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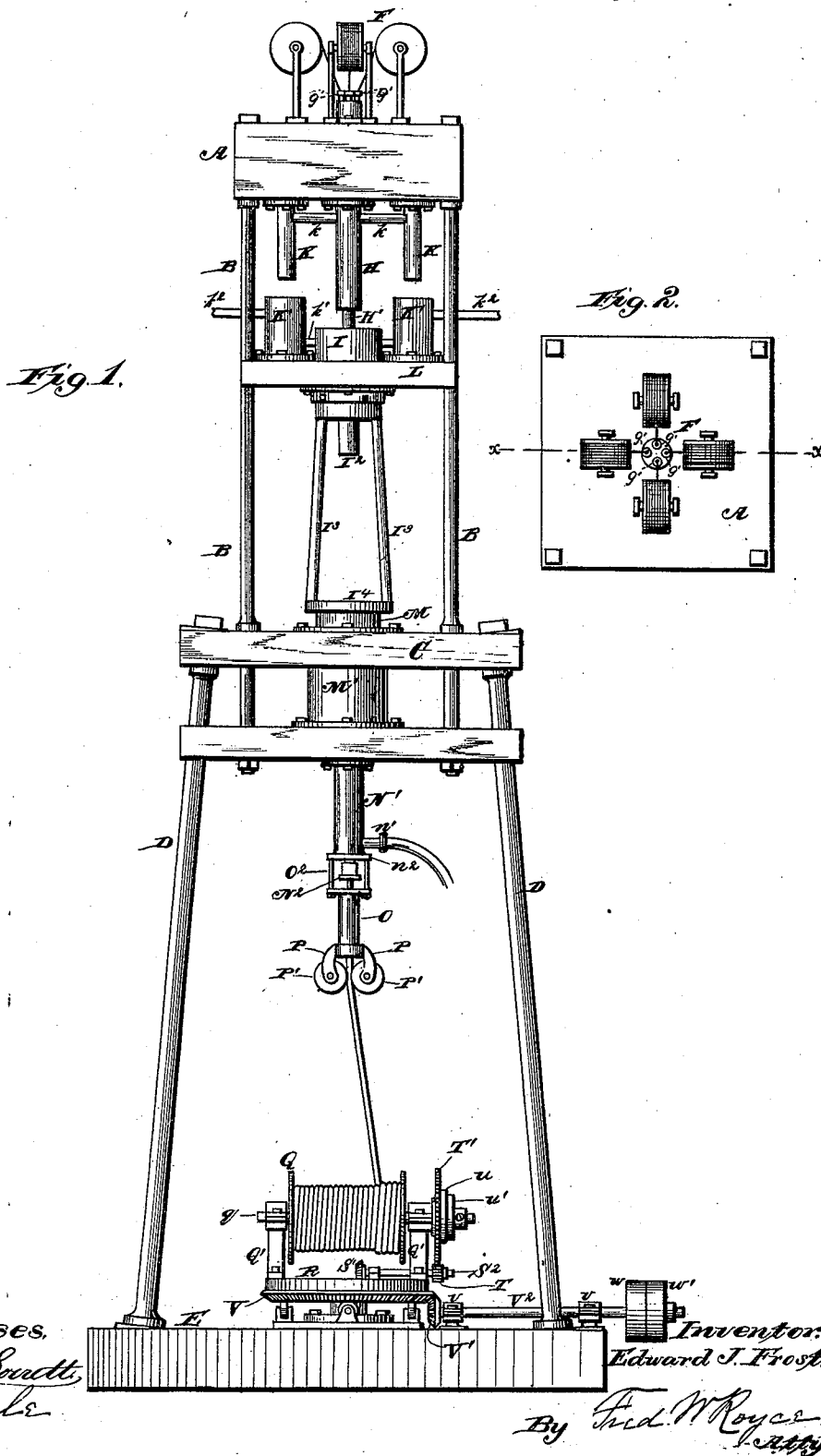
3 Sheets—Sheet 1.

E. J. FROST.

MACHINE FOR THE MANUFACTURE OF ELECTRIC CABLES.

No. 244,120.

Patented July 12, 1881.



Witnesses,
Robert Everett,
W B Hale

Inventor:
Edward J. Frost

By *Fred W Royce*
att'y

(No Model.)

