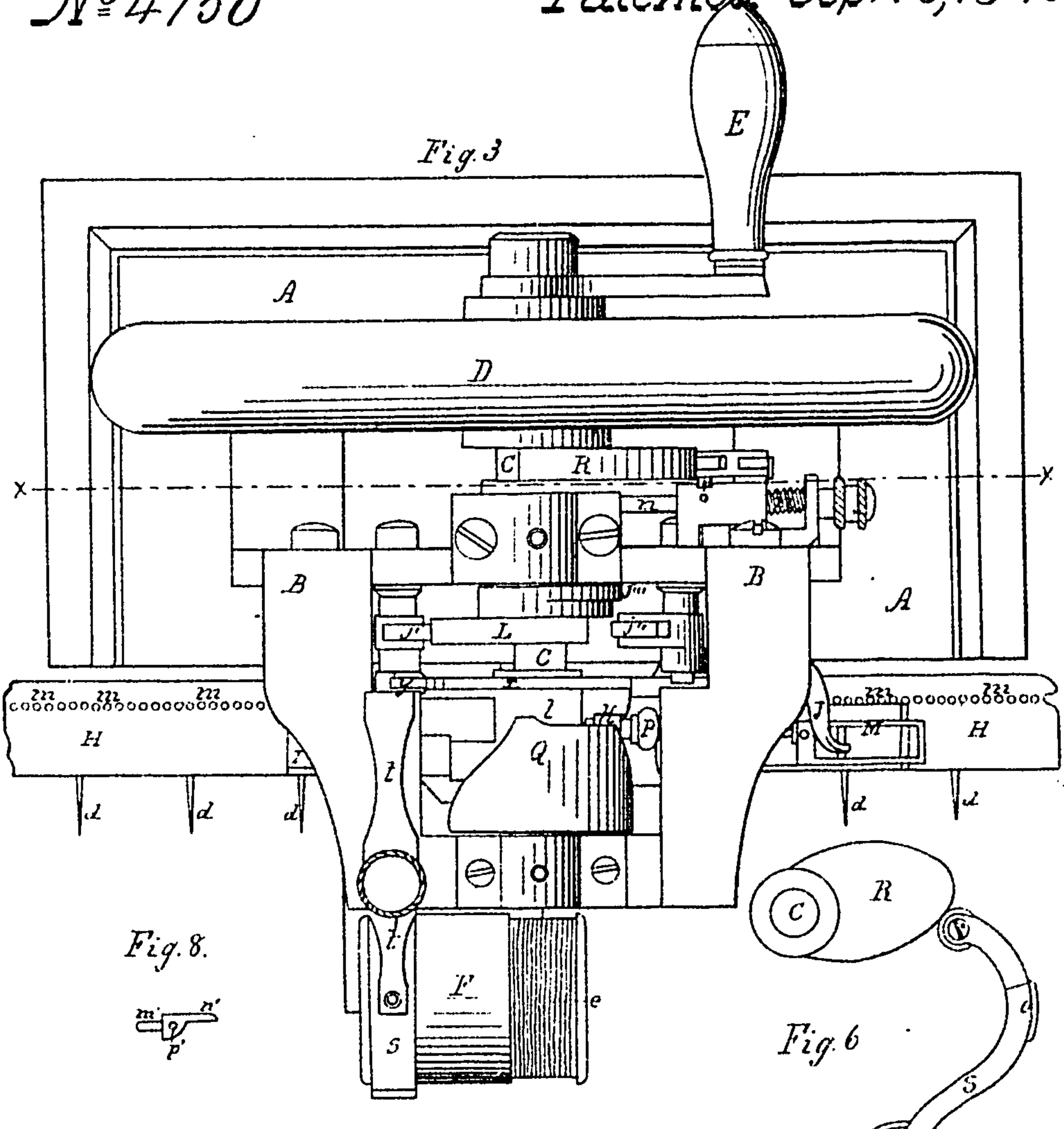


Fig. 8.

Fig. 6

Fig. 9.

UNITED STATES PATENT OFFICE.

ELIAS HOWE, JR., OF CAMBRIDGE, MASSACHUSETTS.

IMPROVEMENT IN SEWING-MACHINES.

Specification forming part of Letters Patent No. **4,750**, dated September 10, 1846.

To all whom it may concern:

Be it known that I, ELIAS HOWE, Jr., of Cambridge, in the county of Middlesex and State of Massachusetts, have invented a new and useful machine for sewing seams in cloth or other articles requiring to be sewed; and I do hereby declare that the following is a full and exact description thereof.

In sewing a seam with my machine two threads are employed, one of which threads is carried through the cloth by means of a curved needle, the pointed end of which is to pass through said cloth. The needle used has the eye that is to receive the thread within a small distance—say, an eighth of an inch—of its inner or pointed end. The other or outer end of the needle is held by an arm that vibrates on a pivot or joint pin, and the curvature of the needle is such as to correspond with the length of the arm as its radius. When the thread is carried through the cloth, which may be done to the distance of about three-fourths of an inch, the thread will be stretched above the curved needle, something in the manner of a bow-string, leaving a small open space between the two. A small shuttle carrying a bobbin filled with silk or thread is then made to pass entirely through this open space between the needle and the thread which it carries, and when the shuttle is returned, which is done by means of a picker-staff or shuttle-driver, the thread which was carried in by the needle is surrounded by that received from the shuttle, and as the needle is drawn out it forces that which was received from the shuttle into the body of the cloth, and as this operation is repeated a seam is formed which has on each side of the cloth the same appearance as that given by stitching, with this peculiarity, that the thread shown on one side of the cloth is exclusively that which was given out by the needle, and the thread seen on the other side is exclusively that which was given out by shuttle. It will therefore be seen that a stitch is made at every back-and-forth movement of the shuttle. The two thicknesses of cloth that are to be sewed are held upon pointed wires which project out from a metallic plate, like the teeth of a comb, but at a considerable distance from each other—say three-fourths of an inch, more or less—these pointed wires sustaining the cloth and answering the purpose of ordinary basting. The metallic plate from which these wires project has numerous holes through it, which answer the purpose of rack-teeth in enabling the plate to be moved forward by means of a pinion as the stitches are taken. The distance to which said plate is moved, and consequently the length of the stitches, may be regulated at pleasure.

In the accompanying drawings, Figure 1 is a front elevation of the machine; Fig. 2, an end elevation thereof, and Fig. 3 a top view. The other figures represent sections and parts in detail, which will be presently explained.

A A is the bed or base of the machine and B B standards rising therefrom, which sustain the main shaft and other parts of the apparatus.

C C is the main shaft, which carries the cams that operate the needle, the shuttle-drivers, and other parts of the machine. D is a fly-wheel, and E a winch, on said shaft.

F is a bobbin on which the silk is wound that is to supply the needle.

G is the needle-arm, that carries the curved needle *a*. This is seen most distinctly in the end elevation, Fig. 2. The thread from the bobbin F passes round a small friction-roller, *b*, or round a smooth groove in the situation of said roller, then up through the eye of the needle at *c*, which eye is situated near to the needle-point. The cloth is stuck on the points *d d*, that project from the metallic plate H, which I will call the "baster-plate." This plate is shown most distinctly in the top view, Fig. 3. When the thread *e* is carried through the cloth by the needle *a*, the upper portion of said thread will be above the needle and will allow the point of the shuttle (to be presently described) to pass between them. To enable it to enter readily, the needle, after entering the cloth, is immediately drawn back to a short distance, which opens the loop slightly. The cam which operates the needle-arm being so formed as to cause such drawing back, the shuttle will, in order to give itself the necessary room, draw a portion of the thread which had been given out by the needle through the cloth, said thread having been left in a loop or slack state for that purpose.

Fig. 4 represents a part of the same portion of the machine that is shown in Fig. 2, but with the needle-arm down and with the needle passed through the cloth. *f* is the cloth, (seen

in section, but not shown in any of the other figures.) *e'* is the loop or slack thread formed on the outside of the cloth, and which is to be drawn through it by the passing of the shuttle.

I in the respective figures is the shuttle box or trough, within which the shuttle is moved back and forth by means of the picker-staves or shuttle-drivers J J. In Fig. 5 I have given a top view of this box with the shuttle K within it. This shuttle is in its general construction similar to the larger shuttle used in weaving, and its spool *g* is capable of containing an ordinary skein of silk. The shuttle-box I is represented as made convex on its under side, by which it is adapted to admit a baster-plate that may be in a curved form, although for most purposes a straight baster-plate may be used. The pieces marked *i i* are light springs above the shuttle, which bear slightly upon it and serve to steady its motion. The shuttle-drivers work on joint-pins, as shown at *j*, Fig. 2, there being a corresponding fixture for the drivers on the other side.

L, Fig. 3, is the cam that operates the shuttle-drivers, on the upper ends of which drivers there may be friction-rollers *j' j'*. The cam L acts upon the shuttle-drivers alternately.

M, Fig. 5, is a sliding box fitted into the shuttle-box and moved back and forth in the rear of the shuttle by one of the drivers, and N is a corresponding sliding piece moved by the other driver and adapted to the fore or pointed end of the shuttle. The needle-arm is attached to the rock-shaft O, Fig. 1, which vibrates on a center pin or pivots, and from this shaft rises an arm, P, that carries a pin and friction-roller, *k*, which enters a space, *l*, in the cam Q, which space operates as a zigzag groove, and is of course so formed as to give the proper vibration to the needle-arm. There is a groove or narrow channel made across the bottom of the shuttle-box to receive the needle, in order that its upper part may be even with said bottom and allow the shuttle to pass freely over it.

The baster-plate H, Fig. 3, which receives the cloth to be sewed, is furnished with a row of small holes, *m m*, drilled at a regular distance from each other, serving the purpose of rack-teeth, and into these round pinion-teeth enter for the purpose of carrying the plate forward to a proper distance at every stitch.

Fig. 6 shows the principal portion of the feeding apparatus as it would appear were a vertical section made through the machine in the line *x x* of Fig. 3. R is a cam on the cam-shaft C, that vibrates an arm, S, carrying a feeding-claw, T, that takes into a ratchet-wheel, U, on the shaft V, which shaft crosses the bed A of the machine, its fore end being seen at V, Fig. 1. This shaft has on it near its fore end the pinion that carries the pins or teeth that take into the holes *m* in the baster and cause it to advance between every stitch. The length of the stitch may be regulated by regulating the play of the arm S, and this is effected by the regulating-screw *n*, Fig. 3, that moves a pin back and forth that serves as a stop to said arm. The pin is represented by the dot *o*, Fig. 6, and is seen at *o*, Figs. 2 and 3. *p* is a spring that retains the ratchet-wheel in place as the claw is taking a new hold. *q* is a spring for holding the arm S against the cam.

In sewing with this machine, the thread from the bobbin F is passed over a notch, *r*, Fig. 1, at the upper end of the needle-arm, and is returned through the notch *r'*. It then passes down in front of said arm, then around the roller *b*, and through the needle-eye. To regulate the giving out of the thread from the bobbin, friction is made on it by the semicircular clasp *s*, that is made to press on it by a spring, *t*, regulated by a tempering-screw. Before the needle passes through the cloth the thread, which extends from the needle-eye to said cloth, is raised or drawn up by a lifting-pin, so as to form the loop or slack, which is subsequently to be drawn in by the passing of the shuttle between the thread and the needle.

W, Figs. 1 and 2, is a lifting-rod, from the side of which projects the lifting-pin *a*. The lifting-rod is attached at its upper end to a crank-arm, *c*, which works on a shaft, *w*, and this shaft is made to vibrate by means of the cam *x* on the cam-shaft. This cam operates on a friction-roller, *y*, on a short arm on the inner end of the shaft *w*. The lifting-rod stands in front of a plate, X, Figs. 1 and 2, which is attached at its upper end to the frame of the machine, and between the lower end of this plate and the shuttle-box the cloth is to pass. The plate X is furnished with a hinge-joint at its upper end, in order that its distance from the shuttle box may be regulated to suit cloth of different thicknesses.

Y, Fig. 1, is a set-screw, by which it is held in place. From the back part of the lifting-rod proceeds a guide-pin, *z*, that moves the lifting-rod laterally, so as to govern the action of the lifting-pin *a*. This guide-pin works against guide-pieces *a' b'*, affixed on the front of the plate X. The dotted lines show the groove formed by the pieces *a' b'*, along which the guide-pin is to pass. The lifting-rod is carried toward the piece *b'* by means of a spiral spring around its shaft, or in any other convenient mode. In the position in which the apparatus is shown in Fig. 1 the lifting-pin is partially raised, and will have lifted the thread. In raising it the guide-pin passes through the groove between *a' b'*, (shown by dotted lines,) and when at the upper end of this groove the needle-arm acts and carries the needle through the cloth. On the side of the needle-arm there is a projecting piece, *c'*, the inclined edge of which, coming in contact with the lifting-rod, pushes it laterally over the angular point of the piece *a'*, and the crank-arm *c* descending at this moment, the lifting-pin is withdrawn from the thread, which is thereby left slack to a sufficient extent for the purpose designated.

The shuttle (shown separately in Fig. 7) has a hole, *d'*, through its side for the thread to pass from the spool; and a slot, *f' f'*, is made through the side of the shuttle-box to allow of the play of the shuttle-thread back and forth. At the time when the shuttle has completed its passage between the needle and its thread, the needle is to be withdrawn from the cloth; and when this is taking place, it is necessary that the shuttle-thread should be held firmly, or the withdrawing of the needle, instead of drawing the shuttle-thread firmly into the body of the cloth and making a perfect seam, would draw a portion of it from the spool and cause it to pass entirely through said cloth.

In Fig. 1, *g'* is the outer end of a lever which is made to rise at the proper moment, and to clip the thread between it and the upper edge of the slot *f'*. This lever is seen in Fig. 2, its fulcrum being at *h'*. The rod *i'* serves to depress the inner end of said lever and to raise its outer end, the cam *j''* on the cam-shaft performing this office.

The sliding box M does not bear directly against the rear end of the shuttle-box, but has a pin, *n'*, projecting from its fore end, which pin acts against the shuttle. The pin *n'* constitutes a part of a small lever shown separately in Fig. 8. The part *n'* of this lever is received within a suitable slot in the sliding box M, and it turns on a fulcrum-pin, *p'*. When the shuttle has passed through the loop formed by the needle-thread, it is received upon the pin *n'*, and as the needle is retracted the thread will be drawn taut upon said pin. At this time the head of an adjustable spring-piece, *z z'*, bears against the end *n'* of the small lever, and the force of its pressure has to be overcome before the thread escapes from the pin, which it does by drawing over against the power of the spring. As the loop then escapes, it will draw up the filling-thread from the shuttle firmly against the cloth and embed it within it. The head of the spring Z passes through a mortise in the shuttle-box, as shown by the dotted lines. *o'* is an adjusting-screw by which the force of the spring Z may be regulated.

Having thus fully described the manner in which I construct my machine for sewing seams, and shown the operation thereof, what I claim therein as new, and desire to secure by Letters Patent, is—

1. The forming of the seam by carrying a thread through the cloth by means of a curved needle on the end of a vibrating arm, and the passing of a shuttle furnished with its bobbin, in the manner set forth, between the needle and the thread which it carries, under a combination and arrangement of parts substantially the same with that described.

2. The lifting of the thread that passes through the needle-eye by means of the lifting-rod W, for the purpose of forming a loop of loose thread that is to be subsequently drawn in by the passage of the shuttle, as herein fully described, said lifting-rod being furnished with a lifting-pin, *u*, and governed in its motions by the guide-pieces and other devices, arranged and operating substantially as described.

3. The holding of the thread that is given out by the shuttle, so as to prevent its unwinding from the shuttle-bobbin after the shuttle has passed through the loop, said thread being held by means of the lever or clipping-piece *g'*, as herein made known, or in any other manner that is substantially the same in its operation and result.

4. The manner of arranging and combining the small lever *m' n'* with the sliding box M, in combination with the spring-piece Z, for the purpose of tightening the stitch as the needle is retracted, as described.

5. The holding of the cloth to be sewed by the use of a baster-plate furnished with points for that purpose, and with holes enabling it to operate as a rack in the manner set forth, thereby carrying the cloth forward and dispensing altogether with the necessity of basting the parts together.

ELIAS HOWE, JR.

Witnesses:
THOS. P. JONES,
GEORGE FISHER.

E. HOWE, Jr.

Sewing Machine.

No. 1,154. Reissued March 19, 1861.

Fig. 1.

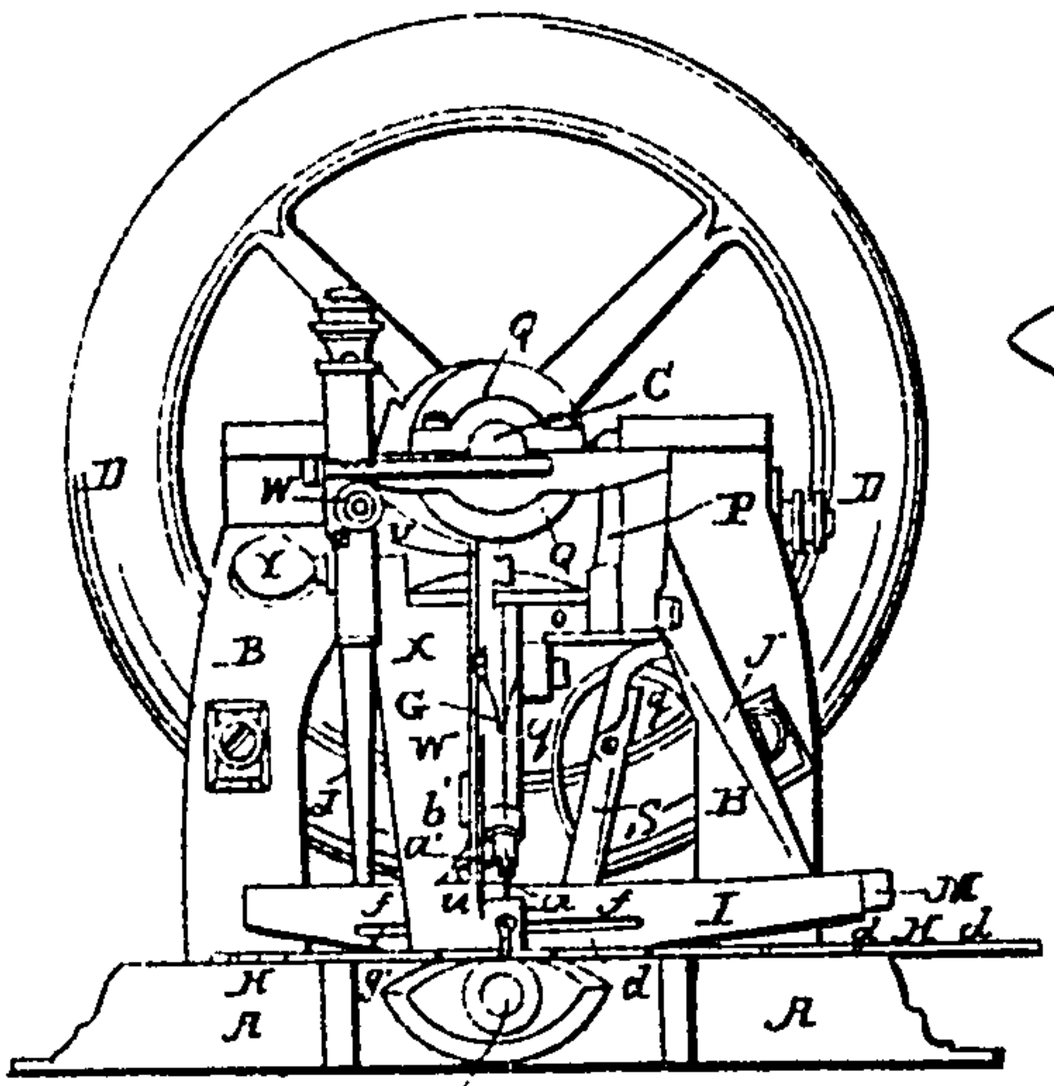


Fig. 2.

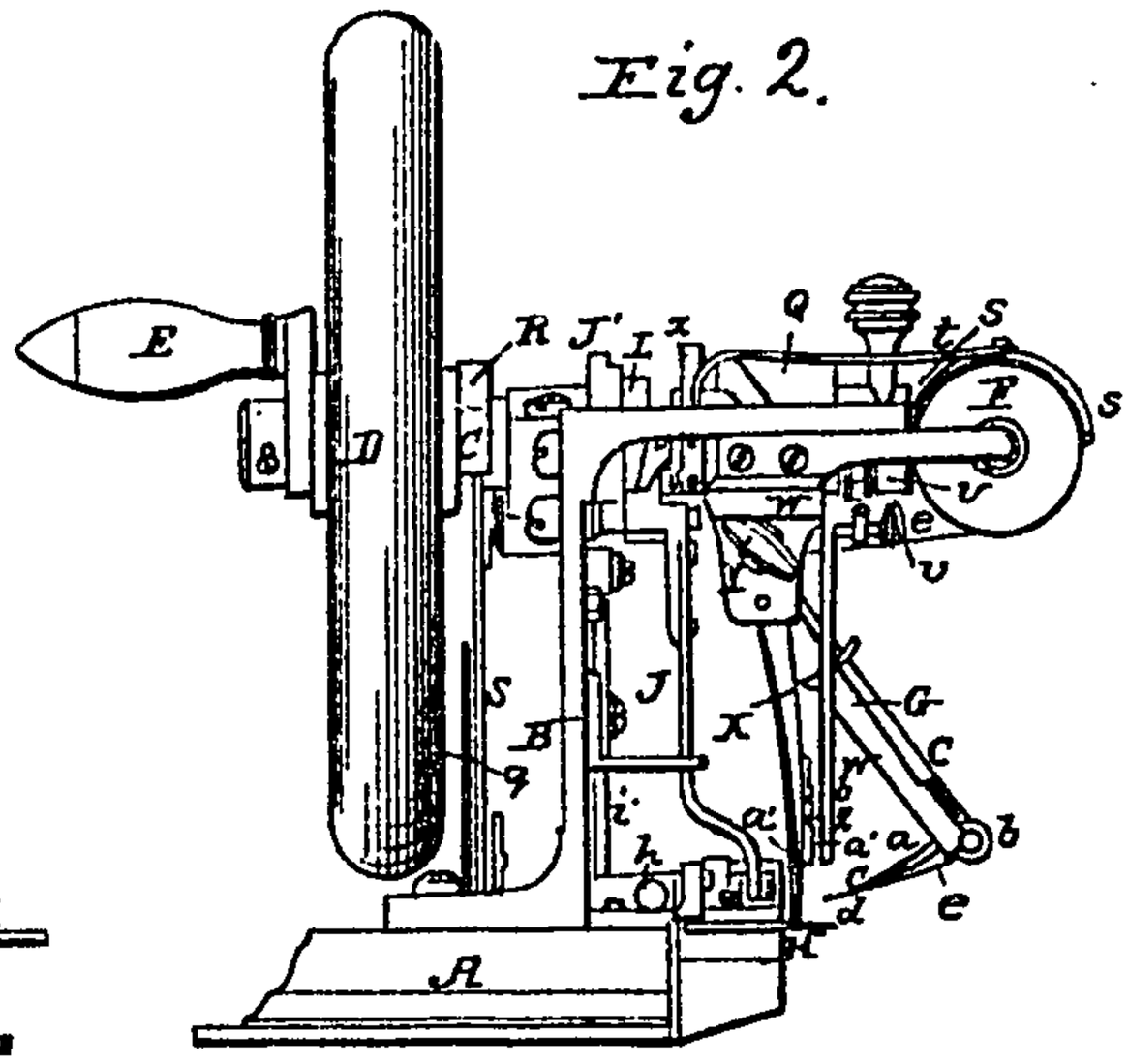
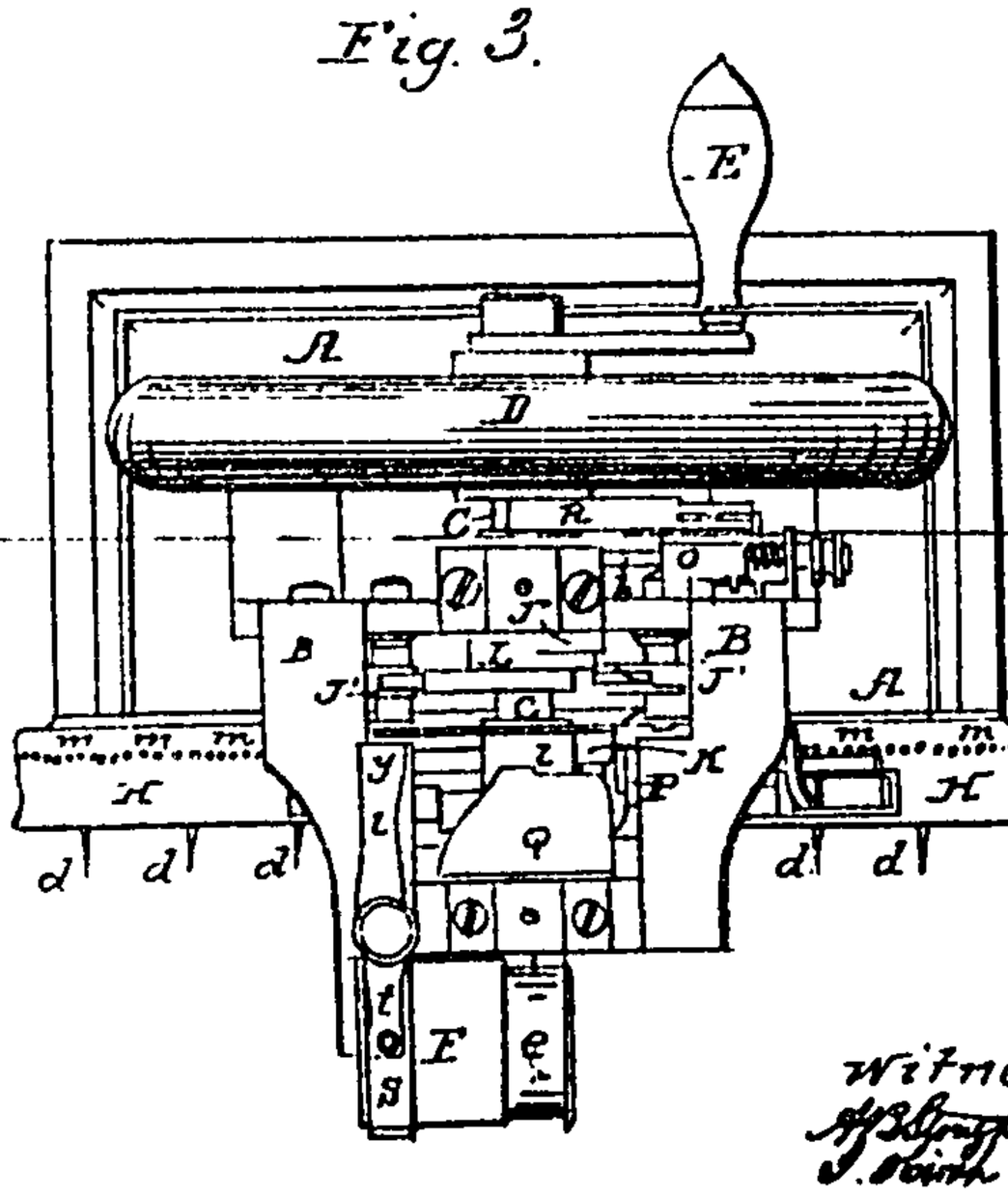


Fig. 3.



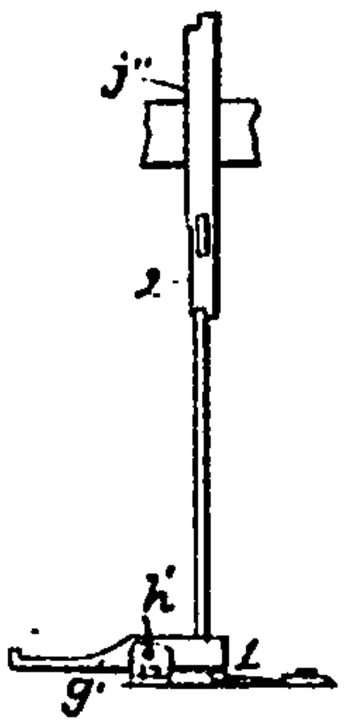


Fig. 4.

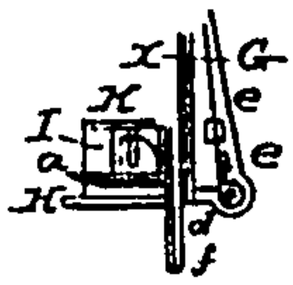


Fig. 9.

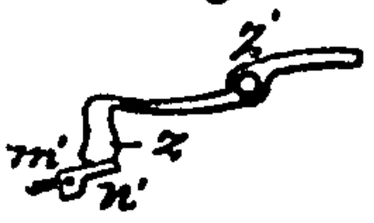
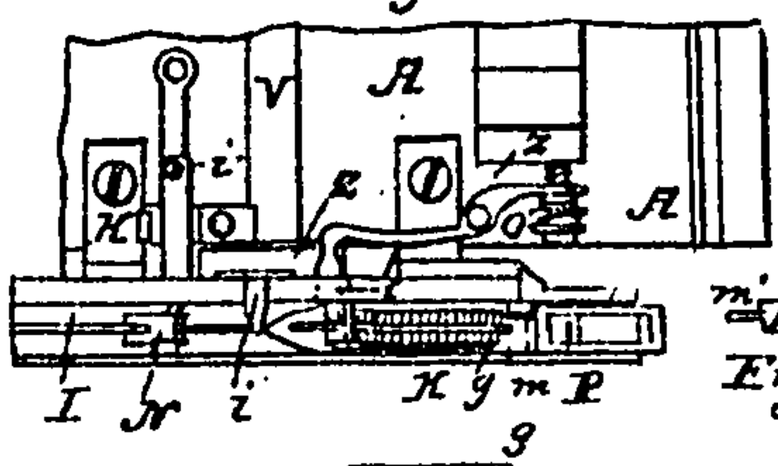


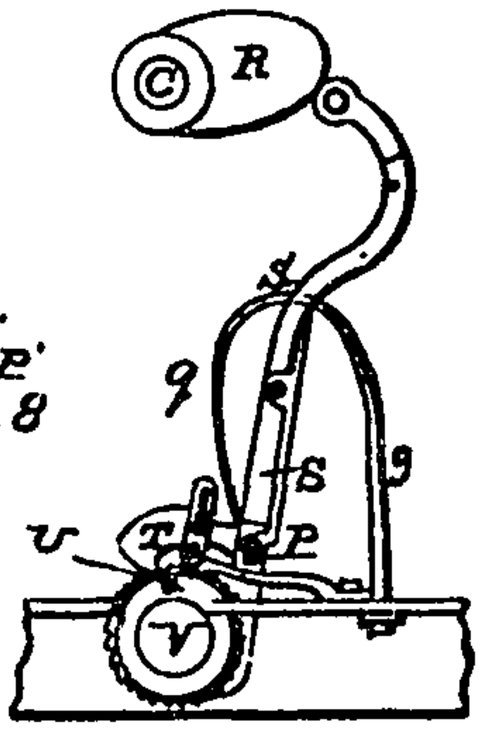
Fig. 5.



m' n'
P'
Fig. 8

Fig. 7.

Fig. 6



Witnesses:
H. B. Langston
J. Smith

Inventor:
Elias Howe Jr

UNITED STATES PATENT OFFICE.

ELIAS HOWE, JR., OF BROOKLYN, NEW YORK.

IMPROVEMENT IN SEWING-MACHINES.

Specification forming part of Letters Patent No. 4,750, dated September 10, 1846; extended seven years; Reissue No. 1,154, dated March 19, 1861.

To all whom it may concern:

Be it known that I, ELIAS HOWE, Jr., of Brooklyn, Kings county, State of New York, and formerly of Cambridge, in the county of Middlesex and State of Massachusetts, have invented a new and useful machine for sewing seams in cloth or other articles requiring to be sewed; and I do hereby declare that the following is a full and exact description thereof.

In sewing a seam with my machine two threads are employed, one of which threads is carried through the cloth by means of a curved needle, the pointed end of which is to pass through said cloth. The needle used has the eye that is to receive the thread within a small distance—say an eighth of an inch—of its inner or pointed end, with a groove to receive and protect the thread in the rapid movement of the needle through the fabric to be sewed, running back from the eye to the heel on both sides. The other or outer end of the needle is held by an arm that vibrates on a pivot or joint pin, and the curvature of the needle is such as to correspond with the length of the arm as its radius. When the thread is carried through the cloth, which may be done to the distance of about three-fourths of an inch, the thread will be stretched above the curved needle something in the manner of a bow-string, leaving a small open space between the two. A small shuttle carrying a bobbin filled with silk or thread is then made to pass entirely through the open space between the needle and the thread which it carries, and when the shuttle is returned, which is done by means of a picker-staff or shuttle-driver, the thread which was carried in by the needle is surrounded by that received from the shuttle, and as the needle is drawn out it forces that which was received from the shuttle into the body of the cloth, and as this operation is repeated a seam is formed which has on each side of the cloth the same appearance as that given by stitching, with this peculiarity, that the thread shown on one side of the cloth is exclusively that which was given out by the needle, and the thread seen on the other side is exclusively that which was given out by the shuttle. It will therefore be seen that a stitch is made at every back-and-forth movement of the shuttle. The two thicknesses of cloth that are to be sewed are held upon pointed wires which project out from a metallic plate, like the teeth of a comb, but at a considerable distance from each other—say three-fourths of an inch, more or less—these pointed wires sustaining the cloth and answering the purpose of ordinary basting. The metallic plate from which these wires project has numerous holes through it, which answer the purpose of rack-teeth in enabling the plate to be moved forward, by means of a pinion, as the stitches are taken. The distance to which said plate is moved, and consequently the length of the stitches, may be regulated at pleasure.

In the accompanying drawings, Figure 1 is a front elevation of the machine; Fig. 2, an end elevation thereof, and Fig. 3 a top view. The other figures represent sections and parts in detail, which will be presently explained.

A A is the bed or base of the machine, and B B standards rising therefrom, which sustain the main shaft and other parts of the apparatus.

C C is the main shaft, which carries the cams that operate the needle, the shuttle-drivers, and other parts of the machine.

D is a fly-wheel, and E a winch on said shaft.

F is a bobbin, on which the silk is wound that is to supply the needle.

G is the needle-arm that carries the curved needle *a*. This is seen most distinctly in the end elevation, Fig. 2. The thread from the bobbin F passes round a small friction-roller, *b*, or round a smooth groove in the situation of said roller, then up through the eye of the needle at *c*, which eye is situated near to the needle-point. The cloth is stuck on the points *d d*, that project from the metallic plate H, which I will call the "baster-plate." This plate is shown most distinctly in the top view, Fig. 3. When the thread *e* is carried through the cloth by the needle *a*, the upper portion of said thread will be above the needle, and will allow the point of the shuttle (to be presently described) to pass between them to enable it to enter readily. The needle, after entering the cloth, is immediately drawn back to a short distance, which opens the loop slightly, the cam which operates the needle-arm being so formed as to cause such drawing back. The

shuttle will, in order to give itself the necessary room, draw a portion of thread which had been given out by the needle through the cloth, said thread having been left in a loop or slack state for that purpose.

