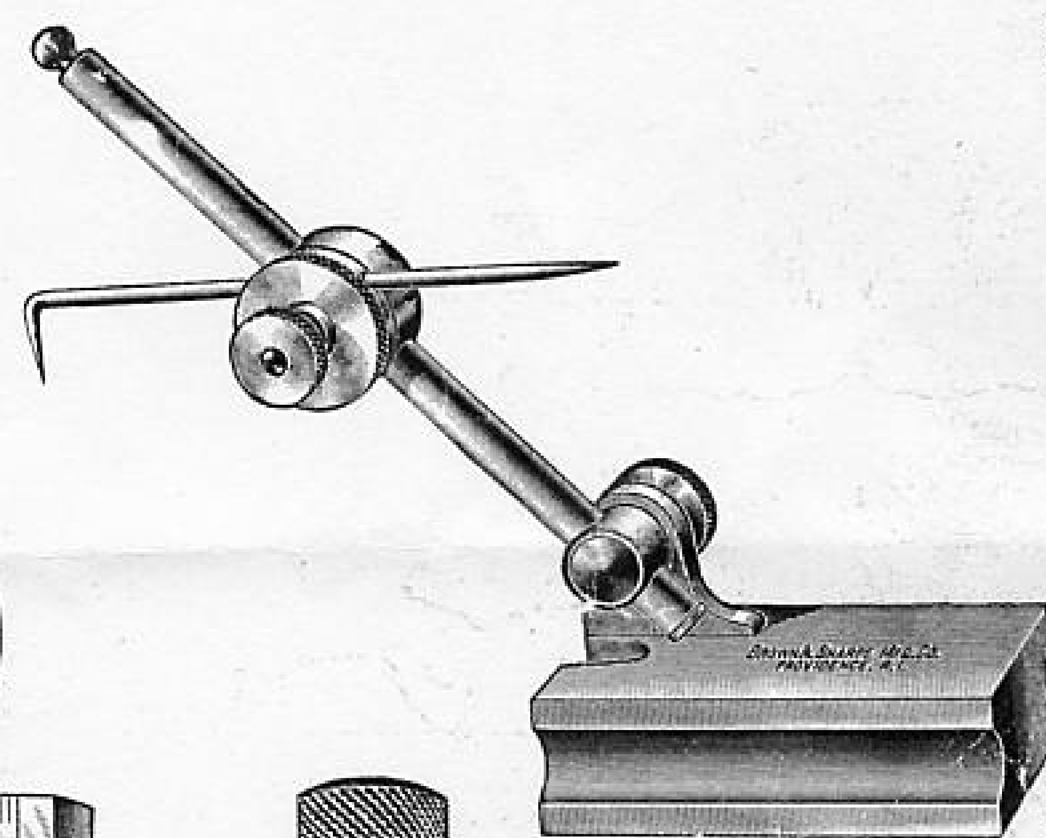
DOMESTIC EDITION. ADV. INDEX PAGE 11. ONE DOLLAR A YEAR·TEN CENTS A COPY DOMESTIC EDITION. ADV. INDEX PAGE 11.

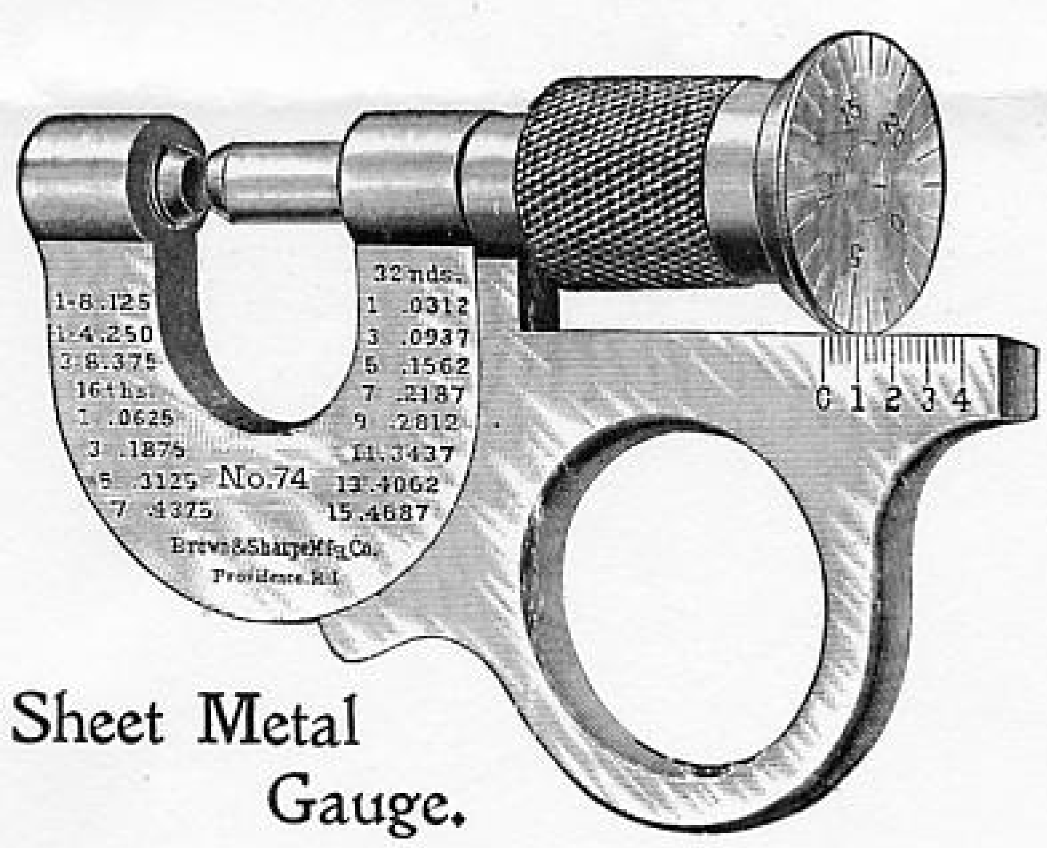
MACHINERY:

VOL. 6. NO. 3. PUBLICATION OFFICE 9-15 MURRAY STREET NEW YORK CITY. NOVEMBER, 1899.