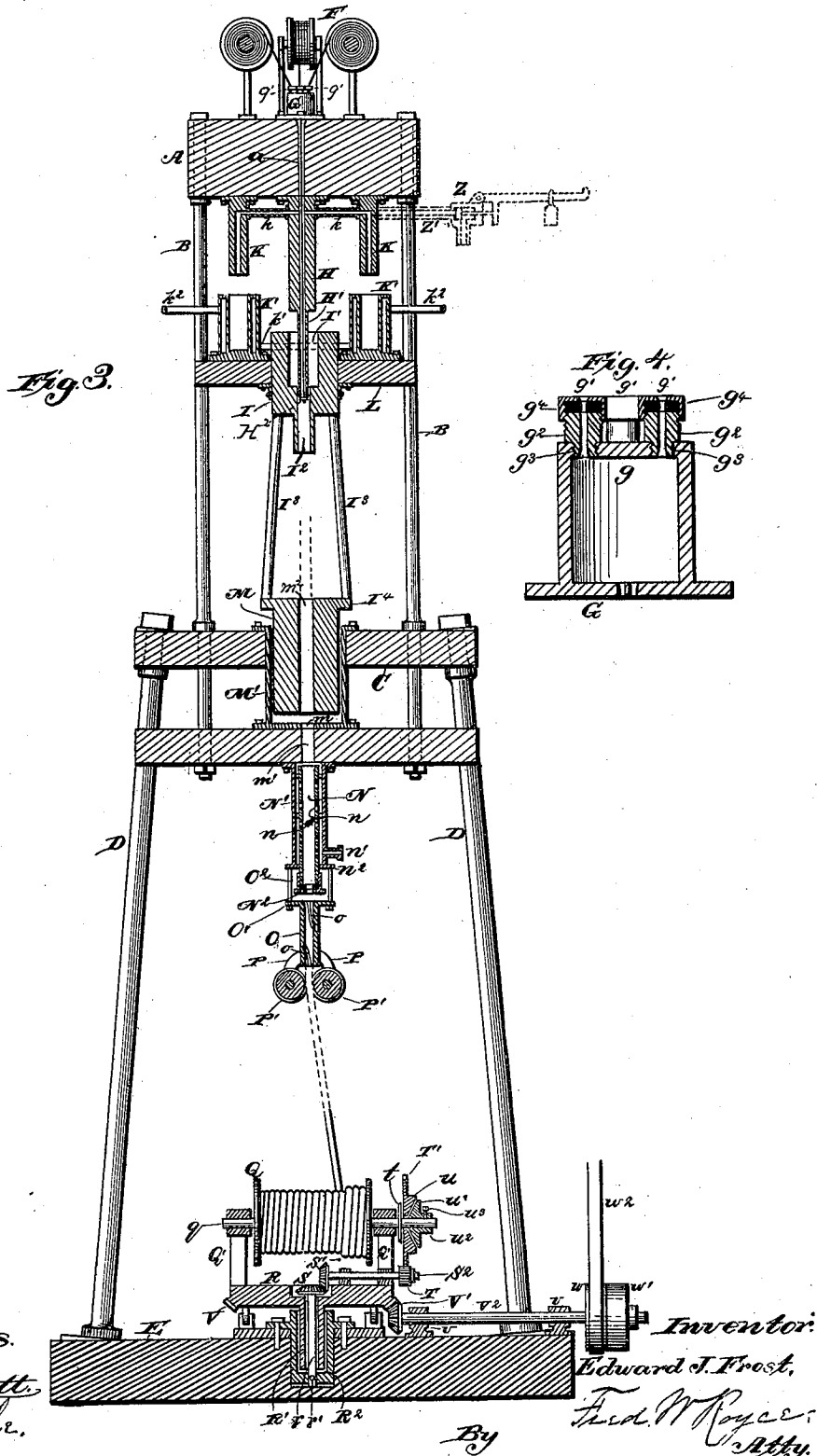
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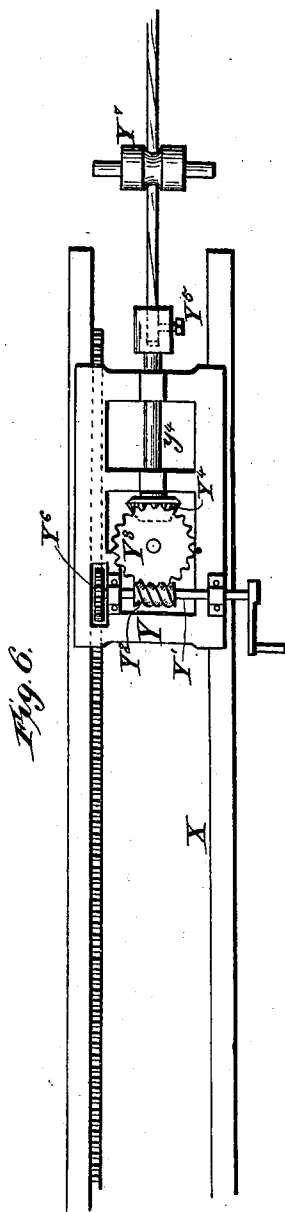
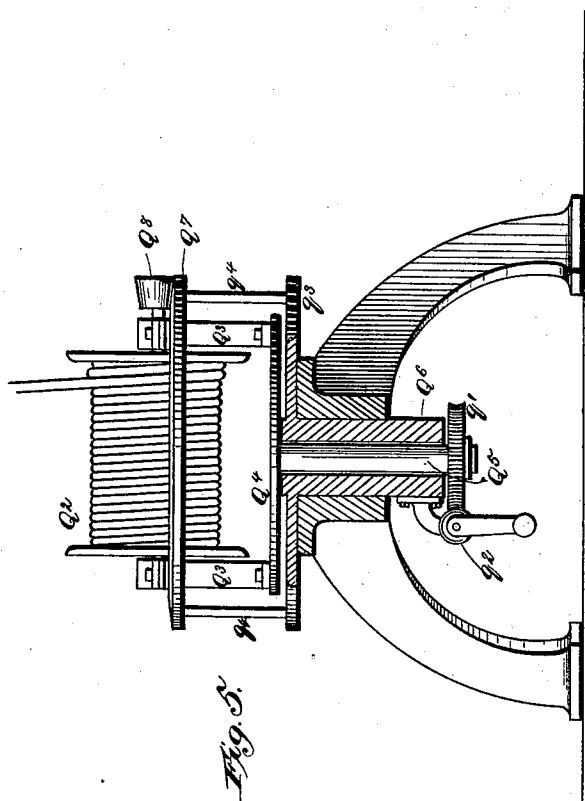
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3 Sheets—Sheet 3.

