THE ELECTRIC HEATER.

By H. E. STAUFFER.

THE subject of electric heating is to-day receiving much attention. The remarkable growth of the electric railway and the extensive distribution of electricity for lighting and power have both contributed largely to bringing the electric heater into prominence. The readiness with which the current can be applied to the heating of cars, together with the high efficiency of the electric heater as a means for transforming electric energy into heat energy, have caused this form of heater to practically supplant all others on electric railways. And, while its adaptation in the household has been by no means so marked as its use on electric cars, it has, nevertheless, begun to take its place with the electric light as an adjunct to the modern house. Also, in many of the arts where it is necessary to concentrate heat at a particular point, or where it is undesirable or impossible to use a fire, the electric heater has been found most valuable. Its constant readiness, its cleanness, its cheapness, its portability and the ease with which it can be managed, all render it a highly desirable means for obtaining heat wherever it can be used. The

what extended, so as to prevent the convolutions thereof from coming in contact with each other.

In the figure, B designates a metallic core covered with an insulating medium, C, over which is wound the resistance, D. N is insulating material wound between the coils to prevent them from coming in contact. The casing is usually only a semicircular back, having a reticulated front plate attached thereto through which the air circulates, the air entering the box through the openings in the bottom of the face plate, passing round the heater and out through the openings in the upper part of the plate.

By this construction it is possible to place within a small space a very large amount of bare wire and yet avoid all danger of short circuiting. Nor is any difficulty occasioned by the expansion of the wire when heated, for all expansion thus occasioned is taken up by the coils themselves by reason of their inherent elasticity. When used for warming cars, the heaters are usually attached to the risers which support the seats, some of the panels being removed and the heaters set back in the openings thus formed until their faces come flush with the risers.

Another form of air heater designed for warming

is either impracticable or impossible to use an ordinary heater. The oil well is an instance. As is well known, an oil well, after having been used for a certain length of time, becomes practically useless as a producer, because the crevices in the rocks through which the oil flows become more or less filled with paraffin, which deposits from the oil, and thus shuts off the flow. To overcome this difficulty, the practice has usually been to "shoot" the well, that is, to explode torpedoes therein. This widens the existing crevices or forms new ones, through which the oil again flows. This process, however, does not remove the paraffin, but only drives it back into the crevices, and, therefore, while the widening of the crevices serves to make the well again produce for a time, it does not remove the real obstruction. Many plans for removing this obstacle have been suggested, one of the most successful of which is the electric heater. The ease with which the heat required can be electrically generated at the point desired, and the facility with which any needed quantity can be supplied, both make the electric heater an ideal one for this purpose.

Several devices designed especially for this work have been produced. A brief description will be given of one of the most recent forms. It comprises a central core several feet in length of some insulating material, around which a resistance is wound. Surrounding this, but insulated therefrom, is a long slender casing which entirely surrounds and hermetically seals the core and its resistance. This casing is of metal, and the terminals of the coil are properly insulated and passed out through the top thereof in order that they may be readily connected to a generator. This casing is surrounded by still another. This latter is of such size as to leave an annular channel about one inch wide between the two and is open at both top and bottom. The heater and its casing must be somewhat smaller than the bore of the ordinary oil well, so that a second annular passage is formed between the wall of the outer casing and the wall of the well. This apparatus is intended not to melt out, but to dissolve out the paraffin. It is well known that paraffin readily dissolves in a number of substances, when such substances are in a heated state, common solvents being coal oil and gasoline. If the well to be operated upon has oil already therein, and they usually have a small amount, it is the purpose of the inventor to simply lower the heater in the well until it nearly reaches the bottom and then turn on the current. Thereupon the heater will immediately become hot and communicate its heat to the oil, which latter will begin to rise through the annular channel between the inner and outer casings of the heater. By this means the contents of the well are set in motion, circulating up through the heater and down between the outer casing thereof and the wall of the well. In time this oil becomes highly heated and will then readily dissolve the paraffin wherever it comes in contact with it; and, because the oil is in motion, it will work its way into and through the crevices in the rocks through which the oil flows, and thus dissolve away the wax which has closed them up. After running the heater for several hours, it is removed, and the oil and dissolved paraffin removed by means of a pump.

