(No Model.)

J. FARRELL.

MANUFACTURE OF LEAD COVERED ELECTRIC CONDUCTORS.

No. 262,029. Patented Aug. 1, 1882.

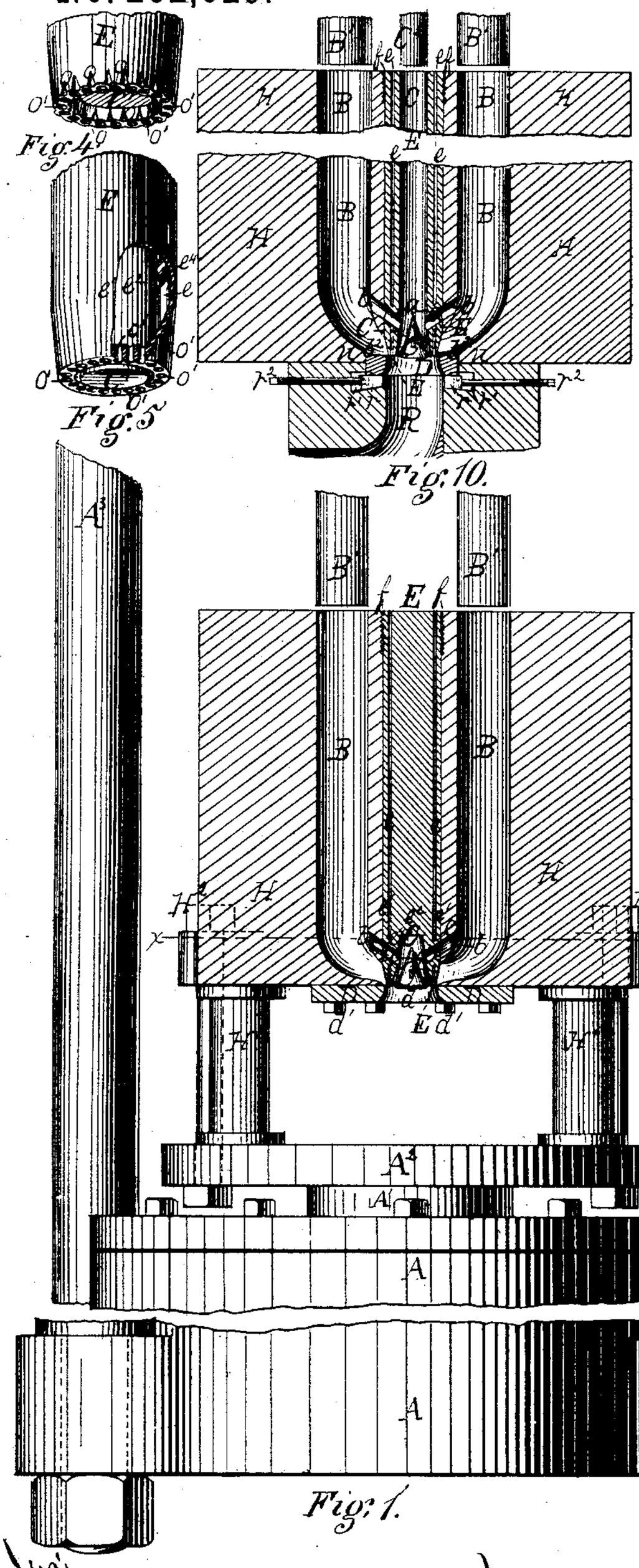

Fig. 1.

Fig. 4.

Fig. 5.

Fig. 10.

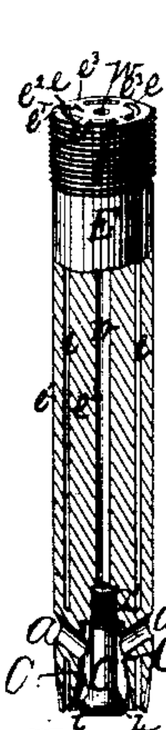

Fig. 7.

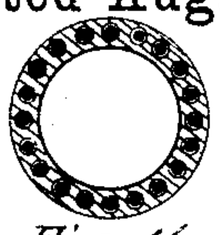

Fig. 11.

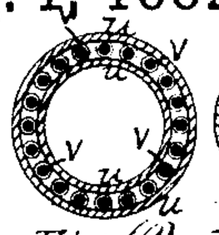

Fig. 12.