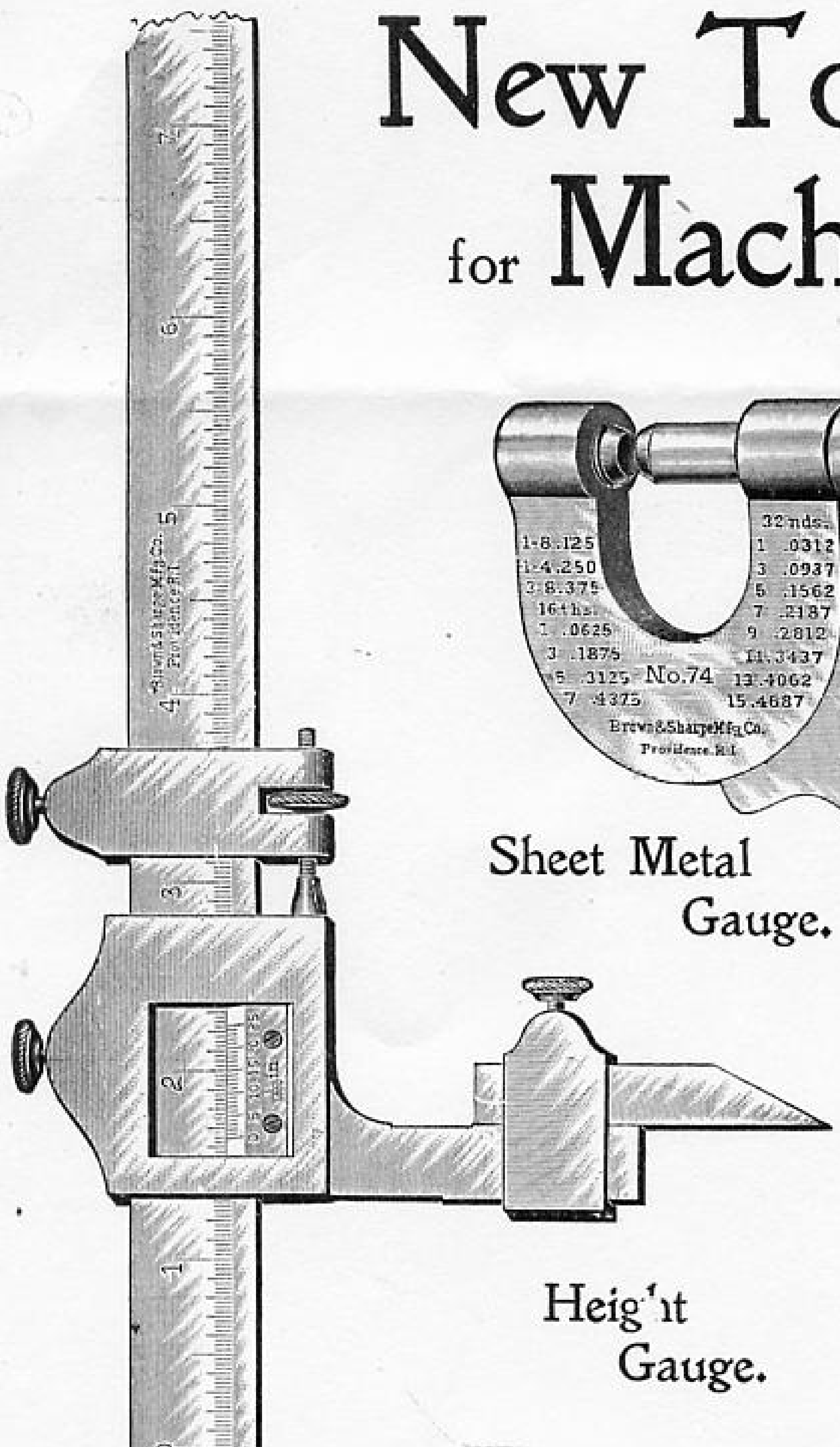
A PRACTICAL JOURNAL FOR MACHINISTS AND ENGINEERS
AND FOR ALL WHO ARE INTERESTED IN MACHINERY:



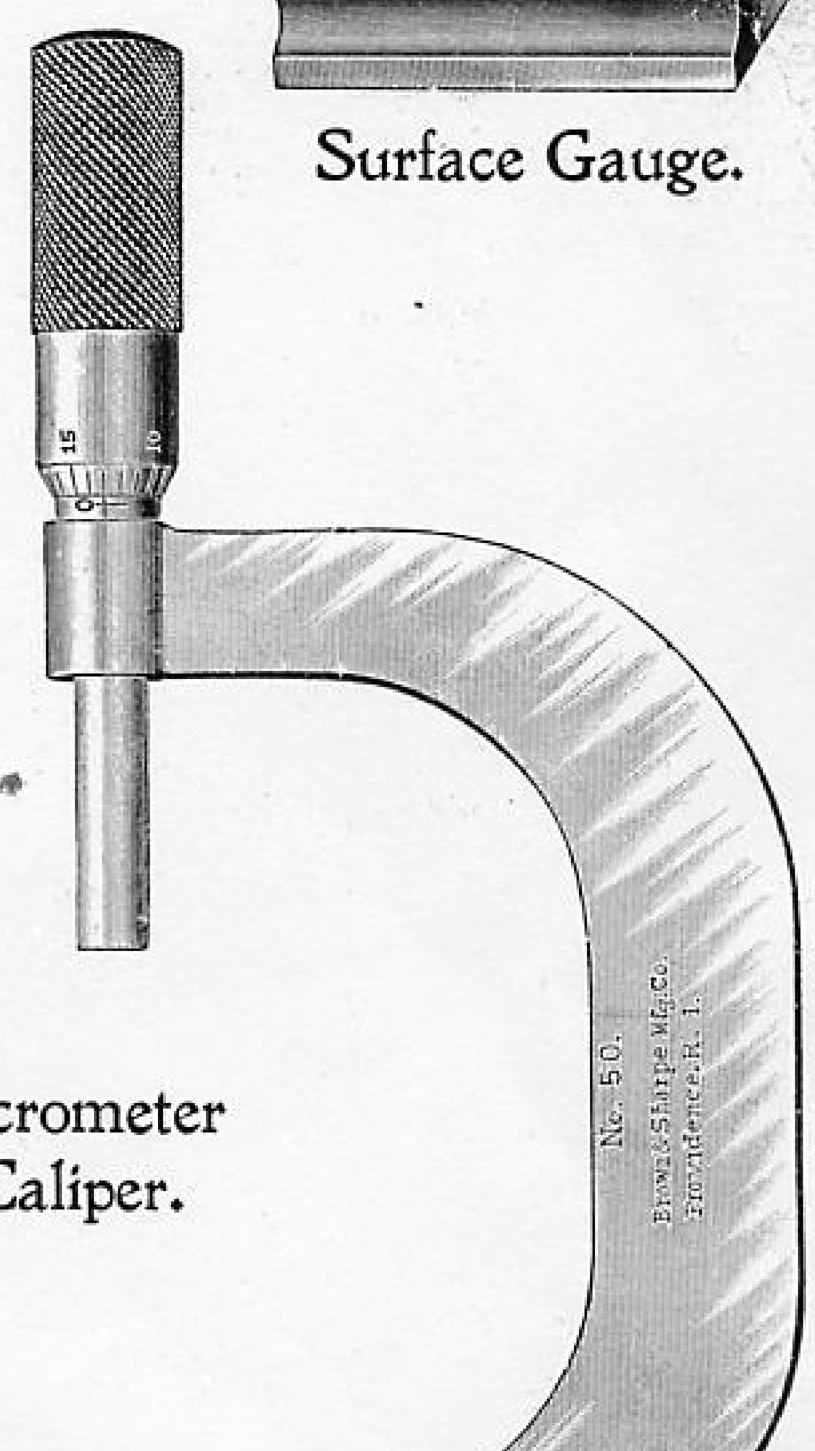
Surface Gauge.



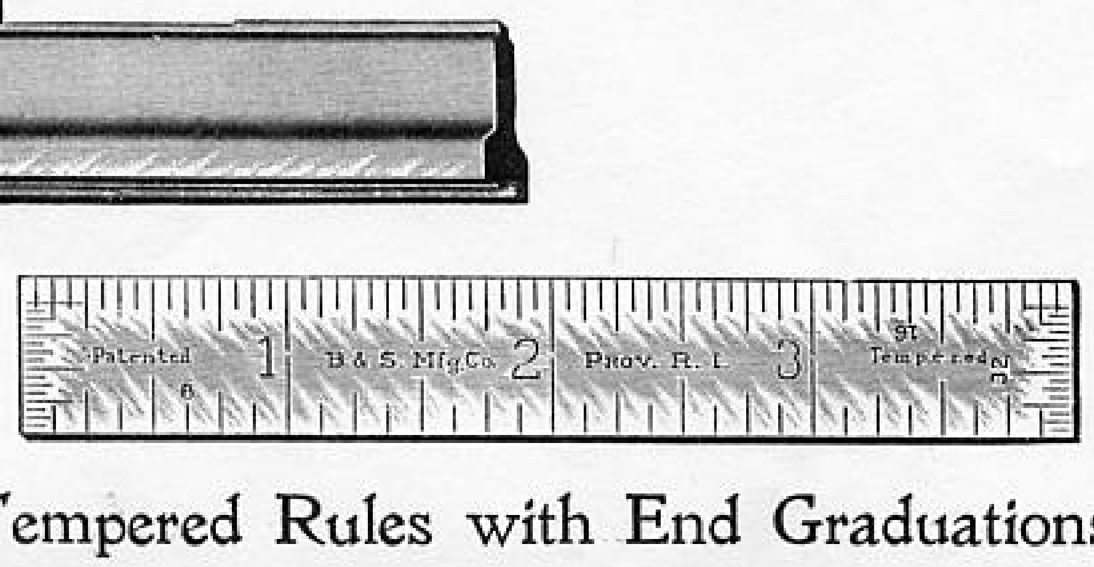
Sheet Metal Gauge.



Heig'ıt Gauge.



3 in. Micrometer Caliper.



Tempered Rules with End Graduations.

As a matter of record, we will state that the longest lathe in the shop will take 80 feet between centers, the longest boring machine will bore a hole 60 feet long, and the largest lathe and drill are described sufficiently in connection with the illustrations 2 and 9.

In the Armor-plate Shop.