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MACHINE FOR THE MANUFACTURE OF ELECTRIC CABLES.
No. 244,120.

Patented July 12, 1881.



Witnesses.

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UNITED STATES PATENT OFFICE.

EDWARD J. FROST, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO
WILLIAM J. PHILIPS, OF SAME PLACE.

MACHINE FOR THE MANUFACTURE OF ELECTRIC CABLES.

SPECIFICATION forming part of Letters Patent No. 244,120, dated July 12, 1881.

Application filed May 23, 1881. (No model.)

To all whom it may concern:

Be it known that I, EDWARD J. FROST, a citizen of the United States of America, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Machines for the Manufacture of Electric Cables; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My invention relates to a machine for the manufacture of that class of electric cables in which the conducting-wires are spiral in form and surrounded by a non-conducting or insulating substance inclosed within a flexible tube.

The object of my invention is to produce a machine by which the wires and insulating substance are placed in a lead tube while it is being formed, and by which the lead tube, as it leaves its forming-die, is automatically twisted for the purpose of giving spiral form to the wires; and, further, to secure the perfect filling of the space within the tube around the wires with the insulating substance.

In the accompanying drawings, Figure 1 is a side elevation of a machine constructed according to my invention. Fig. 2 is a top view of the same. Fig. 3 is a vertical section in the plane indicated by the dotted line *xx*, Fig. 2. Fig. 4 is an enlarged diametric section of the stuffing-box and templet through which the wires pass to the mandrel. Fig. 5 is a side elevation of a modification of the reeling and twisting apparatus. Fig. 6 is a plan view of another modification for twisting without reeling.

Referring to Figs. 1 and 3, the letter A indicates a head-piece, supported by four corner-posts, B, which stand upon a platform, C, which is supported by legs D, the lower ends of which rest upon and are secured to a base, E. Upon the top of the head-piece A are supported, between suitable standards, the wire-

delivery reels F, four of which are shown in the drawings; but a greater or less number may be used, according to the number of conductors the cable is to contain.