Fig. 4 represents a part of the same portion of the machine that is shown in Fig. 2, but with the needle-arm down and with the needle passed through the cloth. *f* is the cloth seen in section, but not shown in any of the other figures. *e'* is the loop or slack thread formed on the outside of the cloth, and which is to be drawn through it by the passing of the shuttle. I in the respective figures is the shuttle box or trough, within which the shuttle is moved back and forth by means of the picker-staves or shuttle-drivers J J. In Fig. 5 I have given a top view of this box with the shuttle K within it. This shuttle is in its general construction similar to the larger shuttles used in weaving, excepting it has but one point, formed, as shown in Fig. 7, by the forward end of the needle side extended, and fitted to run in a longitudinal groove in the bottom of the shuttle-box, even with the upper part of the needle received in the cross-groove, to insure the interlocking of the threads; and its spool *g* is capable of containing an ordinary skein of silk. A clasp-spring applied to the shuttle and its spool, as shown in Fig. 7, regulates the unwinding of the thread. The shuttle-box I is represented as made convex on its under side, by which it is adapted to admit a baster-plate that may be in a curved form, although for most purposes a straight baster-plate may be used. The pieces marked *i i* are light springs above the shuttle, which bear slightly upon it and serve to steady its motion. The shuttle-drivers work on joint-pins, as shown at *j*, Fig. 2, there being a corresponding fixture for the drivers on the other side.

L, Fig. 3, is the cam that operates the shuttle-drivers, on the upper ends of which drivers there may be friction-rollers, *j' j''*. The cam L acts upon the shuttle-drivers alternately. The shuttle-drivers, when not acted on by the cams, are held in position by springs.

M, Fig. 5, is a sliding box, fitted into the shuttle-box, and moved back and forth in the rear of the shuttle by one of the drivers; and N is a corresponding sliding piece moved by the other driver, and adapted to the fore or pointed end of the shuttle. This piece, after each forward movement, is withdrawn by a spring acting on the upper end of its driver, so as not to interfere with the proper action of the needle and its thread.

The needle-arm is attached to the rock-shaft O, Fig. 1, which vibrates on a center pin or pivot, and from this shaft rises an arm, P, that carries a pin and friction-roller, *k*, which enters a space, *l*, in the cam Q, which space operates as a zigzag groove, and is of course so formed as to give the proper vibration to the needle-arm. There is a groove or narrow channel made across the bottom of the shuttle-box to receive the needle, in order that its upper part may be even with said bottom, and allow the shuttle to pass freely over it.

The baster-plate H, Fig. 3, which receives the cloth to be sewed, is furnished with a row of small holes, *m m*, drilled at a regular distance from each other, serving the purpose of rack-teeth, and into these round pinion-teeth enter for the purpose of carrying the plate forward to a proper distance at every stitch. The baster-plate is held down upon these pinion-teeth by a suitable spring.

Fig. 6 shows the principal portion of the feeding apparatus as it would appear were a vertical section made through the machine in the line *x x* of Fig. 3. R is a cam on the cam-shaft C, that vibrates an arm, S, carrying a feeding-claw, T, that takes into a ratchet-wheel, U, on the shaft V, which shaft crosses the bed A of the machine, its fore end being seen at V, Fig. 1. This shaft has on it, near its fore end, the pinion that carries the pins or teeth that take into the holes *m* in the baster and cause it to advance between every stitch.

The length of the stitch may be regulated by regulating the play of the arm S, and this is effected by the regulating-screw *n*, Fig. 3, that moves a pin back and forth that serves as a stop to said arm. The pin is represented by the dot *o*, Fig. 6, and is seen at *o*, Figs. 2 and 3

p is a spring that retains the ratchet-wheel in place as the claw is taking a new hold. *q* is a spring for holding the arm S against the cam.

In sewing with this machine the thread from the bobbin F is passed over a notch, *r*, Fig. 1, at the upper end of the needle-arm, and is returned through the notch *r'*. It then passes down in front of said arm, then around the roller *b*, and through the needle-eye. To regulate the giving out of the thread from the bobbin, friction is made on it by the semicircular clasp *s*, that is made to press on it by a spring, *t*, regulated by a tempering-screw. Before the needle passes through the cloth the thread which extends from the needle-eye to said cloth is raised or drawn up by a lifting-pin, so as to form the loop or slack, which is subsequently to be drawn in by the passing of the shuttle between the thread and the needle, and also to prevent entanglement with the needle and to insure the uniform laying of the stitches.

W, Figs. 1 and 2, is a lifting-rod, from the side of which projects the lifting-pin *u*. The lifting-rod is attached at its upper end to a crank-arm, *v*, which works on a shaft, *w*, and this shaft is made to vibrate by means of the cam *x* on the cam-shaft. This cam operates on a friction-roller, *y*, on a short arm on the inner end of the shaft W. The lifting-rod stands in front of a plate, X, Figs. 1 and 2, which is attached at its upper end to the frame of the machine, and between the lower end of this plate and the shuttle-box the cloth is to pass. The plate X is furnished with a hinge-joint at its upper end, in order that its distance from the shuttle-box may be regulated to suit cloth of different thicknesses. Y, Fig.

1, is a set-screw by which it is held in place. The inner surface of the plate X is slightly beveled, as shown in Fig. 2, to facilitate the entrance and passage of the cloth between it and the shuttle-box. These opposing local surfaces of the plate X and the shuttle-box having a suitable passage for the needle with its thread are smooth, and hold the cloth in position at the place of sewing under the action of the other parts of the machine, and they specially aid the needle and shuttle to form and tighten the successive stitches in the cloth alike, and they also specially aid the baster-plate to hold and guide the cloth forward on its points in the line of seaming.

From the back part of the lifting-rod proceeds a guide-pin, *z*, that moves the lifting-rod laterally, so as to govern the action of the lifting-pin *a*. This guide-pin works against guide-pieces *a' b'*, affixed on the front of the plate X. The dotted lines show the groove formed by the pieces *a' b'*, along which the guide-pin is to pass. The lifting-rod is carried toward the piece *b'* by means of a spiral spring around its shaft, or in any other convenient mode. In the position in which the apparatus is shown in Fig. 1 the lifting-pin is partially raised, and will have lifted the thread. In raising it the guide-pin passes through the groove between *a' b'*, (shown by dotted lines,) and when at the upper end of this groove the needle-arm acts and carries the needle through the cloth.

On the side of the needle-arm there is a projecting piece, C', the inclined edge of which, coming in contact with the lifting-rod, pushes it laterally over the angular point of the piece *a'*, and the crank-arm V descending at this moment, the lifting-pin is withdrawn from the thread which is thereby left slack to a sufficient extent for the purpose designated.

The shuttle shown separately in Fig. 7 has a hole, *d'*, through its side for the thread to pass from the spool, and a slot, *f'' f'*, is made through the side of the shuttle-box to allow of the play of the shuttle-thread back and forth. At the time when the shuttle has completed its passage between the needle and its thread, the needle is to be withdrawn from the cloth, and when this is taking place it is necessary that the shuttle-thread should be held firmly, or the withdrawing of the needle, instead of drawing the shuttle-thread firmly into the body of the cloth and making a perfect seam, would draw a portion of it from the spool and cause it to pass entirely through said cloth.

In Fig. 1, *g'* is the outer end of a lever which is made to rise at the proper moment, and to clip the thread between it and the upper edge of the slot *f'*. This lever is seen in Fig. 2, its fulcrum being at *h'*. The rod *i'* serves to depress the inner end of said lever, which is held up by a spring, 1, and to raise its outer end, the cam *j''* on the cam-shaft performing this office by acting on a spring-treadle, 2, resting on the upper end of said rod, held by an adjustable guide, 3, whereby the pressure of said treadle is regulated.

The sliding box M does not bear directly against the rear end of the shuttle, but has a pin, *m'*, projecting from its fore end, which pin acts against the shuttle. The pin *m'* constitutes a part of a small lever shown separately in Fig. 8. The part *n'* of this lever is received within a suitable slot in the sliding box M, and it turns on a fulcrum-pin, *p'*. When the shuttle has passed through the loop formed by the needle-thread, said loop is received upon the pin *m'*, and as the needle is retracted the thread will be drawn taut upon said pin. At this time the head of an adjustable spring-piece, % %', bears against the end *n'* of the small lever, and the force of its pressure has to be overcome before the thread escapes from the pin, which it does by drawing over against the power of the spring. As the loop then escapes, it will draw up the filling-thread from the shuttle firmly against the cloth and embed it within it. The head of the spring % passes through a mortise in the shuttle-box, as shown by the dotted lines.

O' is an adjusting-screw by which the force of the spring % may be regulated.

The aforesaid machinery, arranged and co-operating as described, constitutes my new machine, which sews a firm seam automatically, and is designed to take the place of hand-sewing.

Having thus fully described the manner in which I construct my machine for sewing seams, and shown the operation thereof, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. A sewing-machine, constructed and operating to form a seam, substantially as described.

2. The combination of a needle and a shuttle, or equivalent, and holding-surfaces, constructed and operating substantially as described.

3. The combination of holding-surfaces with a baster-plate or equivalent, constructed and operating substantially as described.

4. A lifting-rod, a clipper-lever, and a receiving-pin respectively, each constructed and operating to control the threads, substantially as described.

5. A baster-plate, constructed and operating substantially as described.

6. Holding-surfaces, constructed and operating substantially as described.

7. A grooved and eye pointed needle, constructed and adapted for rapid machine-sewing, substantially as described.

8. A side-pointed shuttle, constructed and operating substantially as described.

ELIAS HOWE, JR

Witnesses:
W. H. PLUMMER,
A. MARKS.

Sewing Machine.

On September 10, 1846, Elias Howe took out a patent on a sewing machine, No. 4750. This machine had a swinging arm on the end of which was a curved needle which was concentric to the center of oscillation of the arm. This needle had its eye located near its point. The cloth was held vertically and the arm and needle were located between the cloth and the operator. The needle reciprocated into and out of the cloth with the eye passing a fraction of an inch below the cloth. The needle then moved back a portion of this distance to form a bulge or loop in the thread which it carried below the cloth and stopped for an instant. The cam which drove the needle arm was formed to secure this result.

On the other side of the cloth was a shuttle with a bobbin in it which carried another thread and when the needle thread formed a loop the shuttle was driven through the loop leaving its thread in the loop. In this way the thread above the cloth was interlocked with the thread below it. By the upward movement of the needle and the movement of the bobbin these threads were drawn tight and the lock stitch was formed. By repeating this cycle of operations for every stitch a seam was sewed by the machine. This is substantially the same as the operation of every lock stitch sewing machine at the present time which uses a vibrating shuttle. The reader can watch this operation by tilting the head of the machine back and turning the wheel over by hand a few times. The operation of the rotary hook and the rotating shuttle and the oscillating shuttle machines in forming a lock stitch are the equivalent of this feature of Howe's machine. In all these respects Howe was the pioneer of all that came after him and used these fundamental features of his invention.

The Howe patent contains the usual drawing illustrating the invention and a specification describing the invention. It also contains five claims defining the invention, the first of which claims is probably the broadest.

The five claims in Howe's original patent are for a mechanical process of sewing rather than for claims on the structure of the sewing machine or any parts thereof. The first one of these claims will be considered and at the outset it must be remembered that every patent claim is a definition of an invention or a part thereof and is expressed in a single sentence.

The first claim of Howe's original patent will be considered and it will be better understood if divided into elements as follows:

(A) The forming of the seam by carrying a thread through the cloth,
(B) by means of a curved needle,
(C) on the end of a vibrating arm,
(D) and the passing of a shuttle,
(E) furnished with its bobbin,
(F) in the manner set forth, between the needle and thread which it carries under a combination and arrangement of parts substantially the same with that described.

If the claim had been intended to describe a structure, as is the practice with most patent claims, it might have been written as follows:

"In a sewing machine, the combination of a swinging arm, a curved needle on the end thereof capable of carrying a thread thru a cloth and forming a loop in the thread below the cloth, a shuttle having a bobbin therein capable of carrying a thread thereon, means for passing the shuttle thru the loop and leaving its thread in the loop."

It will be seen that this hypothetical claim describes structure with the function or operation of the parts expressed as qualifications.

The claim specifies "a curved needle." This was bad for Singer's machine soon appeared with a straight needle.

The claim also specifies "a vibrating arm." This is also bad, for Singer's machine had a stationary overhanging arm with a reciprocating needle bar in the end of it and this bar was driven by a shaft revolving in the overhanging arm, a feature which is common to all machines at the present time.

The elements B and C of the claim would have been better or more broadly expressed if written as follows:

"By means of a needle, means for vibrating the point of the needle into and out of the cloth."

As it turned out Howe's claim was given a broad construction by the courts just as though it had been written with the broad terms suggested.

Howe was the first inventor of a sewing machine which sewed with the eye in the point of the needle. He probably could have secured either of the following claims in his original patent:

1. A machine which sews with the eye in the point of the needle;
2. A lock stitch machine which sews with the eye in the point of the needle.

As all machines sew with the eye in the point of the needle the first of these claims would have been sufficient to dominate the whole sewing machine art. The second claim would have been desirable on the ground that the more specific claims are less apt to be declared invalid than the broader claims. The first of these claims would cover both the lock stitch and the chain stitch sewing machines and the second claim would cover the lock stitch sewing machine only.

After considerable litigation, in all of which he was successful, Howe extended his patent for seven years and had it reissued on March 19, 1861. The Reissue patent is No. 1154. None of the claims of the original patent were repeated in the reissued patent, an omission which would now be considered a mistake.

Both the original Howe patent 4750 and his reissue patent 1154 are reproduced herewith to show that the reissue patent disclosed the same invention as the original patent without any additions to or improvements on the machine disclosed therein. This is a fundamental requirement in all reissue patents that they be limited to the same invention that is disclosed in the original patent. Nothing must be added to the disclosure in the reissue application unless the basis for it was laid either in the drawings or specification of the original patent. In Howe's reissue the drawings are identical with the drawings of the original patent except that the drawings of the original patent are on a larger scale and spread out over several sheets while the drawings of the reissue are condensed to one sheet. If something were described in the specification of the original patent that was not shown in the drawings the subject matter thereof could have been added to the drawings of the reissue and if something was shown in the drawings that was not described in the specification a suitable addition could have been made to the description, but this is as far as one can go in applying for a reissue. Matter that is not found in either the drawings or specification of the original application for the patent is new matter and is objectionable and if it is included in the original patent or the reissue patent will make either of them invalid. Such matter must be claimed in a separate patent. A reissue patent is intended principally to correct or improve the claims on the invention originally disclosed in the original application for the original patent.

On the granting of the reissue patent the original patent is cancelled. A reissue does not extend the life of the patent but expires at the same time the original patent would have expired.

In the seventh claim of the reissue patent Howe claimed:

"7. A grooved and eye pointed needle constructed and adapted for rapid machine sewing substantially as described."

In this claim he specified that the needle was grooved. All sewing machine needles are grooved to give clearance to the thread as the needle carries it through the cloth, and the presence of this limitation is not objectionable. But if plain eye pointed needles could be successfully used in sewing machines the presence of this limitation would be hurtful as the claim might have been strictly construed to cover only grooved needles in which case the smooth needles would be outside of the patent.

During the fourteen years in which his first patent was in force Howe met all comers in the sewing machine business, held them for infringement and compelled them to pay tribute. The courts steadily gave his patent a broad construction. While the term "pioneer invention" does not seem to appear in the decisions, the setting for it appears all through the decisions. His claims were broadly construed and all machines complained of were enjoined.

Howe's original patent was for a sewing machine and a mechanical process of sewing. Both of these were new. The first claim of his patent describes the mechanical process of forming a locked stitch. None of the claims of the first patent describe the structure of the machine or any part of it but wherever structure is included it is inferred rather than positively set forth in the claim. In the reissue patent all the claims after the first, cover elements. The second, third, and fourth claims cover combinations of elements. The fifth, sixth, seventh and eighth claims each cover single elements. All of the reissue claims contain the words "constructed and operating substantially as described" except the seventh claim which uses the words "constructed and adapted for rapid machine sewing substantially as described."

These reissued claims all show the breadth of Howe's invention, first because the claims are short, and second, because the claims cover a single element each or a combination of but two or three elements, instead of a combination of a great number of elements or the combination of all the elements of the machine.

The breadth or scope of a patent claim may be explained as follows:

A claim in a patent must be considered in much the same way as a product of prime factors. Thus 2 x 3 x 5 equals 30. Each of these factors may be considered an element. If a pirate used the elements 2 x 3 he does not infringe the claim that calls for the combination of the elements 2 x 3 x 5 for he does not use the combination called for by that claim and the courts always so hold. But if he uses the combination elements 2 x 3 x 5 x 7 he uses the combination of elements 2 x 3 x 5 regardless of what he may have added thereto and the courts always so hold.

The same idea may be stated by the use of letters. The claim may cover the combination of the elements a, b and c. If the pirate uses only elements a and b he does not infringe for he does not use the combination claimed. But if he uses elements a, b, c and d he infringes for he uses the combination of elements a, b and c and this is not altered by the fact that he has added the element d. For this reason it is desirable to claim single elements or the smallest combination of elements possible in each case and then make the claims as broad as possible to hold all possible infringers and give adequate protection to the invention.

This is what Howe did in his reissue patent but he should have retained the claims of the original patent, in which case the reissue patent would have contained thirteen claims instead of eight.

Howe had the experience that many other successful inventors have

had. His patents gave him a chance to litigate. His right to his patent was disputed by Walter Hunt who claimed to have invented practically the same machine ten years before Howe's invention. So in 1853 Hunt applied for a patent.

He caused the following notice to be published in the New York Tribune:

"Sewing Machines—Card to the public.

"I perceive that Elias Howe, Jr., is advertising himself as patentee of the Original Sewing Machine, and claiming that all who use machines having a needle or needles with an eye near the point, are responsible to him. These statements I contradict. Howe was not even the original patentee. John J. Greenough and George R. Corliss, each had a patent on a sewing machine before Howe obtained his patent as the records of the Patent Office show. Howe was not the original and first inventor of the machine on which he obtained his patent. He did not invent the needle with the eye near the point. He was not the original inventor of the combination of the eye pointed needle and the shuttle, making the interlocked stitch with two threads, now in common use. These things which form the essential basis of all sewing machines were first invented by me, and were combined in good operative Sewing Machines which were used and extensively exhibited, both in New York and Baltimore more than 10 years before Howe's patent was granted.

"By law no other person than myself could, or can have a valid patent upon the eye pointed needle and shuttle, or any combination of them. The proof of these facts is abundant and conclusive. I have taken measures, as soon as adverse circumstances would permit, to enforce my rights by applying for a patent for my original invention. I am by law entitled to it, and in due course, no doubt, will get it. In that case, Howe's license will be no protection against my just claims; and I shall then ask and insist upon a just compensation from all who use my invention. All who feel an interest in this subject can, by calling on me, receive the most satisfactory evidence that I was the first and original inventor of the Sewing Machine.

(Signed) Walter Hunt, No. 115 Charles St., N. Y."

"On November 3, 1853, Elias Howe, Jr., with a copy of the above quoted notice as a source of information protested to the Commissioner of Patents against the issuance of a patent to Hunt 'which if granted,' he said, 'will supercede the patent granted to me Sept. 10, 1846, for an Improvement in Sewing Machines.'

"The claims of said Hunt, substantially as set forth in said advertisement, having twice been presented, and investigated before the United States Circuit Court holden in Boston, as a defense in an action at law, and a suit in equity, and well pronounced by the verdict of the jury and the decision of the court to be of no avail against my said patent and a final decree and judgment was rendered in favor of my said patent notwithstanding such defense."

(See page 211, Journal of the Patent Office Society—Jan. 1922.)

The Patent Office refused to give Hunt a patent on the ground that his machine was an abandoned experiment.

In the case of Howe vs. Underwood, February 1854, Fed. case 6775, the Singer sewing machine was complained of as an infringement and the case was defended on the ground that Howe was not the first inventor of the sewing machine and that Howe's patent was therefore not valid.

The defense proved that ten years before Howe's invention this same Walter Hunt had built a sewing machine and had made many demonstrations of it. But as to whether the demonstrations were successful there

was much conflicting testimony. One thing was certain, Hunt and his backers lost interest in the machine and gave it up. It was evident that they abandoned it before it had been perfected, years before Howe came into the field, and the machine was only recalled when Howe showed that his machine had succeeded and it was desired to defeat his patent. Under these circumstances the court held that Hunt's machine was only an abandoned experiment of no benefit to the public and could not possibly invalidate Howe's patent, the machine of which was of benefit to the public.

This doctrine has been followed in all similar cases since that time. Howe's patent was held to be valid and a decree of injunction was, therefore, entered against the Singer machine.

In the decision in this case with reference to the alleged earlier invention of Walter Hunt, Justice Sprague wrote as follows, page 680:

> "To whom is the public indebted for the present useful improvement or useful existence of the sewing machine? Upon that there is no question. There is no evidence in this case, that leaves a shadow of doubt, that, for all the benefit conferred on the public by the introduction of a sewing machine, the public are indebted to Mr. Howe. The Constitution provides that Congress shall have power 'to promote the progress of science and useful art, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.' Now who has promoted this useful art? Who is it in this case that comes within the meaning of the constitution, that to promote the useful arts, Congress shall have power to secure to inventors their inventions? Unquestionably Mr. Howe and no other person. I mean no other person has given to the public this invention from the evidence before the court.
>
> "Then we look at the legislation of Congress, to see what are the requisites to entitle him to a patent and we find that he must be the first and original inventor; and that the thing which he invents must not be known or used before he has obtained his patent or made his invention. That has often received a judicial construction and if there has preceded the invention, for which a patent has been obtained another invention of the same kind and that has been perfected within the meaning of the patent law, so as to be of practical utility and not to end in mere experiment—then it has anticipated the subsequent discovery or invention, and such invention cannot be entitled to the monopoly or exclusive privilege that is claimed by the patent.
>
> "The first inquiry here is whether Hunt's machine, which is alone relied upon as having preceded Mr. Howe's was ever perfected within the meaning of the law; and a second is whether it had not been abandoned and forgotten before Mr. Howe's invention. These are the two questions to which I shall give my attention; because I do not think it necessary to go into the question of the similarity of the Hunt machine to Mr. Howe's. But I go directly to the question whether Mr. Hunt's machine as he made it was perfected; or if in the second place, if perfected whether it was forgotten or abandoned."

The court reviewed the evidence on the alleged use of the Hunt machine about which there was considerable conflict and showed that the performance of the machine was either unsatisfactory or there was considerable doubt about the credibility of the testimony, and then wound up this part of the analysis of the evidence by the following paragraph:

"How invariable is it, that after a great invention has been brought before the world, has become known to the public, and been put in a form to be useful, that people start up in various places and declare that they invented the same thing long before. The cotton-gin and the ether discovery, are illustrations in point; and others of similar character might be added indefinitely. These pretended prior inventors had thought of such a thing; that they had had the conception of such a thing perhaps; but they had never carried it to the extent of making it of practical utility, so that the world could obtain possession of it. But when they find that another has completed that which they had begun, they are astonished that they did not see, think they must have seen, all that is necessary and claim that they had invented it. After having seen what has been done, the mind is very apt to blend the subsequent information with prior recollections and confuse them together. Prophecy after the event is easy prophecy. I think that this is one of the cases in which several of the witnesses have been led into the illusion of believing that they knew before, what they have learned or have been taught by Mr. Howe's invention and specification.

"We come then to another part of the evidence—these old remains. These are very important, undoubtedly; for when a new invention is sought to be intercepted by a former one, the production of the former machine is—I will not say essential—but of very great importance; showing that it does not rest merely in the recollection of witnesses that there was such a thing. These are the remains of a machine claimed to be invented by Mr. Hunt, as a sewing machine which was in the hands of Adoniram Hunt, and transferred to Arrowsmith, kept by him and found by him, as he states, in 1851, in the rubbish of his workshop. They exhibit some of the instrumentalities, but certainly to the eyes of those who are not experts, but few of the means of forming a sewing machine; and to the eyes of the experts they present the same deficiency. One, at least, of the defendant's experts, when he was called upon on a former occasion, looked at them, and then testified that there was nothing there from which a sewing machine could be constructed. He says now, that he has changed his mind, upon a more careful examination. At first view then they would present no satisfactory evidence of having been a sewing machine. The experts differ materially as to that old machine. Those for the defendants say that they saw there sufficient to enable them to construct a sewing machine, by the aid of the reproduction made by Walter Hunt from his memory. I do not think any of them go so far as to say that, from that old machine alone, they could undertake, without other aid, to make a sewing machine that would operate. They thought that from those old remains, there might have been constructed the machine that is described by Walter Hunt; they thought there was room enough to make such a machine. Then a part of that restored machine rests solely upon the recollection of Mr. Walter Hunt. Now, can any man say, from that old machine that Eleazer Johnson's testimony is not true, when he says that it did not operate? How can any man say that there was not a defect which prevented the shuttle from going through the race?—a defect, of which the persons, and they experts, having the machine entire before them could not ascertain the cause. Can these experts ascertain the cause, from the mere dry bones of this old machine, divested of its muscles and nerves? They say it must have operated. Their reasoning is evidently the reasoning from analogy, which is very likely to mislead men. The reasoning of Cuvier, by which from see-

ing a few bones, he could reconstruct a whole animal, proceeded upon the assumption that the animal was a perfect work, made by a creator perfect in his operations; and if the animal was a perfect work, then he could see, from its remains what must have been necessary to make that perfect work. But that would be assuming the point in controversy here. If that old machine was not a perfect work in the hands of Mr. Hunt, how can these experts say, from those remains, how that machine was made—how the other bones, the other operative parts were placed? Thus, they assume the very question which is here to be tried—whether the old machine was perfect or not."

Later on the court said:

"The great fact of this machine having been laid aside, as it was, is not accounted for, and is entirely inconsistent with the idea that it was a perfected or valuable machine at that time.

"The whole testimony leaves upon my mind no doubt, that however far Mr. Hunt had advanced with his machine, it was never perfected in the sense of the Patent Law; that it was only an experiment, and ended in experiment, and was laid aside as an unsuccessful experiment, until the introduction of Mr. Howe's machine."

At the end of the decision the court wrote as follows:

"The plaintiff's patent is valid and the defendant's machine is an infringement. An injunction is granted."

In the case of Howe vs. Morton, March 8, 1860, Fed. case 6769, several prior patents were put in evidence to show that parts of Howe's machine were old in these prior patents. But the court held that in each of them there was something lacking and that Howe was the inventor of the first successful sewing machine. The court also ruled that Howe was prior to a certain British patent which was not issued until after Howe had filed his U. S. application and it, therefore, did not become a printed publication prior to the date of Howe's invention and could not affect Howe's prior rights in this country or the validity of his patent.

In both of these cases the first claim of the original Howe patent was prominent.

In all the machines enjoined the sewing was done by two threads that formed a lock stitch. An eye pointed needle was used for one thread, a shuttle for the other but the similarity in one or more of the machines enjoined did not go beyond this. In the Sloat machine (Fed. case 6769) the shuttle did not go through the loop but the looped thread was drawn around the shuttle. This and other variations did not avoid the claims as construed by the courts and were held to infringe.

This is the policy of the courts in dealing with patents on pioneer inventions because in such cases the courts look to the similarity of the inventions and construe the claims liberally to hold the later user if the inventions are the same or are anywhere near the equivalent of each other in construction and operation.

In Howe vs. Williams, October, 1863, Federal case 6778, Howe sued on his reissued patent 1154 and again several prior patents were pleaded in anticipation but the court held the Howe patent as reissued to be valid nevertheless, for each of the prior patents omitted one or more features that were needed for the successful sewing machine. The court particularly held the seventh claim on the grooved eye pointed needle to be valid.

In the defendant's machine complained of, a shuttle was not used but a lock stitch was formed, although different from and more complex than Howe's simple lock stitch. There were other differences as well. The

court nevertheless held the machine to be an infringement and decreed an injunction.

Compared to later machines Howe's machine was very crude and unhandy. It could sew only a straight seam. It was soon replaced by other machines that were much better but because these later machines were better they did not avoid infringement but infringed for they still used Howe's fundamental ideas. All such machines paid tribute. The importance of the crude pioneer to the improver is set forth at 57 Fed. Rep. p. 506, as follows:

> "It would certainly be a novel doctrine to deny to an inventor the fruits of a broad invention because the machine which first embodied it was rudimentary in character and failed to do as good work as improved machines made subsequently. None of the great inventions could survive such a test. Ten years after the invention of Howe, the machine first made by him would hardly have satisfied the least exacting sewing woman. The Dodds and Stephenson locomotive would, only a short time after its construction, have been discarded as behind the age even by the savages of Tasmania. The telephone of Bell is not the perfected telephone of commerce, the Morse telegraph is looked upon today as an interesting antique. And yet, it would be an unheard-of proposition to withhold from these illustrious men the credit they deserve because their machines were crude at first and were improved afterwards."

Much the same idea is expressed in Knight's Mechanical Dictionary at page 2100 as follows:

> "Ultimate success is attained by a multitude of efforts, and it is not fair, in our admiration of the perfected, to forget the weary, ill-appreciated, and unpaid efforts of those who have the earliest devoted themselves to the work. The growth of invention is in the direction of simplicity, but it is necessary, in the first place, to conceive the needs, and then follow a host of temporary expedients,—mere patchwork, as it afterward appears. In the course of time rises a reorganizer who proposes to devise means adequate to meet the changed conditions which supervene when a machine is called upon to take the place of the human operator. The earliest machine used the needle and needle-full of thread in making a running-stitch. Then the eye was placed in the middle of the needle, which was sharpened at both ends to save turning it about when returning it, the needles being pushed and drawn by steel fingers on each side of the goods. The invention was as yet an implicit copying of the human manipulation, and the next change merely shifted the mode from the stitch of the seamstress to that of the tambour-worker. The needle was passed through the goods and returned, leaving a loop, which was detained, so as to be entered by the needle at its next descent, leaving another loop, and so on. A modification has been mentioned, consisting of a crochet-hook passed through the goods, bringing back with it a loop of thread from below, and enchaining it with the previous loop. This is all the small-beer of invention; the imitation of hands to use the familiar needle or crochet hook. There may be sedulous application and a certain merit in it, but there is no genius. The man of mark will find a new departure. He must devise new modes of procedure adapted to the needs of the new steel man, who is automatic but unskillful, and one of whose principal requirements is continuity of motion. If one must stop and thread his needle, he might as well return from the click and hum of the metal to the clatter of tongues which need no oiling."

From Knight's Mechanical Dictionary, page 2102, the following is quoted:

> "Howe's patent was dated September 10, 1846, and was extended for seven years in 1860. In his petition to Congress, July 15, 1867, for a second extension of his patent he acknowledged having received about $1,185,000 but considered that his invention was worth $150,000,000. If he had received the latter sum he would have been still more certain that it was worth one billion dollars and so on."

Howe had a monopoly of the sewing machine business for twenty-one years in all, fourteen years under his original patent and seven years under the extension. The reissuing of his patent did not lengthen the term of the patent but only changed the form or scope of it by changing and broadening the claims of it.

Howe's patent dominated the sewing machine business and soon gave him big returns. The royalties soon mounted to $200,000 a year. Then the leading manufacturers rebelled against paying further tribute. All parties got into court again. The outcome of the quarrel is well told in Iles on Leading American Inventors published by Henry Holt & Co., from page 361 of which the following is taken:

> "But the peace then ruling the sewing machine industry could not last long in the presence of so broad a stream of gold pouring into Howe's coffers. Leading manufacturers rebelled against paying him further 'tribute' and among themselves they had endless quarrels as to alleged infringements. Early in 1856, the suits of these complaints were to be tried at Albany, New York, and loud were the threats of disaster hurled by each camp in succession. In hotel-lobbies, in the ante-chambers of justice itself, faces were flushed with anger, and imprecations issued from unguarded lips. One party to the fray was an eminent lawyer of New York, George Gifford, who kept his head cool and his mind clear. His professional experience had taught him that the demands of clients are not always free from humbug. Without knowing it, he was a forerunner of the modern trust magnates, who have remodeled American industry. Said he: 'In Albany today are assembled the men who control the sewing machine manufacture of the globe. Let them join hands instead of shutting their fists, and they will find vastly more profit in peace than in war.' A survivor of that conference remembers one cause which contributed to the success of this sagacious plea. Even the most just man of them all did not wish his record unveiled and attacked in open court. Many a new patent bore an unmistakable filial resemblance to an old patent still in force. No accuser of others, however vehement, felt himself to be wholly blameless. The peace-maker was blessed with success. The threatened battle never came off, Howe's patent being recognized as fundamental by the twenty-four assembled licensees. Every machine sold in America was to pay Howe $5; every exported machine $1. In 1861, Howe's patent was renewed; thenceforward his royalty for machines, wherever sold, was one dollar. All licensees taxed themselves heavily to prosecute infringers. These gentry raised an outcry about 'combination' and 'extortion' but they soon grew weary of its hollow and unechoed sound."

As a result of the above move Wheeler and Wilson, Grover & Baker Sewing Machine Companies, I. M. Singer & Co. and Elias Howe united in a big four combination which controlled the important patented features of the sewing machine, namely, the eye pointed needle and shuttle, the four way motion and continuous feeds. The combination thus dominated the sewing machine trade.

Wilson's patent on the four way motion feed expired in 1871 after being twice extended and Batchelder's patent on the continuous feed expired in 1877. This patent had also been twice extended. With the expiration of the Batchelder patent the control of the business ended and competition soon brought down the price of sewing machines.

Probably over 25,000 patents have been granted to date on lock stitch sewing machines, all of which used Howe's invention or its mechanical equivalent or improvements on such machines. A few of the early patents will be mentioned as follows:

6439 Bachelder, May 8, 1849, Sewing Machine. This patent was reissued No. 2,125—December 12, 1865. This patent covered broadly a perpetual feed which consisted of an endless belt in the bedplate of the sewing machine having pins on it that moved forward with a regular intermittent motion and carried the work with it.

This patent was given a broad construction in Federal cases 706, 11,321 and at 7 Fed. Rep. 215.

A. B. Wilson.

Sewing Mach.

No. 3430. Reissued May 11. 1869.

Fig. 1.