When an armor-plate has been finally treated, its face is so hard that it is impossible to drill or otherwise machine it by any ordinary means. Such work must be done before this final treatment takes place, and so these plates are first brought to approximately the right size, and if any openings, such as portholes, are required, these are drilled out previous to the hardening. After hardening, the backs of the plates are still soft enough to be worked, and the edges at the back can be milled down to the exact dimensions to within a few inches of the outer face, and then this remaining face must be ground off. The grinding machine, therefore, plays an important part in the manufacture of armor-plate, and is even more necessary here than in ordinary shop practice, where it is now generally termed a necessity. There are five grinding machines in the armor-plate shop of special design for this work.

The most striking tools in the armor-plate shop are the rotary saws, of which there are four, that trim the edges of the plates. These machines were imported from the Creusot works, France, and will saw a plate 24 inches thick and 33 feet long. The body of the saw is 84 inches in diameter and has 76 inserted cutters, which alternate wide and narrow to more readily break up the chips and prevent binding. Each saw is driven by a worm-wheel 90 inches in diameter.

The combined rotary planer and saw illustrated in Fig. 5 is a more powerful tool than the others, and was designed and built by the Bethlehem Steel Company. It has afforded a good opportunity to compare the merits of the rotary planer and the saw, and the capacity of the planer has been proven to be such that it will take off metal six inches deep from the edge of a plate 16 inches thick quicker than the saw will take off a strip of the same width and thickness. This is a remarkable machine and it is engaged steadily upon remarkable work.

Besides the grinding machines and the saws, there are in this shop two pit-planers like that illustrated in Fig. 6, the universal milling and drilling machine of Fig. 8, and three drills like those in Fig. 9. These illustrations give a clear idea of the character of the operations to be done upon armor-plate and of the character of the tools required.

The plates have to be planed, finished on their edges and any openings have to be drilled out. They are also drilled and tapped at the back for the standing bolts that fasten them to the framework of the ship. All plates are erected side by side in the shop in their relatively correct positions, just as any machine work would be, and to handle such massive weights requires ample crane capacity. A new use for armor-plates has recently been found in the construction of safe-deposit vaults. One was recently built here with a door having ground joints, and it was calculated that the kind of material that has been found efficacious in resisting an enemy's shots would be, at least, troublesome to an evil-minded person who was trying to get on the inside of the vault without the combination. This construction is vastly superior to composite-built vaults.

* * *

HARDENING SOLUTION.

Of all the various receipts for hardening compounds, I have never really known of but one that was of any practical value.

A solution of chloride of sodium in water will make the water a much better conductor of heat and will therefore cool the piece off quicker. The result is that you get the steel much harder and at a lower heat than with clear water. There is also a slight chemical action which causes the scale to drop off, and the piece comes out of the bath considerably cleaner.

The chloride of sodium should be in a cloth bag, hung near the top of the tub, and the water will gradually take up a considerable quantity of it.

P. S.—The above is written for the benefit of those who are not satisfied unless they have something very mysterious and scientific. To those who are satisfied with the plain old common-sense rules, I would say that chloride of sodium is nothing more nor less than common salt.—"The Professor" in "Sparks from the Crescent Anvil."

WIRELESS TELEGRAPHY.

AN EXPLANATION OF THE PRINCIPLES OF THE SYSTEM USED BY MARCONI IN REPORTING THE RECENT RACES FOR THE AMERICA'S CUP.

WM. BAXTER, JR.

Wireless telegraphy is looked upon by the popular mind as the greatest of all electrical mysteries, and, further, it is believed to be an achievement realized only within the past few months. As a matter of fact, the action is not in the least mysterious, and can be readily understood by any one when explained in simple language; and it is not an entirely new development. There are three ways known, at present, in which wireless telegraphy may be accomplished, but in this explanation we will confine ourselves to the system used by Marconi, which is the one that has been brought to the highest state of perfection, and, in fact, the only one that can be said to be commercially successful. Wireless telegraphy has been experimented with for many years, but it was not until about fifteen years ago that any practical results were obtained. In 1884 messages were sent through underground wires, were read upon telephonic circuits located eighty feet above them, and in the following year speech by telephone was carried on over a distance of about one mile and a quarter. In 1892 messages were transmitted over a distance of more than three miles. Marconi's experiments began in 1896, and up to the present time he has succeeded in transmitting messages to a distance of about 30 miles. Most of the apparatus used by Marconi is old and was invented by others, nevertheless he has obtained results far greater than any one else, and the difference appears to be due to the addition of a vertical wire, varying in length from 20 to 100 feet or more, according to the distance to be covered. Thus, it will be seen that in this case the difference between small and great results depends upon a very small thing—a few feet of wire—but this does not in any way detract from the credit due to the inventor for having obtained results far greater than any of his predecessors; in fact, the simplicity should only add to the credit he is entitled to.

In order that the principles of wireless telegraphy may be understood, it is necessary to disabuse the mind of the popular notion with respect to the nature of electricity, for, so long as this remains, a correct insight of the subject cannot be obtained. Electricity is generally regarded as a mysterious fluid that possesses the power of flowing at an enormous velocity and in great quantities through wires, just as water flows through pipes. When a man looks at a trolley car running along the street at a high rate of speed he pictures in his mind's eye a tremendous amount of electric fluid flowing through the trolley wire from the generator in the power station to the motors under the car. He can hardly realize how this incomprehensible fluid can travel along the wire without producing any noticeable effects, but he sees the car and the trolley wire, and knows that the power that moves the former comes from the distant power house and comes over the wire; hence, although he cannot see how the fluid gets through, he knows that it gets there. When he tries to unravel the mysteries of wireless telegraphy by the same process of reasoning he becomes hopelessly entangled, for he cannot understand in what way the mysterious fluid can cut through space from the sending to the receiving station; he wonders why the fluid will not go in the opposite direction, or in any other direction just as well. The first step to take to remove all confusion is to understand that electricity is not a fluid, that it is not a material thing, but simply a force of nature that is made manifest whenever the minute particles of matter are set in motion in a certain way. In other words, electricity is a force which is the result of a certain form of motion.

