3 Sheets—Sheet 1.

M. M. & R. P. MANLY.

Insulating and Protecting Telegraphic Conductors.

No. 215,643. **Patented May 20, 1879.**

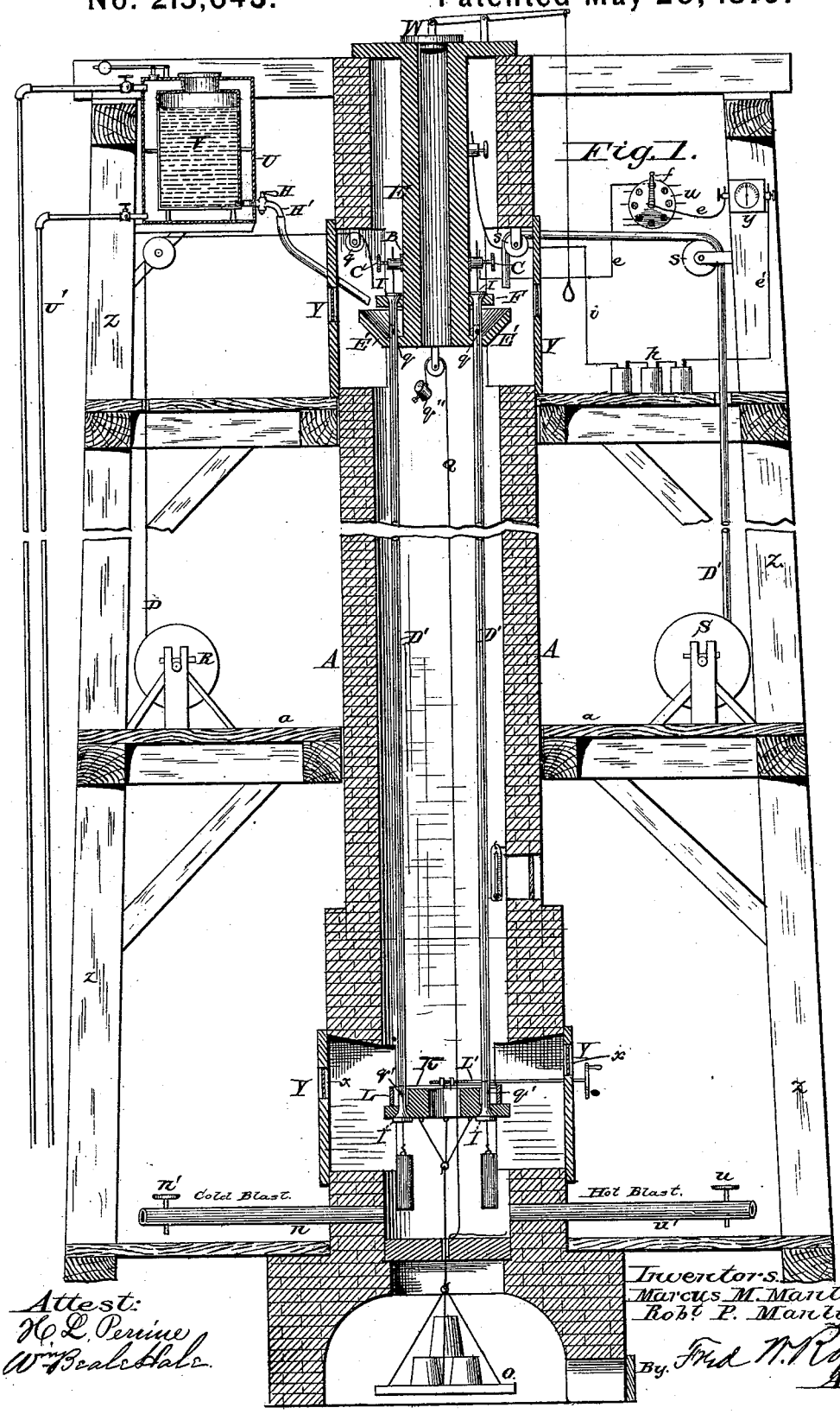

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Fig. 2.

