L. H. ROGERS & W. A. SHAW.

Manufacture of Electrical Conductors.

No. 220,944. Patented Oct. 28, 1879.

Fig. 1.

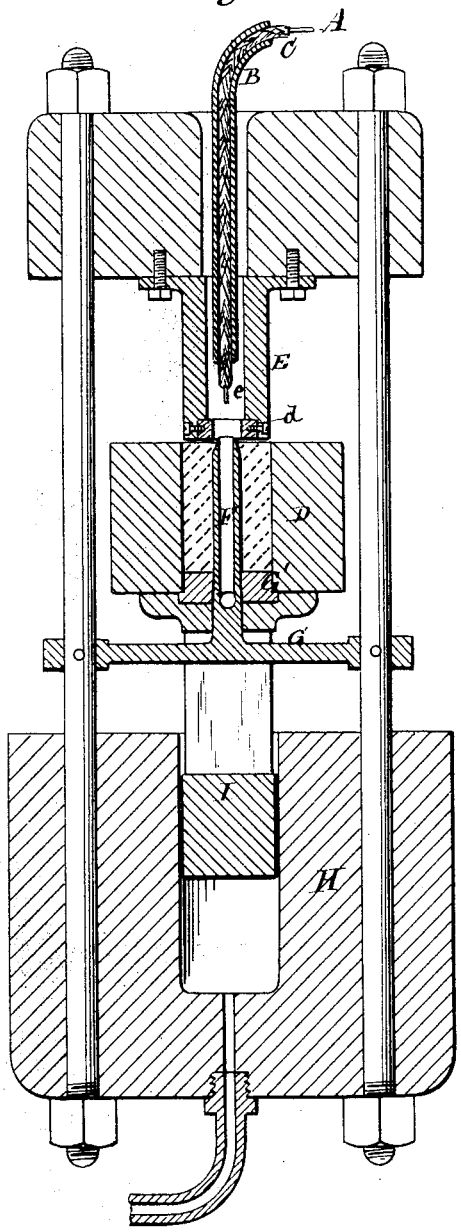


Fig. 2.

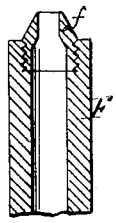


Fig. 3.

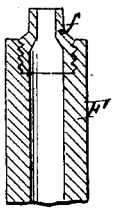


Fig. 4.

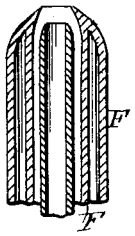


Fig. 5.

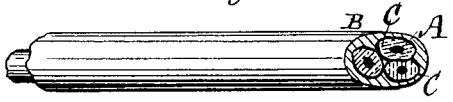


Fig. 6.

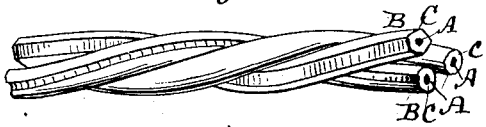
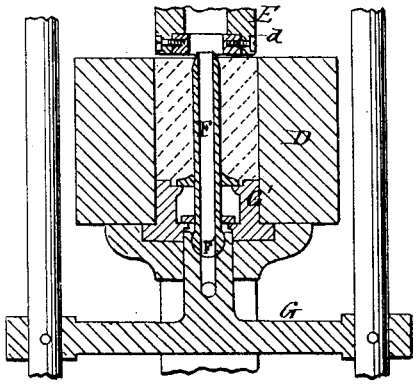


Fig. 1a.



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UNITED STATES PATENT OFFICE.

LEBBEUS H. ROGERS AND WILLIAM A. SHAW, OF NEW YORK, N. Y.; SAID SHAW ASSIGNOR TO SAID ROGERS.

IMPROVEMENT IN MANUFACTURE OF ELECTRICAL CONDUCTORS.

Specification forming part of Letters Patent No. **220,944**, dated October 28, 1879; application filed June 30, 1879.

To all whom it may concern:

Be it known that we, LEBBEUS H. ROGERS and WILLIAM A. SHAW, of New York, N. Y., have invented a new and useful Improvement in the Manufacture of Electrical Conductors, which improvement is fully set forth in the following specification.