It is difficult to understand at a first glance how a form of motion can account for the transferences of hundreds and even thousands of horse-power over long distances, but such an action can be readily illustrated. Suppose we have a trough ten feet long, and say five inches wide and of equal depth and filled with water. If we agitate the water at one end with a paddle we will produce waves that will travel to the other end. If at the distant end we place a float, it will rise and fall with the waves as they roll in from the sending end, and if the float is connected with the plunger of a pump, it will move the latter and thus pump water. Here we have a simple illustration of the manner in which the wave motion imparted to the water by the paddle at one end will cause a float to bob up and down at the other end of the trough and thus operate a pump; hence, we have a transference of the power applied from the paddle at one end to the pump at the other end, and all accomplished by the wave motion imparted to the water. If the trough is made two or three hundred feet long and correspondingly wide, and the water is agitated by a sufficiently powerful paddle, a pump of large size can be operated at the distant end. Now, if power can be transferred from one end of the trough to the other by means of the wave motion imparted to the water, why cannot the same result be accomplished by propagating a wave motion through or along a wire connecting an electric generator with an electric motor? The modern theory of electricity says that it can, and this is the way in which energy is transferred in an electric conductor. Light, according to the modern theory, is also produced by wave motion, but the waves are very short, being, in fact, of microscopic dimensions.

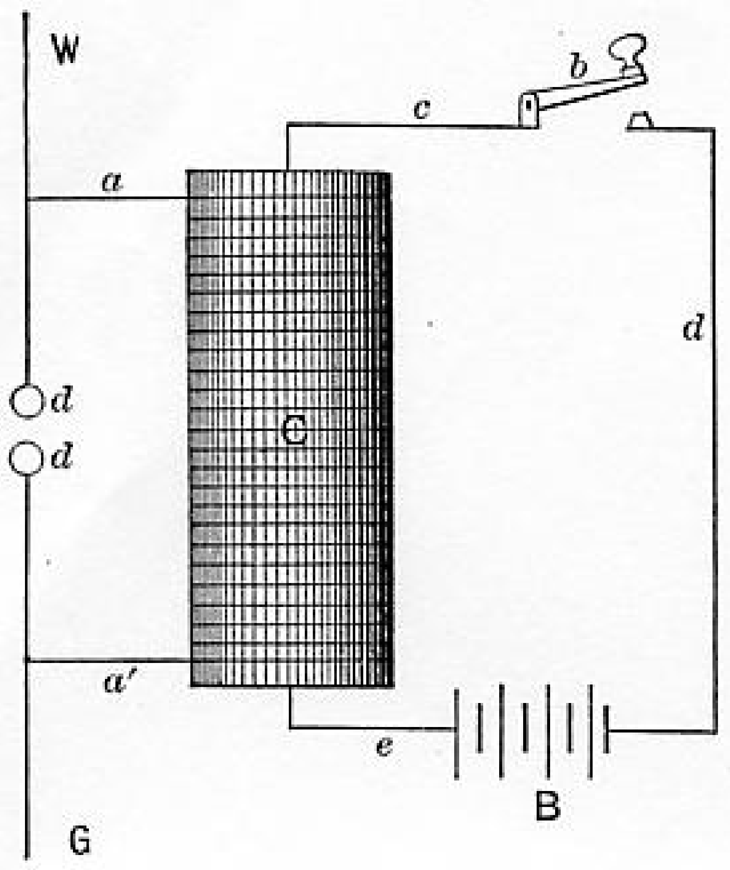


FIG. 1.

