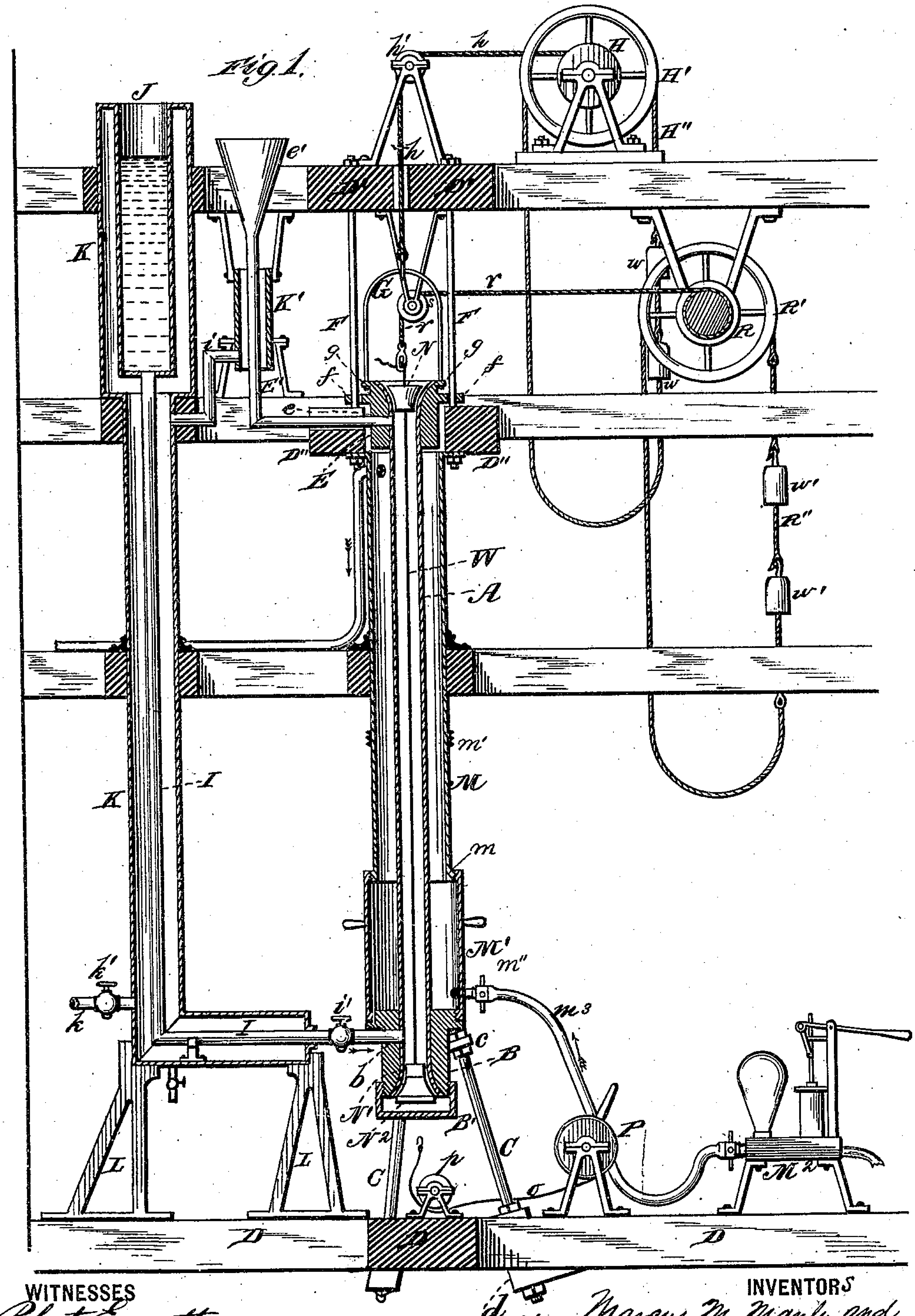
M. M. & R. P. MANLY.

Insulating and Protecting Telegraphic Conductors.

No. 227,371. Patented May 11, 1880.



WITNESSES

Robert Everett

Wm Beale Hale.

INVENTORS

Marcus M. Manly, and

Robert P. Manly, by

F. W. Royce

ATTORNEY

M. M. & R. P. MANLY.

Insulating and Protecting Telegraphic Conductors.

No. 227,371. Patented May 11, 1880.

Fig. 2.