Fig. 13.

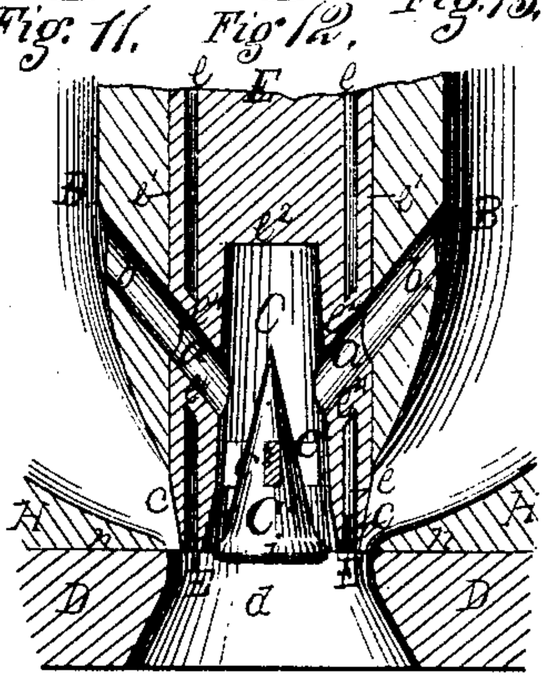

Fig. 2.

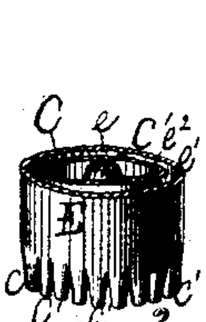

Fig. 3.

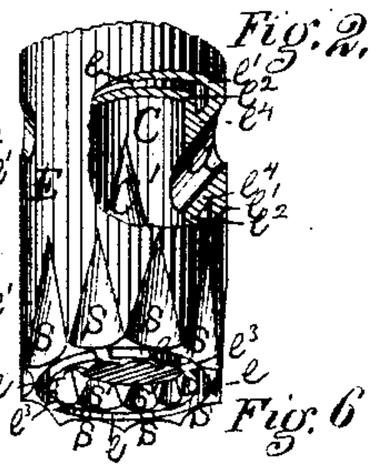

Fig. 6.

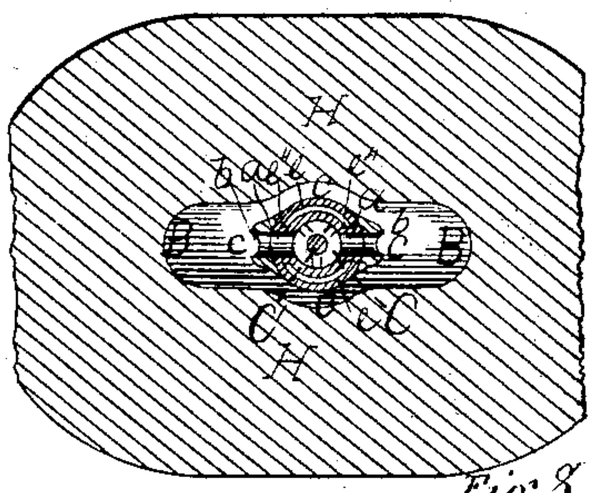

Fig. 8.

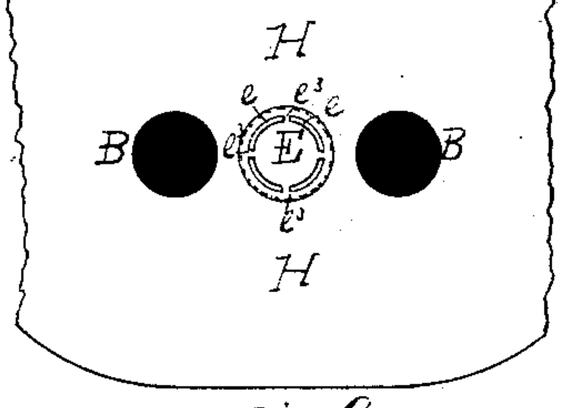

Fig. 9.

Witnesses.
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MANUFACTURE OF LEAD-COVERED ELECTRIC CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 262,029, dated August 1, 1882.

Application filed January 20, 1882. (No model.)