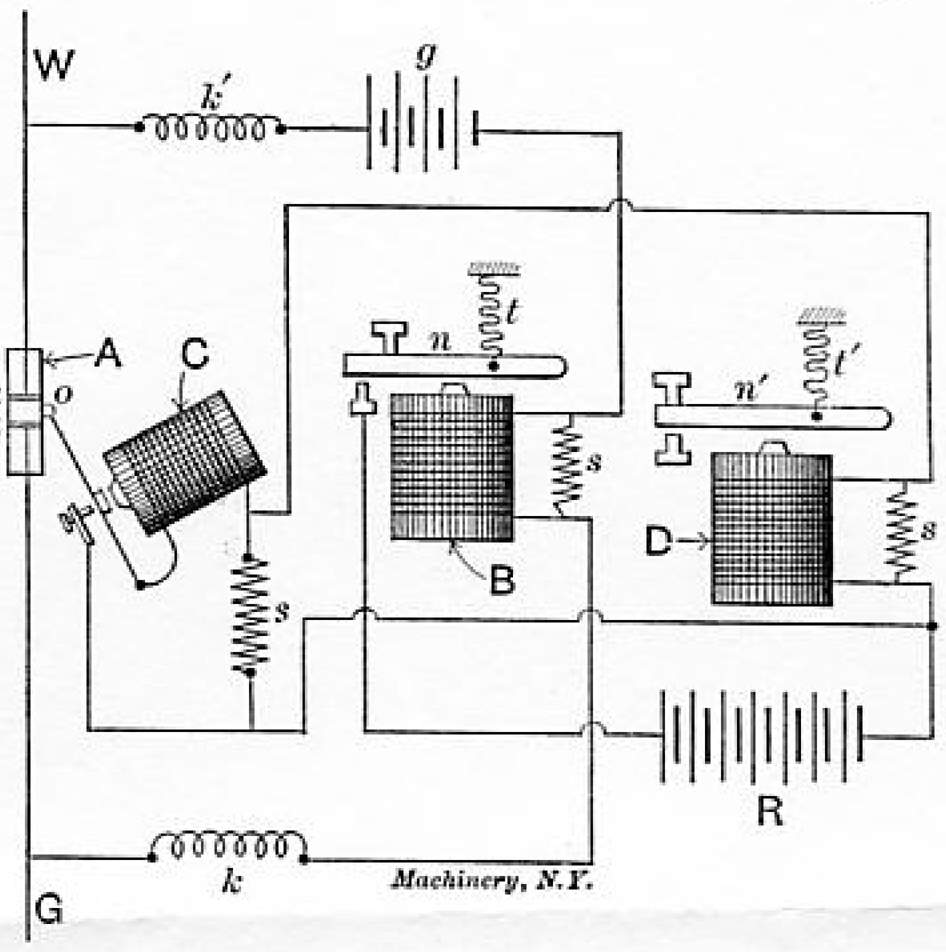


FIG. 2.

About thirty years ago, Prof. Clark Maxwell advanced the theory that light and electricity are of the same nature, and that the only difference between them is in the length of the waves. About ten years ago Prof. Hertz proved experimentally that Maxwell's theory was correct, this proof consisting in the production of an apparatus, called a Hertz oscillator, which develops electric waves that radiate into space in precisely the same way that light rays do. The rays of light emitted by a lamp can be seen by the human eye, because the latter is so constructed that it is affected by light radiations, but the eye cannot see the electric rays emitted from a Hertz oscillator simply because it is not so constructed as to be affected by them. Telegraphing through space by means of powerful lights would not be considered anything wonderful, because the eye can see the light if there is no obstruction in line with it. Now, to telegraph through space with electricity, all we have to do is to provide a Hertz oscillator to develop the electrical radiation at one station, and a device capable of detecting this radiation at the other station. In other words, the sending instrument at one station must be so made as to produce an electric radiation, and the receiving instrument at the other station must be so made as to see this radiation—that is, it must be an electric eye.

The way in which all this is accomplished in the Marconi system can be explained in connection with the diagrams Figs. 1, 2 and 3. Fig. 1 shows the transmitting instrument. C is an induction coil, the same in construction as those used in medical batteries to give shocks, but very much more powerful. An induction coil, it may be well to state, is a device employed to obtain, by means of a current of low pressure, another one of very high pressure. The low-pressure current used is of large quantity and may be compared to a large stream of water moving with a small velocity, while the high-pressure current is of very small quantity, and can be compared to a very small stream of water flowing through a small pipe, but with a very high velocity. The low-pressure current is called the primary, and the high-pressure current is called the secondary. The coil is wound with two separate wires, one for the primary and one for the secondary; the primary coil is made of large wire—say No. 16—and has a small number of turns, generally about as many as will go in two layers. The secondary coil is made of fine wire, about as thick as a hair, and consists of many thousand turns. In Fig. 1 the ends of the primary are connected with the wires c and e, which form part of a circuit in which are located a battery B and a telegraph key b. When the key b is depressed the circuit is closed and a current flows through the primary coil wound on C. This primary current induces a secondary current in the fine wire coil, wound on C, and this current passes by wires a a to wires W and G. The latter wire is connected with the ground and W is connected with a wire that runs vertically up into the air along a supporting pole. The wires G and W terminate in two metallic balls d d, which are placed about one-half of an inch apart. When the key b is depressed, the secondary current induced in the induction coil C passes to the wires G and W, and not finding an outlet through the ends of these, jumps across the space between the balls d d. In consequence of this action the wire W becomes a center from which electrical radiations emanate, and as the upper end is high above surrounding objects the rays can reach to a considerable distance in every direction. If at any point within the range of the radiation an electric eye, or receiving instrument, is placed, it will see the radiation. So long as the key b is held in the depressed position the wire W will emit rays, but these will disappear the instant the key is raised. From this it will be seen that by depressing b at proper intervals and for suitable lengths of time, signals can be transmitted that can be readily detected at the receiving station.

The instrument at the receiving station is illustrated diagramatically in Fig. 2, and the important part of it, that is, the electric eye, is shown on an enlarged scale in Fig. 3. The wires G and W are arranged in this instrument in the same way as in the transmitter—that is, G is connected to the ground and W is run up a high mast. The balls d d of Fig. 1 are replaced by the tube A. As will be seen, the wire leading from W passes through k′, which is an inductive resistance, thence through a battery g, a magnet B, and another inductive resistance k, and then taps wire G. The tube A, as clearly shown in Fig. 3, holds two wires with flanged heads. These heads are some distance apart and the space between them is filled, loosely, with metal filings. These filings when in the normal state offer a very high resistance to the passage of an electric current, but after a current has been established, the resistance falls down to nearly nothing. The battery g cannot force a current through A, in Fig. 2, as the pressure of the current it generates is not sufficient for the purpose, but when the electric radiation from the sending station strikes the wire W it induces therein a current of very high pressure and this is capable of breaking through the resistance of A. As soon as this high-pressure current passes through A the resistance drops down to practically nothing, and then the current from the battery g follows up. This battery