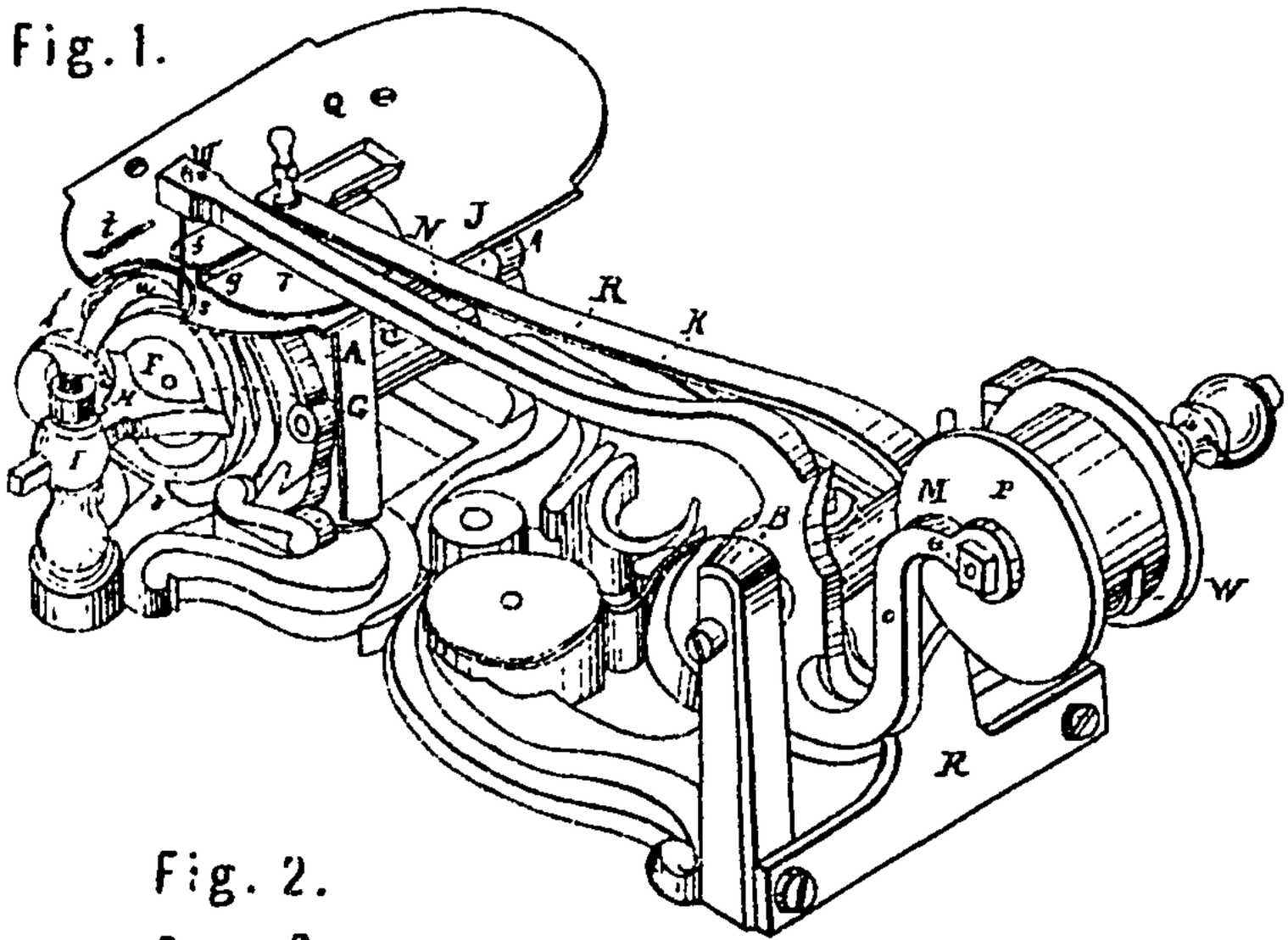


Fig. 2.

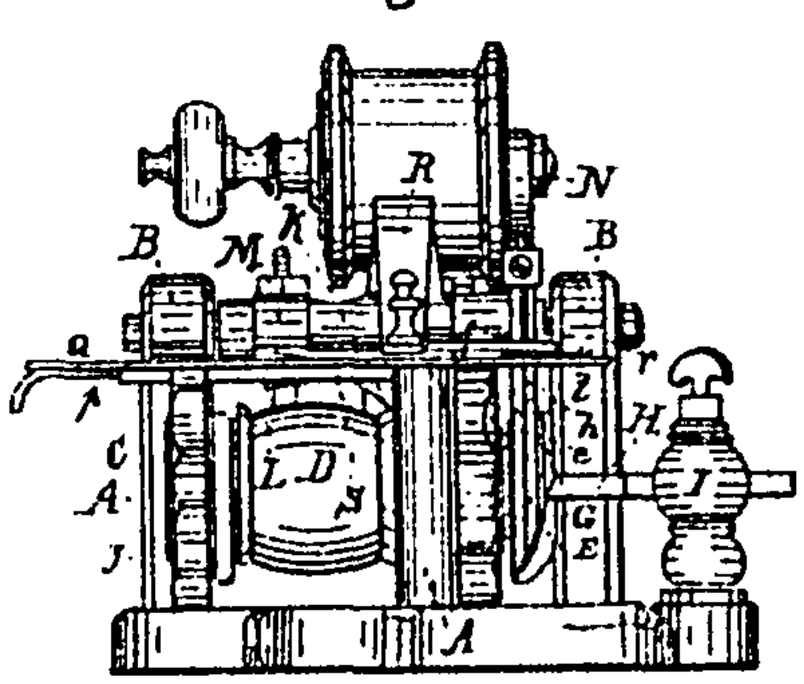


Fig. 3.

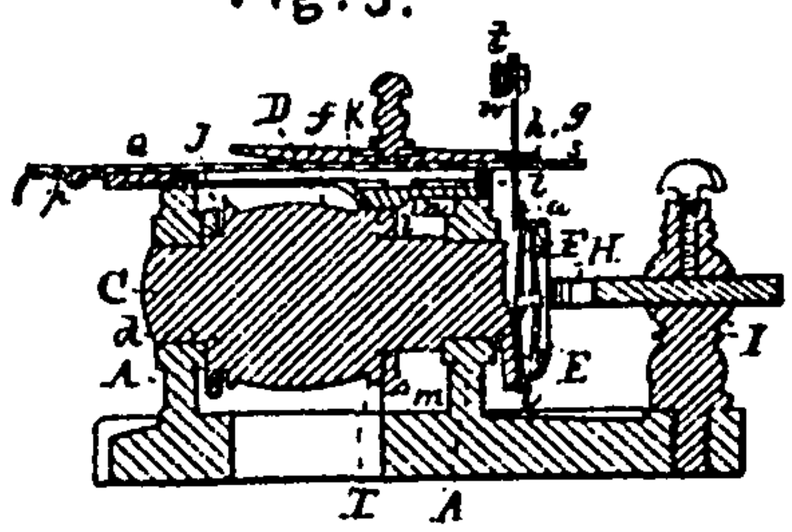


Fig. 4.

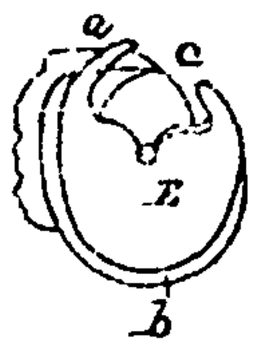
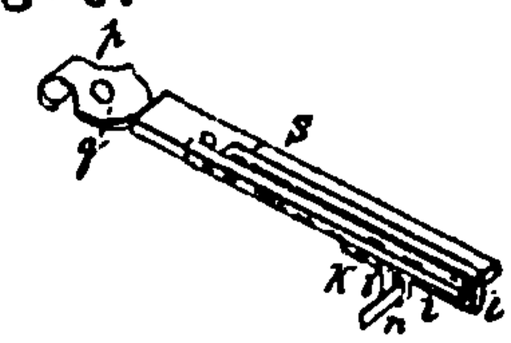


Fig. 5.

Fig. 6.



Witnesses.

Geo. H. Collins.
F. J. Gordon.

Inventor.

Allen B. Wilson

UNITED STATES PATENT OFFICE.

WHEELER & WILSON MANUFACTURING COMPANY, OF BRIDGEPORT, CONN., ASSIGNEE, BY MESNE ASSIGNMENTS, OF ALLEN B. WILSON.

IMPROVEMENT IN SEWING-MACHINES.

Specification forming part of Letters Patent No. 9,041, dated June 15, 1852; extended seven years; reissue No. 3,430, dated May 11, 1869.

To all whom it may concern:

Be it known that I, ALLEN B. WILSON, formerly of Watertown, Connecticut, at present residing in the town of Waterbury, county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Sewing-Machines; and that the following, taken in connection with the drawings, is a full, clear, and exact description thereof.

In the drawings, which represent a machine made in accordance with the principles of my invention, Figure 1 is an isometrical perspective view of the whole machine, which I term a sewing-lathe. Fig. 2 is an end elevation of the same. Fig. 3 is a transverse vertical section of the same, taken through the axis of the vertical hook and its shaft. Fig. 4 is a view in perspective of the rotating hook detached from the machine. Fig. 5 is a view of the bobbin which carries the lower thread, which is surrounded at every stitch by loops of needle-thread. Fig. 6 is a view in perspective of the feed-bar and its appendages detached from the machine.

This machine makes stitches according to the mode of operation of a machine of my invention, which is described in Letters Patent bearing date the 12th day of August, A. D. 1851, in as far as that a loop of upper or needle thread of sufficient length to encircle a bobbin is pulled down below the cloth at every stitch, and in so far as this loop is pulled up or tightened by the expansion or pulling out of a succeeding loop, and in so far as loops are seized, expanded, and cast off by a hook so shaped and moved as to effect these objects, but differs therefrom chiefly in the part that the hook is so formed that it will put this loop completely around a bobbin; and this machine, therefore, employs a bobbin which may be stationary in the line of its axis, or nearly so, and this new machine differs in other particulars, which will hereafter be pointed out as new.

The machine feeds the cloth to be sewed in accordance with the principles of a feeding appliance of my invention described in Letters Patent granted to me on the 12th day of November, A. D. 1850, in so far as the material being fed is clamped between a rough and a comparatively smooth surface, and is advanced when the rough surface moves in the direction of the progression of the cloth; but it differs therefrom in the fact that additional motions are imparted to the rough surface, so that it is out of contact with the cloth when it retrogrades to take a fresh hold thereof, and also in the fact that the smooth surface at times clamps the cloth to the reciprocating roughened surface, and at other times to the table or platform of the machine; and this new machine also differs in other points in relation to the feeding apparatus, which will hereafter be specified as new.

The invention which is the subject-matter of this patent may, therefore, be divided into two heads—first, in relation to the stitching mechanism; second, in relation to the feeding mechanism.

In the drawings, the bed-plate, supporting all parts of the machine, which may be screwed upon a proper stand or bench, is represented at A A B B. In the standards A A is supported, in proper bearings, a revolving shaft, C. This shaft carries, or may have formed upon it, a pulley, D, through which, or through other proper instrumentalities, the shaft may be revolved. Near one of the bearings this shaft is turned eccentrically, or has an eccentric mounted upon it, as at *d*, provided with an eccentric ring, J, provided with an eccentric rod, K, whose end is pivoted to a rock-shaft arm, L, which passes through and is secured to a rock-shaft, M, and upon the same rock-shaft is mounted the needle-arm N, which carries the eye-pointed needle *h*, and is extended behind the rock-shaft, as at O, and there provided with a proper spindle, *o*, to support the bobbin P, upon which the upper needle-thread is to be wound. The thread leads from the bobbin through a hole, *n*, on the arm N, and hence through the eye of the needle, and is prevented from unwinding too rapidly by means of a spring-brake, W, attached to the rock-shaft M, and provided with a set or tension screw, (colored yellow in the drawings,) by means of which the proper tension may be put upon the upper thread. This thread being mounted upon the same arm that

carries the needle, it follows that the distance between the bobbin and the needle-eye is not affected by the oscillations of the needle, and consequently no slack is formed between the eye and the bobbin. The rock-shaft may be fitted in bearings in the standards B B; but as the sidewise adjustment of the needle with reference to the seizing part of the hook, hereafter to be described, is important, and as it is important, also, to preserve the axis of the rock-shaft always in the same position in spite of wear, I prefer to support the rock-shaft as follows: In each standard is a screw, N, the aperture in the standard being properly threaded to receive it. Each of these screws has a rounded point, and each enters a socket in the rock-shaft, which has a somewhat spherical end or bottom, against which the rounded point of one of the screws bears, thus supporting the shaft. By unscrewing one of the screws and screwing up the other it is evident that the shaft, and consequently the needle, may be adjusted with great nicety sidewise, and it is also evident that when either the bottoms of the sockets or the points of the screws wear the latter may be set up, thus always holding the axis of the shaft in the same position.

When the mandrel revolves the eccentric ring and rod cause the rock-shaft to oscillate, and the needle consequently vibrates in substantially a vertical plane, passing in its vibrations so as to intersect, or nearly so, a prolongation of the axis of the mandrel.

Upon the bed plate is mounted a table or platform, O, upon which the cloth is to be laid. This platform may be provided with a gage, *c*, and has so located as to act in combination with it a presser-foot or pressing-plate, *f*, mounted upon a spring rod, R, attached to the bed-plate. This plate is, therefore, a yielding plate, has a comparatively smooth under surface, is provided with a niche, as at *g*, through which the needle passes, and, when in use, presses the cloth downward, clamping it between its lower surface and the table, as between that same surface and the feeding tooth. This surface differs in construction in no substantial way from the upper stationary smooth surface of my machine patented November 12, 1850. Upon the end of the mandrel is mounted the rotating hook E. It consists essentially of a hook proper, *a*, and of a groove, *e*, somewhat like the cant between two threads of a screw, leading from the throat of the hook proper, and vanishing at *b* upon the front of the hook, and as a whole it is an annular or disk shaped projection, cut away so as to form the hook, grooved on the periphery, about one third around, with a chamber, on which the groove vanishes, and with a portion of the disk cut away, (see especially Fig. 4,) so that the needle may strike down sufficiently toward or past its axis. This hook enters between the thread and the needle, thus seizing a loop, expands this loop as it revolves, (see arrow, Fig. 1,) passes one part of the loop behind, and the other part in front of, a bobbin, and finally, as the hook turns point upward, casts off this loop, or permits it to be drawn off, and its shape and motion enable it to perform these functions.

The lower thread, to be used in connection with the upper thread in making the stitches, is wound upon a bobbin, F, (see especially Fig. 6,) somewhat like those used in lace-making machines, the heads of it being, by preference, dished, with the concavities turned toward each other, so that there is a considerable space between them at the center, and so that their edges nearly touch. This bobbin is to lie partially inclosed in the dish or cup shaped cavity of the hook, and is held there by a ring, G, mounted upon a forked rod, H, which slides in a standard, I, and may be clamped therein by a set-screw. This lower thread-bobbin lies between the hook and the ring, the latter being so adjusted that the bobbin may not be pinched, but free to turn upon its own axis, and so that thread may pass between the hook and the bobbin, and between the ring and the bobbin. The ring is also provided with a leather pad, *e*, which bears upon the periphery of the hook at and about that point thereof which is lowest, whose use will hereafter be described.

If both bobbins be wound with thread and in place, the needle threaded, the cloth laid under the presser-foot, and the end of the lower thread be drawn up between the spring *s* and the platform, and so into the notch in the platform through which the needle descends, and thence under the little spring *t*, the machine, if provided with a proper feed apparatus, will be ready for operation: the object of passing the lower thread as described being merely to place it properly for the formation of the first stitch, and the end should be held by the finger till the first stitch is finished. When the needle descends it pierces the cloth, carries a loop between it, and, rising a little, slacks the loop; just then the seizing part of the hook enters (see Figs. 2 and 3) between the thread and the needle, and seizes a loop. As the needle rises, the hook, revolving, pulls out or expands this loop, which lies, one part in the groove *e*, the other part in front of the hook on that side nearest the ring G. As the hook continues to revolve it draws the front part of the loop downward behind the bobbin, and when the vanishing part of the groove gets far enough down, the thread therein rolls off over the chamber, and lies between the bobbin and the ring, (in front of the bobbin.) The bobbin is thus surrounded by a loop of needle thread, and consequently the bobbin thread, extending from the bobbin to the under side of the cloth, is surrounded by the same loop when cast off. Meantime the point of the needle has risen above the cloth, the cloth has been fed, and the needle descends, pierces it again, about or before the time that the loop falls over the chamber. In descending it (the

needle) endeavors to pull up the expended loop, one part of the thread of which it is composed leading up to and through the cloth, thence down again through the cloth to the eye of the needle, and as it endeavors to pull up the loop it strains it sufficiently tight to cause part of it to roll over, so as to lie, as before described, in front of the bobbin. When the seizing part of the hook has rotated so far that its point points upward, the loop is free to slip off, but is held between the hook and the pad or cushion until the strain is sufficient to pull it out from between them. As the hook continues to rotate it seizes a new loop, and, in expanding, this new loop pulls up the first loop, so that the first furnishes the greater part of the thread for the second, the remainder coming from the bobbin of needle-thread. When the first loop is pulled tight it surrounds the under thread, and draws it into the thickness of the cloth, each stitch being, after it is finished, like those made on the Howe sewing-machine.

The action of the pad or cushion is important, as it prevents entangling of the loops, and also any tendency of the hook to catch the same loop a second time. The functions of the hook, which are dependent upon its shape and motion, are, therefore, first, to seize a loop; second, to expand it, and, while expanding, pass it completely around a bobbin; and, third, to cast the loop off.

The moving feeding-surface in this machine consists of a tooth, *l*, formed on a rod, *k*, which at the end farthest from the tooth forms a spring, and is attached to a slotted bar, S, the rod lying in the slot, and the spring always tending to force the tooth down. The bar S is supported in two rabbets or notches on the standards A A, and is free to slide therein in right lines, and it is provided with two pendants, *i i*. A spring, *n*, bears against these pendants, and tends always to force the bar, rod, and tooth backward or away from the revolving hook. Upon the mandrel there is cam T, which is, in fact, a double cam, being of greatest diameter at the point *m*, and being at or about the same point made to extend forward, (see Fig. 3,) so as to act as a face-cam. This cam lifts and advances the tooth by a positive motion, the rod *k* is held down by virtue of its own spring upon the periphery of this cam, and the pendants *i i* are pressed by the spring *n* against its face, so that the tooth is moved downward and rearward by springs. Behind the bar lies an eccentric, *p*, pivoted under the platform at *q*, and the tooth lies under a slot in the table, through which it projects at the time of feeding.

The operation of these parts is as follows: When the cam revolves to the right position it lifts the rod, and consequently the tooth, until the latter projects through the slot, comes in contact with the cloth, and grasps the cloth between the tooth and the lower side of the presser-foot. The face part of the cam then strikes the pendants and moves the tooth forward, carrying the cloth impressed upon it by the presser-foot forward, the cloth being held up by the cam while it is advancing. After the cloth is fed the cam permits the tooth to drop out of engagement with or free itself from the cloth, and then the presser-foot clamps the cloth to the platform and holds it at rest. The face prominence of the cam then leaves the pendants, and the spring *n* forces the tooth back to the place whence it commenced to move.

The cam must be so shaped as to perform the operation above stated when aided by the springs, and it is clear that the tooth, when acted upon by the cam and springs, has four motions, or motions in four directions, viz: first, upward toward the cloth; second, forward longitudinally in the line of progress of the seam; third, downward away from the cloth; and, fourth, rearward, out of contact with the cloth to the place of beginning. The motion forward in the direction of the line of progress of the seam takes place when the needle is out of the cloth.

If the eccentric or rotary wedge be so turned that the end of the bar will never strike against it, the length of each stitch will be equal to the whole amount of projection upon the face of the cam; but if the eccentric be turned so that the bar strikes against it when forced rearward by the spring, then the length of stitch will be shortened, and the amount that it is shortened will depend upon the distance through which the eccentric is turned, and consequently upon the diminished rearward motion of the bar. This contrivance for adjusting the length of the stitch is simple and convenient.

I claim as of my invention—

1. In combination with an eye-pointed reciprocating needle, a hook so shaped and moved, substantially as specified, as to act upon loops of needle-thread, substantially as described.

2. In combination with a hook shaped and moved substantially as specified, a bobbin containing under or lower thread, located in reference to the hook, substantially as set forth.

3. In combination with an eye-pointed needle, a hook and a bobbin, all operating in combination to form a stitch, substantially in the manner specified.

4. A ring, in combination with a hook and bobbin, all operating substantially as specified.

5. In combination with a hook shaped and operating substantially as specified, a pad, constructed and operating substantially as described.

6. In combination, an eye-pointed needle, hook, bobbin, and pad, all operating substantially as set forth.

7. The method, substantially as herein described, of mounting a rock-shaft which carries a needle-arm, whereby the needle may be adjusted, substantially as hereinbefore set forth.

8. The device herein described for feeding the cloth along in a sewing-machine, consisting of a tooth having an upward motion for grasping the cloth between itself and a smooth surface, a motion forward for feeding the cloth along, a downward motion for freeing the tooth from the cloth, and a backward motion, out of contact with the cloth, substantially as above set forth.

9. A tooth having four motions, substantially in the manner and for the purposes set forth, in combination with a surface bearing upon the cloth with a yielding pressure, and a slotted platform, whereby the cloth is not only fed, but is also clamped, so as to be held at rest between the platform and the yielding surface at certain times in the operation of the parts, the combination being and operating substantially as described.

10. A tooth, operating as described, in combination with a cam for lifting the tooth and moving it forward, and a spring for moving it backward, the combination being substantially such as described.

11. The relative arrangement, substantially as herein described, of a rod to which a tooth is attached, beneath a platform, and a cam beneath the rod and acting upon it.

12. A feeding-tooth having four motions, as described, in combination with a slotted platform, in such manner that the tooth rises at times through the slot above the level of the platform, as described.

13. In combination with a feeding-tooth moved forward by a positive motion, as described, and rearward by a spring, an eccentric acting substantially as described, whereby the extent of forward motion is determined, substantially as set forth.

ALLEN B. WILSON.

Witnesses:
GEO. H. COLLINS,
THOS. J. BALDWIN.

Four Way Motion Feed.

Patent No. 7776—Wilson—November 12, 1850, Sewing Machine, was divided thru reissues 345—Jan. 22, 1856—346, Jan. 22, 1856; 414—Dec. 9, 1865. This patent covered a double pointed shuttle which made a lock stitch as it went forward and another lock stitch when it went backward, thus doubling the efficiency of the moving of the shuttle. This invention was broadly claimed in reissue 345 in one claim.

This patent was again reissued in reissue No. 414 in which this particular invention was again covered in three claims.

This same Allen B. Wilson secured a patent 9,041, Wilson June 15, 1852, Sewing Machine, which was reissued No. 3430, May 11, 1869. The important feature about this patent was the rotating hook which is still used on the Wheeler & Wilson sewing machine which was claimed in the original patent and the four way motion feed which was not claimed in the original patent.

The original patent 9041 contained but one claim which covered the rotary hook which claim read as follows:

> "The combination of the bobbin F for carrying one thread with a rotating hook which is of such form or forms part of a disk, or its equivalent of such form, as to extend the loop on the other thread, and pass it completely over the said bobbin, whereby the two threads are interlaced together, the parts being arranged and operating in any way substantially as herein set forth."

This patent disclosed but did not claim the four way motion feed which is now used on nearly every sewing machine and should therefore be regarded as the most important feature of the patent.

This four way motion feed consists of a bar having ratchet teeth or serrations extending across the face of it. The bar at one end gyrates thru the path of a circle and is driven at that end by an eccentric or cam. The other end of the bar slides back and forth in a straight line. The bar is less than one inch long and about one-quarter inch wide and moves in a slot in the bed plate. When the needle rises the one end of the bar moves up and forward carrying the work with it and when the needle descends the bar moves down again and back to the starting point. Its movement in this respect is like the eccentric rod that drives the valve of a steam engine and is admirably adapted to feed the work of the sewing machine in a step-by-step motion which synchronizes with the movement of the needle and secures uniformity in the length of the stitch. By varying the extent to which the bar is exposed above the bed plate, the length of the stitch is varied to correspond.

The original Wilson patent 9,041 is not reproduced for the drawings and specifications are practically the same as in the reissued patent. The reissued patent is reproduced herewith.

The last six claims of the patent are directed to the four way motion feed. No such claims appear in the original patent which includes but one claim which claim is directed to the rotating hook. The claims of Wilson's reissued patent as well as the claims of the reissued Howe patent bear strong evidence of how easy is it to fail to claim important inventions in the original patent, and show how necessary it is to analyze the invention carefully and claim everything in sight above the level of the prior art before the patent is first taken out so as to comply strictly with the law in the first instance and avoid any entanglements with the reissues and the rights of the public to an invention which the courts may consider to have been abandoned to the public because it was disclosed in a patent and not claimed therein. It is well settled by many decisions

that what is shown in a patent and is not claimed therein is dedicated or abandoned to the public and we have seen above how the Supreme Court in the case of Miller vs. Bridgeport Brass Co. invalidated reissue patents taken out with broadened claims when such patents were applied for more than two years after the reissuing of the original patent. A patent can be made worthless by failure to adequately claim the invention in the first instance, and failure to detect this mistake for more than two years becomes fatal.

The big inventor or rather business man in the sewing machine art was Isaac M. Singer. To Singer is entitled the credit of inventing the overhanging arm and a needle and needle bar moving in the end thereof with a straight up and down movement. Singer's patent is 8,294 issued August 12, 1851. Singer reissued this patent as reissue No. 278 on Oct. 3, 1854. In this reissue patent he wanted to claim the overhanging arm but the Patent Office persistently refused to give him any claims thereon. By making a much better machine mechanically and by his aggressiveness and superior business ability Singer quickly became the big producer of sewing machines and the Singer machines have probably kept the lead in production ever since.

Wilson's mistake in failing to claim an important part of his invention is frequently duplicated. A striking instance of this mistake was in the first patent on cable railroads such as were in common use on the streets of large cities before the introduction of electrical traction. The first cable railroad was used in a street in San Francisco in 1873 and the inventor of the railroad took out a patent in which he showed and claimed the grip that the car carried for connecting itself to the cable and disconnecting itself therefrom. It did not claim the slot in the street nor the cable running therein under ground, nor the guide for directing the cable and holding it in place while running in the slot underground, nor did he even show these features in his patent. Later on another inventor produced a grip that was very much better and the pioneer inventor in cable railroads found himself with a patent that was practically worthless. His broad invention had become public property by failure to claim it.

This patent is believed to have been 129,130 Hallidie issued July 16, 1872, on Improvement in Gripping Attachment for Rope Ways. This patent was reissued April 17, 1877, and was R7607. It was never sued on.

R. A. Tilghman,

Decomposing Fat.

NO. 11,766. Patented Oct. 3, 1854.

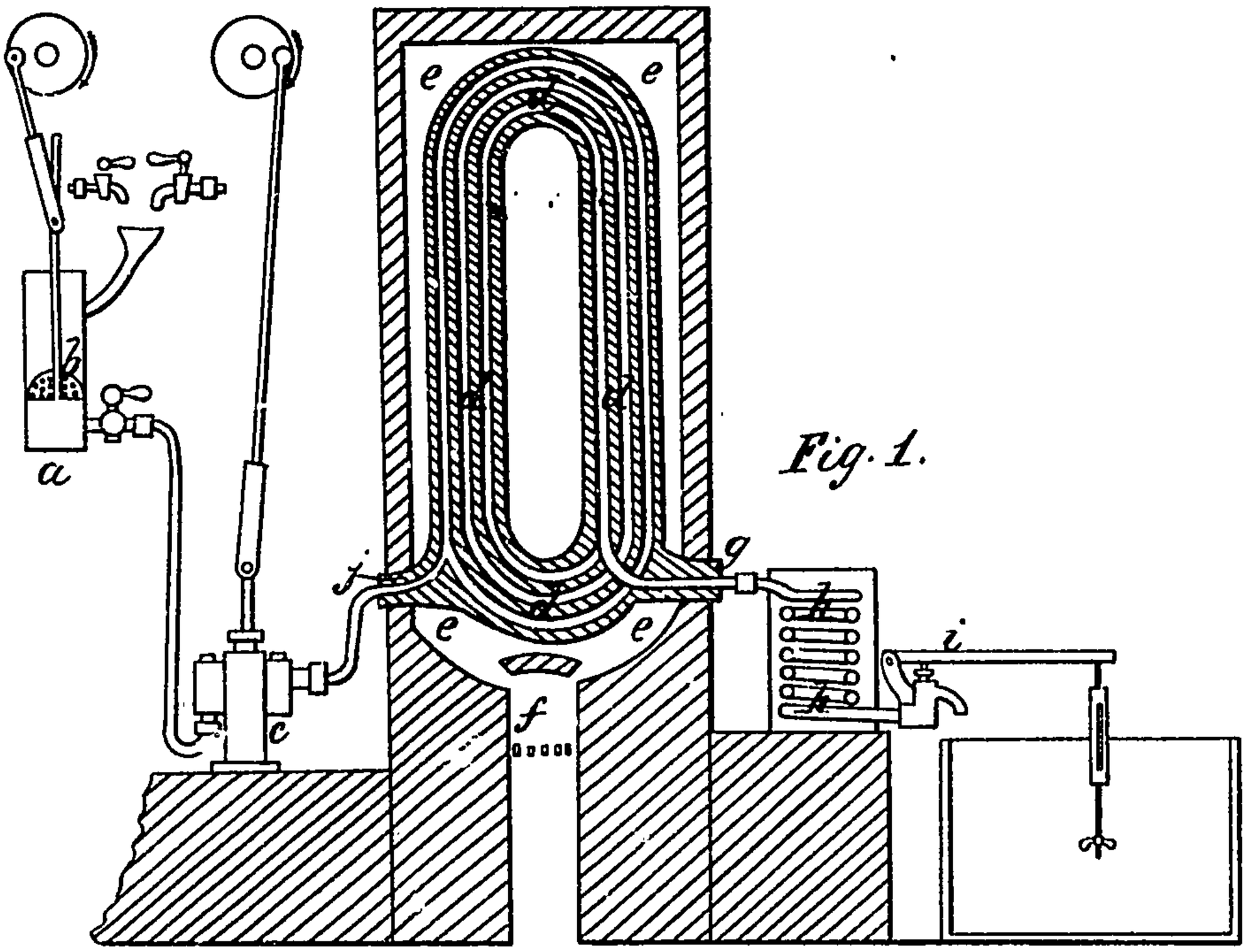


Fig. 1.

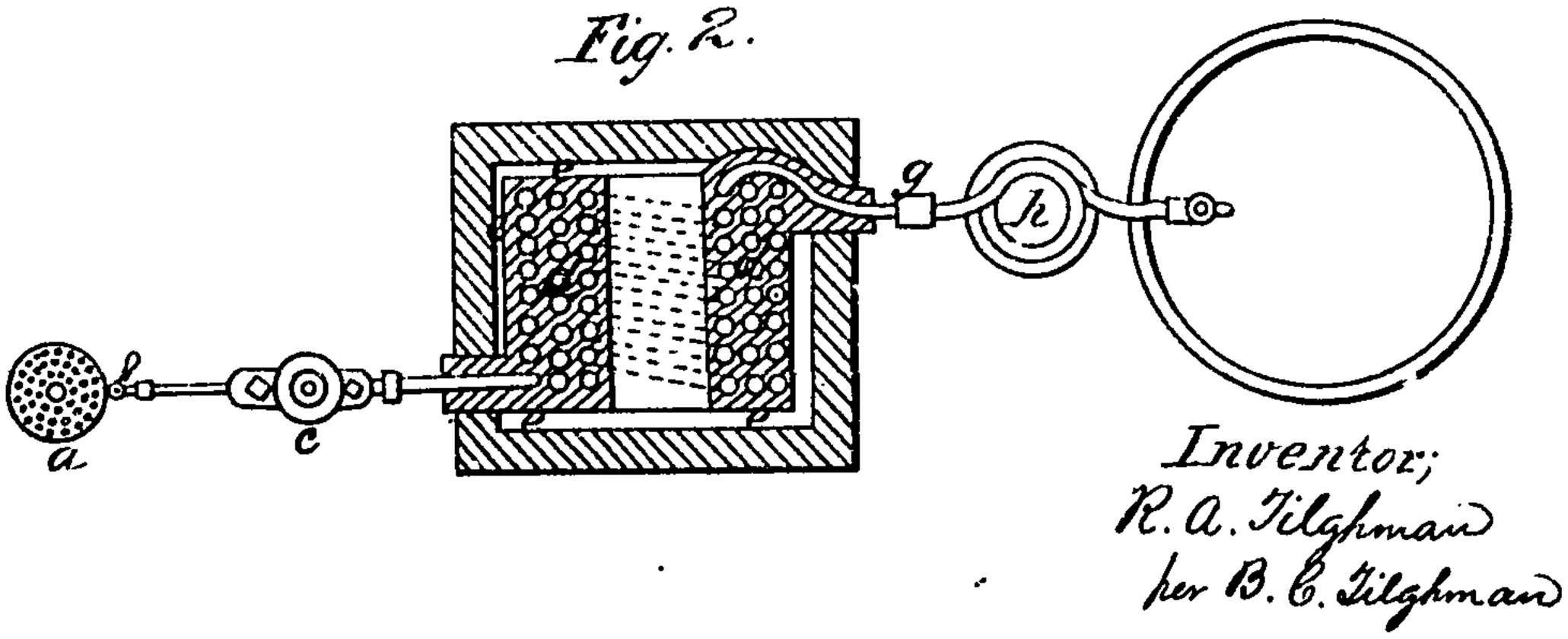


Fig. 2.

Inventor;
R. A. Tilghman
per B. C. Tilghman

UNITED STATES PATENT OFFICE.

RICHARD A. TILGHMAN, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN PROCESSES FOR PURIFYING FATTY BODIES.

Specification forming part of Letters Patent No. **11,766**, dated October 3, 1854.

To all whom it may concern:

Be it known that I, RICHARD ALBERT TILGHMAN, of Philadelphia, State of Pennsylvania, have invented a new and Improved Mode of Treating Fatty and Oily Bodies; and I hereby declare that the following is a full and exact description thereof.

My invention consists of a process for producing free fat acids and solution of glycerine from those fatty or oily bodies of animal and vegetable origin which contain glycerine as their base.

For this purpose I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine.

I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting-point of lead until the operation is complete. The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

The process may be performed more rapidly and also continuously by causing the mixture of fatty matter and water to pass through a tube or continuous channel heated to the temperature already mentioned, the requisite pressure for preventing the conversion of the water into steam being applied during the process; and this, I believe, is the best mode of carrying my invention into effect.

In the drawings hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention.

Figure 1 of the said drawings is a vertical section of this apparatus, and Fig. 2 shows the various parts of the apparatus in horizontal section.

Similar parts in these figures are marked with similar letters of reference.

I place the fat or oil, in a fluid state, in the vessel *a*, with from one-third to one-half its bulk of warm water. The disk or piston *b*, perforated with numerous small holes, being kept in rapid motion up and down in the vessel *a*, causes the fat or oil and water to form an emulsion or intimate mechanical mixture. A force-pump, *c*, like those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube, *d d d d*, which, being placed in the furnace *e e*, is heated by a fire, *f*, to about the temperature of melting lead.

From the exit end *g* of the heating-tubes *d d* the mixture, which has then become converted into free fat acids and solution of glycerine, passes on through another coiled iron tube, *h h h*, immersed in water, by which it is cooled down from its high temperature to below 212° Fahrenheit, after which it makes its escape through the exit-valve *i* into the receiving-vessel.