To all whom it may concern:

Be it known that I, JOHN FARRELL, a citizen of the United States, residing at Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in the Manufacture of Lead-Covered Electric Conductors; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

Figure 1 is a view in sectional elevation of parts of a machine for making lead-covered electric conductors or cables, the same being illustrative of my invention. Fig. 2 is a similar view, to an enlarged scale, of portions of the lead-cylinder, wire-holder, core, and die. Figs. 3, 4, 5, 6, and 7 are perspective views, to different scales, of portions of the wire-holder, and showing the same with modifications in form and construction adapted to carry out my invention in forming different styles of conductors. Fig. 8 is a transverse sectional view of the cylinder and wire-holder drawn to the scale of Fig. 1, and taken in the direction of the line *x x*. Fig. 9 is a top plan view of the cylinder and wire-holder. Fig. 10 is a vertical sectional view, illustrative of certain modifications in details of construction, as hereinafter described; and Figs. 11, 12 and 13 are transverse sectional views of different forms of lead-covered conductors, illustrative of the product secured by different modes of applying my invention.

Heretofore in making lead-covered electric conductors of the general class illustrated by Figs. 11, 12, and 13 it has been customary to form the inner wall or body of the lead covering by forcing the requisite quantity of lead inward between the wires at or below the point of the mandrel or core. In order to do this, it has been necessary to separate the wires considerably to afford sufficient passage-way, resulting in the use of a considerable quantity of lead to cover a comparatively small number of wires.

My present invention consists in part in a new method of applying lead under pressure to form the covering of the wires, and in part in certain improvements in the construction of the wire-holder, core, lead-cylinder, and die of the press, and in combinations of such parts, as hereinafter described and claimed, whereby the wires of the cable or conductor may be brought close together or arranged compactly, and lead be supplied to cover them at or below the point of the wire-holder both through the interior of such holder and also around its exterior.

In the drawings, A represents the cylinder, A′ the piston-stem, and A^2 the platen, of a hydraulic press. The cylinder A is connected by columns A^3 with an upper cross-head, (not shown,) these parts constituting a frame-work the details of which may be of any suitable form and construction. A lead-cylinder, H, is supported on the platen A^2 by tubular blocks H′ and bolts H^2, so as to be movable therewith. Instead of the blocks H′, one central block, R, may be employed to support cylinder H, as presently described with reference to Fig. 10.

In cylinder H are formed by preference two vertical and parallel lead-chambers, B B. Two corresponding rams or plungers, B′ B′, are secured to the upper cross-head in any convenient way in proper position to enter the chambers B B and force the lead therein downward as the cylinder is raised.

To the under face of cylinder H is secured the die D by bolts *d′* or otherwise. The central opening, *d*, of this die corresponds in form to the desired exterior form of the conductor, as round, oval, or other form, as may be preferred. The two lead-chambers B B converge at their lower ends toward and open into the die, and in so doing they unite and form an annular chamber, *c*, around the lower end of the wire-holder E, as represented in Fig. 8.

This wire holder or guard is represented of cylindrical form, and fits closely in a vertical central bore or passage, E′, in the cylinder-block, into which it is screwed by threads *f* at the top or at the bottom of the passage, as desired. This holder extends downward to or slightly into the die-opening *d*. An annular wire-passage, *e*, is formed in this holder, extending from the upper end downward to, or nearly to, the lower end or point. The outer shell, *e′*, is connected with the central body, e^2, by any desired number of bars or bridges e^3 e^4.

The wires to be covered with lead are passed through the annular space, being carried around the bridges e^3 e^4 wherever the latter may chance to come in the direct line of passage. On the lower point of the holder are made by preference separate pipe-like nipples c', (see Fig. 3,) leading from the annular passage e, for separate passage of wires, downward to the die-opening d. One purpose of these nipples is to hold the wires apart in proper relationship as the lead covering is applied to them within the die, and they also direct the flow of lead into the spaces between adjacent wires. These results may be secured in other ways, however, as hereinafter described, without departing from my present invention.