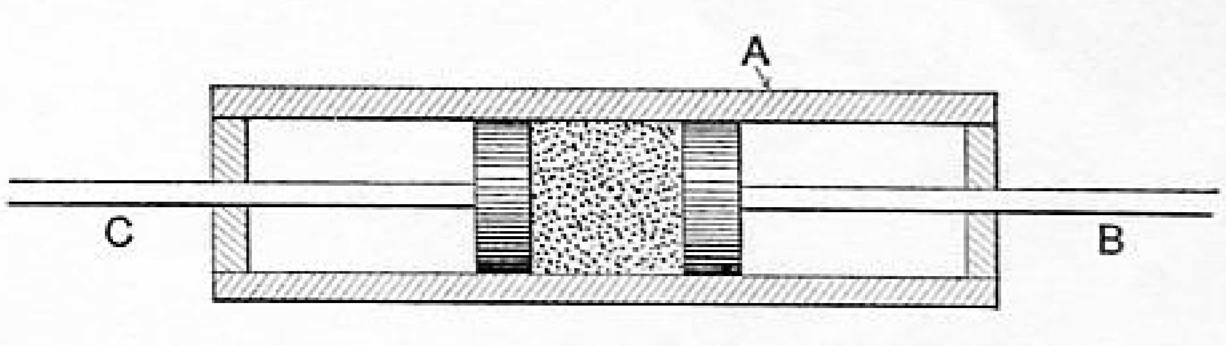


FIG. 3.

current passes through the magnet B and causes the latter to attract the lever n and thus the circuit, in which the battery r is located, is closed. This circuit contains the magnets C and D; the first one acts to vibrate the lever upon the end of which is located the knob o, and the second one actuates the sounder key n′. The tube A, if not disturbed after it has been traversed by an electric current, will remain of low resistance, but it would not do to have it act in this way, for then the current of the battery g would continue to flow and the sounder D would keep up a continuous rattle If, however, the tube A is rapped gently after the current has passed through it, it returns to its natural state, in which, as we have said, its resistance is very great. It is on this account that the striker o is provided. This is operated by the magnet C and is so adjusted that it strikes the tube every time the current passes through it; therefore the battery g cannot send a current through the circuit except while the current induced in the wire W by the radiation from the sending station, is passing. The tube A is called a coherer, but it is also referred to as an electric eye. It is made of glass and is about one inch and a half long and about one-eighth of an inch inside diameter.

The magnet D can be dispensed with if it is not desired to record the signals on paper, for the vibrator o acts as a sounder and the signals given by it could be easily read by a telegraph operator. In the Marconi system the messages are marked down on paper, in dots and dashes, after the fashion of the Morse instruments of days gone by, but if wireless telegraphy becomes common it is more than probable that the sound system used in regular telegraphy will be adopted.

From the foregoing explanation it will be seen that there is nothing mysterious about the operation of wireless telegraphy; it simply consists in using, for a sending instrument, a device that is capable of emitting electrical radiations, and for the receiving instrument a device that is acted upon by these radiations.

The possibilities of wireless telegraphy have been greatly exaggerated by the sensational press. It has been asserted that it would supersede the present methods and that before long messages would be transmitted across the Atlantic and that many other impossible things would be done. As a matter of fact, however, wireless telegraphy is limited to a certain sphere. A light located upon a prominence can be seen by any one within range of it, no matter on what side he may be located, and so with wireless telegraphy; any receiving instrument placed within the range of the transmitter can receive the signals; hence there could be no privacy with it, as an unlimited number of stations could be located so as to receive the message from a given transmitting point. From this it can be seen at once that if ten or fifteen transmitting stations were located within range of each other and within range of several receiving stations, there would be an endless confusion, as each receiver would be acted upon by several transmitters at the same time. It has been proposed to get around this difficulty, in a measure, by using reflectors and focusing the rays in the same manner as the light rays are focused with search-light projectors on board ship, but, so far, it has been found that when reflectors are used, the distance to which the signals can be transmitted is reduced to about four or five miles, so that by this expedient privacy is obtained at the reduction of distance. When reflectors are used the wires W and G are discarded, and the reflectors are placed back of the balls d d, in the transmitter, and back of the coherer A in the receiver. The two instruments are then placed at a considerable elevation so as to be within each other's range when located at the points desired.

It has been asserted by some writers that wireless telegraphy can only be made to operate between points that are in sight of each other, and that on that account the vertical wires W would have to be made of sufficient length to compensate for the curvature of the earth. The experiments of Marconi, however, prove that this conclusion is not correct, as in several instances he has maintained communication between points that were hidden from each other by intervening hills, and, in at least one instance, the distance between the stations was such, relatively to the height of the wires, that the curvature of the earth placed the stations out of sight of each other, and the electrical rays, if they passed in straight lines, must have pierced the surface of the earth. According to Marconi's practice, the wires W are made twenty feet high for a transmission to a distance of one mile, and for greater distances the distance is increased as the square of the height of the wire, so that with a wire 40 feet high the distance between stations can be four miles, and with wires 80 feet high the distance can be 16 miles, while with wires 160 feet high the stations could be 64 miles apart.