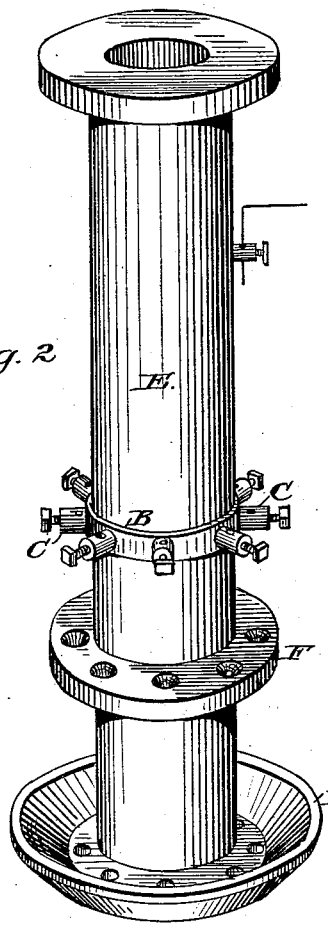

Fig. 3.

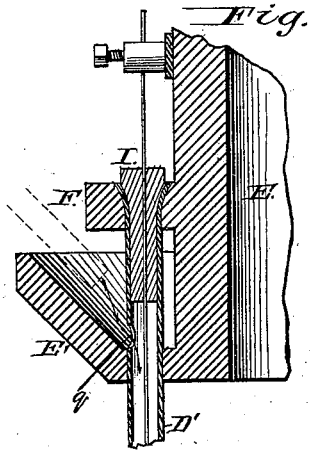

Fig. 4.

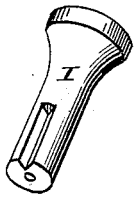

Fig. 10.

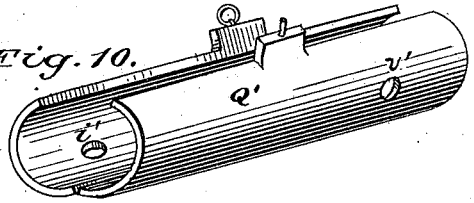

Fig. 11.

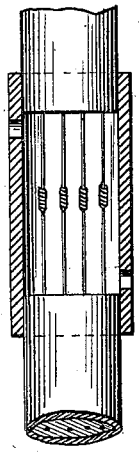

Fig. 5.

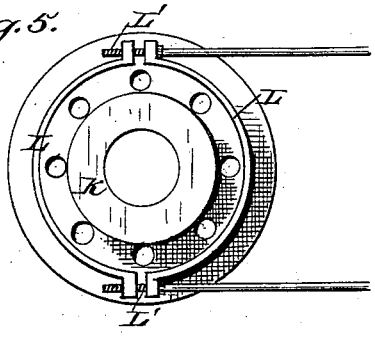

Fig. 6.

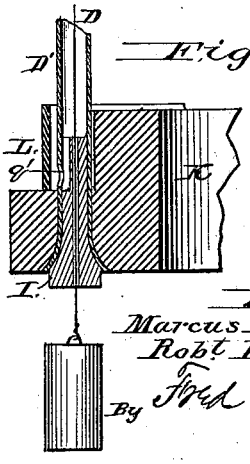

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Fig. 7.