If the well is dry, that is, has no oil therein at the start, a barrel or two of oil can be poured in before the heater is placed in position. Of course, the operation will then be the same as that just described. In the one case, the solvent is already in the well; in the other, it is supplied by the operator.

Another use to which the electric heater has been put and where it seems destined to fill a long felt want is to heat liquids while in motion, for instance, water moving through a pipe, so that it may be delivered to the user in a heated condition. By means of such devices, to secure hot water, all that it is necessary to do is to turn on the current and then turn on the water, whereupon the water will be delivered in a heated state. The temperature of the water can be readily regulated either by varying the amount of current supplied to the heater in any of the well known ways, or by varying the velocity of the current of water flowing through the heater, or both.

A recent form of heater designed for this purpose is shown in Fig. 3. In this form it is, in fact, a converter, with the secondary made hollow. Its construction is really very simple. It comprises in general only a primary coil, a hollow secondary coil, an iron core, a valve for governing the flow of the liquid through the secondary and a switch for closing the circuit between the terminals of the secondary. The parts are so proportioned that the secondary will be heated by the currents which are generated therein by the primary.

In the figure, 1 designates a laminated iron core, which is perforated so that the coils may be passed through. 3 indicates the hollow secondary. The primary coil is not shown, being directly behind the secondary; it consists, however, as in all alternating step-down converters, of a long length of fine wire wound into a coil. 4 designates the end of the secondary at which the liquid is supposed to enter, and 4' that at which it escapes. 6 is a valve in the secondary near the entrance end. This valve is actuated by means of a lever of insulating material, 7, having a handle, 8. On the lever is mounted a contact plate, 9, which serves to short circuit the terminals of the secondary by connecting the plates, 10 and 11. The plate, 9, rests against the plates, 10 and 11, so that it may be moved over the same in adjusting the valve, which is done to vary the amount of liquid which shall flow through the pipe. 12 and 13 show in broken lines two positions of the valve lever. When this lever is in the lower position, the valve is closed; when in the upper position, partially closed; and when it is in the position shown in full lines, it is fully open. 3' indicates the insulation between the coils of the secondary. The generator is conventionally shown at 13.

To operate the apparatus, it is only necessary to turn the current into the primary coil by any suitable means, short circuit the secondary and open the valve. The last two operations are performed simultaneously by raising the lever, 7. The switch which controls the primary coil may also be attached to and actuated by the lever. The device may be used to furnish heated liquid for any purpose, but it is more particularly designed as a generator for hot water and steam circulatory systems and as an instantaneous water heater for household purposes.

Another place where the electric heater has been recent-

VARIOUS FORMS OF ELECTRIC HEATERS.

present cost of operation, however, almost precludes its use for many purposes for which it is most highly suitable.

But it is not the purpose of this article to set forth the advantages or disadvantages of the electric heater, or to discuss the merits or demerits of any particular form or system, but to only give a general description of some of the more recent forms and to show how they are applied and used in such a manner and to such an extent as to illustrate the general progress of the art.

To this end, attention is first called to the heater shown in Fig. 1. This figure illustrates a portion of a heater designed for heating cars, the intention being to heat the air directly by causing it to come into contact with the heated resistance wires. It is here shown without a casing, in order that the construction may be more apparent. It consists of a great length of resistance wire, loosely coiled so as to present a considerable radiating surface, which is wound into a spiral around a core of earthenware, porcelain or some other non-conducting and non-inflammable material; or the core may be a metallic one covered with insulating material. The latter is the construction shown in the figure. When the coil is wound upon the core, it is some-

cars, dwellings, etc., is shown in Fig. 2, the view being in section to clearly illustrate the construction. Here e is a cylinder of fireproof material, around which a resistance wire is wound, the resistance being covered with a coating of talc and silicate of soda mixed with water to form a paste. The cylinder is provided at either end with a flange, f, projecting a little above the surface of the tube to receive an outer casing, a, which is perforated to permit the air to circulate through the same around the core. In the particular form here illustrated the inner cylinder is provided with a diaphragm, g, which divides it into two compartments substantially equal in size. This is to prevent the air which enters the openings, h, with which the bottom of the tube is provided, from all passing out at one end of the heater. In operation, air enters the perforations in the outer casing and passes around the outside of the heated core, and also through the openings, h, and through the interior of the core. Suitable supports, b, are provided on which the heater stands. Should the resistance wire be burned out, the core carrying the same may be removed and another substituted therefor.