Centrally upon the top of the head-piece is arranged a templet, G, having near its center perforations equal in number to the wires, and arranged to guide the wires in proper position to the hollow mandrel below. Upon the top of the templet is arranged a short hollow cylinder, *g*, having its top closed, and into the top of this short cylinder are inserted stuffing-boxes *g'* for the wires to pass through. These stuffing-boxes will be hereinafter particularly described.

Vertically through the head-piece A is a passage, *a*, not quite equal in diameter to the bore of the tube which is to inclose the cable, and from the center of the lower surface of the head-piece A there projects downward a hollow plunger, H, the bore of which is preferably of the same size as the passage *a*, and coincides therewith, and from the center of the lower end of this plunger there projects downward a tubular mandrel, H', the bore of which is of the same size as, and coincides with, that of the plunger.

Immediately under the plunger is a cylindrical vessel, I, the chamber I' of which is of a diameter to receive snugly the plunger H, and through its bottom is a cylindrical passage, I², through which plays the mandrel H', the said passage having a diameter to leave around the mandrel a proper space in which the lead tube is to be formed. The mandrel, plunger, vessel I, chamber I', and passage I² constitute the essential features of a pipe-press.

From the under surface of the head-piece A, and on opposite sides of the plunger H, there project downward two additional plungers, K K, having central bores, which are connected with the bore of the plunger H by cross-pipes *k* and suitable transverse passages coincident therewith in the plungers, respectively. Directly under these plungers K K are melting-vessels K' to snugly receive the same, these vessels being surrounded by steam-jackets, which are connected by a pipe, *k'*, and which are respectively provided with pipes *k*², by

which they may be connected with any suitable apparatus for causing a circulation of steam through them. These vessels K' rest upon a vertically-sliding platform, L , secured to and through the center of which is arranged the vessel I of the pipe-press, the platform L being provided at its corners with suitable guides, which embrace and play vertically upon the post B .

- 10 The vessel I is supported by legs I^3 , the lower ends of which rest upon a platform, I^4 , from the lower surface of which projects downward the plunger M of a hydraulic jack, of which M' is the cylinder, resting upon the platform C .

- 15 Through the center of the bottom of the cylinder M' is formed an aperture, m , which coincides with an aperture m' through the platform. From the bottom of this platform there projects downward a tube, N , somewhat larger in diameter than the pipe which is to be formed by the pipe-press, and the wall of this tube has through it all around, for the greater portion of its length, a multiplicity of perforations, n , while the lower end portion of said tube, which is not perforated, has screwed upon it a stout metallic disk, n^2 , tapped centrally to receive it, and projecting a suitable distance laterally.

- 30 Surrounding the tube N is a larger tube, N' , not perforated, and having its upper end secured to the under surface of the platform C , while its lower end, outside of the tube N , is closed by the disk n^2 , to which it is firmly secured. Near its lower end the tube N' has connected to it a pipe, n' , which may be connected with any suitable water-forcing apparatus.

- Upon the lower screw-threaded end of the tube N , below the disk n^2 , is screwed a stuffing-box, N^2 , through the head of which is an aperture, through which the pipe to be formed may snugly pass, and between said head and the end edge of the tube N is arranged a packing-ring of suitable material, which the stuffing-box will press closely against the surface of the pipe as it passes through.

- Immediately below the tube N is arranged a guide-tube, O , having a flange, O' , which is connected to the disk n^2 by rods O^3 , between which access can be had to the stuffing-box N^2 for removing and replacing it, the distance between said stuffing-box and the tube O being sufficient for that purpose. The bore of the guide-tube O is of the same size as and coincides with the aperture in the head of the stuffing-box.

- From opposite sides of the lower end of the tube O there curve downwardly two short arms, P , having pivoted at their lower ends grooved guide-pulleys, with their peripheries opposite and adjacent to each other, being at a proper distance apart to permit the completed cable to pass between them in their grooves as it comes from the guide-tube.