The iron tubes I have employed and found to be convenient for this purpose are about one inch external diameter and about half an inch internal diameter, being such as are in common use for Perkins' hot-water apparatus. The ends of the tubes are joined together by welding to make the requisite length; but when welding is not practicable I employ the kind of joints used for Perkins' hot-water apparatus, which are now well known. The heating-tube *d d d* is coiled several times backward and forward, so as to arrange a considerable length of tube in a moderate space. The different coils of the tube are kept about a quarter of an inch apart from each other, and the interval between them is filled up solid with cast iron, which also covers the outer coils or rows of tubes to the thickness of half or three-quarters of an inch, as shown in Fig. 2. This casing of metal insures a considerable uniformity of temperature in the different parts of the coil, adding also to its strength and protecting it from injury by the fire.

The exit-valve *i* is so loaded that when the heating-tubes *d d d* are at the desired working temperature, and the pump *c* is not in action, it will not be opened by the internal pressure produced by the application of heat to the mixture, and therefore when the pump *c* is not in action nothing escapes from the valve *i* if the temperature be not too high; but when the pump forces fresh mixture into one end, *j*, of the heating-tubes *d d d* the exit-valve *i* is thereby forced open to allow an equal amount of the mixture which has been operated upon to escape out of the cooling-tubes *h h* at the other end of the apparatus. No steam or air

Decomposing Fat.

All oils and fats of animal and vegetable origin are composed of glycerine as a base and one or more fatty acids. Thus stearic acid, oleic acid and palmitic acid and glycerine exist in tallow. Butyric acid and glycerine exist in butter. Cocinic acid, oleic acid and glycerine exist in cocoanut oil. Tallow was formerly used in making tallow candles but the glycerine is not combustible and caused the candle to drip or run excessively. Stearic acid alone made a much better candle and the candles made therefrom did not get soft in hot weather. Any of these fatty acids, when combined with potash or soda alkali, make soap. In the crude process of boiling the fat and alkali the glycerine was contained in the waste water which was drained off and lost. Economy demanded that the glycerine and stearic acid be extracted in advance and saved, but how? This problem was solved by an invention, which will now be considered.

On October 3, 1854, Richard A. Tilghman took out a patent on "Decomposing Fat or Improvement in processes for purifying fatty bodies," No. 11,766. The patent contains but one claim which reads as follows:

> "The manufacture of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure."

This claim sufficiently describes the invention.

In the specification he says he mixes the fat with from one-third to one-half of its bulk of water and subjects the mixture to heat as much as the melting point of lead, 612 degrees F. or higher being used. He uses a coil of pipe which is capable of sustaining great pressure and in which the mixture is heated as it passes from one end to the other.

This patent was sued on several times. It was first passed on by the Supreme Court in the case of Mitchell vs. Tilghman, 86 U. S. 287, 22 L. Ed., 125, in which the court held that the patent was entitled to only a narrow construction and was not infringed. The lower court had held that the patent was valid and infringed but this was reversed by the Supreme Court.

Tilghman again sued on this patent in the case of Tilghman vs. Proctor. In the decision 102 U. S. 707; 26 L. Ed. 279 (Jan. 24, 1881), the court then sustained the same patent as valid and infringed and gave it a broad construction in so doing and reversed its previous decision. From this later decision the following is quoted:

> "What did Tilghman discover? And what did he, in terms, claim by his patent? He discovered that fat can be dissolved into its constituent elements by the use of water alone under a high degree of heat and pressure; and he patented the process of 'manufacturing fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure.' Had the process been known and used before, and not been Tilghman's invention, he could not then have claimed anything more than the particular apparatus described in his patent; but being the inventor of the process, as we are satisfied is the fact, he was entitled to claim it in the manner he did.
>
> "That a patent can be granted for a process, there can be no doubt. The patent law is not confined to new machines and new compositions of matter, but extends to any new and useful art or manufacture. A manufacturing process is clearly an art, within the meaning of the law. Goodyear's patent was for a process, namely, the process of vulcanizing India rubber by subjecting it to a high degree of heat when mixed with sulphur and a mineral salt. The apparatus for performing the process was not patented, and was not material. The patent pointed out how the process could be effected, and that was deemed sufficient. Neilson's patent was for the process

of applying the hot-blast to furnaces by forcing the blast through a vessel or receptacle situated between the blowing apparatus and the furnace, and heated to a red heat; the form of the heated vessel being stated by the patent to be immaterial. These patents were sustained after the strictest scrutiny and against the strongest opposition."

Page 732:

"Finally, the defendants argue that they only use a low degree of heat and pressure compared with that pointed out by the patent, namely: Only about 310 degrees Fahrenheit instead of 612 degrees. The precise degree of heat, as we have seen, is not of the essence of the patent. The specification only claims that a high degree of heat, such as would be sufficient to melt lead, is most effective and rapid in producing the desired result; but suggests a trial of the apparatus employed with different degrees of heat so as to ascertain that which is best for each particular kind of fat. 'By starting the apparatus,' the language is, 'at a low heat, and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed can easily be determined.' It is probably true, as contended for by the defendants, that by the use of a small portion of lime, the process can be performed with less heat than if none is used. It may be an improvement to use the lime for that purpose; but the process remains substantially the same. The patent cannot be evaded in that way. The matter may be stated thus: Tilghman discovers a process of decomposing fats by mixing them with water, and heating the mixture to a high temperature under a pressure that prevents the formation of steam. It is a new process, never known before. The defendants seeing the utility of the process, and believing that they can use a method somewhat similar without infringing Tilghman's patent, put a little lime into the mixture, and find that it helps the operation, and that they do not have to use so high a degree of heat as would otherwise be necessary. Still, the degree of heat required is very high, at least a hundred degrees above the boiling point; and a strong boiler or vessel is used in order to restrain the water from rising into steam. Can a balder case be conceived of an attempted evasion and a real infringement of a patent?

"And as to the low degree of heat used in the operations of the defendants, this must also be said: that, with the reduction of the temperature, the time of perfecting the operation is more than proportionately increased. Tilghman was aware of this result, and pointed it out in his patent. He expressly says, 'The decomposing action of the water becomes more powerful as the heat is increased.' What can be done in minutes by the application of a very high degree of heat, requires hours to do at the temperature used by the defendant. But the process is still the same, and the defendants fail to evade the patent."

The defendant Proctor in this suit was associated with Gamble and made the firm of Proctor and Gamble whose successors are still making Ivory Soap at Cincinnati. They undoubtedly still use this process the patent on which has long since expired.

In a later decision in the same case, 125 U. S. 136, 31 L. Ed. 664 (March 19, 1888) the court reviewed the accounting of the master and made an award as follows:

> "Moreover, the real question is not of the exact quantity of fatty acid, as proved by chemical tests, contained in the two products, but whether the one is as good as the other for use in the manufacture

of candles. The defendants' testimony shows that manufacturers always test the fitness of the product for that use by pressure with the thumb, and never by chemical analysis; and upon all the evidence there can be no doubt that a difference between 95 and 92½ per cent in the proportion of fatty acids does not affect the commercial or practical value of the product.

"From these considerations, it follows that nothing is to be deducted for a loss in fatty acids, and that to the amount of $182,731.46, saved in chemicals, and $61,701.77, gained in glycerine water, as reported by the master, there is to be added $1,000 for his mistake in adding up the items of chemicals, and $20,720.63 for his error in computing the amount of glycerine water, making a total amount of $266,153.86."

To this sum was added interest from October 7, 1884, or about three and one-half years' interest and costs which made a nice recovery for a famous chemist who was also a famous inventor. The patent was granted October 3, 1854, and the grant must have been for 14 years. It may have been renewed for seven years more so that the patent probably expired in 1875. The award was finally made in 1888 over twelve years after the patent had expired and about 34 years after the patent issued and it is hoped that the inventor lived long enough to get the benefit of it.

Barbed Wire.

On November 24, 1874, Joseph F. Glidden took out a patent on wire fences No. 157,124. This patent was on the so-called wire fence, generally known as barbed wire, and consisted of two strands of wire twisted together, and having at regular intervals spurs or barbs twisted on one or the other of the wires, as the wire was formed. These barbs were formed from a third coil of wire, the end of which was twisted around one of the wires and was then cut off from the coil. This patent figured in one of the leading patent decisions by the Supreme Court known as Washburn & Moen Manufacturing Company vs. Beat 'Em All Barb Wire Company, 143 U. S., 275; 36 L. Ed., 154. The patent is reproduced herewith.

Barbed wire was not a new article when this patent had issued. Other patents had issued on barbed wire formed in other ways, and one of these prior patents showed a barbed wire which was much relied upon by the defendants in the litigation for the purpose of defeating the Glidden patent. The prior patent referred to was the so-called Kelly patent No. 74,379, Feb. 11, 1868, which showed elongated diamond-shaped barbs, which barbs were threaded on to one of the wires from the end, spaced at regular intervals, and held in place by the two strands of twisted wire.

On November 17, 1868, Kelly took out another patent No. 84062 on a flat wire pierced at intervals through which wire thorns were inserted and locked by the blow of a hammer. A celebrated test of Kelly's wire was made in 1871 in the plaza at San Antonio where it resisted the efforts of about thirty of the most ferocious Texas cattle to break through. The evidence in the case showed that of the Kelly type of barbed wire the sales never amounted to more than 3,000 tons per annum, while in 1887 173,000 tons of the Glidden wire had been sold.

Aside from the Kelly patent a great amount of testimony was taken to prove the alleged use of barbed wire in various places before Glidden's invention, but the court treated all such testimony with skepticism or as proving at the most only an unsuccessful and an abandoned experiment. The court reversed the decision of the lower court, which held the patent invalid, and gave a decree for the plaintiff with an order for an accounting.

This case is of peculiar interest because the improvement on the earlier patent was a rather slight one, and which the lower court held did not amount to invention, but which the Supreme Court because of the very extensive use to which the invention had commended itself, held did amount to invention and it therefore sustained the patent as valid and infringed. The court said,

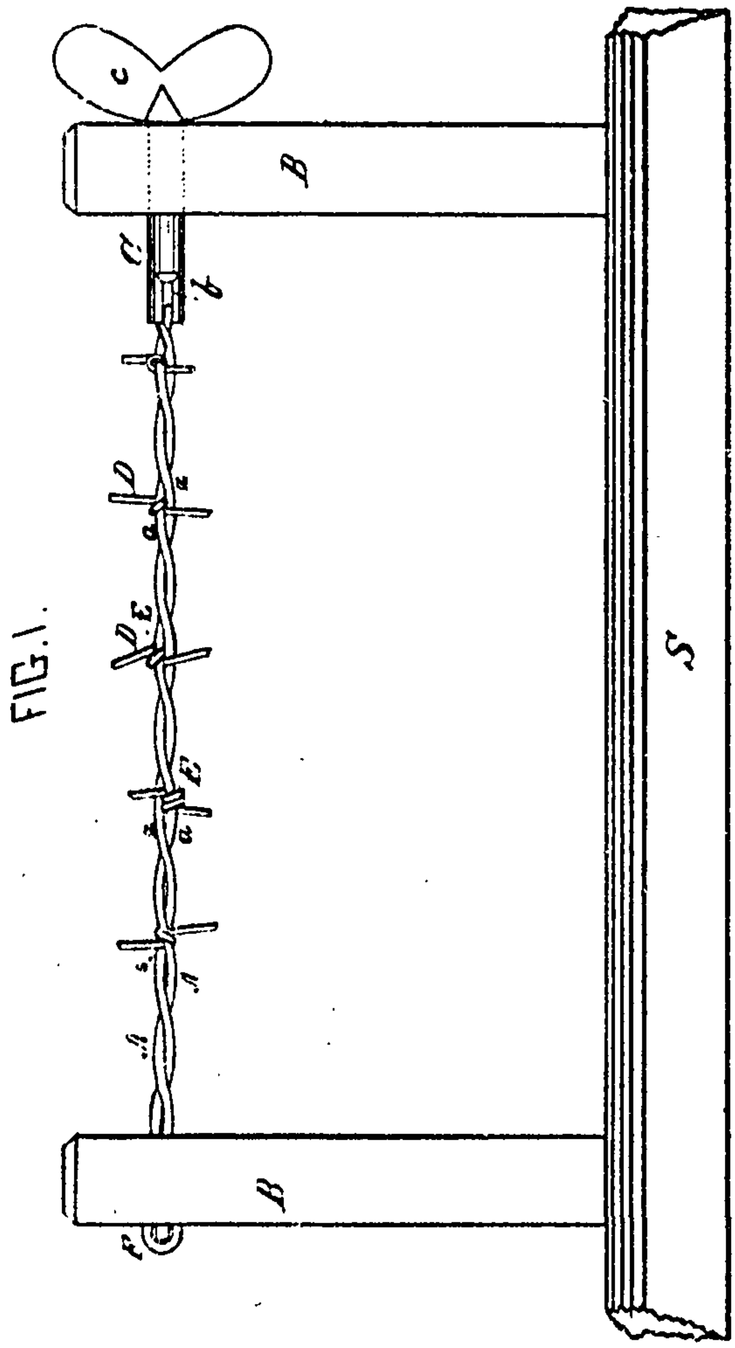
> "In the law of patents it is the last step that wins. It may be strange that, considering the important results obtained by Kelley in his patents, it did not occur to him to substitute a coiled wire in place of the diamond shaped prong, but evidently it did not; and to the man to whom it did ought not to be denied the quality of inventor. There are many instances in the reported decisions of this court where a monopoly has been sustained in favor of the last of a series of inventors, all of whom were groping to attain a certain result, which only the last one of the number seemed able to grasp."

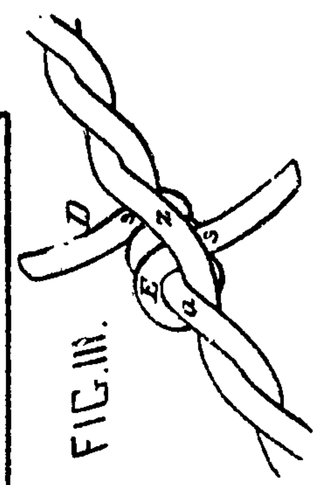
The court recognized that Glidden had taken that last step. All barbed wire since that time has been made substantially in accordance with Gliddon's invention. It is an example of a small contribution in the way of an invention that becomes of vast commercial importance both to the manufacturer who produced it and the farmer and stock raiser that used it.

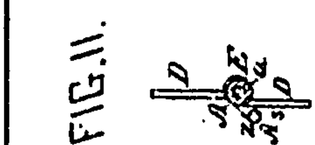
J. F. GLIDDEN.

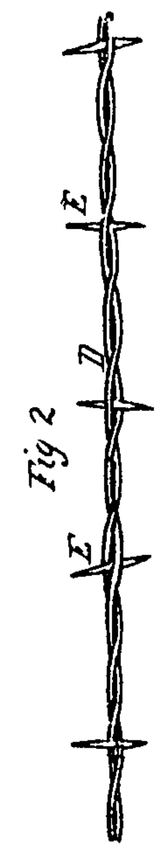
Wire-Fences.

No. 157,124. Patented Nov. 24, 1874.









M. Kelly Patent Nº 74379

UNITED STATES PATENT OFFICE.

JOSEPH F. GLIDDEN, OF DE KALB, ILLINOIS.

IMPROVEMENT IN WIRE FENCES.

Specification forming part of Letters Patent No. **157,124**, dated November 21, 1874; application filed October 27, 1873.

To all whom it may concern:

Be it known that I, JOSEPH F. GLIDDEN, of De Kalb, in the county of De Kalb and State of Illinois, have invented a new and valuable Improvement in Wire Fences; and that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the accompanying drawings, in which—

Figure 1 represents a side view of a section of fence exhibiting my invention. Fig. 2 is a sectional view, and Fig. 3 is a perspective view, of the same.

This invention has relation to means for preventing cattle from breaking through wire fences; and it consists in combining, with the twisted fence-wires, a short transverse wire, coiled or bent at its central portion about one of the wire strands of the twist, with its free ends projecting in opposite directions, the other wire strand serving to bind the spur-wire firmly to its place, and in position, with its spur ends perpendicular to the direction of the fence-wire, lateral movement, as well as vibration, being prevented. It also consists in the construction and novel arrangement, in connection with such a twisted fence-wire, and its spur-wires, connected and arranged as above described, of a twisting-key or head-piece passing through the fence-post, carrying the ends of the fence-wires, and serving, when the spurs become loose, to tighten the twist of the wires, and thus render them rigid and firm in position.

In the accompanying drawings, the letter B designates the fence-posts, the twisted fence-wire connecting the same being indicated by the letter A. C represents the twisting-key, the shank of which passes through the fence-post, and is provided at its end with an eye, *b*, to which the fence-wire is attached. The outer end of said key is provided with a transverse thumb-piece, *c*, which serves for its manipulation, and at the same time, abutting against the post, forms a shoulder or stop, which prevents the contraction of the wire from drawing the key through its perforation in said post.

The fence-wire is composed at least of two strands, *a* and *z*, which are designed to be twisted together after the spur-wires have been arranged in place.

The letter D indicates the spur-wires. Each of these is formed of a short piece of wire, which is bent at its middle portion, as at E, around one only of the wire strands, this strand being designated by the letter *a*. In forming this middle bend or coil several turns are taken in the wire, so that it will extend along the strand-wire for a distance several times the breadth of its diameter, and thereby form a solid and substantial bearing-head for the spurs, which will effectually prevent them from vibrating laterally or being pushed down by cattle against the fence-wire. Although these spur-wires may be turned at once around the wire strand, it is preferred to form the central bend first, and to then slip them on the wire strand, arranging them at suitable distances apart. The spurs having thus been arranged on one of the wire strands are fixed in position and place by approaching the other wire strands *z* on the side of the bend from which the spurs extend, and then twisting the two strands *a z* together by means of the wire key above mentioned, or otherwise. This operation locks each spur-wire at its allotted place, and prevents it from moving therefrom in either direction. It clamps the bend of the spur-wire upon the wire *a*, thereby holding it against rotary vibration. Finally, the spur ends extending out between the strands on each side, and where the wires are more closely approximated in the twist, form shoulders or stops *s*, which effectually prevent such rotation in either direction.

Should the spurs, from the untwisting of the strands, become loose and easily movable on their bearings, a few turns of the twisting-key will make them firm, besides straightening up the fence-wire.

What I claim as my invention, and desire to secure by Letters Patent, is—

A twisted fence-wire having the transverse spur-wire D bent at its middle portion about one of the wire strands *a* of said fence-wire, and clamped in position and place by the other wire strand *z*, twisted upon its fellow, substantially as specified.

JOSEPH F. GLIDDEN.

Witnesses:
G. L. CHAPIN,
J. H. ELLIOTT.

T. A. EDISON.

Electric-Lamp.

No. 223,898. Patented Jan. 27, 1880.

Fig. 1.

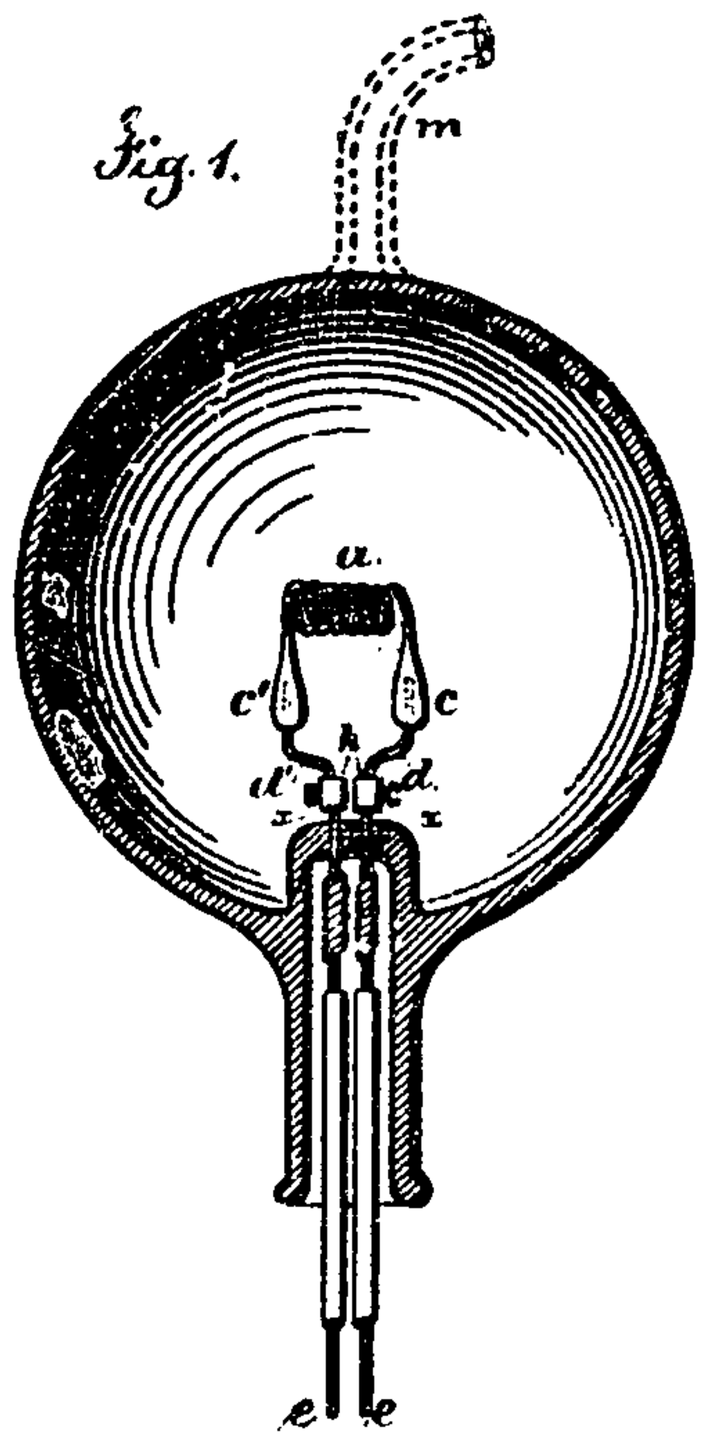


Fig. 2.

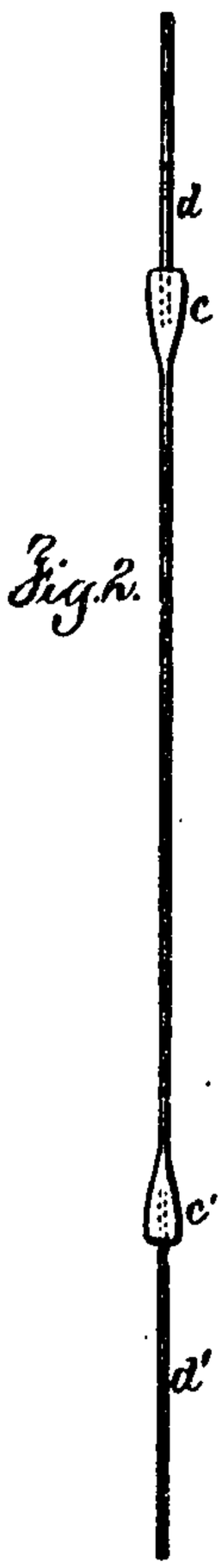
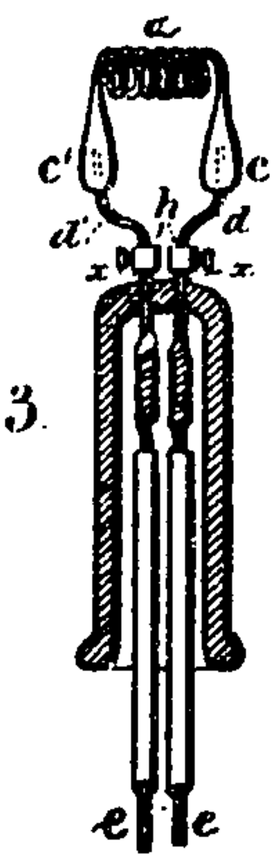


Fig. 3.



Witnesses

Chas. H. Smith

Geo. J. Pinckney

Inventor

Thomas A. Edison

per Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 223,898, dated January 27, 1880.

Application filed November 4, 1879.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, United States of America, have invented an Improvement in Electric Lamps, and in the method of manufacturing the same, (Case No. 186,) of which the following is a specification.

The object of this invention is to produce electric lamps giving light by incandescence, which lamps shall have high resistance, so as to allow of the practical subdivision of the electric light.

The invention consists in a light-giving body of carbon wire or sheets coiled or arranged in such a manner as to offer great resistance to the passage of the electric current, and at the same time present but a slight surface from which radiation can take place.

The invention further consists in placing such burner of great resistance in a nearly-perfect vacuum, to prevent oxidation and injury to the conductor by the atmosphere. The current is conducted into the vacuum-bulb through platina wires sealed into the glass.

The invention further consists in the method of manufacturing carbon conductors of high resistance, so as to be suitable for giving light by incandescence, and in the manner of securing perfect contact between the metallic conductors or leading-wires and the carbon conductor.

Heretofore light by incandescence has been obtained from rods of carbon of one to four ohms resistance, placed in closed vessels, in which the atmospheric air has been replaced by gases that do not combine chemically with the carbon. The vessel holding the burner has been composed of glass cemented to a metallic base. The connection between the leading wires and the carbon has been obtained by clamping the carbon to the metal. The leading-wires have always been large, so that their resistance shall be many times less than the burner, and, in general, the attempts of previous persons have been to reduce the resistance of the carbon rod. The disadvantages of following this practice are, that a lamp having but one to four ohms resistance cannot be worked in great numbers in multiple arc without the employment of main conductors of enormous dimensions; that, owing to the low resistance of the lamp, the leading-wires must be of large dimensions and good conductors, and a glass globe cannot be kept tight at the place where the wires pass in and are cemented; hence the carbon is consumed, because there must be almost a perfect vacuum to render the carbon stable, especially when such carbon is small in mass and high in electrical resistance.

The use of a gas in the receiver at the atmospheric pressure, although not attacking the carbon, serves to destroy it in time by "air-washing," or the attrition produced by the rapid passage of the air over the slightly-coherent highly-heated surface of the carbon. I have reversed this practice. I have discovered that even a cotton thread properly carbonized and placed in a sealed glass bulb exhausted to one-millionth of an atmosphere offers from one hundred to five hundred ohms resistance to the passage of the current, and that it is absolutely stable at very high temperatures; that if the thread be coiled as a spiral and carbonized, or if any fibrous vegetable substance which will leave a carbon residue after heating in a closed chamber be so coiled, as much as two thousand ohms resistance may be obtained without presenting a radiating-surface greater than three-sixteenths of an inch; that if such fibrous material be rubbed with a plastic composed of lamp-black and tar, its resistance may be made high or low, according to the amount of lamp-black placed upon it; that carbon filaments may be made by a combination of tar and lamp-black, the latter being previously ignited in a closed crucible for several hours and afterward moistened and kneaded until it assumes the consistency of thick putty. Small pieces of this material may be rolled out in the form of wire as small as seven one-thousandths of a inch in diameter and over a foot in length, and the same may be coated with a non-conducting non-carbonizing substance and wound on a bobbin, or as a spiral, and the tar carbonized in a closed chamber by subjecting it to high heat, the spiral after carbonization retaining its form.

All these forms are fragile and cannot be clamped to the leading-wires with sufficient force to insure good contact and prevent heating. I have discovered that if platinum wires are used and the plastic lamp-black and tar material be molded around it in the act of carbonization there is an intimate union by com-

bination and by pressure between the carbon and platina, and nearly perfect contact is obtained without the necessity of clamps; hence the burner and the leading-wires are connected to the carbon ready to be placed in the vacuum-bulb.

When fibrous material is used the plastic lamp-black and tar are used to secure it to the platina before carbonizing.

By using the carbon wire of such high resistance I am enabled to use fine platinum wires for leading-wires, as they will have a small resistance compared to the burner, and hence will not heat and crack the sealed vacuum-bulb. Platina can only be used, as its expansion is nearly the same as that of glass.

By using a considerable length of carbon wire and coiling it the exterior, which is only a small portion of its entire surface, will form the principal radiating-surface; hence I am able to raise the specific heat of the whole of the carbon, and thus prevent the rapid reception and disappearance of the light, which on a plain wire is prejudicial, as it shows the least unsteadiness of the current by the flickering of the light; but if the current is steady the defect does not show.

I have carbonized and used cotton and linen thread, wood splints, papers coiled in various ways, also lamp-black, plumbago, and carbon in various forms, mixed with tar and kneaded so that the same may be rolled out into wires of various lengths and diameters. Each wire, however, is to be uniform in size throughout.

If the carbon thread is liable to be distorted during carbonization it is to be coiled between a helix of copper wire. The ends of the carbon or filament are secured to the platina leading-wires by plastic carbonizable material, and the whole placed in the carbonizing-chamber. The copper, which has served to prevent distortion of the carbon thread, is afterward eaten away by nitric acid, and the spiral soaked in water, and then dried and placed on the glass holder, and a glass bulb blown over the whole, with a leading-tube for exhaustion by a mercury pump. This tube, when a high vacuum has been reached, is hermetically sealed.

With substances which are not greatly distorted in carbonizing, they may be coated with a non-conducting non-carbonizable substance, which allows one coil or turn of the carbon to rest upon and be supported by the other.

In the drawings, Figure 1 shows the lamp sectionally. *a* is the carbon spiral or thread. *c c'* are the thickened ends of the spiral, formed of the plastic compound of lamp-black and tar. *d d'* are the platina wires. *h h* are the clamps, which serve to connect the platina wires, cemented in the carbon, with the leading-wires *x x*, sealed in the glass vacuum-bulb. *e e* are copper wires, connected just outside the bulb to the wires *x x*. *m* is the tube (shown by dotted lines) leading to the vacuum-pump, which, after exhaustion, is hermetically sealed and the surplus removed.

Fig 2 represents the plastic material before being wound into a spiral.

Fig. 3 shows the spiral after carbonization, ready to have a bulb blown over it.

I claim as my invention—

1. An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metallic wires, as set forth.

2. The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted, for the purposes set forth.

3. A carbon filament or strip coiled and connected to electric conductors so that only a portion of the surface of such carbon conductors shall be exposed for radiating light, as set forth.

4. The method herein described of securing the platina contact-wires to the carbon filament and carbonizing of the whole in a closed chamber, substantially as set forth.

Signed by me this 1st day of November, A. D. 1879.

THOMAS A. EDISON.

Witnesses:
S. L. GRIFFIN,
JOHN F. RANDOLPH

Incandescent Lamp.

On January 27, 1880, Thomas A. Edison took out his patent No. 223,898, on the Incandescent Electric Lamp. Prior to this time arc lamps had been used in which the electric current jumped the gap between two carbon points that were separated but a short distance and a light of very great intensity was produced thereby. Such lights were useful for outdoor lighting and for lighting large buildings, but would never compete with gas and oil and candles that were used in lights of low candle power. Edison's patent on the electric lamp solved the problem of the application of electricity to low candle power lamps, and to ordinary house lighting. The patent is reproduced herewith.

In the making of this invention Edison had to find a material that was an electrical conductor of high resistance and that would remain intact when heated to a high temperature by the current passing through it. He also found that he had to protect the conductor from oxidation, which would have quickly burned up the carbon filaments if they were exposed to the air, and he found also that he had to protect the filaments against so-called air washing, by which the circulation of air would have carried the carbon from the filament, where it was hot and easily detached, and would have deposited it on the glass enclosing globe, which was relatively cold. He found that he had to exhaust the air from the surrounding glass globe until he reached a very high vacuum, and to insure that this vacuum would remain after the globe had been sealed he found that he must use platinum leading-in wires, because platinum, having substantially the same coefficient of expansion as glass, when sealed into the glass, could be depended upon to preserve a tight joint therewith through which the air could not work in, even though the lamp be in use for many years.

This patent contained an invention that was well presented with the specifications and drawings and was well covered by the claims. It was never reissued, nor was that necessary. The patent was extensively litigated and was uniformly sustained as valid and infringed by the courts.

Twenty-two patent decisions are reported in the Federal Reporter, in cases in which this patent was in controversy, and a few of these will be referred to. In six of these decisions the so-called Goebel defense was the prominent feature, and these decisions are reported as follows: 54 Federal Reporter, 678; 56 F. R., 496; 57 F. R., 616; 60 F. R., 397; 61 F. R., 834; 65 F. R., 551.

The Goebel defense was a defense of alleged prior invention and alleged prior use as follows: Goebel came to this country from Germany in 1848; he was a watchmaker and optician by trade and understood physics and the science of electricity, and made and used arc lamps. He was familiar with the common air pump, the blow pipe, the method of producing Torricellian vacuum, and the making of carbon conductors. He made a number of incandescent lamps and the first form of lamp was called a "fiddle-bow" or "meat saw" in that the filament that produced the light was straight and was supported between two contacts, just as are the horse-hairs of a fiddle-bow or the saw blade of a meat-saw or a hack-saw. This lamp had an exhausted tube made of glass, all in one piece, with leading-in wires sealed into the enclosing chamber by the fusion of the glass.

His next style of lamp was called the "hair-pin" and resembled the ordinary carbon filament lamp of commercial use. He had still other forms of lamps. His carbons were made less than .01" in diameter and were made from flax, reed and black cane. The lamps were exhausted first by a mechanical air pump and later by mercury.

These lamps were publicly exhibited in New York between 1850 and 1872, and there was no six months up to the year 1880 when a number were not made, and prior to 1879 more than 100 were constructed. No secret is made of the lamps or any part of them, and they were lighted and shown to whoever wanted to see them. The lamps were run by a battery, and were publicly used by a wagon carrying a telescope which was exhibited at Union Square and Cooper Institute. For looking through the telescope a small fee was charged, and the lamps were used partly for light and partly to attract attention. Many hundreds of people saw these lamps so exhibited. He also used these lamps in his house. The use of these lamps was not only testified to by Goebel himself, but a great many who saw them at one time or another on public exhibition. Many, and perhaps all of these lamps, contained the broad invention of the Edison patent, yet the court sustained the patent as valid and as not anticipated by the prior work of Goebel, assuming it to have been correctly reported to the court. With reference to the Goebel lamps, 54 F., 691, the court said as follows:

> "At most they were experimental toys used to advertise his telescope, or to flash a light upon his clock, or to attract customers to his shop. They were crudely constructed and their life was brief; they could not be used for domestic purposes. They were in no proper sense the practical commercial lamp of Edison. The literature of the art is full of better lamps, all of which were held not to anticipate the Edison patent. The prior art demonstrates that to protect a carbon filament ten one-thousandths of an inch in diameter from speedy disintegration, the lamp chamber must maintain a nearly perfect and stable vacuum, and every part of the structure must be composed of such materials, and so put together, as not to imperil this vital condition. Leaving out other defects it is abundantly shown that the Goebel lamp did not possess this requirement, and could not by reason of the elements which entered into its composition and the mode in which it was constructed. Goebel says he made more than 100 lamps, and that a continual improvement took place in their construction, and yet the only three lamps produced at the hearing by his own confession were made as early as 1854 or before gas was introduced into his house * * * The evidence of Goebel and his witnesses points to the conclusion that work ceased on these lamps in the fifties and was not revived until Edison 20 years later startled the electric world with his invention.
>
> "It has often been laid down that a meritorious invention is not to be defeated by something which rests in speculation or experiment, or which is rudimentary or incomplete. The law requires not conjecture, but certainty. It is easy, after an important invention has gone into public use, for persons to come forward with claims that they invented the same thing years before, and to endeavor to establish this by the recollection of witnesses as to events long past. Such evidence is to be received with great caution, and the presumption of novelty arising from the grant of the patent is not to be overcome except upon clear and convincing proof."