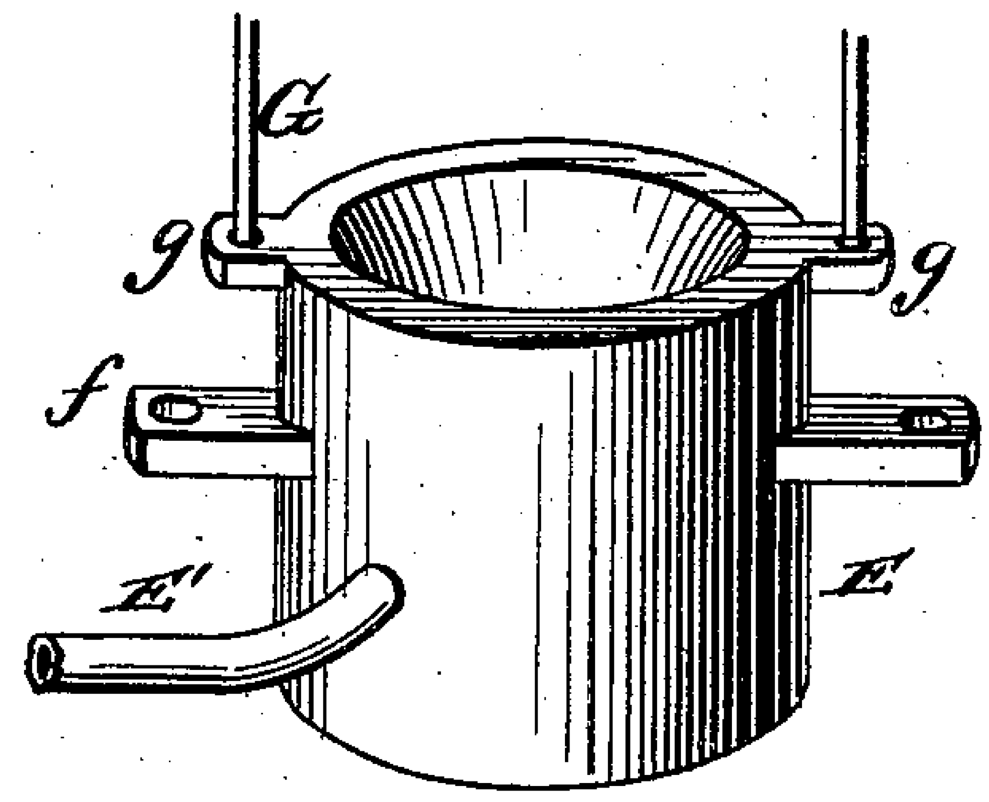


Fig. 4.