- 65 At a proper distance below guide-pulleys P' to permit a free swing of the cable is arranged the reel Q , upon which said cable is to be

wound. This reel is journaled horizontally in standards Q' , which rest upon a turn-table, R , from the center of which there projects downwardly a short shaft, R' , which fits in a socket, R^2 , inserted in the base E . This shaft R' is hollow, and downwardly through it extends a cylindrical standard, r , the lower end of which projects through an aperture in the bottom of the socket, and is fixed therein by means of a pin, r' . Upon the upper end of this standard r , which projects above the upper surface of the turn-table, is fixed a bevel-gear, S , which meshes with a similar bevel-gear, S' , fixed upon the end of a shaft, S^2 , mounted in bearings upon the table and projecting radially beyond the periphery thereof. Upon its outer end this shaft S^2 has fixed a small gear-wheel, T , which meshes with a much larger gear-wheel, T' , loose upon the projecting end of the shaft q of the reel. Concentrically upon the outer face of the wheel T is fixed a disk, u , the outer face of which is dished or concave.

The letter u' denotes a disk having its inner surface convex to correspond with the concavity of the disk u . It is mounted upon the shaft Q , and is provided with a hub, u^2 , through which passes a set-screw, u^3 , by which it may be secured to said shaft. By moving the disk u' closely against the disk u , pressing the gear-wheel T' against the collar t behind it and securing the disk u' , the said gear-wheel T' will be held by friction with sufficient force to cause it, when rotating, to carry around with it the shaft q and the reel Q . The friction, however, may be so adjusted by regulating the position of the disk u' that the wheel T will turn independently of the shaft when a certain resistance is opposed to the rotation of reel.

Upon the outer margin of the under surface of the turn-table R is fixed an annular bevel-gear rim, V , which meshes with a small bevel-gear, V' , fixed upon the end of a shaft, V^2 , mounted in bearings v upon the base E , the end of said shaft projecting outwardly beyond the legs D , and provided with fixed and loose belt-pulleys w w' , in the usual manner.

The operation of the apparatus as now described is as follows: The wires from the reels F are led downward through the stuffing-boxes g' and the perforations in the templet G , and thence downward through the passage a , hollow plunger H , and tubular mandrel H' , their lower ends being passed through perforations in a small templet, H^2 , placed against the lower end of the mandrel and knotted under said templet, so that they will not draw back through it. The vessels K are then filled with a fusible insulating material, and steam caused to circulate through the steam-jackets, which melts said material, which may be any of the fusible insulating substances now in use—say, for instance, a compound of beeswax and rosin in about equal proportions. The insulating material being properly melted, the bore m^2 of plunger M is to be temporarily tightly closed by a suitable plug, and the water is turned on from the forcing apparatus through the pipe

w' , and simultaneously the chamber I' is filled with the properly-molten lead. The water rising through the tubes N' and N , (the aperture in the stuffing-box N^2 being temporarily closed by any suitable means, or a cap with a solid head being used temporarily in place of said stuffing-box,) it passes through the passage m' to the cylinder M' , under the plunger M , forcing upward said plunger and the parts which it carries—namely, the lead-holder I , platform L , and vessels K' . As the lead-holder I rises the mandrel H' passes downward, or the passage I^2 is passed upward around said mandrel, and as the plunger enters the vessel I the lead is forced into said passage around the mandrel to form a portion of the pipe, which, as it is formed, is pressed outward, carrying with it the templet H^2 . Simultaneously with the entering of the plunger H into the lead-chamber I the plungers K enter the vessels K' , forcing the molten insulating material upward through the bores of said plungers and pipes k to the bore of the plunger H and downward into the hollow mandrel, filling the same and surrounding the wires, so that as the pipe passes downward out of the passage I^2 the said insulating material flows immediately into it and fills it, when the end of said pipe carries the templet away from the end of the mandrel, the said insulating material being forced into the said pipe under powerful pressure and perfectly filling it.

The charge of lead in the chamber I should be sufficient to form a length of pipe extending downward somewhat below the platform I^4 , and when the upward stroke is completed the water is to be exhausted in the usual manner, allowing the plunger to sink downward, and more wire is drawn off the reels. At this point of the operation the plug is to be removed from the bore m^2 of the plunger M , and the lower end of the portion of the cable formed is directed through the bore m^2 through the center of the plunger and platform I^4 , and at the next upward stroke, by the formation of more cable, it is forced downward through said bore and through the passage m' and the perforated tube N . When a sufficient length of cable is formed to reach the lower end of the tube N , the aperture of the stuffing-box N^2 is opened, so that the end of the cable may emerge and pass into the guide-tube O , from which it passes between the guide-pulleys P' , and thence to the reel Q , to which it is secured. After the end of the cable is secured to the reel the driving-belt w^2 is shifted from the loose pulley w' to the fast pulley w , and a slow rotary motion communicated through the connections heretofore described to wind up the cable as formed. During the temporary cessation of the formation of the cable at the points of the reversal of movement in the hydraulic jack, there being no cable at that moment to be reeled, the resistance to the rotation of the reel overcomes the friction by which the gear-wheel T' is held to the shaft Q , as heretofore described, and