This invention relates to the manufacture of a compound wire which is adapted to serve as a conductor of electricity, and is particularly applicable to use in underground telegraphs.

It consists in certain methods and apparatus employed in the manufacture, and in a new article or compound wire, as hereinafter more fully set forth.

The following description will enable those skilled in the art to which it appertains to make and use my invention, reference being had to the accompanying drawings, which form a part of this specification.

Figures 1 and 1ª represent a view in section of a modified pipe-press which is preferably employed in carrying this invention into effect; Figs. 2, 3, and 4, enlarged views of a portion of the core, and Figs. 5 and 6 views, respectively, of a compound wire formed of a number of wires inclosed in a single metal tube, and of a cable formed by twisting together a number of tubes, each inclosing a wire or wires. Fig. 1 illustrates also the manner of forming the compound wire by the apparatus shown.

The same letters refer to like parts wherever they occur.

A is a wire or conductor proper; B, a metallic protective coating or lead tube; C, insulating material; D, the lead cylinder of the pipe-press; E, the ram or plunger; F, the core, and G the core-bar.

The plunger is provided with a die, *d*, as well understood, and is perforated at *e*. The core F is hollow, and is held stationary at the mouth of the die by means of the core-bar G, attached to the steel rods, which serve to bind the top and bottom of the press together. At F′, Fig. 1ª, the core is jointed with a ball-and-socket connection, so that it is permitted to adjust itself in a central position with reference to the die.

G′ is a bottom piece, which is placed in the cylinder to prevent the lead squeezing out below. H is the ponderous hollow head-piece, and I the hydraulic piston.

The end of the core F is preferably provided with a detachable piece, *f*, which is beveled or tapered to a more or less fine edge, as shown in Fig. 2, to avoid undue pressure upon the wire, or it may be made of a less diameter than the body of the core, as shown in Fig. 3. The hollow in the core opens in the side of the piston.

In using the apparatus shown, the wire is enveloped with an insulating covering before it is introduced into the machine. This insulation is preferably made by means of a vitreous coating applied as follows: Spun glass is laid on and around the wire or conductor by a wire covering or braiding machine, by wrapping, plaiting, or braiding, or otherwise, and it is heated, if desired, to cause the better adherence of the slivers, or it may be coated with paraffine to increase its insulation. Asbestus fiber may be braided, plaited, or wrapped or otherwise placed around the glass-covered wire. The use of asbestus is desirable, as it protects the glass in subsequent operations. Very good results are obtained by laying spun glass lengthwise of the wire, and then wrapping, braiding, or plaiting asbestus fiber around it.

The wire thus coated is introduced through the core F and the die *d*, and the cylinder D being filled with lead or other plastic metal, the piston I is put in motion, and the wire emerges from the die through the ram with its metal sheathing enveloping and protecting it.

The opening of the end of the core should correspond with the size of the wire to be introduced through it, so that the wire fits snugly therein. The distance between the outer surface of the core and the interior of the die regulates the thickness of the lead tube. The core is therefore beveled, as shown in Figs. 1, 1ª, and 2, or turned to a less diameter, as in Fig. 3, and adjusted just within the die, so as to avoid undue pressure upon the insulating covering. By using a detachable end piece (marked *f*) the same core may be used for many sizes of conductors.

The compound wire as it is delivered from the machine may be wound upon reels or in

coils for storage, transportation, sale, or use. Long lengths may be made in one coil and uncoiled and buried in the earth without a single coupling.

While the coil of insulated wire is being drawn through the pipe-press it can be connected at each end with a battery, and a continued test as to its perfect insulation be made as it issues from the die covered with lead. The same test can be made over the glass coating before it receives its coating of lead.

Instead of forming the vitreous coating by means of spun glass an enamel applied in any ordinary or suitable way may be used.

What is known as "mineral wool" may be employed in place of or in addition to spun glass.

Powdered glass alone or mixed with borax, metallic oxides, and various alkalies, resins, or gums may be applied to the wire, and the whole consolidated by heat and pressure.

In cases where it is not considered essential that the resulting compound conductor should be flexible, solid glass instead of a flexible vitreous coating may be employed.