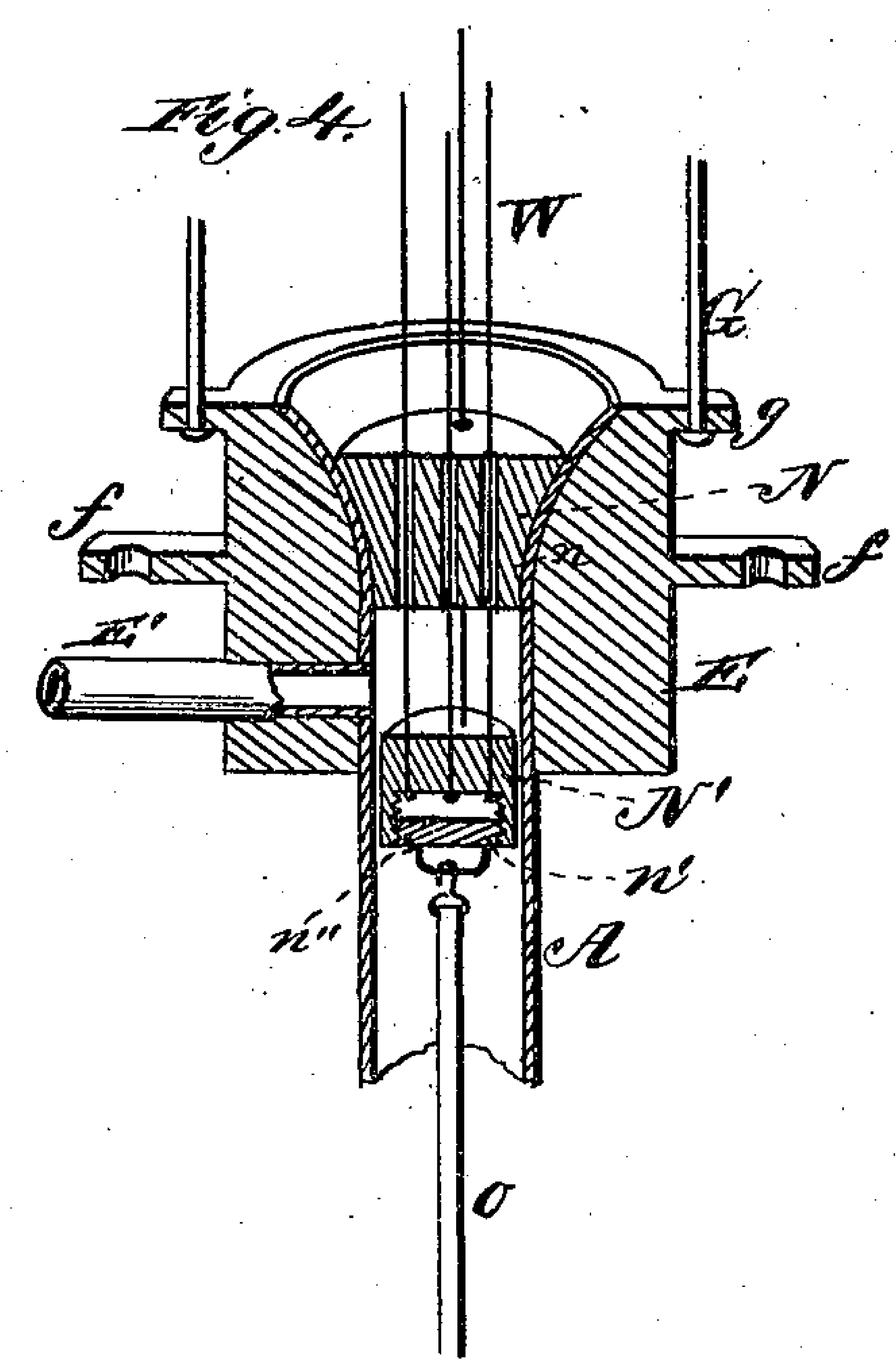


Fig. 3.

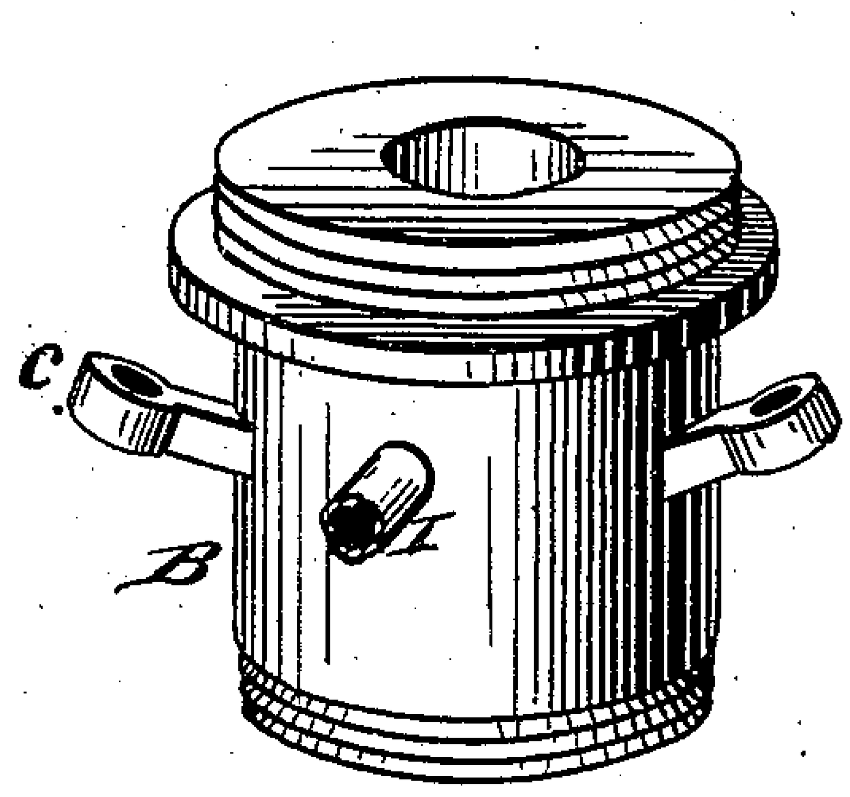
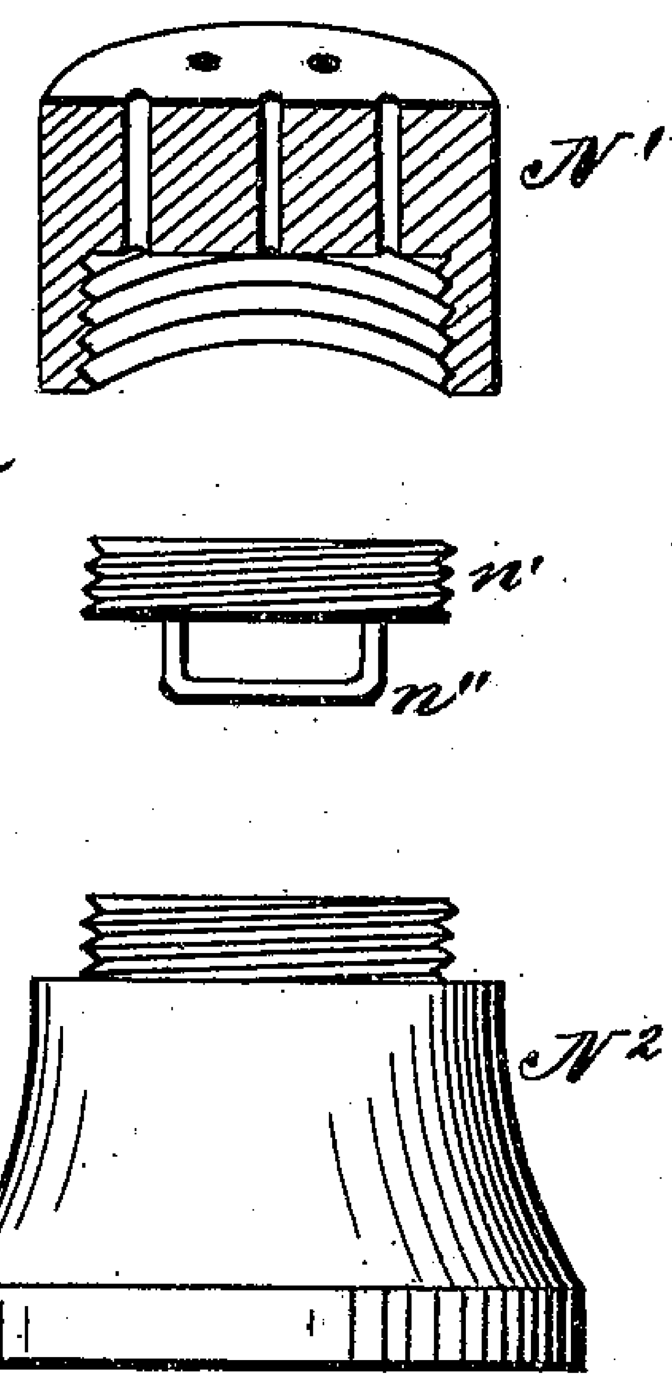