* * *

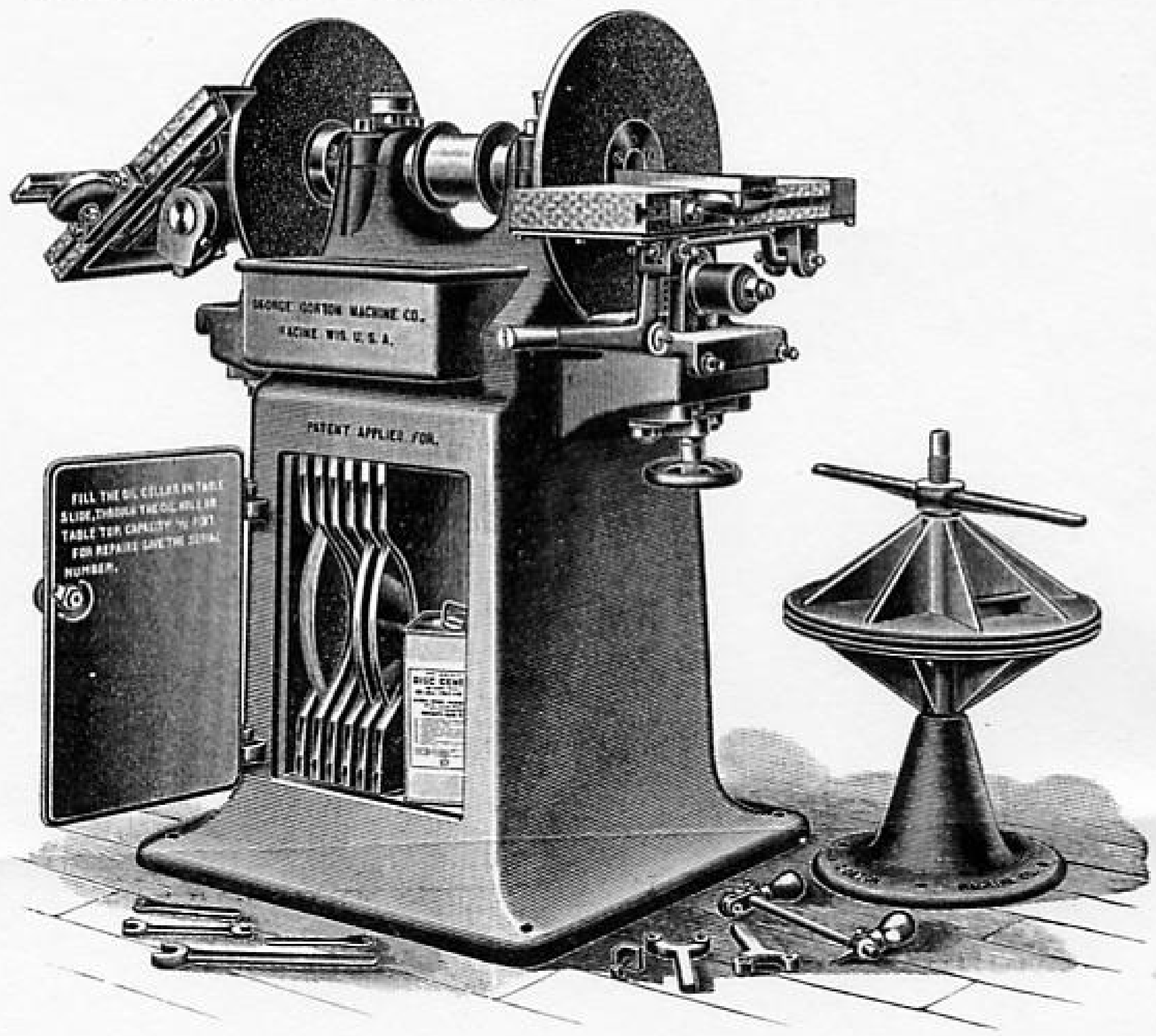
It is evident that the gospel of plenty of light in machine shops cannot be preached too strongly when one notes the many shops throughout the country in which the small amount of light that struggles through the dirty windows is almost entirely absorbed by the grimy walls and ceilings. Plenty of light encourages industry, enables accuracy to be attained, and promotes the efficiency of the entire shop.

UNIVERSAL DISC GRINDER.

We have previously called attention in these columns to the advantages which disc grinders having smooth metal discs, covered with emery cloth cemented to their faces, possess for a great variety of work.

Comparatively few years ago it was considered essential that all the finished parts of machines should be filed and rubbed down by hand, and while this process produced superior results, it was the most expensive work put on the machine and at points where expense was entirely unnecessary. Later, buffing and polishing wheels and straps came into use and greatly reduced the cost of polishing, but had the objection that they would not produce true and even work.

The disc grinder is designed for the rapid finishing of metals, the intention being to produce the work with the speed of the ordinary grinder, but with the accuracy of hand and machine work. The emery, being backed by the true and hard surface of the metal disc, presents an accurate surface for shaping the work, and, as there is no glazing or grooving of the surface, as with the ordinary wheel, it makes a free cutting grinder. When a sheet of emery is worn out it is simply stripped off the disc and a new sheet cemented on.



GORTON GRINDER

In the accompanying illustration is shown the latest style of disc grinder, as made by the George Gorton Machine Company, Racine Wis., which possesses some new features. It is now a universal grinder. The table shown at the left has a graduated angular adjustment through 45 degrees, and also a lateral adjustment for setting the top plate close to the disc. The vertical adjustment is five inches, and a protractor square is provided which may be secured to either the lower or right edge. The sliding table shown at the right is controlled by means of the hand lever, and all sliding surfaces are self-oiling and dust-proof. This latter feature holds when making adjustments, as well as when operating the tables, since a study has been made of the problem of excluding the dust from the wearing or bearing surfaces of the machine under all conditions. This table also has a protractor square. The work done upon this machine by the manufacturers is the same in quality as that found on regular machine tools, the bearing surfaces being scraped to a fit and great care being taken to have all important surfaces square with the faces of the wheels and the gradations of the protractors accurate.

* * *

It is rather unusual for a steamship to be moved on the water and yet not in the water, but this feat was performed recently in New York harbor in the case of the steamship Richmond, of the Old Dominion line. The vessel was in a balance floating dry dock in Erie Basin, and the dock was towed a distance of about a half-mile to a new anchorage. The Richmond is a screw steamer of the following dimensions: Length, 210 feet; beam, 33 feet; depth, 21 feet 6 inches; gross tonnage, 1,102 tons. The balance dock has a capacity of 3,500 tons.—Marine Engineering.