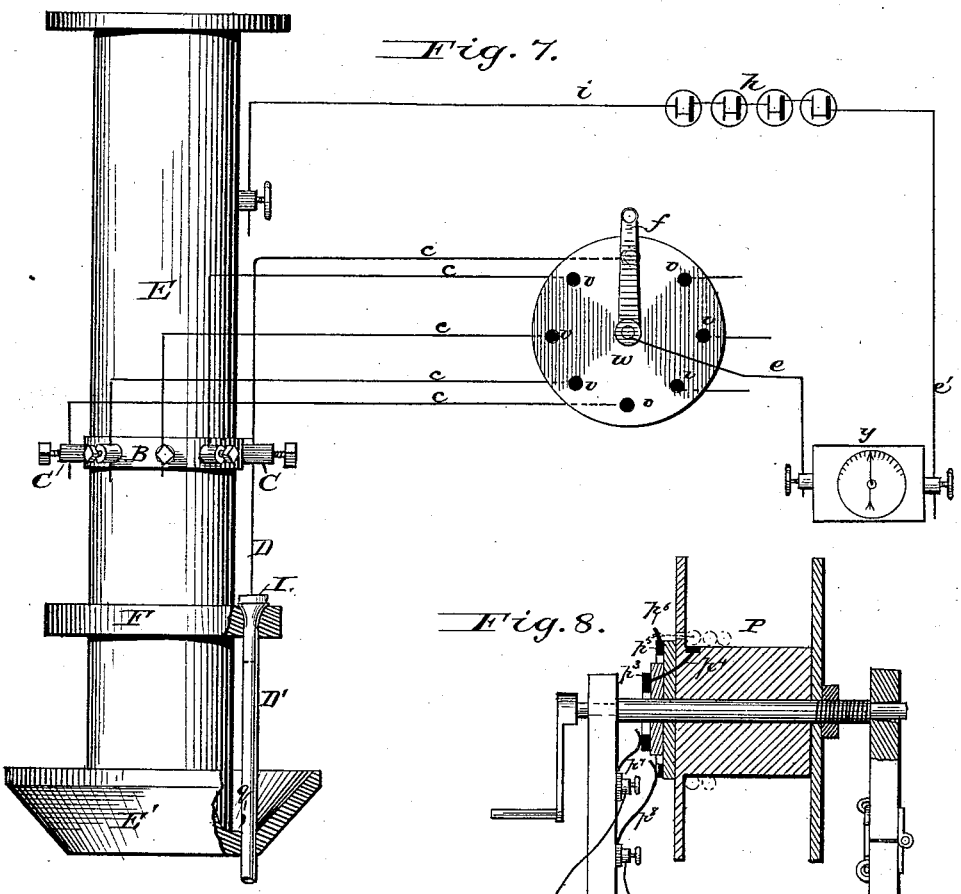

Fig. 8.

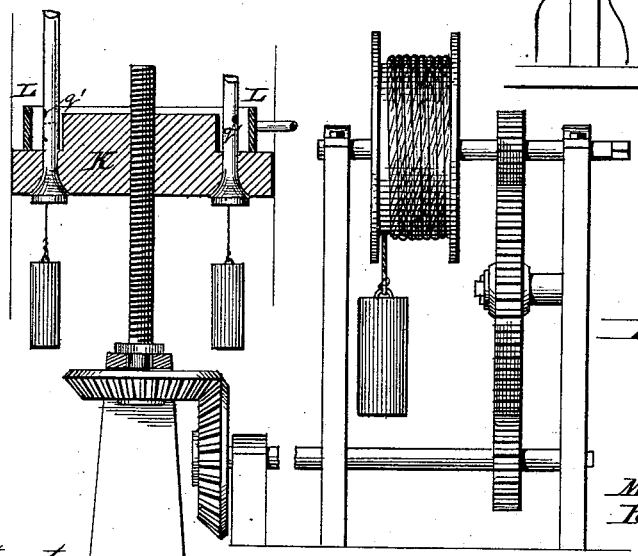

Fig. 9.

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UNITED STATES PATENT OFFICE.

MARCUS M. MANLY AND ROBERT P. MANLY, OF PHILADELPHIA, PA.

IMPROVEMENT IN INSULATING AND PROTECTING TELEGRAPHIC CONDUCTORS.

Specification forming part of Letters Patent No. **215,643**, dated May 20, 1879; application filed April 9, 1879.

To all whom it may concern:

Be it known that we, MARCUS M. MANLY and ROBERT P. MANLY, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Insulated and Protected Telegraph-Cables, of which the following is a specification.

Our invention relates to an improvement in the manufacture of that class of telegraph-cables consisting essentially of a wire or wires surrounded by insulating material within an inclosing-tube; and its object is to insure the perfect insulation of the wire, and to enable the production of such cables in long sections.

The general method of manufacture of this class of cables is to first arrange the wire and properly support it within the tube, and then introduce in a molten state a material fusible by heat, leaving projecting from each end of the tube a sufficient length of wire by which the sections of cable may be spliced together when the insulating material has cooled and solidified, the sections of tubing being connected by sleeve-joints, the space within which between two sections is filled with the insulating material poured in through a suitable aperture in the sleeve.

It has heretofore been found practicable to manufacture cables by this method only in short sections, as the molten insulating material would cool off and become solid before it could flow to the end of a long section of tubing. Even in these short sections it has been found extremely difficult to produce a perfect insulation of the wire, owing to the fact that the tubing and wire are expanded by the heat imparted by the molten insulating material, and in cooling the said material the wire and the tubing contract unequally, causing the tubing frequently to become twisted or bent, and the wire to be forced laterally into contact with the tube or in contact with each other, where there is more than one wire.