The wire can be covered with glass tubing by means of a pipe-press, the cylinder being filled with glass, which is kept in a plastic condition, or it may be otherwise introduced into a glass tube. This tube should be kept hot, so as to bend easily and not break while passing to the lead-pipe press to receive its outer protecting-cover. The tube may be of toughened or tempered glass.

To keep up the temperature of the glass after it passes into the hollow core, where heat cannot be directly applied, the core may be heated by passing currents of electricity through helices placed within its walls, or directly through the core-bar (should a core-bar be used) and core, the parts of the same being properly insulated where they are attached to the machinery. Similar arrangements can be made use of for heating the dies, cylinders, &c. The electricity is derived from dynamo-electric machines or other suitable sources. These methods of heating can be used with others now commonly employed.

Various materials may be used to form the insulating covering with or without a vitreous covering, applied before or after—for example, asbestus, asbestus packing, or other fibrous materials alone or treated with gums, oils, resins, and similar substances, asbestus with paper or other fibrous textile materials, gutta-percha alone or with glass, asbestus, and similar materials, gutta-percha, or rubber, or artificial rubber (kerite) mixed with sulphur to protect the rubber or gutta-percha in passing through the press, celluloid alone or with other materials—in fine, all kinds of flexible insulating materials or compounds which have the capacity to withstand the operation of passing through the die.

It is not necessary that the insulating material be applied wholly or at all before the wire is passed through apparatus for applying the metallic sheathing. It may be applied together with the latter from the same cylinder in a manner similar to that set forth in Letters Patent No. 37,877, Wm. A. Shaw, March 10, 1863, for the manufacture of tin-lined lead pipe, the insulating material, which must be plastic, taking the place of the tin, and the wire being delivered through the hollow core, which is held stationary with respect to the die.

Instead of a single cylinder two or more cylinders, plungers, and dies may be used in a manner similar to that set forth in Letters Patent No. 74,612, Wm. A. Shaw, February 18, 1868, two cores being used of the modified form shown in Figs. 1, 2, and 3.

Naked wire or wire covered with a vitreous coating or other insulating or protecting material may be fed to the dies, and it emerges in a continuous length from one die coated with one or more layers of insulating material, and from another with a metallic sheathing.

Instead of having two or more press-cylinders united in one apparatus they may be separated, the wire being conveyed from the one to the other, and treated, if desired, during the passage.

For example, naked wire or wire covered with a solid or fibrous covering—say, spun glass—may be passed through a die and coated with a plastic insulating material, gutta-percha, then covered with fibrous material—say, asbestus—by braiding, plaiting, or otherwise, and finally passed through the lead press and enveloped in the metallic sheathing.

The invention is not limited to any particular plastic material; but various substances or compositions, as well as those I have before indicated, may be used, such as clay, pulverized glass, plaster, and paraffine or petroleum, paper-pulp alone or mixed with gums, oils, &c.

In order to form a compound wire or conductor with a number of wires inclosed in a single metallic sheath, the wires covered with insulating material may be wrapped or twisted together and then passed through a press, which covers the whole with the metallic sheath, or with a plastic insulating material and then with a sheath.

The twisted wires may be treated in the manner described for a single wire, and each wire may be covered with fibrous or plastic insulating material, or both, as specified.

A compound conductor may also be constructed to carry a divided current or several currents, as follows: In order to distinguish the several strands or wires in the same sheath the wires or conductors themselves may be of different shapes, and they may be surrounded for a greater or less distance with insulating materials of different colors. When a vitreous coating is applied this may readily be effected by using glass covered by different oxides.

Asbestus may be treated with oil-paints, and

gutta-percha and similar plastic substances may be made colored by mixing coloring-matters of various kinds therewith.

A cable can be formed by twisting together a number of metal-sheathed wires. When this is the case, or when a number of compound wires or conductors are laid in the same trench, it is desirable to be able to distinguish them from one another for making connections or for other purposes, and to this end the metallic sheaths are formed with one or more longitudinal ribs, grooves, or projections, or made in different shapes. This result may be accomplished by making the dies by which the metallic sheaths are formed with slight projections or nicks, or of different shapes.

As shown, the die is fixed in the ram and the latter is stationary; but this is not essential. The die may be fixed in the cylinder and the plunger may be movable, as in ordinary pipe-presses. The core, however, when the die is movable should be movable with it, as the core is to be held stationary with respect to the die.