The foregoing line of reasoning was followed in all the other cases in which this defense was offered by every court in which the issue was presented. The court refused to take the alleged prior use seriously, and gave to Edison's great invention which secured the distribution of electric light in small units the recognition that it deserved. Many other defenses were urged as well, including other alleged prior inventions, and ot. er alleged prior publications, but in them all the court found fancy

rather than fact, and insisted in spite of them on awarding to Edison the recognition of the value of his invention and the validity of his patent. The manufacture or sale of lamps by others was enjoined.

By the time the courts had sustained the Edison patent on the Edison lamp, a great many different makes of dynamos had been produced and had gone into general use, and all of these dynamos furnished current to lighting circuits on which incandescent lamps were needed. These lamps could not be obtained except from Edison interests, and it was charged that the Edison interests were selling their lamps principally to the users of Edison dynamos and were withholding the lamps from the users of dynamos made by their competitors. This caused a great outcry of discrimination and protest against it. Just how much foundation there was for the outcry and the protest the author does not assume to say, but the patent in question is an illustration of how one essential of an important industrial development can be used to give a practical working monopoly to everything that goes with it, even though the associated elements are not patented, but are public property.

Some attempts were made to evade the Edison patent. In one instance, reported in 62 F. R., 397, powdered silver was sealed into the glass and used instead of the platinum leading-in wire, and it was urged that this was not the mechanical equivalent of the conductors covered by Edison's patent. But the court held that Edison's invention was a pioneer invention and the patent was entitled to a broad construction, and was entitled to include within its scope all things as equivalents which performed the same function in substantially the same way, so that the use of powdered silver was held to be an infringement and was therefore enjoined.

In 60 F. R., 276, the defendants were using the old lamps over again by replacing the carbon filament. In other words, they were repairing the lamps by putting in a new filament and exhausting the air so as to put the lamp once more in a serviceable condition. The court held that this amounted to reconstruction of the lamp and was therefore an infringement and enjoined the further practice.

Phonograph.

On February 19, 1878, Thomas Edison took out a patent on a phonograph, an instrument which has contributed as much to the entertainment of the human race as anything that has ever been devised. This patent was No. 200,521. It shows a cylinder with a diaphragm having an indenting point for marking the cylinder with marks that correspond to the atmospheric vibrations and it shows another diaphragm that is vibrated by these marks to reproduce the atmospheric vibrations. In his specification Mr. Edison says as follows:

> "I have discovered after a long series of experiments that a diaphragm or other body capable of being set in motion by the human voice does not give, except in rare instances, superimposed vibrations as has heretofore been supposed, but that each vibration is separate and distinct, and, therefore, it becomes possible to record and reproduce the sounds of the human voice."

The original phonograph used a cylinder for recording the sound wave, and the phonograph cylinder was used for many years but for most purposes has now given way to the disk records which are universally used for permanent commercial records. This patent contained four claims, the first and third of which were sufficiently broad to cover all types of phonographs. The patent is reproduced herewith.

The phonograph patent was never contested or disputed. Edison enjoyed a monopoly that was recognized on every hand and the phonograph during the patent period had a very considerable use, but with the expiration of the patent and the introduction of disk records and the improvements in the diaphragm, cabinets, etc., the phonograph has gone into very general use, almost as general as the sewing machine. It is to be found in nearly every household. It is accepted now as commonplace although it is in fact one of the most marvelous inventions that was ever made and was a logical development from the telephone to the development of which Edison made great contributions.

T A. EDISON.

Phonograph or Speaking Machine.

No. 200,521. Patented Feb. 19, 1878.

Fig. 1.

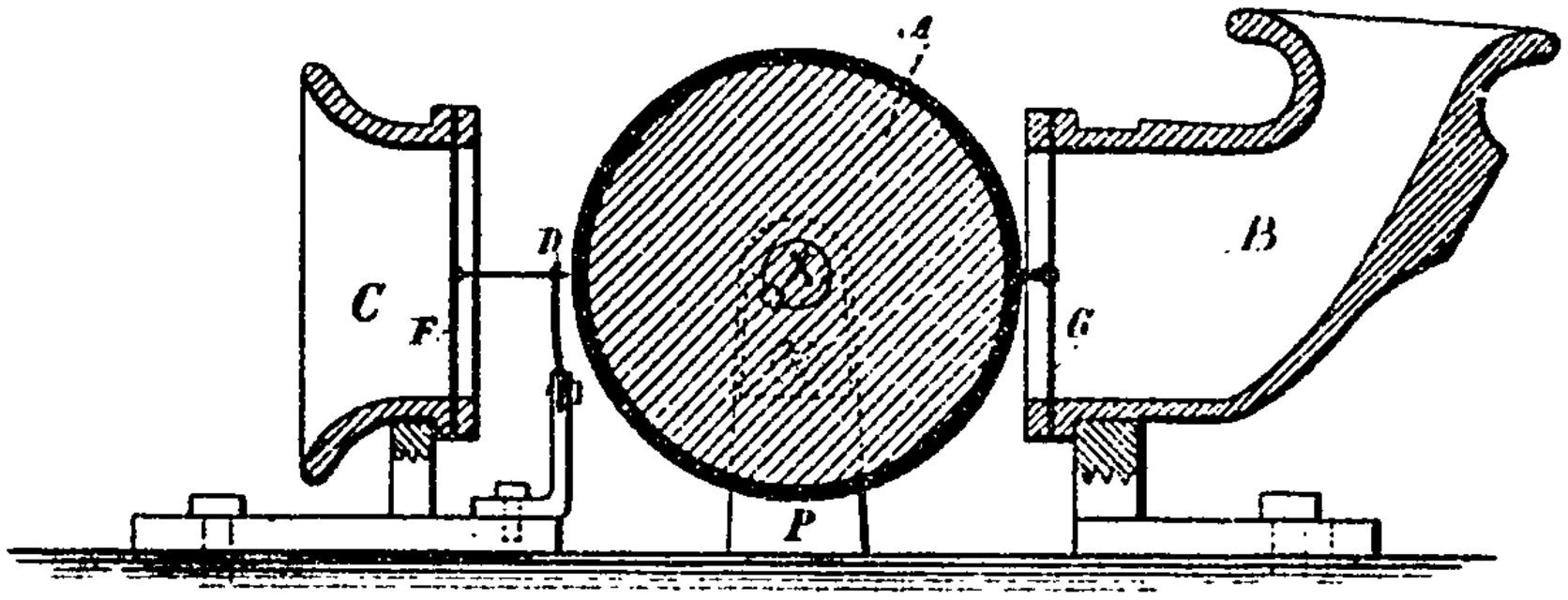


Fig. 4.

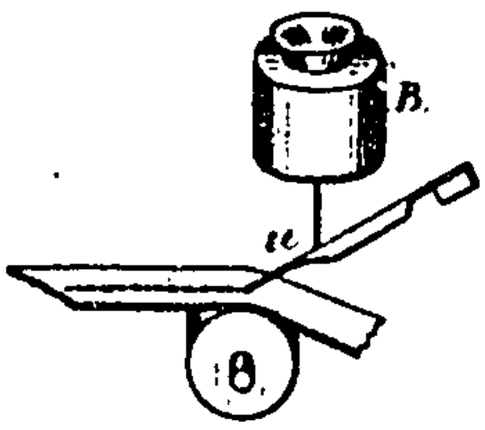


Fig. 3.

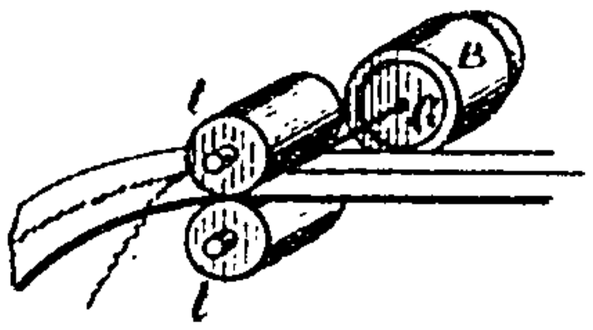


Fig. 2.

Witnesses

Chas. H. Smith

Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN PHONOGRAPH OR SPEAKING MACHINES.

Specification forming part of Letters Patent No. **200,521**, dated February 19, 1878; application filed December 24, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Phonograph or Speaking Machines, of which the following is a specification:

The object of this invention is to record in permanent characters the human voice and other sounds, from which characters such sounds may be reproduced and rendered audible again at a future time.

The invention consists in arranging a plate, diaphragm, or other flexible body capable of being vibrated by the human voice or other sounds, in conjunction with a material capable of registering the movements of such vibrating body by embossing or indenting or altering such material, in such a manner that such register-marks will be sufficient to cause a second vibrating plate or body to be set in motion by them, and thus reproduce the motions of the first vibrating body.

The invention further consists in the various combinations of mechanism to carry out my invention.

I have discovered, after a long series of experiments, that a diaphragm or other body capable of being set in motion by the human voice does not give, except in rare instances, superimposed vibrations, as has heretofore been supposed, but that each vibration is separate and distinct, and therefore it becomes possible to record and reproduce the sounds of the human voice.

In the drawings, Figure 1 is a vertical section, illustrating my invention, and Fig. 2 is a plan of the same.

A is a cylinder having a helical indenting-groove cut from end to end—say, ten grooves to the inch. Upon this is placed the material to be indented, preferably metallic foil. This drum or cylinder is secured to a shaft, X, having at one end a thread cut with ten threads to the inch, the bearing P also having a thread cut in it.

L is a tube, provided with a longitudinal slot, and it is rotated by the clock-work at M, or other source of power.

The shaft X passes into the tube L, and it is rotated by a pin, 2, secured to the shaft, and passing through the slot on the tube L, the object of the long slot being to allow the shaft X to pass endwise through the center or support P by the action of the screw on X. At the same time that the cylinder is rotated it passes toward the support O.

B is the speaking-tube or mouth-piece, which may be of any desired character, so long as proper slots or holes are provided to re-enforce the hissing consonants. Devices to effect this object are shown in my application, No. 143, filed August 28, 1877. Hence they are not shown or further described herein.

Upon the end of the tube or mouth-piece is a diaphragm, having an indenting-point of hard material secured to its center, and so arranged in relation to the cylinder A that the point will be exactly opposite the groove in the cylinder at any position the cylinder may occupy in its forward rotary movement.

The speaking-tube is arranged upon a standard, which, in practice, I provide with devices for causing the tube to approach and recede from the cylinder.

The operation of recording is as follows: The cylinder is, by the action of the screw in X, placed adjacent to the pillar P, which brings the indenting-point of the diaphragm G opposite the first groove on the cylinder, over which is placed a sheet of thick metallic foil, paper, or other yielding material. The tube B is then adjusted toward the cylinder until the indenting-point touches the material and indents it slightly. The clock-work is then set running, and words spoken in the tube B will cause the diaphragm to take up every vibration, and these movements will be recorded with surprising accuracy by indentations in the foil.

After the foil on the cylinder has received the required indentations, or passed to its full limit toward O, it is made to return to P by proper means, and the indented material is brought to a position for reproducing and rendering audible the sounds that had been made by the person speaking into the tube B.

C is a tube similar to B, except that the diaphragm is somewhat lighter and more sensitive, although this is not actually necessary. In front of this diaphragm is a light spring, D, having a small point shorter and finer than

the indenting-point on the diaphragm of B. This spring and point are so arranged as to fall exactly into the path of all the indentations. This spring is connected to the diaphragm F of C by a thread or other substance capable of conveying the movements of D. Now, when the cylinder is allowed to rotate, the spring D is set in motion by each indentation corresponding to its depth and length. This motion is conveyed to the diaphragm either by vibrations through a thread or directly by connecting the spring to the diaphragm F, and these motions being due to the indentations, which are an exact record of every movement of the first diaphragm, the voice of the speaker is reproduced exactly and clearly, and with sufficient volume to be heard at some distance.

The indented material may be detached from the machine and preserved for any length of time, and by replacing the foil in a proper manner the original speaker's voice can be reproduced, and the same may be repeated frequently, as the foil is not changed in shape if the apparatus is properly adjusted.

The record, if it be upon tin-foil, may be stereotyped by means of the plaster-of-paris process. and from the stereotype multiple copies may be made expeditiously and cheaply by casting or by pressing tin-foil or other material upon it. This is valuable when musical compositions are required for numerous machines.

It is obvious that many forms of mechanism may be used to give motion to the material to be indented. For instance, a revolving plate may have a volute spiral cut both on its upper and lower surfaces, on the top of which the foil or indenting material is laid and secured in a proper manner. A two-part arm is used with this disk, the portion beneath the disk having a point in the lower groove, and the portion above the disk carrying the speaking and receiving diaphragmic devices, which arm is caused, by the volute spiral groove upon the lower surface, to swing gradually from near the center to the outer circumference of the plate as it is revolved, or vice versa.

An apparatus of this general character adapted to a magnet that indents the paper is shown in my application for a patent, No. 128, filed March 26, 1877; hence no claim is made herein to such apparatus, and further description of the same is unnecessary.

A wide continuous roll of material may be used, the diaphragmic devices being reciprocated by proper mechanical devices backward and forward over the roll as it passes forward; or a narrow strip like that in a Morse register may be moved in contact with the indenting-point, and from this the sounds may be reproduced. The material employed for this purpose may be soft paper saturated or coated with paraffine or similar material, with a sheet of metal foil on the surface thereof to receive the impression from the indenting-point.

I do not wish to confine myself to reproducing sound by indentations only, as the transmitting or recording device may be in a sinuous form, resulting from the use of a thread passing with paper beneath the pressure-rollers *t*, (see Fig. 3,) such thread being moved laterally by a fork or eye adjacent to the roller *t*, and receiving its motion from the diaphragm G, with which such fork or eye is connected, and thus record the movement of the diaphragm by the impression of the thread in the paper to the right and left of a straight line, from which indentation the receiving-diaphragm may receive its motion and the sound be reproduced, substantially in the manner I have already shown; or the diaphragm may, by its motion, give more or less pressure to an inking-pen, *u*, Fig. 4, the point of which rests upon paper or other material moved along regularly beneath the point of the pen, thus causing more or less ink to be deposited upon the material, according to the greater or lesser movement of the diaphragm. These ink-marks serve to give motion to a second diaphragm when the paper containing such marks is drawn along beneath the end of a lever resting upon them and connected to such diaphragm, the lever and diaphragm being moved by the friction between the point being greatest, or the thickness of the ink being greater where there is a large quantity of ink than where there is a small quantity. Thus the original sound-vibrations are reproduced upon the second diaphragm.

I claim as my invention—

1. The method herein specified of reproducing the human voice or other sounds by causing the sound-vibrations to be recorded, substantially as specified, and obtaining motion from that record, substantially as set forth, for the reproduction of the sound-vibrations.

2. The combination, with a diaphragm exposed to sound-vibrations, of a moving surface of yielding material—such as metallic foil—upon which marks are made corresponding to the sound-vibrations, and of a character adapted to use in the reproduction of the sound, substantially as set forth.

3. The combination, with a surface having marks thereon corresponding to sound-vibrations, of a point receiving motion from such marks, and a diaphragm connected to said point, and responding to the motion of the point, substantially as set forth.

4. In an instrument for making a record of sound-vibrations, the combination, with the diaphragm and point, of a cylinder having a helical groove and means for revolving the cylinder and communicating an end movement corresponding to the inclination of the helical groove, substantially as set forth.

Signed by me this 15th day of December, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

Centrifugal Creamer.

On April 5, 1881, Edwin J. Houston and Elihu Thomson took out a patent on a centrifugal creamer No. 239,659. This invention consisted in feeding the milk slowly through a rapidly revolving separating vessel in which the milk partook of the motion of the vessel, and as it was rapidly revolved the milk was separated into cream and skimmed milk by centrifugal force. The skimmed milk, being heaviest, was forced outward into contact with the vessel, and the cream, being light, was forced to move in away from the vessel. A machine operating on this principle is now in use in every dairy and farmers and milk raisers throughout the country are generally well acquainted with machines that operate in this way. The claims of this patent are unusually well drawn, the fifth and eighth claims being of exceptional breadth. The eighth claim reads as follows:

> "The process of creaming milk and skimming off the cream by the action of centrifugal force."

This patent was litigated and was held to be invalid at 79 F. R. 357, and 84 F. R. 881, on the ground that the invention was broadly shown in a prior patent and if the claims were construed so as not to be anticipated by the prior patent, then they were not infringed by the defendant's machine. It is rather unfortunate that this patent was not passed on by the Supreme Court. The claims of the patent were of exceptional breadth, the invention seems to have been a pioneer invention, and was a very distinct advance in the art. It was claimed very broadly, and the adverse decision is an illustration of the uncertainties of the outcome of patent litigation and the uncertainty with which alleged prior publications and prior patents will be regarded by the court. This patent was not declared invalid until March, 1897, when the patent had about expired, so that after all the owners of it had the benefit of a practical monopoly during nearly the whole life of the patent, which goes to show how even an invalid patent may be turned to a very profitable account as long as no one disputes its validity.

Electric Welding.

On August 10, 1886, Elihu Thomson took out a patent on an apparatus for electric welding No. 347,140. This patent disclosed the broad invention of pressing two pieces of metal together and fusing them at the point of contact with an electric current until the parts joined themselves together and formed a weld between them. This invention has been of very high commercial importance and has also been an extremely profitable one to the owners of it. During the life of the patent the electric welding apparatus was not sold outright, but was leased on terms that were very favorable to the owners of the patent, which included a royalty charge for every joint that was welded by the apparatus.

The claims of this patent are very broad, the third one being the shortest is quoted herewith:

> "The process or art of causing union between the ends of metal pieces in contact by simultaneous application of fusing currents of electricity and mechanical pressure at the contact."

The only instance in which this patent was litigated is reported at 63 F. R. 120, where a preliminary injunction was granted. Aside from this, this patent seems to have been generally acquiesced in by the public and was enforced by the owners with what might be called ruthless severity. Upon the expiration of the patent the use of electric welding expanded with great rapidity and was applied to a large number of metal arts that

were not reached by the original patentee because the high cost of the royalties made the expense of using it too burdensome. In this patent the invention was claimed in terms of an art and the patent was accepted as valid and was generally respected by the public.

The art of electric welding would seem to have been free and open to the public on the expiration of the original Thomson patent, but the Thomson Electric Welding Company sought to extend its hold through the so-called Harmatta patent 1,046,066 issued Dec. 3, 1912, and because of the large commercial interests involved and the bitter controversy over it this patent is entitled to some notice.

The Harmatta patent was applied for Dec. 3, 1903. It was held in the Patent Office for nine years and when issued broadly covered the art of so-called spot welding. This was electric welding applied to sheet metal in which the metal sheets were joined together in a number of places by being fused by current passed through them at those points. Current was communicated through the sheets by large copper pin electrodes that could be moved apart to permit the introduction of the work and then brought together to furnish the heat and pressure. Elecric welding started by clamping rods or bars in jaws by which the electricity was furnished thereto and then moving the one jaw toward the other jaw to bring the ends of the bars into contact under pressure. This closed the circuit through these ends and caused them to be heated by the C^2R loss at the point of contact. The pressure forced the ends into a weld as soon as the metal was softened.

Harmatta's improvement consisted in clamping heavy copper pin electrodes into these jaws and holding the pieces to be welded between the copper pins when they were brought together. This was a very handy arrangement and made it possible to apply electric welding to sheet metal and wire work in a great variety of forms. If the Harmatta patent could be sustained it would be bound to be more valuable than the original Thomson welding patent. Spot welding had sprung up of its own accord in a great number of shops long before the Harmatta patent had issued and in ignorance of Harmatta's invention or his claims, so that when the patent issued the owners of it found the public hostile to its recognition. The users of spot welding apparatus ultimately organized to fight the patent. At first the patent was sustained as valid and infringed by the Circuit Court of Appeals at Boston, (See 227 F. R., p. 428,) in the case of Thomson Electric Welding Co. vs. Barney and Barry. On the strength of this decision many of the users took licenses under the patent but many hundreds of the shops stood firm and refused to pay tribute. Finally the resistance was successful. Suit was brought by the Thomson Spot Welder Co. vs. Ford Motor Company for the infringement of the patent and the Circuit Court of Appeals at Cincinnati held that the change in the apparatus necessary to adapt it to spot welding did not amount to invention and the patent was, therefore, invalid. (281 F. R. 680). Evidence had been taken to prove prior invention or prior use and was recognized by the court to the extent of proving that the change did not amount to invention. The case is on appeal to the Supreme Court and the final disposition of it by that court will be watched with much interest.

Cyclone Dust Collector.

On May 14, 1889, O. M. Morse took out a patent on a dust collector No. 403,362. This dust collector is to be seen on top of every flour mill and every planing mill where it has the shape of a cone, with the big end up and the small end down. The dust laden air is drawn from the mill by the suction of a fan and is shot tangentially into the big end of the cone,

where it is whirled around. In the whirling process all the solid matter, which includes the dust, is thrown to the outside and into contact with the shell of the cone, where it is retarded by friction so that it settles to the bottom of the cone, where it is trapped out, while the air passes out upwardly through an opening in the center of the top or big end of the cone. This is a pioneer invention that was of the greatest of importance and was applied to all kinds of mills where there was any accumulation of dust, from which combustion was apt to arise. Before this invention was applied to flour mills, the flour dust in the air would sometimes burn with such rapidity as to cause an explosion that would literally blow the mill to pieces. After this invention was applied to flour milling these explosions were practically eliminated and the dust was recovered and sold as a low grade flour.

This patent was litigated at 61 F. R. 297, 78 F. R. 878 and 83 F. R. 1014. In all these decisions the patent was sustained as valid and infringed, but the important litigation in connection with this patent occurred before the patent was issued, and thereby hangs a tale. When Morse made his invention he showed it to his patent attorneys who advised him to apply for a patent at once, but he answered "No" and said that he would first put it on the market and see how it would sell and then determine whether it was worth while to apply for a patent. The invention proved to be a tremendous success from the start, and was rapidly copied by a great many imitators who were more aggressive in protecting their rights (?); and promptly filed applications for patents. When Morse finally did apply for a patent a number of other alleged inventors had filed their applications ahead of him, and Morse was compelled to fight for his rights against these more provident and unscrupulous imitators.

In all forty-four different inventors filed applications, each claiming to be the original, first and sole inventor of the invention in controversy. The Patent Office put all of these applications into an interference, which is a proceeding instituted by the Patent Office for the purpose of determining priority among the inventors claiming the same invention. In this proceeding the parties are presumed to have made the invention in the order in which they filed their applications, and as Morse had filed his application among the last, the presumption that he was the originai inventor was strongly against him and strongly in favor of all that had preceded him, being most strongly in favor of the inventor who was first to file his application in the Patent Office. Morse was compelled to take testimony at great length of witnesses in his own behalf, and cross examine the witnesses of others. After protracted litigation he was finally adjudged to be the first inventor and the patent was issued to him and denied to the rest. This cost Morse thousands of dollars. Every once in a while some inventor of an invention of great importance is caught in the same predicament that Morse allowed himself to get into, from which they can extricate themselves only at great expense if at all. The moral of Morse's experience is that the inventor should file his application promptly, for the date of filing an allowable application in the Patent Office is evidence of a complete reduction to practice in favor of the inventor. It proves itself from the records of the Patent Office, without any expense to the inventor.

After Morse's patent issued he collected royalties for the use of dust collectors that had been installed without his consent, which royalties amounted to hundreds of thousands of dollars.

It may here be said that over 1200 interferences are declared in the Patent Office every year. Each interference involves two or more applications. Sometimes it is a contest between inventors or mechanics who have worked on the same machine, each one claiming to be the inventor

of it or it may be that the later comers have copied it in a modified form from the first inventor as in the case of Morse's cyclone dust collector. But more often it is a contest between widely scattered inventors who know nothing of each other but who have each made the invention on his own initiative, each being independently impelled by a desire to produce something new for which a demand already exists or for which there is probably an opening. Where the inventions are independently made, the inventions contain many and striking differences but they are put into interference because the applications are pending at the same time and because there are one or more particulars in which the inventions are the same or are the equivalent of each other, and each inventor can make the same claim that describes the particular feature that is common to the disclosure of all of their applications.

Telephone.

On March 7, 1876, Alexander Graham Bell took out the original telephone patent No. 174,465. The invention of this patent was so little understood at that time that in the patent it was called an improvement in telegraphy.

This patent was by all odds the most valuable patent that was ever issued by the United States Patent Office. Its importance was not understood at the time, and the public and capital were rather slow to grasp its significance. The history of the growth of the telephone is of surpassing interest, and because of the tremendous development some reference to the patent litigation through which Bell passed is of interest on that account alone, aside from the practical questions that were disposed of that would interest the average inventor.

Bell filed his application on Feb. 14, 1876, and his patent therefore issued in twenty-two days, which was an extraordinary example of speed when it is remembered that in these later days applications sometimes remain in the Patent Office for a year before they are even considered by the examiner.

On the same day that Bell filed his application Professor Elisha Gray filed a caveat in the Patent Office, in which he described his invention in telephones. A caveat is a notice to the Patent Office that the caveator has made an invention which is incomplete but is shown in the caveat and on which the inventor desires further time for completing the invention. He, therefore, notifies the Commissioner of Patents not to grant any patent on an application filed within a year after the filing of the caveat without giving the caveator notice so that he may complete his invention and file an application therefor. Caveats have long since been abolished. Their use was not very satisfactory. If Gray had filed an application making the same disclosure that he had made in the caveat he would have been vastly better off. There would have been a presumption that the invention was complete instead of an admission that it was not complete. He would also have been credited with a reduction to practice of the date of filing proven by a government record. If the caveat had been filed the day before Bell filed his application it would have been the legal duty of the examiner to withhold Bell's patent for the statutory period of ninety days and give Gray notice to file his application. At first the examiner decided that the caveator was entitled to the notice anyhow and gave the notice even though he had filed on the same day as the filing date of Bell's application. He also notified Bell's attorneys. Then he changed his mind and concluded that Gray was not entitled to the notice and issued Bell's patent. If the records of the Patent Office had shown the exact hour and minute when Gray filed his caveat and Bell filed his application, the record might have saved considerable controversy, for Gray's attorneys contended that the caveat was filed earlier in the day than the application, and being filed earlier was at the bottom of the file and was entered later in consequence. But the Patent Office record book showed the fifth entry on that day was "A. G. Bell $15." and the thirty-ninth entry was "E. Gray $10." All this uncertainty aggravated the conditions of the litigation that followed, which litigation lasted a great many years and cost hundreds of thousands of dollars, with the result that Bell finally emerged triumphant in a decision by the Supreme Court in the so-called telephone cases, which decision was given March 19, 1888, and in which Bell was triumphant.

In popular literature a great deal had been written on the telephone litigation, much of which affords very interesting reading. Two authorities are worthy of note, one entitled "The Romance of the Telephone" which appeared in Munsey's Magazine of November, 1900, and the other

"A History of the Telephone" by Herbert N. Casson, published by A. C. McClurg & Company of Chicago, in 1913. In addition to this is the report of the decisions of the Supreme Court on the Bell patent, 126 U. S. 31 L. Ed. 863, which is set forth with exhibits, cuts, argument of counsel and statement of the case, making therein a very full history of Bell's struggles and his triumphs. With the technique of the telephone and the experiments that led to its invention and development by Bell, we are not greatly concerned, except insofar as Bell succeeded in doing the impossible and made pieces of metal talk. He made an extraordinary invention and one that was entitled to all the recognition that was given to it as a pioneer invention. Bell exhibited his invention at the Centennial Exposition in Philadelphia in 1876, where it was submerged in educational appliances with which it was classified until a lucky circumstance revealed its importance and won for it the prominence of display that was thereafter given to it as the most important invention of the Centennial. The circumstances may be narrated as follows:

On a Sunday afternoon Don Pedro, the Emperor of Brazil with his wife and a number of courtiers and scientists were visiting the Exposition, and they came to the educational department in the course of their visit. It so happened that the inventor and the emperor had met before on educational work, and the emperor at once recognized the inventor and greeted him most cordially. But what is of more importance, he tried the telephone, was amazed at its performance, and exclaimed almost involuntarily, "My God—it talks." With him were Joseph Henry and Sir William Thompson, the leading authorities on electricity in their day, and they pronounced it the greatest wonder that they had ever seen. Thereafter the telephone for the balance of the Exposition was given a prominent place for display and was almost mobbed by judges and scientists so great was the interest which it attracted.

But this interest did not win subscribers and build telephone exchanges and enlist the aid of capital. That was a growth, or rather a struggle all of its own, to demonstrate to the public the commercial value of the telephone, and while the telephone business was struggling to its feet, it was weighted down by many ambitious rival (?) inventors who claimed priority over Bell and spent hundreds of thousands of dollars in litigating his priority with him.

Then began a search of the prior art to prove from its records that the telephone was old and well known, and that Bell was not the first inventor of it. Then inventors here, there and elsewhere sprung up, each claiming to have been previous inventors. Among them were Gray, McDonough, Drawbaugh and Dolbear, all of whom produced more or less imperfect models and zealous witnesses who could supply the defects of exhibits by the vividness of their recollections.

The troubles of Bell and his associates were accentuated by Edison who made a very important improvement in a microphone transmitter with a low resistance conductor. This invention fell into the hands of the Western Union Co. and soon became a commercial necessity in the telephone business that put Bell and his associates at a great disadvantage. This invention is described in patent 474,231 issued May 3, 1892. At the same time the Western Union was backing Dolbear and Gray in disputing Bell's rights and all this put Bell in a very precarious condition. When Bell's gloom was about the deepest Blake came forward with his improved transmitter and once more Bell and his associates were placed on a competitive basis thereby. Blake's transmitter is described in his patents 250,127, 250,128 and 250,129, issued Nov. 29, 1881.

The competition of the Western Union Co. was like a recognition and

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A. G. BELL.

TELEGRAPHY.

No. 174,465. Patented March 7, 1876.

Fig. 1

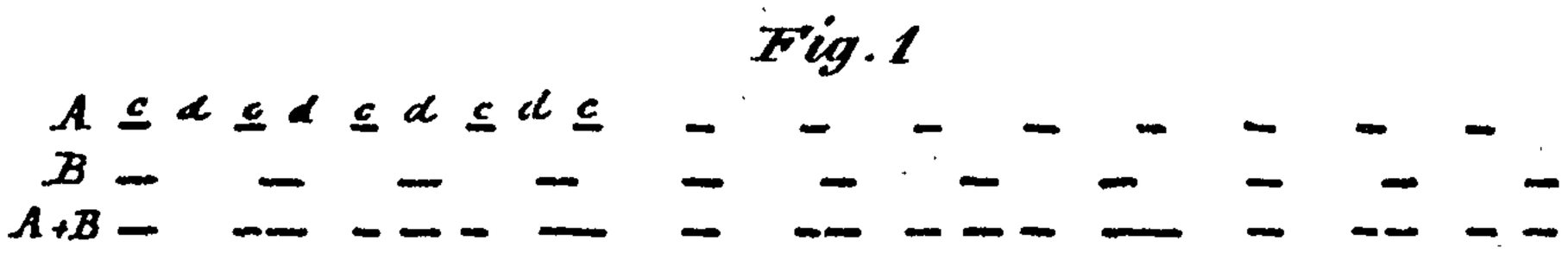


Fig. 2.

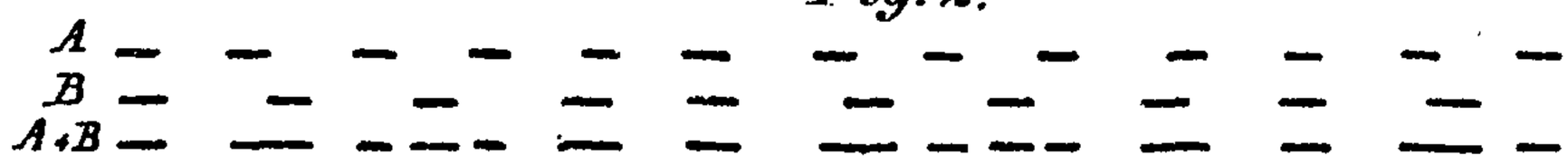


Fig. 3.

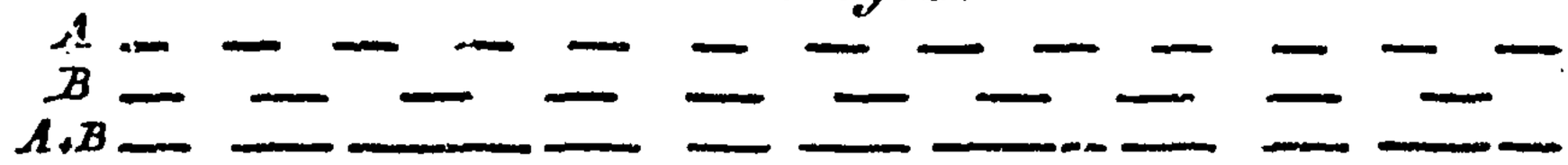


Fig. 4.