In overcoming the disadvantages which we have referred to, our invention consists in keeping the wire and its surrounding tube under tension and at a temperature equal to that of the molten insulating material while the latter is being introduced into the tube, and maintaining the wire and tubing under tension while filled section is cooling. The temperature of the wire and tubing equaling that of the molten insulating material, the latter is, of course, prevented from solidifying, and will freely flow into and fill any length of tubing into which it may be directed; and the tension of the wire and tubing prevents both from bending or twisting while cooling, and permits the insulating material to follow its own law of contraction without affecting the other members of the cable.

The invention also consists in an improved apparatus for carrying into effect the process which we have set forth, as will be hereinafter particularly described, and its operation fully explained.

In the accompanying drawings, Figure 1 is a central vertical section of our improved apparatus. Fig. 2 is a perspective view of the draft-pipe and top tube-clamp detached. Fig. 3 is a perspective view of the lower tube-clamp detached. Fig. 4 is a perspective view of one of the pins for holding the wire in position. Fig. 5 is a view of a mold for connecting two sections of cable. Fig. 6 is a sectional view, showing the ends of two sections of cable inserted in a connecting-sleeve. Fig. 7 is a detail view illustrating the mode of testing the sections. Fig. 8 is a sectional view of a reel adapted to receive the connected sections. Fig. 9 illustrates a modified form of apparatus for stretching the pipe.

Referring to Fig. 1, the letter Z indicates the walls of a tower of any desired height—say, one hundred feet. Within this tower is a chimney, A, preferably of brick. Within the chimney A and at its top is a cast-iron draft-tube, E, having at its lower end an upward-turned flange, E′, and at a short distance above said flange is an annular projecting shoulder or shelf, F. The flange E and shelf F have each an annular series of holes surrounding the tube and parallel with the axis thereof, the holes of the shelf coinciding with those of the flange, and flaring somewhat at their upper ends. Surrounding the tube E at a short distance above the shelf F is a hard rubber ring or hoop, B, from which project radially a series of binding-posts, C, each extending directly over one of the holes in the shelf F.

The letter I designates a pin formed of hard rubber having a central aperture and a flaring head. The cylindrical portion of this pin is

of a size to fit snugly in the size of tubing which it is proposed to use in the manufacture of cable. The flange E and shelf F may have any desired number of holes—say, twenty-six holes in each—and they are of proper size to receive the tubing.

The chimney A is provided with an annular series of doorways and sliding doors, Y, permitting access to the lower end of the tube E and the devices above described, and upon the floor *a* of the tower, which is convenient to said doorways, is a reel, R, for carrying wire, and another, S, for carrying lead tubing D′.

In making cable the tubing D′ is drawn from the reel S, passed over a suitable pulley, *s*, and down the chimney, at or near the bottom of which its end is inserted in one of a series of holes in an annular clamp, K, these holes being of proper size to receive the tubing snugly, and flaring somewhat at their bottoms. The annular clamp K is supported by a removable stand (not shown in the drawings) at a proper height for convenient manipulation, and when the end of the lead tubing has been inserted in its hole a rubber pin, I, having a flaring head, as before described, is driven into the end of the tube, expanding or swaging it out into the flaring portion of the hole, so that it cannot be withdrawn upward, nor can the clamp slip from it so long as the pin I remains in its place. The lower end having been thus properly secured, a suitable section of tubing is cut off from the reel, and its upper end passed upward through one of the holes in the flange E and shelf F, these holes being in a direct vertical line above the hole in clamp K, in which the lower end of the section of tubing is secured. One of the hard-rubber pins I is now driven into the upper end of the section, expanding and clamping it in the flaring-top portion of the hole in the shelf F. The remaining holes of the upper and lower clamping devices are now filled by the ends of additional tube-sections in a similar manner, and the stand is removed from under the annular lower clamp, K. Sufficient weight is now placed upon the platform O, hung to the annular clamp K, to draw said clamp downward—say, six inches, or a distance sufficient to perfectly straighten the several tube-sections. Suitable windows, accessible by a ladder, should be located in the chimney, to permit thorough inspection of the tubing.