Fig. 5.



WITNESSES

Robert Everett

Wm Beale Hale.

INVENTORS

Marcus M. Manly, and Robert P. Manly, by F. W. Royce

ATTORNEY

M. M. & R. P. MANLY.

Insulating and Protecting Telegraphic Conductors.

No. 227,371. **Patented May 11, 1880.**

Fig. 6.

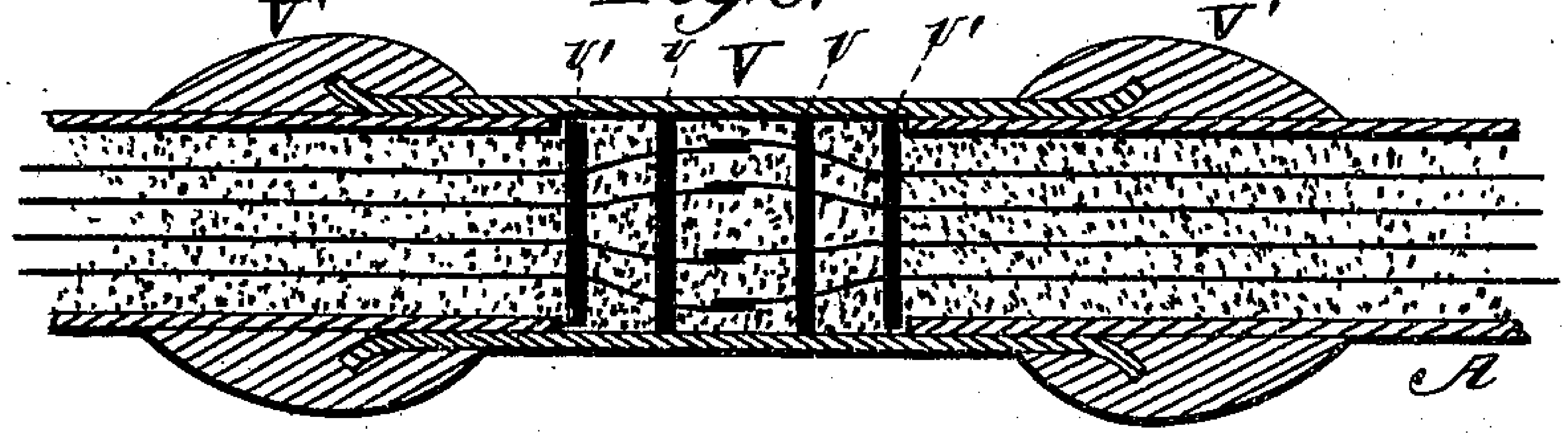


Fig. 7.

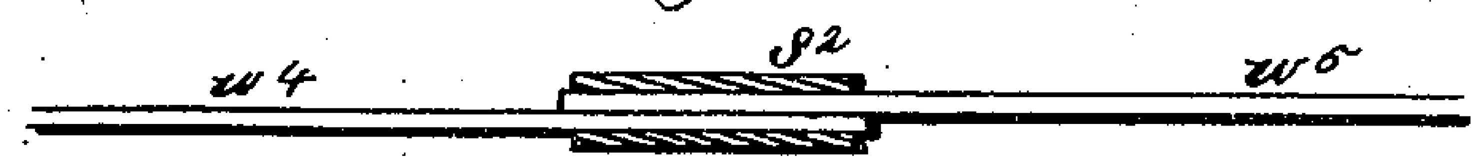


Fig. 8.