The electric heater is particularly useful in places where heat is needed, but where, from some reason, it

ly employed, and where it seems to fill a long felt want, is in the sick room, as a substitute for hot water bags, hot cloths, etc., in warming patients. For this purpose the heater is made flexible, so that it can be made to conform to any part of the body. The electric heater seems most admirably adapted for this purpose. The ease with which it can be moved about and applied whenever and wherever needed, its constant readiness and the ease with which its temperature can be controlled, all render it a most satisfactory substitute for the old apparatus used for this purpose.

Fig. 4 illustrates such a heater. It is a woven fabric, the warp threads whereof are of asbestos or other suitable insulating non-combustible material, and the woof threads of the same material, with three separate continuous and insulated resistance wires embedded therein and forming a part thereof. These conductors, therefore, are woven into the fabric and become a part of the same. By inserting a plurality of resistance wires, the heat can be readily varied by varying the number placed in circuit. For instance, if only a slight heat is wanted, one conductor may be thrown in circuit; if a greater amount is desired, two may be used; if still more, all three. The current, and, consequently, the heat, could, of course, be governed by a rheostat, but the above described construction avoids the necessity of any such instrument, and yet effects the necessary regulation. A suitable switch for throwing one or more of the conductors into circuit is always provided. In the figure, A designates the body of the heater. B, C and D represent the resistance wires, and E, F and G the insulation thereon. L, L' and L'' are the conductors which connect the wires to the switch. The entire heater is covered with some suitable material which protects the structure and adds a finish of the character desired. It may be of any suitable size, even large enough to entirely envelop the patient.

As a means for heating soldering irons and flat irons, the electric heater has been found very satisfactory. These implements, when in use, are almost constantly in motion, and, consequently, it is next thing to the impossible to apply to them any permanent heating means but the electric heater. Thus heated, the iron may be used indefinitely without change or rest.

A soldering iron heated in this manner is shown in Fig. 5. In this instance the heater is not simply a resistance coil, but is a combined resistance and induction apparatus. It is designed to be used with an alternating current, and comprises a primary coil, a secondary coil short circuited upon itself and a hard magnetic core. In the figure, A designates the point of the iron, B a magnetic plug therein, having an extension, C, of magnetic material, the two constituting a core. The extension, C, of the core is surrounded by a layer of iron wires, D. The core and wires, D, are surrounded by a resistance wire, F, the terminals of which are x and y. E is a metal casing surrounding the coil and core. This casing is also the secondary coil of the apparatus, it being of such a resistance as to be materially heated by the currents induced therein. I is an insulating plug and N a binding nut. When an alternating current is passed through the primary coil, this coil becomes heated by reason of its resistance; the shell becomes heated by the currents induced therein, and the magnetic core becomes heated by hysteresis or magnetic lag due to its changes in polarity. It will, therefore, be seen that the entire apparatus becomes quickly heated, and constitutes a very satisfactory heater for the purpose intended.

In heaters having large, flat surfaces, such as cooking stoves or tables, and irons, etc., no little difficulty has been experienced in securing a uniform distribution of the heat at different points on the surface. One means for overcoming this difficulty is shown in Fig. 6. A resistance wire of the ordinary kind is used. This is wound on a tapered mandrel, so that, when coiled, it presents the form of a helix, one end of which is larger than the other, the increase in size being regular and gradual. This helix is then disposed in the form of a spiral, beginning with the smaller end, which thus becomes the center of the spiral, so that the convolutions of the spiral and the convolutions of the helix both increase in size together as the distance from the center is increased. It will, of course, be readily seen that a unit length of the helix will include a larger amount of wire, and, consequently, have a greater resistance, at the outer end than at the inner. Therefore, it is equally clear that when such a coil is disposed on a plate in the form of a spiral, the plate will be heated to a practically uniform temperature over its entire surface, the excess of radiation from the parts more distant from the center being offset by the excess of heat supplied to these parts.