The tube-sections having all been properly arranged, the wire D is now drawn from its reel R, passed over the pulley *r* and to the bottom of the chimney, stretched a few inches to straighten it, and a section of suitable length cut off, which is then passed down through one of the tube-sections and the apertures in the pins I. The upper ends of the wires are respectively secured to the binding-posts C in the usual manner, and each is, by weighting at its lower end, stretched, say, two feet, and then has a less weight attached to keep it taut, and is left to swing freely.

The weight upon the platform O should be just sufficient to keep the tube-sections taut and take up any expansion occasioned by increase of temperature, and will, of course, vary with the number and size of the pipes used.

The wire sections having all been arranged, it is necessary that they be tested in order to show whether or not they are all clear of their tubes and otherwise in good conductive condition, and the devices for this purpose I will now describe.

Each of the binding-posts C is lettered, (A B C, &c.,) and is connected through a wire, *c*, with a correspondingly-lettered metallic button, *v*, on a switch-board, *w*, near a suitable galvanometer, *y*. These buttons are arranged in a circle, at the center of which is pivoted a switch-arm, *f*, which may be brought in contact with each of said buttons. This switch-arm *f* is connected by a wire, *e*, with one pole of the galvanometer *y*, the other pole of which is connected with one pole of a battery, *h*, by a wire, *e′*. The other pole of the battery is connected by a wire, *i*, with the cast-iron draft-tube E.

Now, suppose the switch-arm *f* to be in contact with the button lettered A of the switch-board. This button is connected with the wire leading from binding-post lettered A through one of the tube-sections, and if this wire is clear of its tube of course no circuit will be formed, and the galvanometer-needle will remain stationary. If, however, the wire should at any point be in contact with the tube surrounding it, the circuit would be established through the tube, draft-tube, wire *i*, battery, wire *e′*, galvanometer, wire *e*, switch-arm *f*, and wire *c*, and the galvanometer-needle would be deflected from its normal position, thus betraying the fault. The slightest imperfection in the insulation of any of the wires may be thus detected.

If any wire is not perfectly insulated the fault is removed, if possible, by a farther stretching of either the wire or tube, or both.

The testing being completed, a hole, *q*, is cut in each one of the tube-sections a little above the inner edge of the upward-projecting flange E, and another, *q′*, at its bottom, about even with the upper edge of the annular clamp K.

Top and bottom holes having been made in all the pipes, and all clear, the sliding doors Y at top and bottom of the chimney are to be now closed, the draft-gate W dropped into the top of tube E, thus closing the chimney, and the valve *u* in the pipe *u′* opened. This pipe *u′* leads from a suitable hot-blast apparatus and opens into the bottom of the chimney, and the pipe *n*, having a valve, *n′*, leads into the chimney from a cold-blast apparatus.

The hot-blast being on the temperature within the chimney should be raised to the melting-point of the insulating material to be used. As the temperature rises the tube-sections and wires will be elongated.

A thermometer, *p*, is located near and inside

of a glass or mica covered opening in the chimney, and the indications of the temperature are thus observable without disturbing the operation.

A tank, V, surrounded by a stem-jacket, U, having been filled with the fusible insulating material, of whatever kind is to be used, steam is now to be introduced into the jacket U through a steam-pipe, U′, and the material thoroughly liquefied. Then let the cock H in a spout, H′, leading from tank V, be opened, and regulate the flow of the molten material, so that the V-shaped space within the upward-turned flange E′ will be kept full, thus securing a head or pressure which will cause the material to flow freely into the top holes of the tube-sections and through said sections, forcing all the air therefrom through the bottom holes, itself filling the tubes, flowing downward to the bottoms through notches in the sides of the pins and out through the vent-holes.

When, through suitable mica windows X, the material is observed to spout from the bottom holes in all the tube-sections, a band, L, which rests upon a ledge of the annular clamp K, is tightened by screw-rods L′, so as to close said holes. Occasional checking of the flow from the melting-vessel and observation at the same time whether or not the material is flowing from the V-shaped space will show when the tubes are all full.

A revolution of the switch-arm *f* will detect any fault from the pouring or filling; and should it prove impossible to remove such a fault by increased tension of wire and pipe, or both, the bottom pin may be removed from the pipe, the insulator drawn off, and pipe and wire saved for further or other use.