As the plungers B′ B′ press upon the lead in chambers B B it is forced downward through chamber c, around the lower end of wire-holder E, and through the die-opening, thus forming the exterior wall of the lead covering of the wires. Lead for the interior wall or central body is supplied as follows: Through two bars, e^4, which support the outer shell, e', of the wire-holder, are made lead-passages a a, adapted to register with corresponding holes, b b, in the inner walls of lead-chambers B B. These holes a and b permit passage of lead from each chamber B, by preference in a downward direction, to a central chamber, C, formed in the lower end of the holder within the wire-passage e. The holes a b and chamber C may be made of any desired capacity, depending upon the amount of lead required to form the inner wall or central body of the conductor. Ordinarily a pipe-like conductor is preferred, having the wires embedded in the body of its walls, as illustrated in Fig. 11, and in order to give such pipe-like form to the inner wall I employ a core, C′, which may be made integral with the wire-holder E by connecting bars or bridges c^2 in any desired number, as illustrated in Fig. 2; or the upper end of such core may be screwed into a tapped socket, a', in the central part, e^2, of the holder. I prefer to flare or enlarge this core downward, forming a button, i, on its lower end, the largest diameter of which is in or near the plane of least area of die-opening d. The purpose of this button or flare i is to direct the flow of lead outward to meet and balance the inward flow from the exterior of the holder. By adjusting the lower extremity of wire-holder and core a proper distance into the die-opening this inner and outer flow of lead may be made to meet in or near the circle or line of wires, and thus, filling the spaces between wires, form a solid covering, as in Fig. 11, without passing between wires more lead than is required to fill such intermediate spaces. Consequently the wires may be placed as closely together or compactly as may be consistent with their successful use, and any desired thickness of lead walls or covering be applied to them, the inner wall being formed by a flow of lead through the center of the wire-holder within the wires, and the outer wall being formed by lead flowing downward outside the wires. Instead of taking this central supply or flow of lead from chambers B B, as described, the chamber C may be extended upward through the holder, as represented in Fig. 10, thus forming an independent lead chamber or cylinder, from which lead may be forced by ram C^2 simultaneously with that in chambers B. It will be found convenient, however, to retain communicating passages a b from chambers B B to C, which may be either horizontal or inclined, as shown, in order to equalize the pressure and discharge from such chambers. Such equalization is most readily secured, however, by supplying chamber C from chambers B B, as illustrated in Figs. 1 and 2, and for this reason I prefer such construction. It is obvious, also, that one chamber B or three or more such chambers may be used instead of two, as shown, provided such chamber or chambers lead to a surrounding chamber, c, at sufficient height above the extremity of the wire-holder to give the lead equal flow and pressure around it within the die. In thus converging chambers B B through chamber c to the die-opening the bottom walls, n, of the cylinder are carried under such chambers, so as to receive the downward pressure of lead from the plungers or an excess of such pressure over upward pressure on the cylinder. The die D, being secured to the under face of these cylinder-walls n, is protected thereby from downward lead-pressure; also, the wire-holder E, being screwed into the center of the cylinder, has practically a rigid connection therewith, and upward pressure upon it within chamber C, Fig. 2, is nearly balanced by downward pressure upon core C′, so that any excess of upward pressure upon the holder, when arranged as in this figure, will not be sufficient to displace it or separate it from the die. In case, however, the construction illustrated in Fig. 10 be employed, there will be an excess of downward pressure upon the holder, and if equalizing-passages a b be provided this excess of downward pressure upon the holder will be the same for equal area as upon the cylinder. Thus in either form almost the entire working strain is expended on the cylinder H, and very little, if any, is effective in causing a separation of the wire-holder and core from the die. This I consider an important feature of my invention.

The die D, Fig. 2, may be adjusted toward and from the point of the wire-holder and core by liners of the usual or any desired construction placed between the die and the bottom face of the cylinder; or, if preferred, the means of adjustment shown in Fig. 10 may be employed, in which the die is shown resting with the cylinder upon a tubular block, R, the die being moved vertically by sliding wedges r, which are seated in suitable recesses, r', in the block and moved by screw-rods r^2, extending outward through the block.

In order to prevent lead from entering the joint between the block and cylinder, the upper face of the die is raised above such joint, and

its sides are fitted closely in the opening b^2 in the cylinder-bottom. In this construction there will be downward pressure upon the die equal for given area to that upon the cylinder and holder, and, as these parts are supported upon the platen of the press by a common block, R, there will be little or no tendency during work to disturb any previously-determined adjustment of these parts.

I have illustrated the wire-holder E terminating at its lower end in several different forms adapted to form different kinds of lead coverings, as may be desired.