A movable core may be employed in covering single wires or several wires in the same tube, the wire naked or covered with fibrous, vitreous, or other insulating material being introduced, as hereinbefore described, plastic insulating substances being forced through the central perforation and completely filling all the space between the wire and the walls of the outer lead tube or sheathing.

Instead of using a floating core in the form shown, it may be of any suitable kind. Such as described in Letters Patent No. 74,611, granted Wm. A. Shaw, February 18, 1868, may be used, the core being grooved or made hollow, as before described, and attached to a core-bar, so as to be held stationary, or connected with the movable part of the press, as set forth.

The core may be constructed with several concentric chambers, as shown in Fig. 4, the wire being introduced through the inner one, paraffine or other plastic material through another, and a third closed at the upper end and divided longitudinally may be used for the circulation of water. The water being caused to flow up one side and down the other keeps the core cool and prevents injury to the wire and insulating material when those used are apt to be injured by the high temperature. Instead of using water, any suitable cooling or heating medium may be employed, if deemed desirable.

A heating medium circulated in the walls of the core could be employed in place of electric currents, before described, for keeping flexible the insulating material when formed of a glass tube. When paraffine is introduced in the manner just described it is introduced in a liquid condition and sets on cooling after leaving the die.

In some cases, if desired, a core may be dispensed with altogether, the wire being introduced through a perforation in the plunger or lead cylinder.

When it becomes necessary to unite two lengths of the compound wires or conductors couplings of any ordinary or suitable form may be used—as, for example, T or other shaped joints made complete or in halves, as stated in Letters Patent No. 151,166, Wm. A. Shaw, May 19, 1874.

The process and machinery, as above stated, may be used to coat "line-wires" with a thin film of lead or other ductile metal to prevent corrosion, as this product will stand better than galvanized wire, as is now commonly employed.

Instead of lead, the alloys described in Letters Patent No. 72,919, December 31, 1867, and No. 97,972, December 14, 1869, both issued to Wm. A. Shaw, may be used, as being lighter, stronger, and cheaper than lead.

The metal sheathing, by using two or more presses, or a press with two or more cylinders, may be made of two or more layers of the same metal or of different metals.

In some cases, when the wire or conductor proper is made of a plastic metal, it may be formed and coated with a protecting or insulating and protecting coating at one operation by means of a press with two, three, or more cylinders.

Having fully described our said invention, and the manner in which the same is or may be carried into effect, what we claim, and desire to secure by Letters Patent, is—

1. A flexible compound wire or conductor in continuous lengths, consisting of a wire or conductor insulated with a vitreous covering, and closely enveloped in a lead tube or sheathing of plastic metal, substantially as described, with a layer of asbestus interposed between said vitreous covering and metal sheathing, as set forth.

2. The method of covering wire evenly with plastic materials, the same consisting in passing the wire through a die, forcing the plastic material into close contact therewith as it passes through the die, and permitting to the wire sufficient freedom of movement sidewise to adjust itself centrally with respect to the plastic material, substantially as described.

3. The method of making compound wires or conductors, which consists in passing one or more wires covered with suitable insulating material through the core and die of a pipe-press, and retaining, by means of heat, the insulating material in a flexible or plastic condition while passing through the die, and simultaneously and progressively pressing through said die a sheathing of plastic metal, and applying the latter as it is formed to the insulated wire or wires, undue pressure upon the insulating material being prevented by the adjustment of the core of the pipe-press relatively to the die, substantially as described.

4. The combination, with the cylinder, ram, and die of a pipe-press, of a hollow or grooved floating core, substantially as described.

5. The combination, with the cylinder, ram, and die of a pipe-press, of a core containing

two or more chambers extending through the core into the die, and communicating by suitable openings with the outside of the press, substantially as described.

6. The method of forming compound wires or conductors, the same consisting in passing the wire naked or coated with insulating material through one or more dies, pressing out and applying a tube of plastic insulating material over said wire, and a tube of plastic metal over the tube of insulating material, the two tubes being pressed out simultaneously through one die, substantially as described.

In testimony whereof we have signed this specification in the presence of two subscribing witnesses.

LEBBEUS H. ROGERS.
WM. A. SHAW.

Witnesses:
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