said wheel is allowed to slip, so that there is no necessity of shifting the belt at each reversal of the hydraulic jack. At the same time the rotary motion is given to the reel upon its axis the turn-table is caused to revolve by the meshing of the gear V' with the bevel gear-rim V , and the reel is caused to revolve in a plane at right angles to its axis, thus causing a twisting of the cable below the guide-pulleys P' , this twisting giving a spiral form to the wires, which tends to prevent induction of the said wires one upon another, as it to a great extent destroys their parallelism, placing them in crossing planes. It further permits the cable to be reeled without displacing the wires. When the wires are left straight and the cable wound upon a reel the ends of the outer wires are drawn inwardly and the inner wires are bowed and forced into contact with the other wires or the pipe; but when the wires are spiral each continually changes position, and therefore all the wires are equally inner and outer wires and bend equally without interfering with each other. When the water from the forcing apparatus flows upward through the tube N' it also flows through the perforations n of the tube N and comes in contact with the cable passing through said perforated tube, thus cooling said cable, which is necessary preparatory to its being wound, the stuffing-box N^2 preventing the escape of the water, while the snug fit of the cable in the passages $m m' m^2$ prevents the escape of water at the top, as no very great degree of water-pressure is required.

The stuffing-boxes g' prevent upward escape of the fused insulating material. Each of these stuffing-boxes consists of a screw-nipple, g^2 , having a screw-shank, g^3 , which is screwed into the head of the cylinder g , and each is provided with a screw-cap, g^4 , the head of which is centrally bored for the passage of the wire. Between the top edge of the screw-nipple and the inner surface of the head of the cap is arranged a suitable packing-ring, which hugs the wire closely.

A suitable spring may be arranged to bear upon the head of each reel F , or upon the wire thereon, to steady the reel in its rotation.

A safety-valve, Z , as indicated in dotted lines, Fig. 3, may be connected by a pipe, Z' , with the upper end of one of the plungers K , in order to relieve the pressure of the insulating material, should it from any cause be too great. A trough may be arranged to conduct the material escaping from the safety-valve back to one of the vessels K' .

In the modification of the reeling and twisting apparatus shown in Fig. 5, the reel Q^2 is mounted in standards Q^3 , fixed to a turn-table, Q^4 , from which a shaft, Q^5 , extends downwardly through a sleeve, Q^6 , and has fixed upon its lower end a worm-wheel, q' , with which meshes a worm, q^2 , fixed upon a shaft provided with a crank. From the top of the sleeve Q^6 there project arms q^3 , from which rise stand-

ards q^4 , supporting a horizontal annular ring or track, Q^7 , having a beveled upper surface. On the projecting end of the reel-shaft there is tightly mounted a friction-roller, Q^8 , having its periphery in contact with the beveled surface of the track, and is itself beveled in correspondence therewith. As the turn-table revolves in its horizontal plane the friction of the beveled roller upon the track causes it to be rotated also on its axis; but if the resistance to the rotation of the reel exceeds a given point, as before explained, the friction-pulley will slip on its journal and the reel will not be rotated on its axis.