All the tubes being filled, shut off the hot-blast, raise the draft-gate, and open the cold-blast pipe *n*, when the temperature of the chimney will be rapidly reduced below the solidifying-point of the insulating material. Now, open the sliding doors and the tube-sections may be removed. In order to remove the sections and form them into a continuous cable, the bottom end of the first tube is attached to a reel, the wire and pipe being respectively connected to two metallic rings arranged in the head of said reel. The reel P, Fig. 8, we find well suited for the purpose of reeling and testing our cable. The letter p^3 indicates a flat ring of metal arranged upon the outer surface of one of the heads of the reel. An arm, p^4, leading from this ring through the head terminates flush with the inner surface of said head in the angle it makes with the drum. Another metallic ring, p^5, surrounds, but is separated from, ring p^3, and is provided with a pin, p^6. In commencing to reel the cable, the end of the first tube-section is laid in contact with the terminal of arm p^4, and the end of the wire is passed through a hole in the head of the reel and wrapped around pin p^6. The two springs p^7 p^8, secured to the reel-standard by binding-posts, press upon these rings p^3 p^5, respectively. Connection being made between the binding-posts and the galvanometer, any imperfection occuring during the reeling may be readily detected.

In reeling, the sections must be lowered as reeled by a suitable rope, Q, passing over a pulley, said rope being provided with a clasp, *q″*, for holding the tube.

The wire at the upper end of the first section lowered is connected to that at the lower end of the next section by an ordinary joint, and by means of a mold, Q′, the joint may be covered with an insulator similar to that with which the tubes are filled.

The mold is clamped over the joint, and has an inlet, *i′*, and a vent, *v′*, so that the air may escape as the insulator is poured in. While the joint is being covered the portions of the tubes which were occupied by the pins I are also filled.

After the insulator at the joint has cooled and solidified and the mold removed, a leaden sleeve, which has been previously placed upon one of the sections, may be drawn over the joint and soldered to each of the sections, being first set closely to them by a pair of reducing-pliers. The succeeding sections are connected and passed onto the reel in a similar manner, and if the galvanometer remains unaffected the coil may be considered perfect.

In making the joint the mold may be dispensed with, and a sleeve having a vent-hole and a pouring-hole may be used, and slipped over the ends of the two sections and soldered in place, as shown in Fig. 11, as soon as the wires are spliced. This sleeve may be then filled with the insulator, and the holes closed with solder.

We do not confine ourselves to using lead pipe, as by using the form of stretching apparatus shown in Fig. 9 we may stretch iron pipe as well, and the joints may be made as for lead pipe; nor do we confine ourselves to one wire in the tubing, as the pins I may have two or more apertures, and, in testing, the wires in each tube would be gathered in a single binding-post at the top and secured to a ring at the bottom, to which the weight could be attached, though it is obvious that the wires might be separated at both ends, if found desirable.

Having now fully described our invention and explained its operation, we claim—

1. The herein-described improvement in the manufacture of insulated and protected telegraph-cables, the same consisting in subjecting a metallic tube and a wire or wires inclosed thereby to tension while a molten insulating material is being introduced into said tube to fill it, and while the same and said wire and tube are cooling, substantially as set forth.

2. The improved process of manufacturing insulated and protected telegraph-cables herein described, the same consisting in subjecting a metallic tube and a wire or wires surrounded thereby to tensile strain while a molten insulating material is being introduced

into said tube to fill it, and at the same time maintaining said wire and tube at a degree equaling or about that of the melting-point of said insulating material, substantially as set forth.

3. The combination, in an apparatus for the manufacture of insulated and protected telegraph-cables, of two devices, one of which is adapted for the tensile straining of a metallic tube, and the other for the simultaneous and independent tensile strain of a wire or wires surrounded by said tube, substantially as set forth.

4. The combination, in an apparatus for the manufacture of insulated and protected telegraph-cables, of devices for producing simultaneous and independent tensile strain, of a metallic tube and of a wire or wires inclosed or surrounded thereby, and a device for introducing a molten insulating material into said tube, substantially as described.

5. The combination of devices for producing simultaneous and independent tensile strain, of a metallic tube and a wire or wires surrounded thereby, a device for introducing a molten insulating material into said tube, and an apparatus for maintaining said tube and wire at a temperature equaling or approximating that of the melting-point of said insulating material, substantially as set forth.

In testimony that we claim the foregoing we have hereunto set our hands in the presence of the subscribing witnesses.

MARCUS M. MANLY.
ROBERT P. MANLY.

Witnesses:
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E. S. WEST.