In the form of heater shown in the figure two enameled plates are provided, one a plain, flat plate and the other somewhat conical in form, to conform to the outline of the coil when in position. These plates are united at their centers and the coil is wound between them. In this particular instance two coils are used, they being laid side by side in alternate spiral paths. Each is provided with terminals, so that either or both may be thrown in circuit, according to the amount of heat required.

Referring now to the figure in detail, A and B designate the coils and C and D the enameled plates, the enamel being shown at E. A threaded boss, b, is arranged on the under side of the plate, C, and the plate, D, is provided with a perforated and threaded boss, d. A metal base, E, provided with feet, f, g, supports the plates and coils, and is rigidly attached thereto by means of a screw, s, and nut, h, the screw being passed through the boss, d, the threads of which it engages, and into the boss, b. By this means the parts are rigidly secured together, and at the same time the plates may be turned independently to vary the tension of the same upon the coils. The space between the plate, D, and the base, E, is filled with mineral wool or some other non-conductor of heat, W. The terminals, 5, 6 and 7, of the coils are fastened to the bottom of the base, E.

The same principle has been applied to sad irons. When thus applied, the helix, instead of being wound on a tapered mandrel, is wound upon one which increases in size by distinct steps, by which means there is produced a helix composed of two or more continuous sections, the convolutions of each section being all of equal diameter. For heating sad irons, the helix is usually wound in three sections. The base of the iron

is provided with grooves, and the upper surface thereof is enameled.

It is a matter of common knowledge that the rear portion of a sad iron loses heat more rapidly than any other portion, while the center loses the least. Therefore, when the iron is built, the smaller end of the helix is wound upon the center of the base; that which is next in size is wound upon the sides; and that which has the greatest diameter upon the rear portion. By this means an admirable distribution of the heat of the coil is effected.

The uses to which the electric heater have been put are very numerous, and many special forms have been produced for special purposes. No attempt, therefore, has been made to do more than give a brief description of some of the forms which have been more recently produced and show how they are to be used. The art is a growing one, and the time is doubtless near at hand when the electric heater will be a far more common sight than now. However, from the very nature of things, it cannot come into general use for household purposes until the current is produced much more economically than now. The cost of the current almost precludes its use for this purpose at the present time.

APPARATUS FOR REGISTERING THE OUTGOING AND INCOMING OF CARRIER PIGEONS.

CARRIER pigeon fanciers are becoming more and more numerous, and, in view of the important role that the bird plays in time of war, and that it is now playing in Madagascar and Tonquin, this is a thing to be rejoiced at. It is unnecessary to say that at such a time it is of the greatest interest to prevent any delay in the transmission of a dispatch carried by a pigeon, and, as a general thing, a watcher is intrusted with the duty of awaiting the bird's arrival. Aside from the fact that this man sometimes frightens the pigeon and prevents it from immediately entering the cote, one has to run the risk of negligence or dishonesty on his part.

These are inconveniences that are suppressed by the

fifty pigeons, it is necessary to have two manipulators. When all the pigeons are in the cote, the hands of the registering device should be at zero. For their exits the hands move in the direction of those of a watch, and, for their entrances, in a contrary direction. After the readings have been made, the hands are placed at zero by a pressure upon buttons provided for that purpose upon the face of the apparatus.

Besides this indication, which is very accurate, the pigeon, in passing over the pedal, may actuate an electric bell that announces its entrance or exit.—L'Illustration.

THE COMMENCEMENT OF SUBMARINE TELEGRAPHY.

By J. H. JACKSON, in the Nautical Magazine.

It is at once interesting and difficult to try to discover to whom is due the honor of inventing submarine telegraphy. Many nations have claimed the distinction, but so far as research enables a judgment to be passed, the palm must be awarded to a Russian scientist, Prof. Soemmering. This gentleman, in the year 1807 or 1808, first practically proved the possibility of so insulating a wire as to enable an electrical current to pass through it when immersed in water. His experiment took the form of exploding a small charge of gunpowder across a river. This experiment was repeated during a visit to France in 1815, and to his success in igniting the same explosive across the Seine we may attribute the attention which was at once aroused in the minds of all scientific men. They were quick to perceive that in these useless exhibitions there existed the germ of great potentialities. When, therefore, a few years afterward, Prof. Soemmering suggested to the Russian government the construction of a short cable connecting Cronstadt with St. Petersburg, he was favorably received and the requisite authority given. For some reason or other, not quite plain now, the project never became realized. This failure enabled an Irish doctor, resident in India, to be the first in the field with a practical telegraphic cable. In 1839 this Dr. W. O'Shaughnessy constructed in Calcutta a copper wire coated with cotton thread saturated with pitch and