In the modification shown in Fig. 6 the apparatus illustrated is simply for twisting the cable and drawing it away in lengths from the machine without reeling. In this figure the letter X indicates a railway-track, one of the rails of which has its inner edge provided with cog-teeth a little below the level of its upper surface. Y is a carriage arranged to travel on said rails, and having journaled in the side bars of its frame a shaft, Y^1 , provided with a crank, upon which is fixed a worm, Y^2 , meshing with a worm-wheel, Y^3 , arranged to turn horizontally, and fixed upon a shaft mounted in suitable bearings on the carriage. The under surface of this worm-wheel is beveled, and is in frictional contact with a similarly-beveled wheel, Y^4 , fixed upon a shaft, y^4 , mounted longitudinally upon the frame of the carriage in bearings upon its side bars. The forward projecting end of this shaft is provided with a central socket, through the wall of which passes a set-screw, Y^5 . The end of the worm-shaft has fixed upon it a small gear-wheel, Y^6 , which meshes with the cog-teeth of the rail. The cable passes under the guide-pulley Y^7 from the guide-pulleys P^1 , and has its ends secured in the socket of the shaft y^4 by means of a set-screw. When the crank is turned the carriage is driven along on the track, the worm imparts rotary motion to the horizontal worm-wheel, which, by its frictional contact with the bevel-wheel on the shaft y^4 , gives said shaft a rotary motion, which twists the cable as it is drawn away by the carriage.

In order that the first-formed portion of the cable may be twisted before a sufficient length is completed to reach the reel, I provide the inner surface of the guide-tube O with one or more spiral grooves, o, the edges of the walls of which, coming in contact with the surface of the pipe, cause the cable to be twisted as it passes through said guide-tube. This twisting in the guide-tube continues, of course, after the cable is attached to the reel, and thus a preliminary twist is given the cable, which is all the better, as the twisting should be gradual and applied to as great a length of cable as practicable at the same time. The spiral groove may, however, be omitted.

What I claim is—

1. In a machine for the manufacture of electric cables, the combination, with a pipe-press

and devices for introducing wires into a pipe simultaneously with its formation by said press, of twisting devices arranged to withdraw the pipe as formed and its inclosed wires, and twist the same during its withdrawal, substantially as described.

2. In a machine for the manufacture of electric cables, the combination, with a pipe-press and devices for introducing wires and a molten insulating material into a pipe simultaneously with its formation by said press for completing the cable, of devices, substantially as described, for withdrawing and twisting the cable, substantially as described.

3. In a machine for the manufacture of electric cables, the combination, with a pipe-press and means for introducing wires and a molten insulating material into a pipe simultaneously with its formation by said press, of a reel arranged to wind the cable thus formed as delivered from the press and to revolve in a plane at right angles to that of its winding rotation, substantially as described, whereby the cable is twisted simultaneously with its reeling.

4. In a machine for the manufacture of electric cables, the combination, with a pipe-press and means for introducing wires and a molten insulating material into a pipe simultaneously with its formation by said press, of devices for twisting and reeling the cable as delivered by the apparatus, and means for cooling said cable previous to its twisting, substantially as described.

5. In a machine for the manufacture of electric cables, the combination, with the cable-forming devices, of mechanism for reeling and twisting the cable as delivered from said devices, and provided with means for automatically arresting the reeling when excessive resistance is opposed to the same, while allowing the twisting to continue, substantially as and for the purpose set forth.

6. In a machine for the manufacture of electric cables, the combination, with a pipe-press and means for introducing wires into the pipe simultaneously with its formation by said press, of mechanism operated by said press for forcing a molten insulating material into the pipe as it leaves the pipe-forming devices, substantially as described, and for the purpose set forth.

7. The combination, with the pipe-press having a hollow plunger and mandrel, of one or more hollow plungers, K, connected with the bores of said press-plunger and mandrel, one or more vessels, K^1 , for holding a molten insulating material, and means for forcing said vessels upward to receive the plunger or plungers K simultaneously with the operation of the press, substantially as described.

8. The combination, with cable-forming devices, substantially as described, of the hydraulic jack having its plunger and cylinder bored centrally for the passage of the cable from said devices, for the purpose set forth.

9. In a machine for the manufacture of elec-

tric cables, the combination, with the pipe-form-
ing devices having a plunger and cylinder pro-
vided with passages for the cable, of the per-
forated tube N, its surrounding tube N', and
5 means for introducing water into said tube N',
substantially as described, and for the pur-
pose set forth.

10 10. In a machine for the manufacture of lead-
inclosed telegraph-cables, substantially as de-
scribed, the combination, with the cable-form-

ing devices, of the suitably-arranged guide-
tube O, having one or more spiral internal
grooves, substantially as described, and for the
purpose set forth.

In testimony whereof I have affixed my sig- 15
nature in presence of two witnesses.

EDWARD J. FROST.

Witnesses:

L. R. FLETCHER,

WALTER E. BRAND.