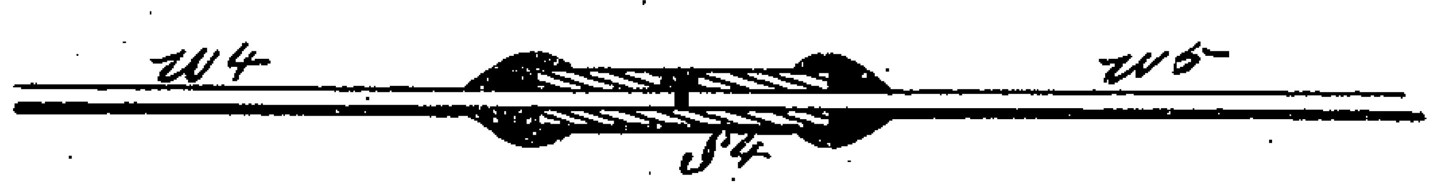


Fig. 9.

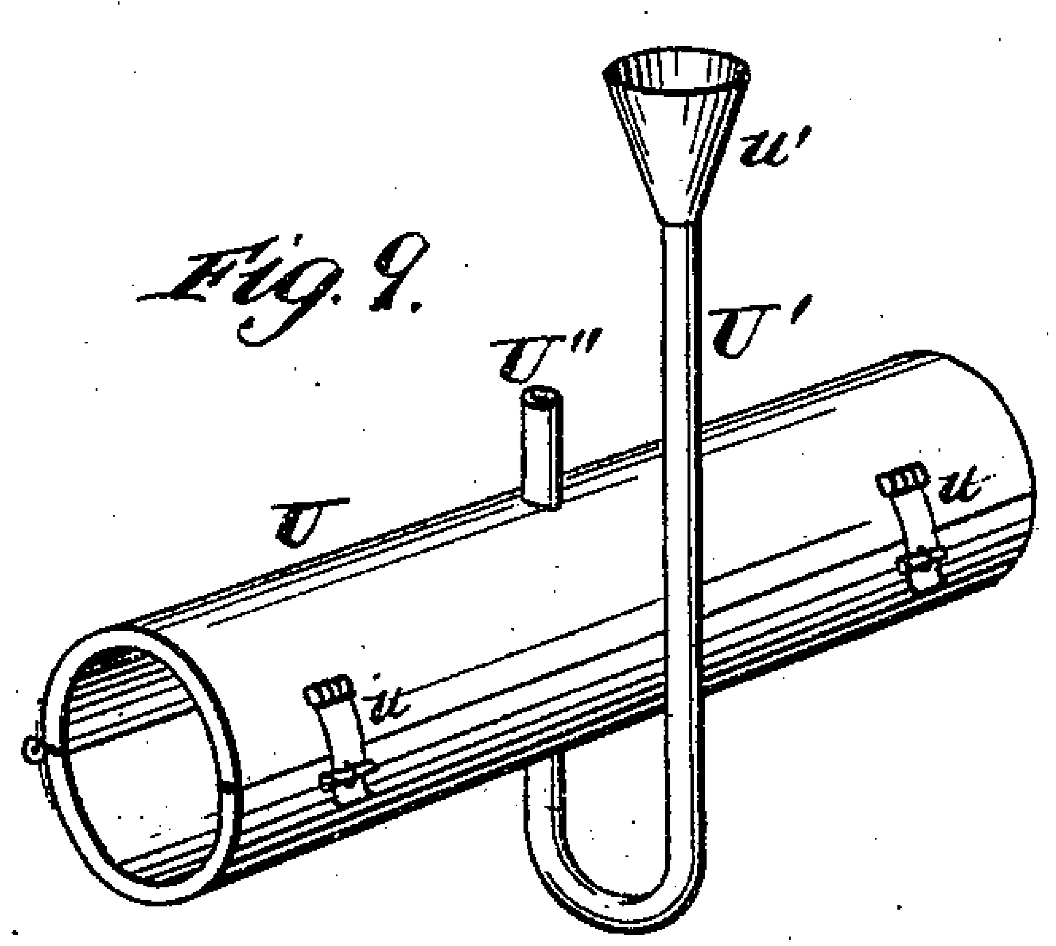


Fig. 10.