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Vilpou electric registering apparatus, which permits the fancier to inform himself as to what is taking place at every instant in his cote, to verify the entrances and exits, and to learn whether strange pigeons have entered, etc. In order to learn all this, he has only to take a glance at the registering apparatus placed in his office, bedroom or parlor, so that there is no longer any need of his climbing up to his cote.

The apparatus consists of two parts, of a manipulator or automatic door and a registering device. The first of these consists of a sort of a wooden portico, between whose uprights there is a space of about 2 in. The two uprights are joined at the top by a horizontal bar of wood that supports a wire wicket mounted upon two pivots. When the wicket is pushed either backward or forward by the pigeon, it comes into contact with an electric tappet arranged against one of the sides of the frame. On each side of the wicket there is a pedal, which, at the passage of the pigeon, is depressed and interrupts the current.

Moreover, one of the uprights of the frame carries a small bar of wood capable of being turned down so as to arrest the wicket in case it is pushed toward the exterior. In consequence of this ingenious combination, it is possible to prevent a pigeon from making its exit, while allowing those that are still outside to enter the cote.

The object of the lattice work at the sides is to prevent the birds from making their way out in that direction or from stationing themselves near the entrance of the cote. The birds hasten to make their exit through the narrow passage, and in this way the access to the apparatus is always free.

It is easy to accustom the bird to experience no fright at the sight of this manipulator and at the slight resistance that it encounters in maneuvering the wicket.

The registering device, which may be placed as far away from the cote as may be desired (it is only a question of wire), comprises a clockwork movement actuated by two electrodes. It does not, therefore, have to be wound up. Over a dial that carries 60 divisions move two hands, the larger of which is designed to mark the divisions up to 60 and the smaller one those above 60. The dial is thus capable of registering the exits or entrances of 360 pigeons. There is no cote that possesses such a number. Moreover, for more than

tar, and with it transmitted signals from one bank of the Hugli to the other. In 1840 Prof. Wheatstone got the House of Commons to pass a scheme for a Dover-Calais cable, but nothing followed until ten years later. The brilliant success of the Irish experimenter was followed in 1842 by the laying down of a cable between Governor's Island and Castle Garden in New York, by Mr. Morse, whose name subsequently became a household word in matters telegraphic.

In 1844 Prof. Wheatstone transmitted messages to the Mumbles lighthouse from a vessel anchored in the bay; two years after this Mr. West laid a cable across Portsmouth Harbor. This was intended as an advertisement to encourage the French and English governments to proceed with a line connecting the two countries. Meantime, Americans were not idle, for in 1845 Ezra Cornell placed a two miles' length of cable between Fort Lee and New York, but the following winter's ice soon disposed of it. In 1847 Mr. Craven, of New Jersey, laid an iron wire, insulated with gutta-percha in the place of pitch and tar, in the waters of a small creek, and found that this substance afforded a marked increase in insularity. In the following year a similar line was laid between New York and Jersey City.

Lord Palmerston was much impressed with the reports of the success attending the foregoing experiments, as is evidenced by a prophecy he made in the House, that the time was surely coming when a minister, in reply to a question as to the existence of war in India, would say: "Wait a minute. I'll just telegraph to the governor-general and let you know." But few years passed by ere this prophecy was realized. Passing by the institution of two more cables insulated in gutta percha in the Hudson and at Kiel by Armstrong and Werner Siemens respectively, we come, in 1849, to another experiment carried out by Mr. West, already mentioned, with the same object in view. He judiciously chose a spot likely to become the locus in quo. He anchored the Princess Clementine some two miles off Folkestone, having previously connected the land ends of his cable with the 83 miles of line running by the Southeastern Railway's system to London, and successfully transmitted messages between the ship and the metropolis. The bait thus skillfully laid was swallowed. In the following year, 1850, a