In Fig. 3 separate pipe-like nipples *c'* are shown, through which the wires pass, the purpose and function of which have been described. They serve an additional purpose, however, in protecting the wires and their insulating-coverings from injury by too great pressure of lead thereon, the lead covering being given a tubular form around each wire before coming in direct contact therewith. Substantially the same results may also be secured by the form of holder shown in Fig. 4, where notches or grooves *o* are made both in the inner and outer walls of the holder between separate perforations *o'*, which latter afford separate passage for wires from the annular space *e* to the die. These notches *o* will give direction to the flow of lead into the spaces between adjacent wires, thus forming a solid metallic envelope for the separate wires, like Fig. 11, substantially in the same manner as the holder, Fig. 3, having separate nipples.

By omitting the notches *o*, as in Fig. 5, but retaining the separate perforations *o'*, a conductor may be formed, like Fig. 12, having two concentric pipes, *u u*, with the insulated wires *v* pressed more or less tightly between the two pipes, depending upon the relative adjustment of wire-holder, core, and die.

By varying the depth of notches *o* from the forms shown in Figs. 3 and 4 to the plain surfaces, Fig. 5, the character of the filling between adjacent wires may be varied from a solid covering, Fig. 11, to the form Fig. 12 without any metal between wires, thus filling such intermediate spaces to any desired extent with metal, and leaving more or less space, as may be desired, to be filled with any suitable preservative or insulating material, which may be forced into such spaces in any of the ways known in the art.

In Fig. 6 I have shown a portion of a wire-holder in which the separate perforations for the wires are not employed, the annular passage *e* being extended to the lower extremity of the holder. Strengthening-bridges e^3 may be used as required, between which any desired number of wires may be passed downward to the die. In order to space such wires, grooves *s s'* are made in the holder, both on its inner and outer walls, similar to the notches *o*. These grooves are deepened and enlarged toward the lower end. They are arranged in pairs directly opposite, taken in radial lines, and the flow of lead both from the interior of the holder through chamber C and also around its exterior, being directed by such grooves, will press the wires on all sides and hold them in line between successive pairs of grooves.

In making round conductors, with the wires arranged in circles, I prefer the perforated holder, Figs. 3 and 4; but in this and other forms, with the wires differently arranged, the holder Fig. 6 may be used with good results.

The particular method and means involved in this wire-holder for spacing wires by lead-pressure alone considered are not claimed herein, but will form the subject-matter of a separate application.

The same principle of central and exterior flow of lead is involved in all these forms of holders, and I have shown them with special reference to illustrating different constructions of details with which my present invention may be applied.

In Fig. 7 I have shown a wire-passage, *w*, made through the longitudinal center of the holder, of size adapted to receive one or more wires. By replacing core C' (shown in this figure) with one having a central passage corresponding to passage *w* and a plain cylindrical exterior a central wire or wires may be covered with lead along with the surrounding wires, as illustrated in Fig. 13; or, on the other hand, the core C' may be omitted entirely and a solid cable or conductor be made. In such solid conductor, as well as in those before described, the lead for forming the inner body within the wires is supplied by the central flow through chamber C. Consequently the wires may be placed closer together than would be practicable if the lead for the inner wall or body be forced from the outside between the wires.

Ordinarily a form of conductor is preferred which requires a small quantity of lead to cover separately a large number of wires—for example, like that shown in Fig. 11—and while I have illustrated my invention by a construction of parts adapted to form what I now consider a preferable form of conductor, I do not wish to limit it to such application, since by obvious changes, and without departing therefrom, it may be applied in substantially the same way to form cables of various other forms in cross-section—as oval, flat, angular, corrugated, or ribbed—with wires arranged within the same in any desired manner.

In making such conductors by methods heretofore practiced difficulty is experienced not only in passing between the several wires from their exterior the requisite amount of lead for forming the inner wall, but also it is especially difficult to secure a proper union of lead on the inner side of the wires, so as to form a continuous or unbroken inner wall, and even with the exercise of care and skill breaks, openings, or flaws are liable to occur in such inner wall, one of which may injure or practically destroy a large amount of cable. This feature of difficulty is peculiar to the working of lead and similar soft metals which are made

to unite under heavy pressure, and the difficulty is greatly increased by the presence of the wires in close relationship. By applying the lead in separate supplies to form the inner and outer walls of the covering, as above described, this peculiar difficulty is effectually obviated.