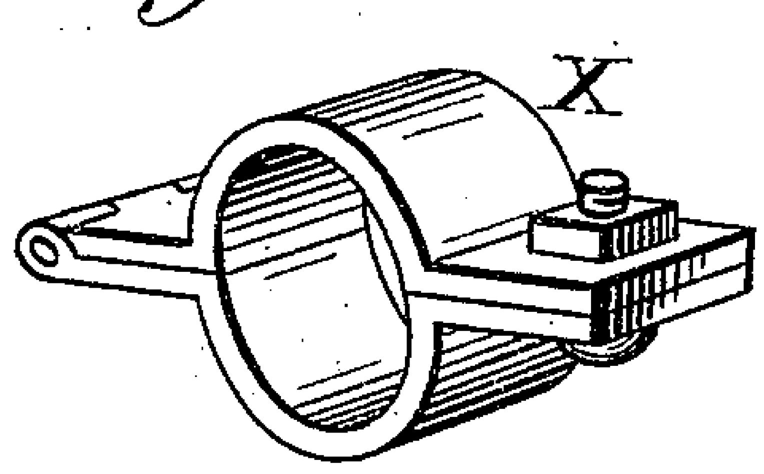
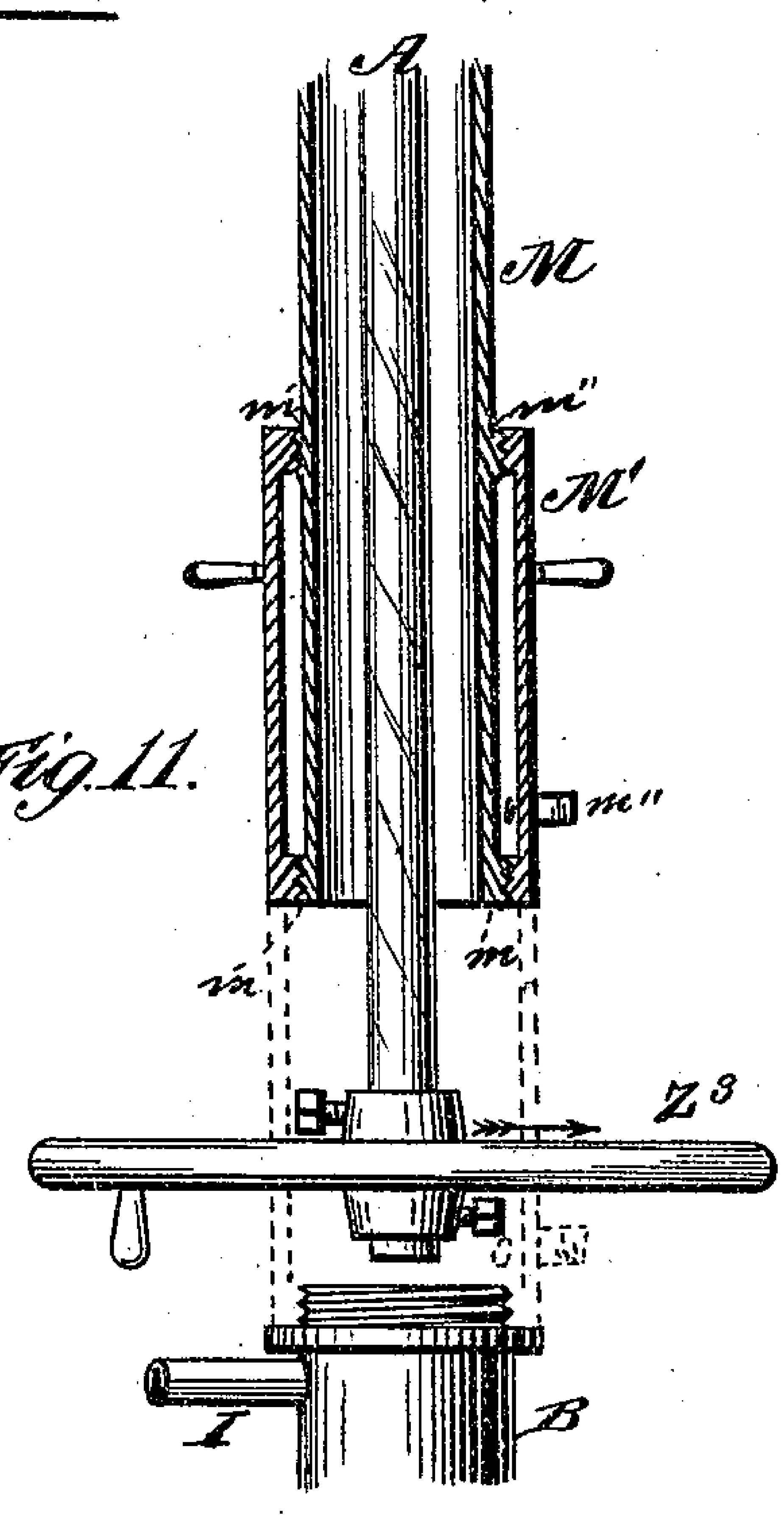


Fig. 11.



WITNESSES
Robert Everett
Wm Beale Hale

INVENTORS
Marcus M. Manly, and
Robert P. Manly, by
F. W. Royce,
ATTORNEY

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

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

INSULATING AND PROTECTING TELEGRAPHIC CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 227,371, dated May 11, 1880.

Application filed February 24, 1880.

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 the Manufacture of Insulated and Protected Telegraph-Cables; and we 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 of reference marked thereon, which form a part of this specification.

This invention relates to an improvement in the manufacture of insulated and protected telegraphic cables or conductors, consisting of wires or a wire surrounded by a tube and inclosed insulating material.

In a process heretofore used for the manufacture of such cables the inclosing-tube and wire are kept under tensile strain while the tube is being filled with molten insulating material, and during the entire operation of filling there is applied to the outside of the tube a degree of heat equaling about that of the melting-point of the insulating material.

In the apparatus for carrying out this process the tube and wire are suspended vertically, secured at their upper ends, and strained downward, and the insulating material is poured into the upper end of the tube. The heating of the tube outside was intended to expel the air therefrom and prevent the formation of bubbles or air-pockets in the composition, to prevent the too sudden cooling and resulting shrinkage of the composition from the tube, and also to prevent the congelation of the composition during its descent and before its proper settling.