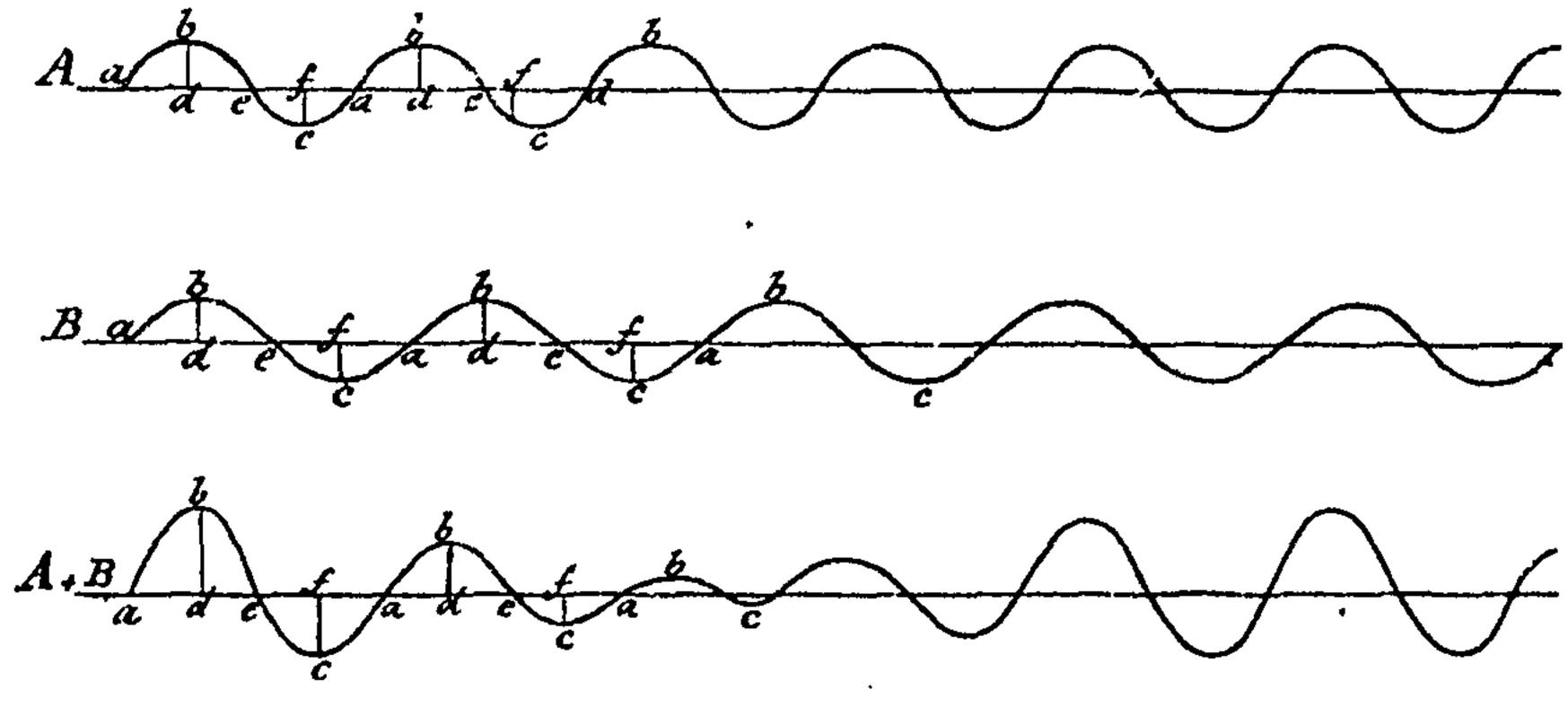
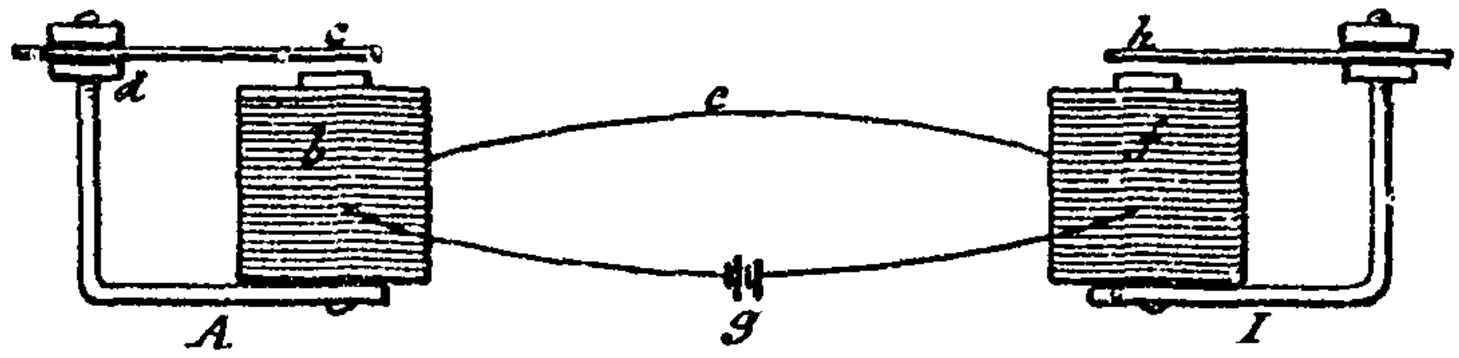


Fig. 5.



Witnesses:

Ewell A. Brick,

H. J. Hutchinson

Inventor:

A. Graham Bell

by Cagger Fisher & Bailey

2 Sheets—Sheet 2.

A. G. BELL.

TELEGRAPHY.

No. 174,465. Patented March 7, 1876.

Fig 6.

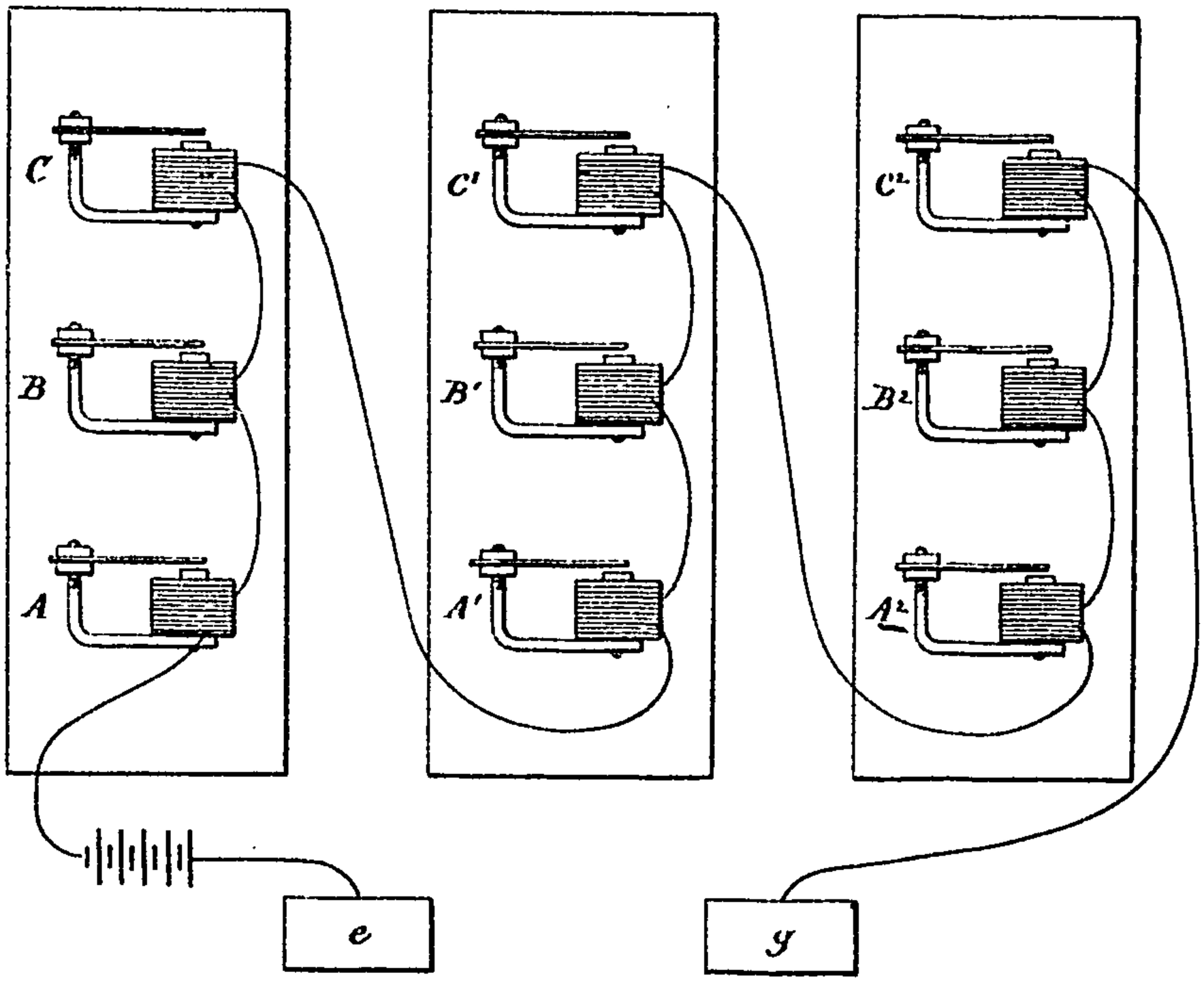
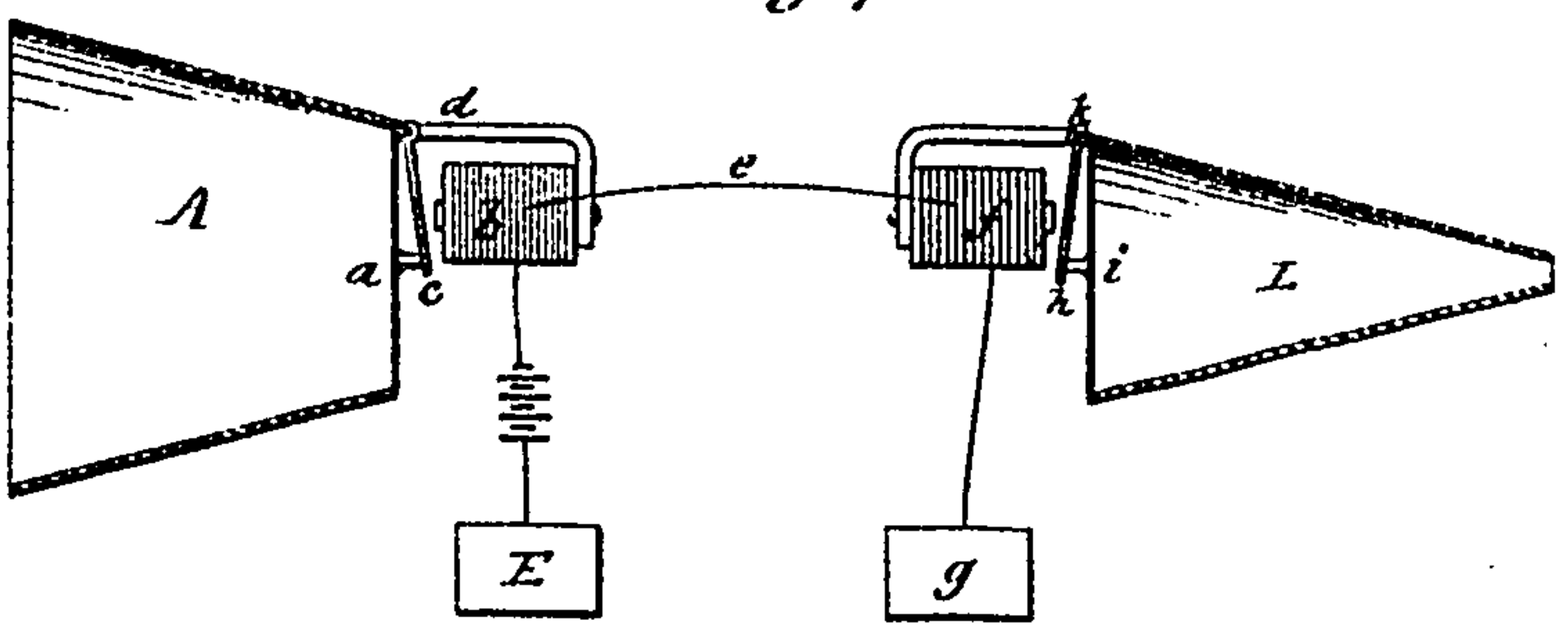


Fig. 7



Witnesses

Ewell & Brick

H. J. Hutchinson

Inventor:

A. Graham Bell

by atty's Bills & Bailey

UNITED STATES PATENT OFFICE.

ALEXANDER GRAHAM BELL, OF SALEM, MASSACHUSETTS.

IMPROVEMENT IN TELEGRAPHY.

Specification forming part of Letters Patent No. 174,465, dated March 7, 1876; application filed February 14, 1876.

To all whom it may concern:

Be it known that I, ALEXANDER GRAHAM BELL, of Salem, Massachusetts, have invented certain new and useful Improvements in Telegraphy, of which the following is a specification:

In Letters Patent granted to me April 6, 1875, No. 161,739, I have described a method of, and apparatus for, transmitting two or more telegraphic signals simultaneously along a single wire by the employment of transmitting-instruments, each of which occasions a succession of electrical impulses differing in rate from the others; and of receiving-instruments, each tuned to a pitch at which it will be put in vibration to produce its fundamental note by one only of the transmitting-instruments; and of vibratory circuit-breakers operating to convert the vibratory movement of the receiving-instrument into a permanent make or break (as the case may be) of a local circuit, in which is placed a Morse sounder, register, or other telegraphic apparatus. I have also therein described a form of autograph-telegraph based upon the action of the above-mentioned instruments.

In illustration of my method of multiple telegraphy I have shown in the patent aforesaid, as one form of transmitting-instrument, an electro-magnet having a steel-spring armature, which is kept in vibration by the action of a local battery. This armature in vibrating makes and breaks the main circuit, producing an intermittent current upon the line-wire. I have found, however, that upon this plan the limit to the number of signals that can be sent simultaneously over the same wire is very speedily reached; for, when a number of transmitting-instruments, having different rates of vibration, are simultaneously making and breaking the same circuit, the effect upon the main line is practically equivalent to one continuous current.

In a pending application for Letters Patent, filed in the United States Patent Office February 25, 1875, I have described two ways of producing the intermittent current—the one by actual make and break of contact, the other by alternately increasing and diminishing the intensity of the current without actually breaking the circuit. The current produced by the latter method I shall term, for distinction sake, a pulsatory current.

My present invention consists in the employment of a vibratory or undulatory current of electricity in contradistinction to a merely intermittent or pulsatory current, and of a method of, and apparatus for, producing electrical undulations upon the line-wire.

The distinction between an undulatory and a pulsatory current will be understood by considering that electrical pulsations are caused by sudden or instantaneous changes of intensity, and that electrical undulations result from gradual changes of intensity exactly analogous to the changes in the density of air occasioned by simple pendulous vibrations. The electrical movement, like the aerial motion, can be represented by a sinusoidal curve or by the resultant of several sinusoidal curves.

Intermittent or pulsatory and undulatory currents may be of two kinds, accordingly as the successive impulses have all the same polarity or are alternately positive and negative.

The advantages I claim to derive from the use of an undulatory current in place of a merely intermittent one are, first, that a very much larger number of signals can be transmitted simultaneously on the same circuit; second, that a closed circuit and single main battery may be used; third, that communication in both directions is established without the necessity of special induction-coils; fourth, that cable dispatches may be transmitted more rapidly than by means of an intermittent current or by the methods at present in use; for, as it is unnecessary to discharge the cable before a new signal can be made, the lagging of cable-signals is prevented; fifth, and that as the circuit is never broken a spark-arrester becomes unnecessary.

It has long been known that when a permanent magnet is caused to approach the pole of an electro-magnet a current of electricity is induced in the coils of the latter, and that when it is made to recede a current of opposite polarity to the first appears upon the wire. When, therefore, a permanent magnet is caused to vibrate in front of the pole of an electro-magnet an undulatory current of electricity is induced in the coils of the electro-magnet, the

undulations of which correspond, in rapidity of succession, to the vibrations of the magnet, in polarity to the direction of its motion, and in intensity to the amplitude of its vibration.

That the difference between an undulatory and an intermittent current may be more clearly understood I shall describe the condition of the electrical current when the attempt is made to transmit two musical notes simultaneously—first upon the one plan and then upon the other. Let the interval between the two sounds be a major third; then their rates of vibration are in the ratio of 4 to 5. Now, when the intermittent current is used the circuit is made and broken four times by one transmitting-instrument in the same time that five makes and breaks are caused by the other. A and B, Figs. 1, 2, and 3, represent the intermittent currents produced, four impulses of B being made in the same time as five impulses of A. *c c c*, &c., show where and for how long time the circuit is made, and *d d d*, &c., indicate the duration of the breaks of the circuit. The line A and B shows the total effect upon the current when the transmitting-instruments for A and B are caused simultaneously to make and break the same circuit. The resultant effect depends very much upon the duration of the make relatively to the break. In Fig. 1 the ratio is as 1 to 4; in Fig. 2, as 1 to 2; and in Fig. 3 the makes and breaks are of equal duration. The combined effect, A and B, Fig. 3, is very nearly equivalent to a continuous current.

When many transmitting-instruments of different rates of vibration are simultaneously making and breaking the same circuit the current upon the main line becomes for all practical purposes continuous.

Next, consider the affect when an undulatory current is employed. Electrical undulations, induced by the vibration of a body capable of inductive action, can be represented graphically, without error, by the same sinusoidal curve which expresses the vibration of the inducing body itself, and the effect of its vibration upon the air; for, as above stated, the rate of oscillation in the electrical current corresponds to the rate of vibration of the inducing body—that is, to the pitch of the sound produced. The intensity of the current varies with the amplitude of the vibration—that is, with the loudness of the sound; and the polarity of the current corresponds to the direction of the vibrating body—that is, to the condensations and rarefactions of air produced by the vibration. Hence, the sinusoidal curve A or B, Fig. 4, represents, graphically, the electrical undulations induced in a circuit by the vibration of a body capable of inductive action.

The horizontal line *a d e f*, &c., represents the zero of current. The elevations *b b b*, &c., indicate impulses of positive electricity. The depressions *c c c*, &c., show impulses of negative electricity. The vertical distance *b d* or *e f* of any portion of the curve from the zero-line expresses the intensity of the positive or negative impulse at the part observed, and the horizontal distance *a a* indicates the duration of the electrical oscillation. The vibrations represented by the sinusoidal curves B and A, Fig. 4, are in the ratio aforesaid, of 4 to 5—that is, four oscillations of B are made in the same time as five oscillations of A.

The combined effect of A and B, when induced simultaneously on the same circuit, is expressed by the curve A+B, Fig. 4, which is the algebraical sum of the sinusoidal curves A and B. This curve A+B also indicates the actual motion of the air when the two musical notes considered are sounded simultaneously. Thus, when electrical undulations of different rates are simultaneously induced in the same circuit, an effect is produced exactly analogous to that occasioned in the air by the vibration of the inducing bodies. Hence, the coexistence upon a telegraphic circuit of electrical vibrations of different pitch is manifested not by the obliteration of the vibratory character of the current, but by peculiarities in the shapes of the electrical undulations, or, in other words, by peculiarities in the shapes of the curves which represent those undulations.

There are many ways of producing undulatory currents of electricity, dependent for effect upon the vibrations or motions of bodies capable of inductive action. A few of the methods that may be employed I shall here specify. When a wire, through which a continuous current of electricity is passing, is caused to vibrate in the neighborhood of another wire, an undulatory current of electricity is induced in the latter. When a cylinder, upon which are arranged bar-magnets, is made to rotate in front of the pole of an electro-magnet, an undulatory current of electricity is induced in the coils of the electro-magnet.

Undulations are caused in a continuous voltaic current by the vibration or motion of bodies capable of inductive action; or by the vibration of the conducting-wire itself in the neighborhood of such bodies. Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery. The internal resistance of a battery is diminished by bringing the voltaic elements nearer together, and increased by placing them farther apart. The reciprocal vibration of the elements of a battery, therefore, occasions an undulatory action in the voltaic current. The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting-wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current. Hence, the vibration of the conducting-wire in mercury or other liquid included in the circuit occasions undulations in the current. The vertical vibrations of the elements of a battery in the liquid in which

they are immersed produces an undulatory action in the current by alternately increasing and diminishing the power of the battery.

In illustration of the method of creating electrical undulations, I shall show and describe one form of apparatus for producing the effect. I prefer to employ for this purpose an electro-magnet, A, Fig. 5, having a coil upon only one of its legs *b*. A steel-spring armature, *c*, is firmly clamped by one extremity to the uncovered leg *d* of the magnet, and its free end is allowed to project above the pole of the covered leg. The armature *c* can be set in vibration in a variety of ways, one of which is by wind, and, in vibrating, it produces a musical note of a certain definite pitch.

When the instrument A is placed in a voltaic circuit, *g b e f g*, the armature *c* becomes magnetic, and the polarity of its free end is opposed to that of the magnet underneath. So long as the armature *c* remains at rest, no effect is produced upon the voltaic current, but the moment it is set in vibration to produce its musical note a powerful inductive action takes place, and electrical undulations traverse the circuit *g b e f g*. The vibratory current passing through the coil of the electro-magnet *f* causes vibration in its armature *h* when the armatures *c h* of the two instruments A I are normally in unison with one another; but the armature *h* is unaffected by the passage of the undulatory current when the pitches of the two instruments are different.

A number of instruments may be placed upon a telegraphic circuit, as in Fig. 6. When the armature of any one of the instruments is set in vibration all the other instruments upon the circuit which are in unison with it respond, but those which have normally a different rate of vibration remain silent. Thus, if A, Fig. 6, is set in vibration, the armatures of A^1 and A^2 will vibrate also, but all the others on the circuit will remain still. So if B^1 is caused to emit its musical note the instruments B B^2 respond. They continue sounding so long as the mechanical vibration of B^1 is continued, but become silent with the cessation of its motion. The duration of the sound may be used to indicate the dot or dash of the Morse alphabet, and thus a telegraphic dispatch may be indicated by alternately interrupting and renewing the sound.

When two or more instruments of different pitch are simultaneously caused to vibrate, all the instruments of corresponding pitches upon the circuit are set in vibration, each responding to that one only of the transmitting instruments with which it is in unison. Thus the signals of A, Fig. 6, are repeated by A^1 and A^2, but by no other instrument upon the circuit; the signals of B^2 by B and B^1; and the signals of C^1 by C and C^2—whether A, B^2, and C^1 are successively or simultaneously caused to vibrate. Hence by these instruments two or more telegraphic signals or messages may be sent simultaneously over the same circuit without interfering with one another.

I desire here to remark that there are many other uses to which these instruments may be put, such as the simultaneous transmission of musical notes, differing in loudness as well as in pitch, and the telegraphic transmission of noises or sounds of any kind.

When the armature *e*, Fig. 5, is set in vibration the armature *h* responds not only in pitch, but in loudness. Thus, when *c* vibrates with little amplitude, a very soft musical note proceeds from *h*; and when *c* vibrates forcibly the amplitude of the vibration of *h* is considerably increased, and the resulting sound becomes louder. So, if A and B, Fig. 6, are sounded simultaneously, (A loudly and B softly,) the instruments A^1 and A^2 repeat loudly the signals of A, and B^1 B^2 repeat softly those of B.

One of the ways in which the armature *c*, Fig. 5, may be set in vibration has been stated above to be by wind. Another mode is shown in Fig. 7, whereby motion can be imparted to the armature by the human voice or by means of a musical instrument.

The armature *c*, Fig. 7, is fastened loosely by one extremity to the uncovered leg *d* of the electro-magnet *b*, and its other extremity is attached to the center of a stretched membrane, *a*. A cone, A, is used to converge sound-vibrations upon the membrane. When a sound is uttered in the cone the membrane *a* is set in vibration, the armature *c* is forced to partake of the motion, and thus electrical undulations are created upon the circuit E *b e f g*. These undulations are similar in form to the air vibrations caused by the sound—that is, they are represented graphically by similar curves.

The undulatory current passing through the electro-magnet *f* influences its armature *h* to copy the motion of the armature *c*. A similar sound to that uttered into A is then heard to proceed from L.

In this specification the three words "oscillation," "vibration," and "undulation," are used synonymously, and in contradistinction to the terms "intermittent" and "pulsatory." By the terms "body capable of inductive action," I mean a body which, when in motion, produces dynamical electricity. I include in the category of bodies capable of inductive action—brass, copper, and other metals, as well as iron and steel.

Having described my invention, what I claim, and desire to secure by Letters Patent is as follows:

1. A system of telegraphy in which the receiver is set in vibration by the employment of undulatory currents of electricity, substantially as set forth.

2. The combination, substantially as set forth, of a permanent magnet or other body capable of inductive action, with a closed circuit, so that the vibration of the one shall occasion electrical undulations in the other, or in itself, and this I claim, whether the permanent magnet be set in vibration in the neighborhood of the conducting-wire form-

ing the circuit, or whether the conducting-wire be set in vibration in the neighborhood of the permanent magnet, or whether the conducting-wire and the permanent magnet both simultaneously be set in vibration in each other's neighborhood.

3. The method of producing undulations in a continuous voltaic current by the vibration or motion of bodies capable of inductive action, or by the vibration or motion of the conducting-wire itself, in the neighborhood of such bodies, as set forth.

4. The method of producing undulations in a continuous voltaic circuit by gradually increasing and diminishing the resistance of the circuit, or by gradually increasing and diminishing the power of the battery, as set forth.

5. The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sound, substantially as set forth.

In testimony whereof I have hereunto signed my name this 20th day of January, A. D. 1876.

ALEX. GRAHAM BELL.

Witnesses:

THOMAS E. BARRY,

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an endorsement of Bell's pretentions and instead of hurting him it soon enabled him to attract capital so that he could at least meet the W. U. competition on an equal footing. Finally the Western Union Co. sold out to Bell with an arrangement that was profitable to both of them and gave Bell the benefit of all the inventions acquired by that company.

In the meantime the Bell Company had its hands full, so to speak, in defending its rights against those who were trying to rob Bell of his glory and his reward.

For in all the Bell Company fought out thirteen lawsuits that were of national interest, five of which went to the Supreme Court of the United States. It also fought out 587 other lawsuits of various natures, and in all this litigation it never lost a case, except two of minor importance. Only a small part of these were patent cases, but the patent suits were the most important of the litigations in which Bell and his associates were involved, for they involved the very foundation of the business.

Having said this much, a further reference to the other inventors is now in order. When Bell was exhibiting his telephone there was another telephone at the Smithsonian Institution that was made by Philip Reis, who had died in Germany two years before, and great emphasis was placed upon the Reis telephone by those who sought to break Bell's monopoly. There is ample evidence to show that Reis had the correct idea of how a telephone should be made and how it should work, but apparently he never actually succeeded in making his telephone work. On this subject after reviewing the evidence on the Reis telephone, the Supreme Court at 31 L. Ed. 992, said as follows:

> "But it is needless to quote further from the evidence on this branch of the case. It is not contended that Reis had ever succeeded in actually transmitting speech, but only that his instrument was capable of it if he had known how. He did not know how, and all his experiments in that direction were failures. With the help of Bell's later discoveries in 1875, we now know why he failed."

It is quite probable that if Reis had filed an application, describing the construction and operation of the telephone, he could have secured a patent on it that would have dominated the art, and on the other hand, the examiner might have called for a demonstration before granting the patent, which Reis could not have furnished. If such a demonstration was furnished by Bell to the Patent Office, the writer does not know. The decision of the Supreme Court in 31 L. Ed. page 989, indicates otherwise for it says as follows:

> "It is quite true that when Bell applied for his patent he had never actually transmitted telegraphically spoken words so that they could be distinctly heard and understood at the receiving end of his line, but in his specification he did describe accurately and with admirable clearness his process, that is to say, the exact electrical condition that must be created to accomplish his purpose; and he also described, with sufficient precision to enable one of ordinary skill in such matters to make it, a form of apparatus which, if used in the way pointed out, would produce the required effect, receive the words, and carry them to and deliver them at the appointed place."

This is a practical illustration of the value of filing an allowable application in the Patent Office in which the invention is clearly disclosed and not waiting to perfect and amplify an operative mechanical structure.

But it sometimes happens that the Patent Office calls for a demonstration and when it does, the inventor who is entirely theoretical, and not practical, may find himself in trouble. For example, the inventor who claims to have discovered perpetual motion is very apt to be required to

make a demonstration by the Patent Office. Experience has shown that this is the easiest way of getting rid of him without argument.

Another inventor was James W. McDonough, who filed an application on April 10, 1876, but this application filed after Bell's patent had issued availed him nothing, in spite of other evidence as to his priority, because it seemed clear that even if he had had the invention, he had abandoned it by his neglect and delay. Furthermore, McDonough, like Reis, had worked with an intermittent current in which the circuit was actually interrupted, while Bell worked with an undulating current in which the circuit was complete all the time but the strength of the current was varied by using an armature as a diaphragm which was vibrated by the voice and vibrations of the armature changed the magnetic field of an electro magnet which in turn caused variations in the electric current of the telephone circuit.

Daniel Drawbaugh filed an application in the Patent Office on the 21st of July, 1880, claiming to be the first inventor of the telephone, and this was given great publicity by the interests that were hostile to Bell. He claimed to have had a number of telephone exhibits made before Bell's invention, but during the time that Bell was active Drawbaugh was at work on other things, and never made a move to assert his rights until four years after Bell's patent had issued. Under those circumstances, his contentions were regarded with great suspicion.

On this point the court said as follows:

> "We do not doubt that Drawbaugh may have conceived the idea that speech could be transmitted to a distance by means of electricity and that he was experimenting on that subject; but to hold that he had discovered the art of doing it before Bell did would be to construe testimony without regard to the 'ordinary laws that govern human conduct'."

Even if he had made out a case of complete success of prior use the court would have been bound to hold that he had lost his right by the concealment or abandonment of his invention.

In the same case the court passed on the fifth claim of the Bell patent which claim read as follows:

> "The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sound, substantially as set forth."

This claim was attacked for every reason that the ingenuity of counsel could suggest, but it was sustained with all the breadth of meaning that could be attached to it and the court refused to confine it to the crude instrument disclosed in Bell's original patent. It was held to cover all the improved apparatus that came after it for accomplishing the same purpose.

Early in the controversy one of the most important improvements was the microphone transmitter of the Beriner patent 463,569 issued Nov. 17, 1891, the application for which patent was soon annexed by the Bell Company. This application was filed on June 4, 1877, and was held in the Patent Office for about 14 years or until the Bell patent had nearly expired. The issuing of this patent, covering as it did an improvement that had become a necessity, virtually doubled the length of the patent monopoly of the Bell Co. Its stock went up many points when this patent issued and the Government believing that the public had been imposed upon brought suit to cancel the patent alleging that the withholding of the patent in the Patent Office was a fraud on the public. The lower court sustained this contention but the Supreme Court in the case of U.

S. vs. American Bell Telephone Co. 167 U. S. 224, 42 L. Ed. 144, reversed the lower court and declared that the Bell Telephone Co. was within its legal rights in delaying the issuing of the patent, and sustained the patent as valid. The patent had a tremendous moral force but when it was sued on later the Federal Court in 119 F. R. 893, Jan. 1903, refused to give the patent a broad construction but gave it a very narrow construction instead and held that it was not infringed in spite of the fact that the claims of thepatent were stated quite broadly. In this way the advantage which the Bell Telephone Co. expected to get by delaying the issuing of the patent was somewhat neutralized.

Radio.

Morse signalled his code by sending intermittent electric impulses thru metal wires. These impulses worked electromagnets that worked a sounder. Bell sent sound over the same metal wires by substituting undulating electric currents for the intermittent electric impulses, and worked a diaphragm with an electromagnet. His telephone carried not only speech, but all other sounds, musical and otherwise. The radio does all that has been done by the telegraph and the telephone by converting sound into electromagnetic impulses and sending them broadcast thru the air or ether to the apparatus for converting them back into sound without the use of a metal circuit, and even amplifies the sound.

Wireless telegraphy and radio started with the Marconi patent 586,193 issued July 13th, 1897. This patent was reissued June 4th, 1901, and became R-11,913. Marconi was the first to produce an apparatus that would detect Hertzian waves intelligibly and combine it with a sending apparatus. He was the first to connect an aerial to one side of a spark gap and a ground to the other side of it. He used an induction coil to energize the spark gap, and a telegraph key in the primary circuit to break up the current into signals. An important feature of Marconi's receiving apparatus was a tiny glass vacuum tube about two inches long and a tenth of an inch in diameter. A wire entered each end of the tube and these wires, terminated in two filament plugs that fitted the bore of the tube. A space of one thirty-second of an inch was left between the plugs, and this space was filled with a mixture of metal filings, ninety-six parts of nickel and four parts of silver with the merest trace of mercury. The tube was exhausted before being sealed. Ordinarily this tube was a non-conductor. This tube was connected to the antenna, and as the impulses were received from the air the metallic particles would cohere and form a metallic circuit thru which a current from a battery could pass. A tapper operated by the battery current would shake the tube after each impulse. The particles would be separated thereby and this would interrupt the battery circuit until the next impulse from the air would cause the particles to cohere. In this way the signals were detected by using a telephone or sounder on the battery circuit. This patent was sustained at 138 F. R. 657 and 154 F. R. 75.

Patent 803,684 was issued to Fleming on November 7th, 1905, and shows a vacuum tube containing two elements for detecting feeble currents. Fleming proposed to detect the feeble currents in a way that was quite different from the solution proposed by Marconi, and to understand the difference between the two a statement of the problem is necessary. The Hertzian waves are produced by the sparks of the radio sending apparatus and these sparks are like the discharge of the Leyden jar. The discharge of the Leyden jar is oscillatory like the vibrating of a spring or the prongs of a tuning fork. The observer sees but one spark. In reality, however, for each visible spark there is a series of sparks passing back

and forth rapidly decreasing in intensity to zero for each spark that the observer sees. The oscillations from each spark are of very high frequency and the dot or dash character in the code signal consists of a long or short group of these sparks, the groups being at audio frequency. These sparks correspond to an alternating current at a high frequency and high potential, and these sparks produce both electromagnetic and electrostatic waves that correspond in form to the alternating current waves of the spark. These waves so produced cannot give an audible signal as long as they remain complete and at such high frequency, and to make it possible to detect a signal it is necessary to rectify the waves, that is, it is necessary to shut out the half-waves that move in one direction without interfering with the passage of the half-waves that move in the other direction.

Fleming was the first to produce an apparatus that would rectify these high frequency waves, and the two elements of the Fleming tube are used for this purpose. Fleming's specification makes the following statement:

> "I have discovered that if two conductors are enclosed in a vessel in which a good vacuum is made, one being heated to a high temperature, the space between the hot and cold conductors possesses a unilateral electric conductivity and negative electricity can pass from the hot conductor to the cold conductor but not in the reverse direction."

One element of the Fleming tube is a filament which is heated by a continuous current from the battery. This filament is practically the same as the filament of the incandescent lamp. The other element is a plate or a cylinder which is connected to the same battery and to the secondary winding of an induction coil. The antenna is connected to the primary winding of the induction coil and the impulses of the antenna induce a current in the secondary coil that flows from the plate to the filament due to the discharge of electrons from the filament to the plate, and is rectified in so doing. The waves are still of high radio frequency yet they can actuate the telephone diaphragm at an audio frequency. This current is passed into a condenser which discharges at audio frequencies thru a telephone receiver and produces stronger signals therein than were produced by Marconi's apparatus. Fleming's tube made the apparatus much handier. This patent was sustained at 236 F. R. 942, 243 F. R. 560, 261 F. R. 393, 278 F. R. 628, and 294 F. R. 136. The Fleming tube could not be used for sending, and was used to receive with spark transmission, and would therefore not reproduce speech at that time, but would only give the code signals of the spark transmission.

On October 21st, 1884, patent 307,031 was issued to Edison on an Electrical Indicator which included an incandescent lamp that contained the hot filament and cold plate in a vacuum bulb just as Fleming used it in his detector tube. In the suit reported in 236 F. R. this prior invention of Edison's was pleaded as a defense, but the Court held that the bulb of the Edison patent had never been used except to measure currents with a galvanometer, and that the use of it for the purpose of rectifying the feeble radio currents so that they could be detected amounted to an invention. (It is also probably true that Edison used the tube to measure strong low frequency and low voltage currents, while Fleming used it to detect feeble high frequency and high voltage currents.) The Court further pointed out that the Edison patent belonged to another art, or, as it has been put in other cases, it belonged to a non-analogous art, in which respect the finding of the court follows the rule laid down in Potts vs. Creager, 155 U. S. 597, in which it was held that a cylinder that was provided with longitudinal grooves and scraping bars used for dis-

integrating clay was not anticipated by a similar device used for cutting apples, for preparing paper, or for polishing wood, because these devices belonged to non-analogous arts and were not used for analogous purposes. The reader will find much of great technical interest in the decisions in 236 F. R. and 243 F. R.