In describing this improved process I have illustrated the wires arranged in a circle around the central lead-passage, C; but I do not wish to limit my invention to this specific form, as the wires in any desired number may be arranged in zigzag or other more or less irregular lines around the central lead-passage, and be covered or incased by the two separate lead-supplies applied to the inner and outer sides of such lines simultaneously under pressure, whereby an adhesive union is formed between the two lead-supplies, and each wire is separately incased in and surrounded by a body or covering of lead, as before described.

The process herein described of making cables, substantially such as shown in Fig. 12, where the wires are pressed and held between two concentric pipes, will, in so far as the same may involve patentable invention not covered herein, form the subject-matter of a separate application for patent.

I claim herein as my invention—

1. The method herein described of making lead-covered electric cables, consisting in arranging the conducting-wires at intervals in circular or equivalent order, directing two separate lead-supplies simultaneously into a common body upon the inner and outer sides of the line of wires, and subjecting both lead-supplies to pressure at the point of junction, whereby an adhesive metallic union is formed between the two around the separate wires, substantially as set forth.

2. In combination with one or more lead-cylinders and the die of a lead-press, a wire-holder for conducting two or more wires to the die, a lead-supply passage from a lead-cylinder to the die outside the holder surrounding the wires, and a lead-supply passage from a lead-cylinder to the die within the wires through the interior of the holder, substantially as set forth.

3. In combination with the cylinder and die of a lead-press, a wire-holder for passing wires through the cylinder to the die, one or more lead-chambers within the cylinder leading to the die outside of and surrounding the wires, a lead-chamber within the wire-passage in the holder leading to the die, and lead-passages communicating between such exterior and interior chambers, substantially as set forth.

4. In a lead-press for making pipe-like electric conductors, the combination of a die, a wire-holder for passing wires to the die, a lead-supply chamber outside the holder leading to the die, a lead-supply chamber within the wire-passage in the holder leading to the die, and a core secured in or near the mouth of the latter chamber, substantially as set forth.

5. A mandrel for a lead-press, provided with an annular wire-passage, *e*, and a lead-supply chamber within such passage, in combination with a core secured in the mouth of such chamber, substantially as set forth.

6. In a press for covering electric-circuit wires with lead, the combination of a die for shaping the exterior of the lead covering, a wire-holder, as described, for passing wires separately to the die, a lead-chamber leading to the die through the interior of the holder within the wire-passage, and a core for directing the flow of lead from such chamber outward toward the walls of the die, substantially as set forth.

7. A lead-cylinder, H, having two or more lead-chambers therein converging to a common discharge, in combination with central wire-holder, E, provided with wire-passage *e*, and having within such wire-passage a lead-chamber, C, with lead-passages *a b* leading therefrom to each of the surrounding lead-chambers, substantially as set forth.

8. In combination with the die of a lead-press, a wire-holder having separate wire-passages leading to the die, with grooves or depressions in its inner and outer walls at the point between such passages, a lead-supply chamber leading to the die outside of and surrounding the holder, a lead-supply chamber leading to the die through the interior of the holder, and a core for deflecting outward the flow of lead from the latter chamber, substantially as set forth.

9. A lead-press cylinder having two or more lead-chambers therein converging to a common discharge, with a bottom wall, *n*, integral with the cylinder, projecting under such chambers, in combination with plungers for forcing lead from the chambers, a die, D, secured to the outer face of wall *n*, through which the lead is forced, a wire-holder secured to the cylinder between the lead-chambers, a lead-supply chamber, C, within the wire-holder, and a core at the mouth of the latter chamber for shaping the interior of the lead covering of the wires, substantially as set forth.

10. In combination with a lead-cylinder and plunger, such cylinder having a lead-discharge in the same direction as the plunger-stroke, a die secured to the cylinder in the line of such discharge, and a wire-holder secured directly to the body of the cylinder above the die, substantially as set forth.

11. A mandrel, E, for a lead-press, having a central lead-supply chamber, C, therein, a passage, *e*, for two or more conducting-wires, surrounding the central chamber, and lateral lead-passages *a*, leading from the exterior through the wire-passage to the central chamber, substantially as set forth.

In testimony whereof I have hereunto set my hand.

JOHN FARRELL.

Witnesses:
C. L. PARKER,
R. H. WHITTLESEY.