Satisfactory results are not obtained from this old process, for, notwithstanding the precautions taken, bubbles or air-pockets will occur in the insulating material in great number, and an equable and compensating expansion and contraction does not take place between all the elements of the cable.

To overcome these disadvantages of the old process is the object of the present improvement, which consists, first, in fixing the tube and wire at their lower ends, straining them constantly upward, and filling the tube by forcing the molten insulating material into its lower end. The insulating material rising in the tube against the action of gravity forces the air out before it, and is kept well condensed, so that there is no danger of the formation of bubbles or air-pockets or vacuums. The gradual rise of the heated material causes the tube and wire to expand longitudinally before it, and this expansion is taken up by the upward strain upon them, so that they will not slip or become separated from the composition. By this improvement we are enabled to dispense with the external application of heat to the tube, and have secured much better results, as regards the avoidance of bubbles and vacuums, than by the old process.

A further improvement consists in keeping the wire and tube under a yielding tensile strain while cooling after filling, and keeping the insulating material at the same time under pressure applied at both ends of the tube through columns of said material in a molten state, thus furnishing a constant supply to compensate for any contraction which may occur.

Another improvement relates especially to the manner of introducing the wires into the tube when a cable is to be formed having more than one wire. This improvement consists in threading the ends of the wires through perforations in two plugs, one of which is of a size to pass through the tube to be filled, and the other adapted to be secured in the end of said tube, securing the said ends of the wire to the plug for passing through the tube, then placing the two plugs in the upper end of a tube, the traveling plug being introduced first and the other secured against inward movement, and then drawing the traveling plug, and with it the wires, through the tube to its opposite end. The wires are thus prevented from becoming entangled within the tube, and the movement of the close-fitting plug corrects any bends or indentations in the tube.

Our invention also consists in cooling from the bottom gradually upward a vertical tube surrounding wires under yielding upward tension and filled with molten insulating material, and being itself under upward tensile but yielding strain. By this improvement the contraction of all the members of the cable is caused to be in a downward direction, and shrinkage of the cooling insulating material, either from center or circumference at any point, is compensated by the settling of the superincumbent molten material.

In the old process the introduction of cold air into an inclosure surrounding the entire tube, and cooling said tube throughout its whole length at the same time, frequently resulted in detachment of the insulating material from the tube by shrinkage from its circumference, and at the other times in separation of the cooled material at various points.

Still another improvement consists in twisting each section of cable (tube, wires, and insulating material) after it has been filled and cooled. This is to permit the cable to be reeled without displacing the wires. When the wires were left straight and the cable was wound upon a reel, it was found that the ends of the outer wires were drawn inwardly from the ends of the tube, and the inner wires were forced into contact with each other; but when the cable is twisted each wire continually changes position on account of the spiral form given it, and therefore, when the cable is reeled, all the wires are equally inner and outer wires, and bend equally without interfering with each other. Neither are they drawn into the tube, as the coils permit them to extend and contract in correspondence with the coils of the tube around the reel. To twist a section of cable we clamp a fly-wheel to its lower end, the section being suspended and firmly fixed at its upper end, and turn the fly-wheel about fifteen times, more or less.

Our invention finally consists in certain improved constructions of mechanical devices for carrying into effect the improvements hereinbefore set forth, and which we will now proceed to describe with reference to the accompanying drawings, in which—

Figure 1 is a vertical section of the apparatus for the manufacture of the separate sections of the cable. Figs. 2 and 3 are detached views of the upper and lower heads for holding the tube. Fig. 4 is a detail sectional view, illustrating the manner of introducing several wires simultaneously into a tube. Fig. 5 is a sectional view of the two parts of the complete lower plug, the upper of which is used in introducing several wires at once into the tube, and also of the drawing-plug. Fig. 6 is a diametric section of a joint which may be used between two sections of cable. Fig. 7 shows two lapping wires inclosed by a sleeve. Fig. 8 shows the wires as simply abutting in the sleeve and connected by solder-joint. Fig. 9 illustrates the mold for forming the joint of insulating material. Fig. 10 shows a clamp used for compressing the joint-sleeve. Fig. 11 illustrates the mode of twisting the cable.

The letter A in Fig. 1 designates a lead tube, with one wire arranged therein and ready to be filled with an insulating material. The lower end of this tube is firmly secured to a centrally-bored stationary head, B, which is secured in position by three tie-rods, C, which are secured to said head by having their screw-threaded upper end passed through ears *c*, projecting, at equal distances apart, from the perimeter of the head and retained by suitable nuts. The lower ends of these tie-rods are also screw-threaded, and pass through beams D, which form a portion of the structure inclosing the apparatus, and also through oblique-faced nut-seats *d*, arranged upon the under sides of the beams, and against which are screwed the retaining-nuts *d'*. Any other suitable means may, of course, be used for securing the head B in position. The bore of this head is of size to receive snugly the tube A, and flares downwardly, so that when the end of the tube is inserted therein, and is by a suitable tool flared snugly against the surrounding wall of the head, as shown in Fig. 1, said tube will not be withdrawn from the head by the upward tensile strain to which it is to be subjected.