Patent 841,387 was issued to DeForest on January 15th, 1907, and covers the combination of a tube containing two elements, the filament of which is connected to a low voltage battery, and the plate of which has impressed on it the potential of a high voltage battery. This is used as a device for amplifying feeble electric currents, and is an important step forward over the Fleming patent, using substantially the same Fleming two element detector tube both as a detector and as an amplifier.

Patent 879,532 was issued to DeForest, February 18th, 1908, and shows a detector tube having three elements therein. First, a filament heated by a continuous current from a low voltage battery, second, a grid inductively connected to the antenna, the antenna being on the primary circuit of the induction coil, the grid being on the secondary circuit, and third, a plate having a high potential impressed thereon by a high voltage battery. The grid is between the filament and the plate and when the impulses of the antenna are impressed on the grid it acts as a valve or a gate which is opened by the impulses to varying extents to let the electrons flow in an intermittent or undulating current from the plate to the filament, thus completing the secondary circuit in which the impulses are many times stronger than in the antenna circuit. This patent was sustained at 294 F. R. 136. The DeForest tube could be used for both sending and receiving and made it practical to broadcast and receive any sound that would go over a telephone.

Patent 1,113,149 was issued to Armstrong, October 6th, 1914, and covers the regenerative or feed-back circuit. This patent has been sustained at 279 F. R. 445, 280 F. R. 584, and 294 F. R. 136, and many radio receiving sets using this principle are licensed under this patent.

The so-called crystal set was first invented by Dunwoody and is shown in his patent 837,616, issued December 4th, 1906. This contains the first disclosure of a crystalline rectifier for which purpose he used carborundum. In his patent 854,813 he disclosed the use of loadstone, or Fe_3O_4, for this purpose.

Patent 877,451 was issued January 21st, 1908, to Pickard and was reissued September 8th, 1914, as reissue No. 13,798. This patent covers a crystal receiver and rectifier with a movable spring contact that made it possible to manually select the sensitive spots on the crystal rectifier. Patent 836,531 is a companion to this. Pickard's patent 1,104,073 was issued July 21st, 1914, and covers broadly the use of a crystal rectifier with the so-called "cat whisker" contact. The "cat whisker" combines the spring and contact in one piece and this combination is claimed in the patent.

Suits are pending on many of these patents but the decisions are not yet reported.

The direct conversion of the feeble waves in the air into sound on the telephones by the so-called crystal set without the aid of a battery is to the author the most wonderful performance in the science of applied physics. The fact that a single set of impulses from a single station can be simultaneously caught by a countless number of receiving sets scattered over a large area and converted directly into sound by each set that faithfully reproduces the original sound in pitch and timber only increases his wonder. All honor to the inventors who have invented the appliances by which these wonderful results have been produced. They have aroused

more interest, enlisted more amateurs, started more experimenting and research, and given more pleasure to more people in a shorter time than has ever been done in all time by any other development.

General Statement.

Of the foregoing patents the Morse patent on the electric telegraph, the Bell telephone patents and the Thompson welding patents were clearly patents on an art. The Goodyear rubber patent and the Tilghman patent on the decomposing of fat were more strictly speaking for processes and come within the meaning of the word "art" as used by the Patent Law. The Howe sewing machine is an illustration of a patent on a machine. The Glidden barbed wire patent is an illustration of an article of manufacture. The Goodyear rubber patent R 1084 covered a composition of matter and these patents illustrate the various classes of invention that are recognized as patentable by the Patent Laws of the United States.

The foregoing inventions are all pioneers and are land marks in a logical line of development of the human race. The alphabet simplified and speeded up the recording of thought, reacted on thought and the spoken language and thereby immeasurably stimulated the growth of thought and growth of human intelligence. The invention of printing multiplied this possibility and this tendency many hundreds of times over and still further speeded up the growth of intelligence and civilization. The invention of the steam engine released man from slavery and still further speeded up the development of the race. The invention of the telegraph and the telephone were further steps forward that quickened the pace of humanity. The average man of today has lived longer than Methuselah and has accomplished more than all the patriarchs because of these inventions, and what has been said about the sewing machine, the incandescent lamp, the phonograph, and chemical processes that produce rubber and glycerin, may be repeated indefinitely in connection with such inventions as the typewriter, the harvester and twine binder, improved weaving and spinning machinery, machine tools, the steam locomotive, the steam ship, the Bessemer process for making steel, the dynamo, the steam turbine, the automobile, the flying machine, the typesetting machine, moving pictures, radio, aluminum, carborundum, steel alloys, or the processes for making them and hundreds of other epoch making inventions equally great, inventions that made aluminum more common in 1918 that steel was in 1865, and have put into daily use many other metals that were unknown fifty years ago or the knowledge of which was confined to the laboratory, all of which have been merged into the foundation and superstructures of our present civilization. All or nearly all of these inventions have been made by United States inventors and have played their part in making this the most civilized, the most efficient and the most productive country in the world. Copies of all patents on these and thousands of other wonderful inventions can be had from the U. S. Patent Office and the reader can get the patents and make his investigation of these history making inventions at any length that he desires. He will always find it interesting and profitable and will learn much from them that never gets into text books.

PART II.

New Problems.

So far we have considered patents and the effect of them. We will now consider the making of inventions and the obtaining of patents on inventions yet to be made. Instead of the past we will talk more of the future.

This book is intended for the general public and among them engineers, and it will probably reach many who are just leaving school or just entering their profession. They will soon put into practice the theory which they have learned in school. They will continually meet new conditions and will be called upon to solve new problems or solve old ones in a better way. Problems arise in which the highly developed machine, tools and implements give but little or no assistance and engineers will be left to their own resources to make new equipment and find their own way out of their difficulty. They frequently find entirely new ways or ways that are partly old and partly new and in either case they will probably have made an invention.

Inventions usually start with sketches and drawings. Later models are made and finally a complete reduction to practice is made. All this involves a great deal of experimental work and experimental work is expensive and there would be little inducement to incur the great expense unless a monopoly of the fruits of it could be secured. In other words, unless a patent can be obtained upon the invention worked out no one will be willing to incur the cost of experimental work to produce a serviceable and a salable product. In doing experimental work it is always necessary to guard against waste and even with the best precautions and the best aid the cost runs up very high. In order to keep down the cost of experimental work it is necessary to get acquainted with everything that has been done before and benefit by it as much as possible. If any of the work that has previously been done can be assimilated it should be discovered and understood before the work begins and should not be left to be found after a large expense has been incurred in working out the same product. Thousands of inventions have been made and patented which have not gone into use for one reason or another, frequently because they were made in advance of their time. Where such inventions are disclosed in a patent and the patent has expired the inventions are public property, and if the patent is still in force and the part that interests the investigator is not claimed such part of the invention is public property. If, however, the patent is still in force and the invention is well claimed then it may be necessary to buy the patent or get a license under it. If the invention is not in use it frequently happens that the patent can be bought for a small amount.

It is, therefore, necessary for the investigator to begin as near as possible where others have left off instead of traveling the same road that others have already traveled.

Before starting his experimental work the inventor or manufacturer should collect all of the patents on the same line of invention and utilize or adapt as much of their contents as he can profitably.

The United States Patent Office is the greatest depository of mechanical information in the World. Over 1,450,000 U. S. patents have been issued and even a greater number of foreign patents have been issued as well. All of these patents are classified or indexed by the U. S. Patent Office so that the patents on any particular line of invention for doing the same work can be had at a moderate cost, much smaller than the cost of the experimental work which they may make unnecessary. The more complex the invention the more urgent the need of all this advance infor-

mation. Frequently the desired patents can be ordered by sub-classes but where the classification of the Patent Office does not fit the particular requirement a search through a number of classes and sub-classes may be necessary to separate the wheat from the chaff and get the patents desired. The Patent Office prints a classification book giving the names of the classes and sub-classes, a copy of which can be had for a small charge and this book will greatly facilitate the selection of the patents desired. The number of patents in sub-classes differs very greatly but the exact number and cost can be obtained from the Commissioner of Patents. Any patent attorney can always give valuable assistance in directing or making the search and getting the information that is desired.

We will assume that the invention has been made and it is now necessary to decide on what shall be done to protect it.

Trade Secrets.

The invention can always be patented if it is new, but frequently it is desirable not to patent it but hold the invention as a trade secret. A great many important inventions are not patented but are kept as trade-secrets. A composition of matter can be kept as a trade-secret for even though the product is disclosed to the public it may be impossible for the public to detect its ingredients and still more difficult to discover the process or apparatus by which it was made, so that compositions of matter which are sold to the public and processes and machinery which are not sold to the public, but the product of which is sold to the public, can be kept as trade secrets.

Photographic films which are used in cameras and moving picture machines are a good illustration of a trade secret. Neither the process by which they are made nor the product is protected by patents. The composition of them can only be guessed at by the chemist even if he has the film before him for analysis. He may accurately determine the elements of the composition, but the condition in which the elements must exist in the film before exposure to light is quite another matter. The secrets of the processes of the various manufacturers of these films are very carefully guarded. The various steps of the processes are divided among a number of chemists or groups of chemists each of whom is rigidly confined to his own department and excluded from all others. They never come in contact with each other and are forbidden to communicate with each other. All such employees are classed as confidential employees who have received confidential communications in trust and they are bound to respect the trust which is imposed in them. Any violation of the trust is a fraud that can be enjoined. The courts will protect the owners of the secrets by compelling the confidential employees and all others to respect the secrets. The courts will always act to suppress a fraudulent invasion of the secret.

A few instances of such protection by court action will be noted here.

Many years ago the Eastman Kodak Co. employed a chemist by the name of Reichenbach. This chemist left their employ and set up in business for himself. He advertised and offered for sale photographic printing papers that he claimed were made by the same processes that were used by the Eastman Kodak Co. The Eastman Kodak Co. obtained an injunction against him which prevented him from using the information involved in the making of the paper because it was a trade secret communicated to him as a confidential employee (79 Hun N. Y. 183).

The Thum Co. makes sticky fly paper which consists of paper coated with a particular kind of dope. The dope and the machinery for coating it were trade secrets which were known to a confidential employee by the name of Tloczynski. This employee left the company and some months

later wrote the company stating that certain parties had offered him employment at an attractive salary if he would give them the benefit of his experience in the manufacture of sticky fly paper and he refused the offer. Then these same parties made a still better offer which he said he could not afford to decline. Still, however, if the Thum Co. would pay him he would decline the offer and keep secret the machinery, etc., of the Thum Co. The Thum Co. did not pay him, neither did he disclose the secrets, because the Thum Co. promptly sued out an injunction restraining him from disclosing the trade-secrets that were disclosed to him in confidence. 114 Mich. 149.

In Vulcan Detinning Cc. vs. American Can Co., 72 N. J. Equity Reports 387; 75 ditto 542 and 80 ditto 443, the Vulcan Detinning Co. had been using a secret process for recovering the tin coating from old tin cans. This process was disclosed to the American Can Co. by confidential employees of the Vulcan Detinning Co. After considerable use by the defendant without knowledge of the fraud involved or intent to defraud, the Vulcan Detinning Co. notified the defendant of the fraud and sued for an injunction and an accounting of the profits. It was awarded the injunction and finally secured on the accounting an award of $677,352.18 plus a large additional amount of interest for the use of the invention after the suit had begun.

The foregoing decisions show the protection which the courts will give to trade secrets so that they should always be considered in the policy of any manufacturer. If the public discovers the secret legitimately the use cannot be interfered with by the original manufacturer. To guard against this possibility it is sometimes desirable for the manufacturer to file an application for a patent on his trade secret but such application must be filed within less than two years from the time the use of it began in secret for commercial purposes, for otherwise, a valid patent could not issue on the application.

The secret use of an invention for commercial purposes, that is for a profit, is a public use within the meaning of the Patent Law and will make void a patent issued on an application filed more than two years after such use began. It is, therefore, desirable to file the application for a patent within two years from the time the use began and keep the application pending as long as possible. Such an application can easily be kept pending for five years or even longer and if during that time the public has discovered the secret legitimately and is competing the patent can be issued and the competing use can be stopped. But if the secret remains intact then it would be better to abandon the application rather than have the patent issue, for the patent would disclose the secret to the public and make it public property 17 years thereafter.

If the manufacturer has concluded to patent his invention he must file an application for patent thereon promptly and prosecute it vigorously to secure the broadest possible claims, in fact, all of the claims that are allowable and should give his attorney all the assistance he can give in defining the scope of the invention and securing adequate claims thereon. Ordinarily these details are easily taken care of, and need not be described at any length here.

Inventor and Employer.

Inventions are frequently made by an inventor when he is in the employ of another and it frequently becomes a debatable question as to who the inventor actually is. If A sees the need of securing a certain result and employs B to invent a machine that will produce the result B is the inventor if he actually made the invention and A is not the inventor

unless he disclosed at the outset to B the general plan of the machine in a complete and operative disclosure. If having done this B embodies the disclosure in a machine and makes improvements on it incidental to the original disclosure by A the whole machine including the improvements belongs to A as the inventor and may be patented by him as his own invention. Frequently two inventors work together to make an invention and if the invention is the joint product of the two of them it is patentable to them as joint inventors. If one merely furnishes the money and another makes the invention, that does not make them joint inventors. It is not necessary that both parties join in the filing of an application so that they can jointly own the patent. In each case the application must be executed and filed by the inventor and he can then assign the application or any part of it to another by a deed of assignment that must be recorded in the Patent Office. In this way the inventor can associate with him one or more other persons. Until the inventor executes an assignment the application and patent thereon belongs to him. Frequently the employer may have an interest in the invention either by a written agreement or by an implied agreement. If the inventor works for an employer and signs a written contract to assign to the employer all the inventions he may make during his employment, then the employer is entitled to the patent on the invention and the inventor must execute all papers needed to secure this result. A Court of Equity will enforce the contract to this extent. Such contracts are frequently contained in the printed form that employees are required to sign when they apply for work, and by using it in the application blank employers can profit very well by the genius of their workmen. On the other hand, the employee should be careful to examine the papers that he signs if he wishes to keep a claim on future inventions. If the employer wishes to keep the invention as a trade secret the inventor must respect his wishes.

If there is no written agreement there may be an implied agreement as follows: If the inventor makes the invention using his employer's time and materials and during his employment sees his employer put the invention to use in his business or make preparations to make or sell the invention and makes no objection then the employer is said to take a license or a shop right to use the invention in his business and the employee is estopped later on from denying this right in the employer. He should have asserted his exclusive right to the invention as soon as it was completed and before the employer began to use it. Having acquiesced in the use he cannot later on interfere with the use of it by the employer.

But the employer cannot assign this implied license to another. When his business comes to an end the license ends as well, and if the inventor has patented the invention he then has the exclusive use of it. A written license is not assignable unless the writing so provides.

If the inventor is specially employed at specified pay to make a particular invention the invention when made and the patent thereon belong to the employer even though the contract under which the inventor was working said nothing about the title of the patent. This was held February 18th, 1924, by the United States Supreme Court in the case of Standard Parts Company vs. Peck. In this case Peck was employed by the Hess Company under a written contract to invent a process and machinery to make the front spring for the Ford automobile. The Hess Company afterward sold the business and good-will to the Standard Parts Company as its successor in business. Peck then sued the Standard Parts Company for infringement of his patent. Under these circumstances the court held that the assignee was entitled to own the patent and Peck had no cause of action on that account.

The employer would not be entitled to the patent where the inventor was generally employed and where the making of the invention was merely incidental to his general employment. Such was the case in Dalzell vs. Dueber, 149 U. S. 315, where the same court held that when a skilled workman was employed generally to make improvements the patents on the inventions belong to the inventor in the absence of a special contract to assign. In the Peck case the Court made no reference to its previous decision in the Dalzell case.

In both of these cases the inventor sued for infringement and the suits were necessarily brought in the Federal Court under the patent law. If the manufacturer, however, had sued the inventor to compel him to assign the patent the suit would have been to enforce an alleged contract right and would not have been a suit under the patent laws. In such case the suit would have been tried in a State Court unless because of diversity of citizenship of the parties the Federal Court could take jurisdiction.

In the absence of a contract to assign the inventor is not bound to assign even if he is an officer of the company. Frequently it is to his interest to assign but if this is doubtful he can always protect his interest by including in the assignment a clause: "This assignment is subject to the following conditions, etc." and in this clause he can include any conditions that he may choose to name. If the invention is of sufficient importance he need have little fear but what the conditions will be accepted and lived up to, especially if the clause further provides: "Failure to observe these conditions will operate as a cancellation of the assignment and the inventor may on ten days' notice demand and shall receive the return of the patent and the cancellation of all rights thereunder." The inventor should stand his ground in spite of all pressure. The tendency of capital is to absorb inventions and patents and pay little or nothing for them. To this policy the rapid accumulation of capital in manufacturing is largely due. The man who makes a success of a business venture is entitled to all the profit he makes out of it, but it too frequently happens that the inventor is lost sight of and the profits are wholly absorbed by the exploiter and the salesman.

There is no doubt but that the manufacturer makes off of the inventor many times over what he loses on strikes and other labor troubles, but the inventor does not have a remedy that compares with the strike of the labor union for efficiency. Labor unions are hostile to inventions. The inventor does not share in the benefit of strikes. Yet inventions have steadily improved the conditions and wages of labor without adequate return to the inventor.

This is an economic wrong. More will be said about this under the head of Blue Sky Promises.

Frequently it is desirable for the inventor to hold his patent and grant a written license thereunder. In such case it is always desirable, first, to get the advice of a patent attorney or other attorney who has had experience in making such contracts; and second, it is equally desirable never to sign a contract the same day that it is prepared. No license should be given under a patent unless it specifies a certain amount of annual royalty to be paid as a minimum with the further provision that the inventor or owner may cancel the license if this provision is not lived up to. A license carelessly drawn can convey rights in such a way as to completely destroy the value of a patent to its owner.

Sometimes it is desirable for the inventor to sell a part interest in the patent. In such case the joint owners should agree to act for their mutual interests by a clause in the assignment as follows, or its equivalent:

"The parties hereto agree that neither will assign their interest or any right thereunder without the written consent of the others and that each party will account to the others for a reasonable share of any profits made from the independent manufacture of the invention."

Specification Writing.

The engineer is frequently called upon to write a specification. Almost any patent will give him a model which he can profitably follow in writing specifications for many purposes. If it is necessary for him to describe a machine he will always find it a good rule to begin his description of the machine at the point where the power is applied to the machine and trace out each application of power in the various parts of the machine to the work to be done. In this way he will find that the description of a very complicated machine will become a comparatively simple matter. Patent specifications ordinarily do not describe materials and sizes of parts, but these additions can readily be made to the models furnished by the specifications of patents as circumstances may require.

Interference.

The more valuable the invention the more apt it is to be claimed by two or more inventors each of whom has filed an application. In such case all of the applications are put into interference as has been described above in connection with the Morse patent on the cyclone dust collector. In such case the inventor or manufacturer must be able to furnish a complete history of the development of the invention sufficiently proven by the inventor and one or more disinterested witnesses. To this end all sketches and drawings of the invention should be dated and signed when made and witnessed and should be carefully preserved. It is customary in shops to date both the drawings and tracings and it is also customary for the name of the draftsman to appear on the drawing. All this helps in proving the history of the invention and in proving the priority of the applicant over his competitors in the Patent Office. Other shop records should be kept, as well, consisting of photographs, models, experimental parts, etc., for these will be of service in proving the case.

The patent will be issued not necessarily to the first inventor but to the one who proves that he is the first inventor by the proofs he files in the Patent Office. It is, therefore, necessary to make the proofs as complete as possible. In all interferences the senior party is the inventor who filed his application first and the junior party is the inventor who filed his application last. The junior party to have any standing in the interference must show convincingly that he made the invention before the senior party filed his application and if he fails to do this judgment will be given in favor of the senior party on the record date of his application as filed in the Patent Office without any additional proofs being taken by the senior party. The Patent Office always regards the filing of an allowable application as a constructive reduction to practice and gives it the date on which it was filed in the Patent Office. The application is regarded as the equivalent of an actual reduction to practice. For a later inventor to overcome this he must prove an earlier date of conception and disclosure of the invention and an earlier date of actual reduction to practice or he must prove diligence on his own part from the time of the disclosure of the invention to the time he reduced it to practice.

In proving a reduction to practice the inventor must prove not only that he made or built the invention full size and of the usual materials, but he must also prove that he tested it by actual trial in the usual way and showed that it would work and did work. In such case the burden of proof will be shifted to the senior party who can then prove a still earlier conception ond disclosure, etc., if possible, in which case priority will be awarded to him. To prevent false swearing each party is required to file an affidavit in the Patent Office stating the dates of conception, disclosure, drawings, reduction to practice and extent of use of his invention. This affidavit is called a preliminary statement and must be filed within thirty days after the interference is declared. The inventor is barred from proving in his testimony any dates earlier than those set forth in his preliminary statement and this preliminary statement must be furnished to the Patent Office before he is allowed any information as to the filing date or the subject matter of the applications of his competitors.

It, therefore, is very desirable for the inventor to be diligent in reducing his invention to practice or in filing his application or in doing both of these things, and it is equally desirable for him to keep ample records that will enable him to prove the history of the development of his invention.

After all preliminary steps have been disposed of the parties are allowed to get copies of each other's application papers and times are set for taking testimony thirty days being usually allowed each party for this purpose.

The junior party must take his testimony first and the senior party takes his testimony last and need not take any testimony at all unless the showing made by the other party or parties makes it necessary. In passing on the proofs and deciding who is the first inventor the Patent Office follows three rules that may be stated as follows:

1. The first to conceive and the first to reduce to practice is the first inventor.

2. The first to conceive and the last to reduce to practice is the first inventor if he was diligent in reducing to practice from the time his competitor entered the field.

3. The last to conceive and the first to reduce to practice is the first inventor if he was diligent throughout in the absence of diligence on the part of the first to conceive from the time the later party entered the field.

Interferences are usually between pending applications but they are sometimes between a pending application and an original patent or a reissue patent.

Sometimes the Patent Office by mistake issues a patent when it should have withheld the patent and put the application in interference with another pending application. This mistake sometimes occurs but the patent gains no advantage thereby. It is put into interference and a patent is issued to another applicant if he proves his priority. Unfortunately the Patent Office has no authority to revoke the patent that was issued by mistake.

If the first inventor delays filing his application until after a patent has issued to another, he is at a big disadvantage for he must then prove his priority and diligence beyond all reasonable doubt. In Mason vs. Hepburn, 1898 C. D. 510, 84 O. G. 147, Hepburn took out a patent on a gun clip on Sept. 11, 1894. Mason applied for a patent on December 31, 1894, and proved that he made a clip and put it on a gun and tested it out satisfactorily in 1887. He then stored it away in a model room where it was kept until Hepburn took out his patent. The gun and clip were

never made public and no one ever saw it except the inventor and a few employees of the Winchester Repeating Arms Co. Under these circumstances the Court of Appeals of the District of Columbia held that Mason had abandoned the invention and awarded priority to Hepburn. This decision has been cited with approval in 122 patent cases.

Manufacturing.

The invention is a gift to the public when the patent on it expires. It sometimes becomes a gift from the date of the disclosure. If the invention never goes into use the public is not harmed by the issue of the patent. In such case the patent shows a latent resource of no apparent value. Changed conditions may make it an active resource of great value. Many inventors are ahead of the times like Janney was with his car coupler. The hope of gain stimulates nearly all of us but many inventors are disappointed. Few inventors are good business men and capitalists. The combination of a good patent on a popular product with money and brains to push it is hard to beat for a business success. This combination seldom exists in the inventor alone. Inventions need capital the same as any other enterprise, but capital is exacting. It always demands control and usually gets it. On the other hand capital needs an enterprise and in normal times there is always a surplus that is always looking for enterprises. The inventor that knows how to raise money for the manufacture and marketing of an invention is doubly gifted. Such was Westinghouse with his air brake patents and Ford with his patents on an auto engine with the electric generator in the fly wheel. Next to such an inventor is the one that knows how to use the services of others in raising money. The inventor need not look to one man for his capital. Big sums are raised daily from many small investors and more easily than from one or several big investors. The inventor is more apt to keep control and raise his money with less expense if he deals with many small investors than with large ones. If the inventor must pay more than 15% for raising his money there is something wrong with his business ability or with his enterprise. He should start by writing a prospectus that makes a fair statement of the enterprise, its assets, its probable earnings, expenses and profits, carefully avoiding any statements that are not true. He should then make a plan of incorporation without incorporating. (He may find that he must change this plan before he can make headway in selling his stock). He should then get subscriptions to his stock, the subscriptions to become binding as soon as a stated amount of stock is sold. After this is done the corporation can be organized and the money paid in and the stock issued. Many an inventor has incorporated a company, transferred his patent to it, given a large share of the stock to a promoter on his promise to raise money only to find later, that the promise was worthless. Later he might see the patent sold to pay the expense of incorporating or for some other reason. It would then pass into other hands who would use better judgment in promoting it. The inventor can always get good business advice in financing and promoting an invention from lawyers, business men, or bankers and he should get advice as much as possible. It is worth more before he makes mistakes than after. Many books have been written on the subject. These can be found in most libraries. Cooper on Financing an Enterprise, in 3 small volumes, is one that is well worth reading. Many inventions do not warrant the maintenance of a separate manufacturing plant. In such case the inventor must choose between licensing another to manufacture and having the invention made by contract.

Giving a half interest to another for the cost of taking out the patent with the expectation that he will finance the making and selling

of the invention is bad business for the inventor as he is apt to be disappointed in his expectations. The inventor should estimate the value of his invention and patent and should insist on his backer putting in an equal amount or a liberal part of it for the half interest.

If they are made by contract he must have a correct sample to follow and let the contract on a flat price with a time limit and a penalty agreed on for delay in delivery.

Selling a Patent.

After his patent issues the inventor will receive many offers from persons who claim to be able to sell his patent. All of these will want an advance fee. The inventor should not advance money to any such agent until he is satisfied that the agent has made and can make sales. To this end he should ask the agent for the numbers of the last five patents that he has sold, the name and address of both the buyer and seller and the selling price.

The average inventor should make a better salesman of his patent than a hired agent can possibly be. He knows what it will do and knows the demand. Thomas Register published in New York will give him a list of manufacturers in the particular line or lines nearest to his invention. Every large manufacturer or dealer has this directory and it can be seen at many libraries. He can buy ten copies of his patent from the Commissioner of Patents for a dollar and he can send these to various manufacturers and thereby make a sale if a sale can be made.

Expert Witnesses.

Engineers are frequently called upon to testify as expert witnesses. Their function is to inform the court by giving their opinion on a given state of facts. An expert must show that he is competent to testify as an expert. If he is a graduate of an engineering or technical school and has followed his profession actively since graduation a statement of those facts will be sufficient proof of his qualifications. The expert witness must stick to his facts and give no opinion unless it is based on the facts and unless he can give a good and sufficient reason therefor. He should closely adhere to the maxim "Every oath ought to be founded on certain knowledge" and if he does this he need have no fear of cross examination. Experts frequently become partisans and when this is apparent from their testimony the value of their testimony is impaired thereby. The extremes to which experts can go and the bad impression which they make on the court as well set forth in the decision, at 140 F. R., at 167. All this must be avoided.

Patent Litigation.

Patent suits can be brought as suits at law in which case they would be tried before a jury or they can be brought as suits in equity in which case there is no jury and the case will be tried by the judge. Nearly all patent suits are suits in equity, for many reasons, principal among which is that if the plaintiff wins the court will issue an injunction stopping further infringement. Another reason is that a judge is more apt to understand the merits of the case than is a jury.

In patent cases the courts make three classes of decisions:

1st. The patent or claim is valid and infringed.
2nd. The patent or claim is valid and not infringed.
3rd. The patent or claim is void and is therefore not infringed.

The third class of these decisions is most satisfactory to the public if they are interested only in piracy.

All three classes of decisions may be entered against the claims of a single patent. That is to say, in a single patent one claim may be held valid and infringed, another claim may be held valid and not infringed and still another claim may be held invalid.

It is necessary, therefore, to make not only broad claims in a patent but narrow and specific claims as well to secure the best chance of success in suing for infringement. It frequently happens that the broad claim is declared invalid and the narrow claim is held valid, and if the narrow claim is held to be infringed it has served the same purpose as could have been attained by a broad valid claim. Hence all inventions should be covered broadly and specifically and in the intermediate degrees as well to get the best results in litigating the patent.

A tabulated statement showing the results of the infringement suits brought on patents issued in seven years as follows: 1889, 1890, 1891, 1892, 1900, 1901, 1902 is given below.

The patents issued in these years have all expired and no more infringement suits will be brought on these patents. The data compiled on the patents of these seven years is as complete as it can be made. This data is tabulated from Underwood's list of adjudicated patents. It is probably true that many infringement suits have been prosecuted to a decree that are not found in the printed reports because the court did not make a decision giving its reasons at length. It is believed that in most of these cases the court held the patent void. This must be kept in mind when considering the figures given below as it will probably increase the number of suits decided by declaring the patent void more than the number of suits decided in either of the other ways. It is also believed that for every suit prosecuted to a final hearing and decree there will be found to have been from three to five suits dismissed for want of prosecution or settled without going to trial.

Year	Infringed	Not Infringed	Void	Patents Issued
1889	60	44	36	23,360
1890	49	55	34	25,322
1891	51	39	47	22,328
1892	44	44	41	22,661
1900	59	45	39	24,660
1901	65	57	48	25,558
1902	57	32	43	27,136
	385	316	288	171,025

In the patents issued in these seven years there is a total of 989 patents passed on in reported decision. In 385 of these cases the patents were held to be valid and infringed and in 316 the patents were held to be valid but not infringed and in 288 the patents were held to be void. It is believed that the unreported cases will bring the number of patents held void up to or even greater in number than the patents held valid and infringed.

Blue Sky Promises.

In any war the government needs the best equipment to fight with that it can get. The Monitor saved a critical situation in the Civil War. The "Y" Gun, the depth bomb, the tank, and many other inventions appeared during the late war and were priceless contributions by inventors. All honor to their inventors. They are entitled to the best treatment at the hands of the government. They should have been rewarded promptly and liberally but have they been rewarded or have they been put off with Blue Sky promises. Let us see how fair and honest the government has been with inventors.

In 1844 Ericsson made the inventions and furnished the plans for the Steam Frigate Princeton that made her the best warship of her time. He also superintended its construction. His inventions included the improvements that placed the boilers and engines below the water line and gave forced draft to the boilers and provided the ship with a screw propeller and provided guns that were reinforced with hoops around the breech that made it possible to use heavier charges and get higher pressure, greater velocity and longer range. He improved the gun carriage and spirit level which gave more rapid and more accurate training of the guns. His bill for this work was over $15,000 and it should have been paid at once on the completion of the vessel. The Navy Department, however, refused to pay it because of the opposition of one captain and then Congress refused to pay it. The Court of Claims finally gave him judgment 12 years later but Congress never paid the judgment.

This experience well nigh ruined Ericsson and when the Civil War started Ericsson's experience would naturally have prompted him to let government work alone and to that extent at least he could have followed the example of the Pied Piper of Hamlin for Ericsson was born and raised in Sweden, but he built the Monitor and it whipped the Virginia, before the Monitor was paid for. The Monitor was the most valuable contribution ever made by an inventor to the needs of any government and it was made in a desperate crisis in the Civil War by a man who had had a grievance against the government for 18 years past. It is hardly to be expected that all inventors will be so generous to a government that has treated them once unfairly. The government sent Ericsson's body home to Sweden on a Man of War after the death of that great inventor but Congress has never paid the judgment of the Court of Claims. In this way the United States handed a large piece of Blue Sky to one of its greatest benefactors and every employee of the government since then has been encouraged to treat later inventors in the same shabby way.

At the end of the Civil War the government was well nigh bankrupt and avoided the payment of claims of every sort and it is quite probable that the inventors of the Civil War suffered with all other claimants. Of this no complaint should be made as long as all claimants were treated alike.

During the late war the Acts of October 6th, 1917, were passed one of which declares in its title that it was intended "to stimulate invention and provide adequate protection to owners of patents." The Acts by implication at least were intended to encourage the making of inventions that would help to win the war and encourage the filing of applications thereon in the U. S. Patent Office, where the invention would only be accessible to the confidential agents of the government. The Acts authorized the Commissioner of Patents and the President to order the inventors to keep the inventions secret if it appeared that the inventions could be used by our government to help win the war or if it could be used against us if it fell into the hands of the enemy. The Acts also authorized the

Commissioner of Patents and the President to withhold the issuing of tne patent until the end of the war. 2100 applications for patents were made subject to such orders by the Commissioner of Patents as appears from the report of the Commissioner of Patents, for the year ending December 31, 1918. It is quite probable that at least 200 of these inventions were used by or for the government in connection with the war. The inventors of all such inventions are entitled to ample compensation. None of these inventors have yet been paid up to the end of 1923 and the fault for this lies with Congress which failed to provide for the settlement of claims of inventors in the same way as other claimants were settled with, namely, by the department having knowledge of the use of the invention and of the liability of the Government and having possession of records bearing on the claim. Contrast this neglect of inventors with the treatment of other claimants.

At the end of the war all contracts were suspended and the Dent Act was passed in haste to protect the contractors against loss and give them a prompt settlement. This Act directed the Secretary of War to settle with the contractors at once and gave him ample funds with which to make the settlement. After the claim was filed, the War Department took the initiative in the handling of the claim, gave the claimants liberal assistance and put them to but little expense and made prompt settlement with them. Most of the contractors were settled with in two years under this act.

In all 31417 claims were filed based on formal and informal contracts. The informal contracts were those that had not been executed in the manner prescribed by law. Of these 5315 were denied or withdrawn and 26102 were settled. 17814 formal contracts and 8288 informal contracts were settled for the amounts offered by the War Department Claims Board. The value of the suspended portions of the formal contracts was about $1,869,669,953.96. That is, the Government would have paid this amount if the contracts had been fully carried out. The government paid $247,676,034.55 for the cancellation of these contracts. The value of the suspended portions of the informal contracts was $1,946,342,-776.38, for the cancellation of which the Government paid $257,614,908.59. The total value of the suspended contracts (both formal and informal) was $3,816,012,730.34 and these were settled for $505,290,943.14, which is believed to pay for all work done and expense incurred and protect the contractors from all possible loss that could properly be charged to the Government. This settlement was at the rate of 13.24% of the amount that was or might have been claimed if the contracts had been fully carried out. Apparently none of these awards were appealed. Of the claims denied about 400 claims were taken to the Court of Claims and up to January 25, 1924, 48 of these claims had been passed on by the Court. Of these 23 were again denied and 25 were allowed with judgments totaling about $1,900,000.00

There was no Blue Sky about the Dent Act or the settlements under it

Congress treated the railroads in the same liberal way. During the War the railroads were taken over by the Government. They were promptly and fully paid for their current use by the Government and in due time were turned back to their owners. The railroads then filed claims with the Director General and the Railroad administration for unpaid use, maintenance, repairs, renewals, retirements, depreciation, material, supplies and money belonging to the carrier and taken by the government.

The total amount of claims filed was $1,014,397,446.72. These were voluntarily reduced to $769,974,783.25, of which up to December 31, 1923, $763,106,521.24 had been settled by the payment of $242,828,947.42, or

over 31.5% of the amount finally claimed. The claimants spent very little for attorney's help.

The report of the Director General of January 3rd, 1924, (House doc. 148) states that "this liquidation now so nearly completed has been made without litigation" which is believed to mean that no railroad has appealed to the Court of Claims.

No Blue Sky to the railroads.

The ratio of the amount awarded by the Railroad Administration to the amount claimed is very high as compared with the ratio of the amount awarded by the U. S. Court of Claims and the Court of Claims of the State of New York to the amount claimed in those courts as will now be seen.

In 12 years from 1911 to 1922 the U. S. Court of Claims disposed of general jurisdiction claims amounting to $309,633,155.48 and awarded the claimants $10,349,269.78 or about 3.34% of the amount claimed.

In the 6 years from 1916 to 1921 inclusive the Court of Claims of the State of New York disposed of claims amounting to $112,896,013.10 and allowed $14,454,474.44 or over 12.8% of the amount claimed. In the same 6 years the U. S. Court of Claims disposed of claims amounting to $155,758,999.43 and allowed $6,314,547.83 or over 4.05% of the amount claimed.

In the U. S. Court of Claims the record of the amounts claimed by the successful claimants is available for eight years and in those eight years the claimants were allowed $7,755,840.10 out of $29,419,268.50 claimed by those same claimants or about 26.4% of the amount claimed.

The figures by years are as follows:

U. S. COURT OF CLAIMS.

Year	Amt. Claimed	Judgments for Claimants	Amt. claimed by successful claimants
1911	2,689,449.50	457,695.06	879,658.79
1912	66,243,846.38	618,762.29	1,987,841.93
1913	12,328,713.74	279,614.45	
1914	27,559,531.28	306,083.83	
1915	7,224,815.62	390,122.09	1,213,313.70
1916	12,755,809.98	1,206,485.77	4,521,579.61
1917	16,900,874.71	1,271,665.89	2,566,887.93
1918	55,398,070.55	1,120,491.10	
1919	26,019,362.91	637,999.81	1,699,176.89
1920	15,838,194.67	1,190,670.96	4,084,712.41
1921	28,837,686.61	887,234.30	
1922	37,836,799.53	1,982,444.23	13,966,097.24
	309,633,155.48	10,349,269.78	29,419,268.50

NEW YORK STATE COURT OF CLAIMS.

1916	15,465,598.46	3,983,369.98	
1917	13,869,960.21	1,946,625.66	
1918	42,124,587.95	1,898,550.69	9,879,941.36
1919	15,935,095.12	1,856,163.02	
1920	11,839,570.48	1,678,696.35	
1921	13,661,200.88	3,091,068.74	
	112,896,013.10	14,454,474.44	9,879,941.36

The figures above quoted or on which the above estimates are based are taken from the annual reports of the Attorney General of the United States and of the State of New York. For over 5 years from April 8th, 1918, no claim based on a patent was allowed by the U. S. Court of Claims and in the year of 1922 alone 9 claims against the government were dismissed by the Court, all of which claims were based on patents. It is hard to get money out of the Government on any claim and it is quite probable that most of the inventors whose inventions were used by the Government during the late war will not even try to collect.

In prosecuting a suit before the Court of Claims the law does not give the inventor any right to get information directly from the War or Navy Department in support of his claim and the regulations of these departments forbid any person in the military or naval service to give any claimant any information in support of his claim.

Regulation 824 of the War Department reads as follows:

> "No information will be furnished by any person in the military service which can be made the basis of a claim against the Government, except it be given as the regulations prescribed to the proper officers of the War, Treasury, or Interior Departments, or the Department of Justice."

The practical result of this regulation is to force every claimant to make a motion in the Court of Claims for papers and information after he has brought suit, or go without. He must know what papers to ask for without being permitted to see them. He will get no help from the War or Navy Departments that will aid him in presenting his motion.

The officers that mean to be fair are thus muzzled. All others can fight the claims without limit. The visible attitude of the Departments is therefore hostile or indifferent.

The owner of any tangible property knows when it is taken by the Government and knows the amount and value of it and needs no information from the departments on which to base a claim. But the Government sells nothing and an invention can be used by the Government without the inventor's knowledge and unless the inventor can get some evidence outside of the Department he cannot bring a suit and ask for pay, nor can he know what additional evidence to ask for, if he has secured enough evidence to warrant the start of a suit. Attorneys generally admit that in most cases the only way to get evidence of infringement by the Government before suit is to get it from discharged employees of the Government. This probably makes it harder for inventors to collect than for any other class of claimants.

The policy of the government has been to take the invention, use it without pay and then aggravate and humiliate the inventor when he tries to collect.

All this violates the fifth amendment directly or by implication, yet every employee or officer of the Government is sworn to support the constitution including the fifth amendment.

Practically all records of state and local governments are public records. This is especially true in New York State, but the records of the War and Navy Department are not public. No order of court is needed by a claimant to get papers or information from any department in the State of New York but an order of the U. S. Court of Claims is needed by a claimant to get any information from the War or Navy Departments but such an order is not needed by the Department of Justice. All this causes vexation, delay and expense to the claimants and probably defeats most patent claims in advance, but the Government is sovereign and can not be sued without its consent and then only in the way it consents to be sued. The Court is without jurisdiction except as Congress provides by

law for while the Constitution is the supreme law of the land the fifth amendment is not self-executing and can only operate as the laws of Congress permit. In this way the Sovereignty of the government is maintained and even rubbed in as the experience of many inventor claimants will bear witness.

During the War, twelve Acts were passed authorizing the Government to take property of various kinds and pay a fair compensation therefore. This payment of compensation had to be made by the Executive Department that took the property and was made without expense to the claimant and was made at once. If the claimant was not satisfied he could take 75% of the award and sue in the Court of Claims for the balance of what he was entitled to. No Blue Sky about this.

Several Indian Acts recently passed provided that the department shall give the claimants all records, documents and evidence that they may need to prove their claim in the Court of Claims. No Blue Sky to the red men.

But no such accommodations have been given to inventors or those claiming on patents. No Department is authorized to offer them a settlement. Only in the Interior Department are the records made public by law so that there only can the inventor get at the records to obtain evidence in support of his claim. Most inventions are used by the War and Navy Departments so that the records of the Interior Department do but little good.

If the settlement of claims and the payment of them direct by the Department is a good thing for the railroads and contractors, etc., it would be equally good for the inventors, and the law should so provide and should only require inventors to resort to the Court of Claims when the departments failed to make a fair settlement. This would require the department to assume a just attitude and would deter the department from assuming the hostile attitude which the present practice encourages.

During the war much radio apparatus was used by the Government. Most of this was patented and much was not patented until later. Twenty-five owners of these patents filed claims in the War Department. Members of the War Department, Navy Department and Department of Justice came together under the name of Interdepartmental Board and sifted these claims and recognized 24 of them based on 209 patents. These patents were finally reduced to 149 of which 27 were admitted to be of substantial value. They induced 20 of these claimants to agree to accept a compromise of a total of $2,500,000.00 divided among them according to their merits, this being only a fraction of the total amount claimed. They reported this to Congress and asked for an appropriation with which to make the settlement. A hearing was had before the House Committee on military affairs May 23, 1921. At that hearing Commander Loftin speaking about the difficulty of settling the claims on these radio patents said:

> "I predict that under our judicial system, and with the extreme difficulty in presenting patent cases, that the task could not have been covered in the courts in 25 years, in the same comprehensive but centralized method of the board." (P. 15 of printed report of Hearing.)
>
> "The Government has no too good reputation as to its relation to inventors." (P. 17.)

Mr. Curtiss for the Department of Justice said:

> "It would cost the Department of Justice probably no less than $500,000.00 in Counsel fees, expert fees, and other expenses to fight through the Courts these various claims that this board has succeeded in getting to this point of settlement." (P. 49.)

The House Committee vetoed the bill and put these claimants to their remedy by suit in the Court of Claims. Very few of these radio inventors have sued in the Court of Claims and it is safe to say that most of them will not even try to collect. The incident shows what the Government owes to inventors in a single field of invention and indicates what the Government must owe to other inventors in many other fields of invention. It also shows what can and must be done by the departments to secure justice to the inventors, and how helpless inventors are without the help of the department in presenting their claims.

How much insurance of any kind could be sold if the agent had to make similar admissions on the cost and difficulty of collecting on insurance claims. Insurance companies owe their existence to the fact that on their own motion they make prompt and fair settlements on claims. The Workmen's Compensation Acts were passed to give justice to the workers and did it by putting the obligation on the executive officers of the department to make settlements in all cases and make them promptly. Under these acts the workers are receiving twenty times as much each year in settlements for injury as they ever received before. The workers would never consent to go back to the old Common Law practice of suits for damages, because that practice was a failure. It meant endless and wasteful suits in court for compensation with all of the uncertainties of litigation. Against this workmen are now protected. Why is not genius entitled to the same protection?

The printed docket of the U. S. Court of Claims of December, 1923, shows that on November 1st, 1923, there were over 1500 suits of all kinds pending on the docket of which but 49 were Patent suits, yet the Government used the inventions of probably 500 patents issued or suppressed during the war. Less than 10% of the claims based on the use of patented inventions have been sued on and nearly all the balance will be outlawed by June, 1925. Nine of these suits are based on patents on radio apparatus four of which suits were filed after May, 1921. Yet the War and Navy Departments admit the use of many times that number of patented inventions on radio, as above pointed out. The docket also shows that 19 patent suits were filed before the end of 1920 and are still pending out of 79 suits of all kinds that were filed before the end of 1920 and are still pending. From this it would appear that patent suits (unless dismissed) are disposed of more slowly than any other class of suits pending in the Court of Claims which is another way of saying that even if successful, the inventor must wait longer for his pay than any other class of claimants. On September 16, 1909, President Taft said at Chicago as follows:

> "On the civil side of the Courts there is undue delay and this always works for the benefit of the man with the longest purse."

Yet the Attorney General who defends all these suits for the Government made a public statement about these patent claims that was printed in the New York Times of March 15th, 1922, from which the following is quoted:

> "Claims involving a billion and a quarter dollars are now on file. * * * Of this amount $380,000,000.00 arises out of alleged infringement of patents alone. * * * The Government will be lucky if it settles them for as little as 50 cents on the dollars. * * * This financing for the most part, will have to be provided for within another year."

None of these claims have yet been settled.

In United States vs. Societe Anonyme, 224 U. S., 309, the Supreme Court on April 8th, 1921, affirmed a judgment for $136,000.00 in a suit brought January, 1895, for an invention in guns covered by patents 301220 and

331618, the use of which began by the Navy Department in 1884 and the liability for which was admitted in 1894. This delay of 26 or 37 years is extreme. It is only fair to say that later cases were disposed of in much less time. But even these later cases, each running into many years delay, should have been disposed of by the Departments in a fraction of the time that was taken in the Courts. The oldest patent case pending in the Court of Claims in November 1923, was filed in July, 1916, another filed September, 1917, and two more were filed in 1918. Two of these claims call for a total of $6,400,000.00. It is quite probable that the claimants would have accepted a fraction of this amount if it had been offered promptly by the department. Such conditions naturally deter many inventors from suing at all.

Inventors are not organized and cannot maintain a lobby at Washington. Hence they are easy prey for the Government and every one else that wishes to impose on them and are sufficiently organized for the purpose. Contrast this with the square deal of the British government as will now be described.

Promptly after the War the British government appointed a Royal Commission on awards to inventors with instructions to investigate the claims of inventors and make settlement thereon. This commission was appointed on March 19th, 1919, and it finished its work November 14th, 1922. It made two printed reports showing that it had passed on the claims of 227 inventors or owners of patents. 74 of these claims were denied and 153 claims were allowed. Awards were made to inventors of as low as 10 pounds. The highest award was 110,375 pounds, 81 of these awards were for 1,000 pounds or more. The total of these 81 awards was 564,188 pounds or an average of 6,965.28 pounds each. Awards were made to inventors in the government service as well as to inventors in civil life but at a lower rate. The claimants spent very little for attorneys' help. In this way British justice was dealt out to the inventive genius of the country and British inventors will be encouraged to help their country in the next emergency. The British inventors did not get Blue Sky promises but real promises from an honest government and prompt fulfillment of the promises.

During the world war necessity not only mothered invention but in many lines forced it to cover in a few years a normal half century of progress. It did this on promises to inventors that have not been kept. Labor got justice during the war by going on strikes and stopping the productions of munitions until its demands were met. The Government made haste to settle the strikes and even anticipated them. The inventors did their best to speed up the production of munitions and improve their quality and made a big success of both in spite of strikes, but their pay is yet to come and they must go to court to get it. Labor did not go to court, and the Government respects labor, but the Government has but little or no respect for the inventor who must work for the Government on credit and has not been paid as yet although the war has been ended for over five years. Does this country as a business proposition expect similar progress in the next war in spite of this record and why? Military secrets must be kept at all times for the common good. If the Government owes an inventor for the use of his invention, the debt is not of itself a military secret and in most cases does not involve a military secret and can be paid without disclosing any military secret. If it involves a military secret, that does not justify any acts in time of peace that will prevent payment in violation of the fifth amendment. The fifth amendment is part of the supreme law of the land and it must not be violated. The rights of inventors claiming under it must be respected and the inventors

must be paid. To this extent in time of peace the military power of the nation must be subject to the civil power. How can this be done better than to place the obligation for the settlement for the use of the inventions on the department using the invention in the first instance. The Departments can settle for the inventions used and still keep its secrets. This can be done by a board of Patent Experts similar to the Munitions Patent Board that existed in the War Department during the war and for some time thereafter.

This condition warrants an investigation by Congress but it is doubtful if that body can be induced to pay any attention to it. A suggestion was made some months ago to the head of a Senate Committee that a resolution be adopted calling on the Commissioner of Patents for a list of the 2100 inventions that were ordered to be kept secret during the war together with the names and addresses of the inventors and the numbers of their patents or applications and calling on the War and Navy Department for a report showing the extent of use of each of these inventions. The suggestion so far has been without fruit. The writer hopes that others may be more successful.

Until Congress acts most inventors and their inventions will continue to be treated by the Government much like Naboth and his vineyard were treated by his Government. There is no Elijah to rebuke the Government and call it to judgment.

There can be no doubt that a fair settlement with the inventors who helped to win the last war will repay the Government many hundreds of times over when the Government needs the assistance of the inventors in the next war.

Still inventors will continue to help the Government and anticipate its needs on these indefinite promises of pay and will therein show more patriotism than the Government that makes the promise, uses the inventions, and then fights the claims and misrepresents the inventors and neglects to provide a plain, speedy and adequate settlement for the claims and discriminates against the inventors and favors all other classes of claimants at the same time. Citizens owe loyalty to the Government and the Government owes protection and the square deal to its loyal citizens. Without the square deal the American inventors must work at a great disadvantage and it is not strange that they have been rather idle since the war, while foreigners (Germans especially) have taken out large numbers of U. S. Patents on war materials; of these 201 patents pertaining to ordnance were issued between July 1, 1920, and April 20, 1921, and were assigned to Frederick Krupp, Essen, Germany. The issuing of these patents to Germans caused the Secretary of War to send a letter to the President of the Senate under date of April 20th, 1921 (Senate Document No. 6) calling attention to the danger of this and suggesting corrective legislation. If American inventors had been paid for their work done during the war, many of these patents would have been granted to inventors of this country instead of foreign inventors and the country would to that extent have been protected by its own citizens. This antidote has never been suggested by the War Department. The Blue Sky policy is still in force.

Congress has refused to allow any employee of the Government to claim pay for the use of his invention and this does not make the department act any more justly to the inventor on the outside but rather the reverse.

All inventors in the employ of the Government should be paid for the use of their inventions by the Government but at a lower rate than outside inventors can claim. When the millionaires are all willing to pay taxes on their exempted incomes or waive the payment of interest or their government bonds it will be time to think otherwise. The poverty

(?) of the Government can never excuse its failure to pay the inventor and least of all while the idle rich evades the payment of its taxes.

In view of the example set by the Government of pirating inventions and fighting the inventor when he asks for pay, it is not strange that other large users follow the Government's example. When the Government sets the example of the square deal to the inventor, big business generally will follow the example and will deal more justly with the inventor.

It is clear, therefore, that, first, a Munitions Patent Board should be created by law to pass on all claims against the Government based on patents, the chairman of which board should be a patent lawyer from civil life not otherwise connected with the Government; second, War, Department Regulation 824, and the corresponding regulation of the Navy Department, should be abolished so far as claims by inventors are concerned; third, War and Navy Department records should be made accessible to inventor claimants; and fourth, the Judicial Code should be amended to require the Government to plead all of its defences in a patent suit and to furnish a Bill of Particulars when called for, just as a private person is expected to do when defending a suit based on a patent. Inventors and patent attorneys should press on Congress these wholesome amendments to the law.

These changes should be made in the law to secure justice from the Government to the inventor. After they have been made and put into working order the law should be further changed to help the inventor, especially in all cases where the invention is used in secret by big business and where it is difficult to get evidence of an infringement or the invasion of a trade secret. The Government should enforce patents under some circumstances in a ministerial way and not merely in a judicial way. The foregoing suggestions are a beginning in this direction.

The author will be glad to receive reports or complaints from inventors and owners of patents who have been treated unfairly by the government. The report should make a plain statement of the facts. Give the number of the patent, the nature of the invention and the use of it, or the reasons for believing that it has been used by the government. When sufficient reports are received he will present them to Congress.

Trade-Marks.

In many well established businesses the trade-mark has grown to be more valuable than any patent could be to the business. A few well known trade-marks will be considered.

In the five and ten cent stores will be found side by side a small bottle of Vaseline and a large bottle of Petroleum jelly, both offered for sale at ten cents each. The average buyer will take the small bottle of Vaseline in preference to the large bottle of Petroleum jelly, although they are the same thing. The small bottle is put up by Cheeseboro Brothers who own the word Vaseline as their trade-mark. They even mark their bottles in addition with the words Petroleum jelly. Their product is perhaps no better than the Petroleum jelly that is sold by their competitor at a much lower price per ounce but because of the fact that they own the mark Vaseline they are able to sell their product at a much higher profit. The public has associated the name Vaseline with a particular product and by force of habit looks for the name Vaseline for the purpose of identifying the particular product they want. It is this tendency of the public to buy a particular product because it has a particular name that is capitalized by Cheeseboro Brothers and is to them a source of great profit. In this way the word Vaseline has been made by them a very valuable trademark and is perhaps the most important asset in their business.

The word Celluloid identifies a product or a composition made of gun cotton, camphor and other ingredients which can be made to imitate ivory, tortoise shell, amber, coral, etc. Many articles useful and ornamental are made from it and the public knows these articles by the name Celluloid in preference to any other name that can be attached to it. The composition of Celluloid is well known and the same product is made by a great many competing manufacturers, but the word Celluloid is a trade-mark that is owned by the Celluloid Company and no goods can be called Celluloid without their consent.

The same product is made by their competitors and called Xylonite, Pyralin, Pyroxalin, Fiberloid, Viscoloid, French Ivory and many other names, but the public persists in recognizing these goods by the name Celluloid and asking for Celluloid goods all of which increases the patronage of the Celluloid Company who own the trade-mark Celluloid.

Pond's Extract is another name for witch hazel but Pond's Extract has been well advertised and the public has been made acquainted with the merits of the product of that name and they have formed the habit of calling for it and paying a higher price for it when they could buy witch hazel at a much lower price. This enables Pond's Extract Co. to do a very profitable business in a product that is open to great competition.

Ivory is the trade-mark name of a favorite brand of soap that is much advertised and is used in almost every household. The composition of the soap is no secret. Anybody can make practically the same soap as Ivory soap or a soap that is just as good as Ivory and sell it in competition but Proctor and Gamble will continue to do the bulk of the business because the public has become acquainted with the merits of a particular brand of soap named Ivory and insists on buying that soap to the great profit of the manufacturers of it.

Royal is the name of a well-known brand of baking powder. The ingredients of it are well known. Anyone can make the same kind of baking powder and advertise it to be just as good as the Royal baking powder but the Royal Baking Powder Co. will continue to do the bulk of the business because the public has formed the habit of using Royal baking powder and insist on having it to the exclusion of all other makes, from which habit the Royal Baking Powder Co. makes a large profit.

Kodak is the name of a particular make of hand camera. Other manufacturers make hand cameras that are just as good as the Kodak camera. Some of them have advantages that are not present in the Kodak camera but the word Kodak has become a household word from the advertising of the Eastman Kodak Co. and the public is therefore led to call for Kodaks. The Eastman Kodak Co. does a large and profitable business because of this habit which the public has formed.

The words Kodak, Ivory and Royal are all short words and as trade-marks are worth to their respective owners several millions of dollars per letter. To a less extent the same thing may be said of the other trade-marks that have been mentioned. These marks have been made valuable because they are associated with meritorious goods that are useful to the public and the public has been educated in the merits of these goods by the very extensive advertising that had been given to them in connection with their trade-marks. The average individual is not an expert on soap or baking powder and it could not tell a cake of Ivory soap from another brand of white soap if the marks were removed, but the mark enables him to identify the goods that he wants and on which he can depend and makes expert knowledge on his part unnecessary. The mark represents the good-will of the public, that is, the tendency of the public to buy that particular product again and again. It assures the producer of the continued patronage of his customer and his

business is built around the trade-mark as much as the quality of the goods.

If a competitor imitates the mark and deceives the public thereby so that the public is misled into buying the goods of the imitator instead of the genuine article, then the imitator is stealing a part of the business of the producer of the genuine article. This business has long since been recognized as a property right which cannot be fraudulently taken away and the owner of the mark which is imitated has a right to demand of the imitator that he stop the imitation and the courts will assist the producer of the genuine goods in protecting and enforcing his rights in this respect. The courts are always ready to suppress any kind of unfair competition or fraud upon the public or upon the business of the manufacturer of a genuine or meritorious article.

All trade-marks used in interstate commerce, foreign commerce or commerce with the Indian tribes can be registered in the United States Patent Office. Such use is necessary before registration can be applied for because the United States Government can only take jurisdiction of trade marks under the Commerce Clause of the Constitution. Copies of all marks registered are printed by the Patent Office and are sold at ten cents each. They are also printed in the Official Gazette.

Before any mark is printed for use it should be searched in the Patent Offic eto avoid conflict or infringement with prior marks. If the search shows that a similar mark has been registered for use with goods of the same descriptive properties another mark must be chosen unless on investigation it is found that the prior mark has been abandoned by its owner; that is, its use has been discontinued. In such case, the abandoned mark can be appropriated by another.

In the United States and many other countries the trade-mark belongs to the first user of it regardless of how long he delays applying for registration of the mark but in many of the South American countries and many of the other countries the mark belongs to the one who first secures registration of it. Certain persons in those foreign countries watch the publication of trade-marks in the Official Gazette of the United States Patent Office and secure registration of such marks as promise to be of value in their own countries and then interfere with the importation and sale of the goods in the foreign country until the legitimate owner of it in the United States yields and buys the foreign mark for an exorbitant sum. This frequently prevents the export of products from the United States to those countries. It therefore is important that each manufacturer register his mark as early as possible in all countries to which he expects to export his product.

The foreign registrant can own the mark in a foreign country without using it in trade for the law so permits in many countries. In this country ownership depends on use and not on registration. With us registration merely creates a presumption of ownership but that presumption can be rebutted by the facts showing abandonment. Failure to use a mark in this country works abandonment and on proof of this the Patent Office will consider the registration cancelled and will then grant registration to a later user.

The trade-mark law is only a small part of the law on unfair competition. The National Government has established the Interstate Commerce Commission, has passed the Sherman law and has more recently established the Federal Trade Commission and all this has been done for the purpose of suppressing various forms of unfair competition.

Patent Office Positions.

As patents are issued by the Patent Office, a few words about the Patent Office and its organization and publications will be appropriate.

The head of the Patent Office is the Commissioner of Patents, and all communications to the Patent Office should be addressed to the Commissioner of Patents, Washington, D. C. For his immediate assistance there are two Assistant Commissioners of Patents. Next in rank is the Board of Examiners in Chief which is made up of five men who have come up from the ranks of the Patent Office. Next to them are forty-eight principal examiners each of whom is in charge of an examining division. Under them are four hundred assistant examiners divided into four classes each of which classes is divided into three sub-classes, making twelve classes of assistant examiners in all. The lowest class of fourth assistants receives a salary of $1740.00 a year. The highest grade of 1st Assistant Examiners are paid $3300 a year. The principal examiners are paid $3900 a year. In addition to these are two examiners of interferences and examiner of trade-marks and eleven assistant examiners of trade-marks and designs together with such other help as is needed for the operation of the office.

The Patent Office is a court of which the examiners are the judges and the Commissioner is the chief justice.

Nearly all of the examiners have been educated as mechanical experts and many of them are members of the bar as well. There are three law schools in Washington. They all hold their sessions at night and many government employees study law and even find it necessary in connection with their work. Cornell, Boston Tech, Purdue, Annapolis, and many other engineering schools are largely represented in the examining corps, and altogether the examiners and assistant examiners of the Patent Office make a body of the finest legal and technical experts that are to be found anywhere. The law requires that the Examiners in Chief shall be persons of competent legal knowledge and scientific ability. But all of the examining force is composed of persons of scientific ability and all of the principal examiners and higher grades of assistants have legal knowledge as well. Legal knowledge is essential to promotion. Each examiner becomes a specialist in the class of which he has charge. The Patent Office has always had difficulty in getting men to take the examiners' positions. Every year a large number of examiners resign to practice patent law or work for large companies and the Patent Office is, therefore, continually calling on the Civil Service Commission for new men. Such is the demand that as soon as an applicant has passed the Civil Service Examination and been put on the eligible list he is appointed to the examining force of the Patent Office. For several years past the eligible list has always been exhausted before the vacancies in the Patent Office were filled so that anyone that passed the examination was sure of an appointment. Most any graduate of an engineering school can pass the examination with the certainty of an appointment if he passes. The Patent Office is the best school for the study of patent law and for the study of many branches of techniques as well. Washington is a beautiful city and has many advantages that make it a desirable place for residence and study and an appointment is for life. Engineering students should consider the Patent Office as it offers one of the best careers open to them. The Civil Service Commission and the Commissioner of Patents will give them full information about the examination and the nature of the work on application.

The Patent Office earns a surplus every year and in the past fifty years has paid the Government a profit of about ten millions of dollars. It is the only department that is self-supporting and is entitled to a much better building than it now has and to much better treatment generally by Congress. At least, this much recognition is due to the inventors and manufacturers of the country.

Patent Office Publications.

The Patent Office issues the following publications:

1st. All patents are printed and a copy of any patent can be obtained for ten cents. It is frequently desirable to have not only a particular patent but copies of all patents in the same sub-class in which it is classified and frequently it is desirable to have the associated sub-classes as well in order to get a comprehensive view of the state of the art.

2nd. Every Tuesday the Patent Office publishes the Official Gazette of the Patent Office. Therein is printed an abstract of every patent issued under that date. The Gazette also gives the classification of the patent. An annual Index of the Gazette is published which indexes all of the patents issued during the year both by the title of the invention and by the name of the inventor. These indexes together with the classification given by the Gzaette make it easy to find any particular patent or set of patents that may be desired.

3d. A manual of classification is published from time to time showing the classes and the sub-classes into which the patents are divided. It also shows the classes in each of the examining divisions. The Patent Office also publishes bulletins containing the definitions of these classes and sub-classes.

With all of the foregoing the engineers generally should have a speaking acquaintance.

4th. The Patent Office also publishes the Patent Statutes and the Rules of Practice. These publications, however, are of more interest to the attorney than to the engineer or the inventor.

5th. The Patent Office keeps on file two copies of every foreign patent and these are accessible to the general public. Photostat copies of any of these foreign patents can be had for a nominal price.

The British Patent Office publishes a series of digests covering 146 classes, one or more series of digests for each of these classes. These digests are for sale to the public at a shilling or two per volume. There are ten volumes in a series, and many of the volumes contain more than 500 pages. The patents are well abstracted therein and the abstracts contain a wonderful amount of information for a very small sum of money. It is to be regretted that the United States Patent Office does not publish a similar set of books. Such publications would make the information contained in the U. S. patents very much more accessible to the public.

CONCLUSION.

The patents that have been presented herein are sufficient to give the student some idea of what an invention is in the eye of the patent law and how it must be presented in a patent. The patents show how the inventions are disclosed by drawings and specifications and the claims show how an invention is protected or neglected as the case may be. A valuable patent has two important requisites. First, it must disclose a valuable invention, and second, it must claim the invention in a way that will insure the owner of it of a monopoly.

Patent attorneys make mistakes in claiming an invention. Every reissue patent is evidence of this and it frequently turns out in an infringement suit that the invention was either not claimed broadly enough or part of it was not claimed at all and was thus dedicated to the public. Patent attorneys, like all other attorneys, are human and some of them make mistakes. If some of the lawyers did not make mistakes there would not be so many lawyers. For as Justice Brewer once said: "The main hope of the legal profession lies in the fact that one poor lawyer can make work enough for two good ones." In preparing patents as well as

any other legal instruments the whole responsibility should not be left to the attorney. Usually the inventor knows more about the art and frequently knows more about his invention than does his attorney and in every instance the inventor should try to give to his attorney all the details of his invention as fully as possible, and a description of what it improves upon and the defects of the old and the advantages and objects of the new. Attorneys must rely upon inventors for this technical information in preparing patent papers and the inventor must give it to him fully and clearly. Good team work between the inventor and his attorney always pays many fold. When they work together intelligently on important inventions they make a combination that is hard to beat. Occasionally a patent is held invalid because of lack of disclosure and when this happens it is quite probable that both the attorney and the inventor have blundered.

In Topliff vs. Topliff, 145 U. S., 156, 36 L. Ed. 658, the Supreme Court said as follows:

> "The specification and claims of a patent, particularly if the invention be at all complicated, constitute one of the most difficult legal instruments to draw with accuracy, and in view of the fact that valuable inventions are often placed in the hands of inexperienced persons to prepare such specifications and claims, it is no matter of surprise that the latter frequently fail to describe with requisite certainty the exact invention of the patentee, and err either in claiming that which the patentee had not in fact invented, or in omitting some element which was a valuable or essential part of his actual invention."

The Patent Laws require the inventor to "particularly point out and distinctly claim the part, improvement or combination which he claims as his invention or discovery." Patents are sometimes issued containing as many as several hundred claims, and the work of drawing the claims is perhaps the most difficult work that the attorney is called upon to do. If the invention that is of so much importance commercially is not covered by the claims of the patent, the invention belongs to the public and not to the owner of the patent, hence the need of describing the invention in the claims as well as in the specification, and the need of an attorney who is capable of doing it. Otherwise the patent may be worthless for the purpose of protecting the invention disclosed in it. If through the incompetence or negligence of the attorney the claims are defective, the inventor cannot depend upon the courts to remedy the defects. On these points the courts have spoken on a number of occasions, and by way of illustration the following language is quoted from the case of Keystone Bridge Co. vs. Phoenix Iron Co., 95 U. S. 274, 24 L. Ed. 344:

> "Since the Act of 1836, the patent laws require that an applicant for a patent shall not only, by a specification in writing, fully explain his invention, but that he shall particularly specify and point out the part, improvement or combination which he claims as his own invention or discovery. This provision was inserted in the law for the purpose of relieving the courts from the duty of ascertaining the exact invention of the patentee by inference and conjecture, derived from a laborious examination of previous inventions, and a comparison thereof with that claimed by him. The duty is now cast upon the Patent Office. There his claim is, or is supposed to be, examined, scrutinized, limited and made to conform to what he is entitled to. If the Office refuses to allow him all that he asks, he has an appeal. But the courts have no right to enlarge a patent beyond the scope of its claim as allowed by the Patent Office, or the appellate tribunal to which contested applications are referred. When the terms of a

claim in a patent are clear and distinct, as they always should be, the patentee, in a suit brought upon the patent, is bound by it. Merrill vs. Yoemans, 94 U. S., 573. He can claim nothing beyond it. But the defendant may at all times, under proper pleadings, resort to prior use and the general history of the art to assail the validity of a patent or to restrain its construction. The door is then opened to the plaintiff to resort to the same kind of evidence in rebuttal; but he can never go beyond his claim. As patents are procured ex parte, the public is not bound by them, but the patentees are. And the latter cannot show that their invention is broader than the terms of their claim; or, if broader, they must be held to have surrendered the surplus to the public."

Knowing what the claims of a patent are, innocent persons can avoid infringing the patent and can use everything disclosed in the patent that is not claimed therein.

Inventions and patents on them are a necessary part of our present day development and they must be reckoned with in every line of manufacture and every branch of endeavor. Every engineer and every mechanic has more or less opportunity open to him to make important inventions and usually it is only by patenting them that he can profit by them. If these pages will help the average layman to understand patents the better so as to avoid mistakes in the development of inventions and the procuring of patents thereon and the handling of the patent the writing of them will be regarded as worth while.

We are living in an age of wonderful scientific, technical and industrial development. This is all produced first by the spirit of research, that has gone hand in hand with the growth of liberty and has produced abstract truths. Second the genius of the inventor has applied these truths to a useful purpose. Franklin took a chance with his kite when he drew lightning from the clouds and showed that lightning and electricity were the same. He might have been a victim of his own investigations. Had a bolt of lightning killed him it would have been taken as the judgment of God and he would have furnished the subject of many a sermon on Divine wrath punishing an impudent and sacrilegious sinner just as Galileo became a martyr when he invented the telescope and discovered the moons of Jupiter and the phases of Venus. Franklin laid the basis for the electric art and Galileo laid the basis for the art of optics. The study of modern astronomy and every inventor and investigator in these arts has profited by the work of these pioneers.

It is the spirit of investigation and the desire to improve and the guarantee of reward that has made this age develop, and the absence of these factors that brought development in previous ages to a stand still. In a hundred years the Egyptians developed from the crudest masonry to the building of wonderful temples and pyramids. Then they stopped. In a hundred years Greece developed from crude beginnings to the golden age of Pericles. Then they stopped. In both cases stopping meant decay.

If Egypt and Greece had developed the spirit of research and had paid the inventor, the present development might have taken place two or three thousand years ago for then Tubal Cain forged iron and Hero played with steam, but it took James Watt and the British patent law to make the steam engine and put it to work in civilizing humanity. The world always has needed service and always will need service but it is only in the last century or two that the law has paid the inventor, has made him the superman of civilization and has got from him a service that that has doubled the effciency of every man ten to twenty fold.

The service that he has given has carried the world forward at a rate that is but dimly comprehended. It has both increased the sum of

knowledge and has also produced or increased those unexplored fields in which the unknown or unattainable of yesterday is the goal of today and the starting point of tomorrow. The inventor is always solving problems and producing results that were believed to be impossible by the rest of us. The human race has benefited thereby. These benefits are all due to the zeal of the scientist and the genius of the inventor. In these new fields this and future generations may work out still higher planes of development and civilization, each decade improving on the work of its predecessor so that the progress of humanity is ever onward and upward. But through it all the world must remember the debt it owes to the inventor and must pay to him his immediate reward if his genius is to be kept in harness for the benefit of mankind through all the ages. All this and more does civiliation, humanity and the world owe in patent protection and the square deal to its greatest benefactor, the American Inventor, for many scores of years past the greatest genius of the world in the making of Pioneer Inventions.

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