The head B is provided with a lateral passage, *b*, connecting with a supply-pipe, I, to be hereinafter described, and the lower end of said head is threaded to receive a screw-cap, B'. The upper end of said head is also screw-threaded, for a purpose which will be hereinafter explained.

The letter E indicates a vertically-movable upper head, arranged directly above the lower head, B, and having a similar central bore flaring upward for a similar purpose. The upper end of pipe A is shown flared in this upper head. This head E has a lateral passage, *e*, connecting with its bore and with an attached pipe, E', bent upward and terminating in a funnel, *e'*, and said head is provided with two radial projecting ears, *f*, diametrically opposite each other, and pierced to embrace guide-rods F, which extend vertically between and are secured to the cross-beams D' and D'' of the inclosing structure. When the head is in its lowermost position the ears *f* rest upon the beams D''. The head E is provided with other and shorter ears, *g*, also diametrically opposite each other, and to which are secured the feet or lower ends of an elongated bail or arched rod, G, and to the top of this bail is fastened a rope, *h*, extending upward over a pulley, *h'*, and thence to a windlass, H, provided with a drum-wheel, H', having around and depending from it an endless rope, H'', after the manner of hoisting apparatus, said rope being provided with loops or rings, to which may be attached weights *w*, the purpose of which will be hereinafter explained.

The supply-pipe I, heretofore referred to as connected with the passage *b* in the lower head, B, extends horizontally to a convenient distance from the head, and then vertically to a point somewhat higher than the upper head, E, will ever be drawn in use. The pipe I terminates at its top in a reservoir, J, having a capacity preferably somewhat greater than that of the tube-sections which the apparatus is intended to fill, and this reservoir J and the supply-pipe I (the latter to a point a short distance from the head B) are surrounded by a continuous steam-jacket, K, connected by a pipe, *k*, with a suitable steam-generator, which may be located as convenient.

From the upper portion of the steam-jacket K a pipe, *i*, leads to a smaller steam-jacket, K′, which surrounds but is disconnected from the pipe E′, leading from the upper head, E. The lower and horizontal portion of the main steam-jacket K rests upon standards L, preferably of cast-iron, cast with seats to receive it, and standing upon the lower floor of the inclosing structure. The pipe I is provided with a stop-cock, *i*′, between the head B and the lower terminus of the steam-jacket K.

The letter M indicates a vertical tube of, say, about four or five times the diameter of the cable-tube A, and having its upper end flanged and secured to the beams D″. The lower end of this tube M terminates at a suitable distance (in practice about four feet) above the lower head, B, and has at its edge a slightly-projecting flange, *m*, screw-threaded on its periphery. At a distance above this flange equal to the distance between the end of the tube and the head B said tube has another flange, *m*′, projecting the same as the lower one, and also screw-threaded on its periphery. The diameter of these flanges is the same as that of the upper screw-threaded portion of head B.

The letter M′ designates a movable tube-section having a diameter slightly greater than that of the tube M. This tube-section has at each end a very narrow inwardly-projecting rim internally screw-threaded and of a size to engage with the upper screw-threaded portion of head B and flanges *m* and *m*′. Near its lower end the section M′ carries a screw-nipple, *m*″, which may be connected by a suitable hose or pipe, m^3, with the discharge-pipe of a force-pump, M^2, while a waste-pipe leads from its top outside the building. Said tube M serves as a water-jacket for the tube A in the process of cooling. The lower portion or section, M′, of this water-jacket is secured to the lower head by its screw-connection and to the upper portion by means of a screw-flange, *m*, when in use, and may be removed upward and secured to permit access to the tube for twisting, as hereinafter explained, and as illustrated in Fig. 11.

If the mass of metal (tube and wires) preponderates over that of the filling, as in the case of many large conductors in a small tube, the temperature of said mass may be brought to the proper point before filling the tube by filling the jacket with warm—say steam-heated—water, and changing the temperature of the latter as the process of cooling may require.

Now, supposing the apparatus to be adapted to treat sections of tubing of a length of one hundred feet, (more or less,) lead tube being generally used, such a section is cut from a reel or coil and passed downward through the upper head, E, and the water-jacket, one end flared by a suitable tool in the upper head E, and the other lowered into the lower head, B, and flared therein. Flaring plugs should be temporarily forced into the ends of the tube. The upper head, E, is then drawn upward by means of the rope and windlass until the tube is stretched straight as nearly as possible by this means, and then weights are attached to the hoisting-rope to keep the tube in this condition under upward tensile strain.

A uniform and at the same time adjustably-uniform tension for all of the operations of expansion, stretching, insertion of wires, and tension during the process may be also obtained by substituting an adjustable friction-clutch on the shafts to which the ropes are attached in place of the windlass and weighted rope. The plugs are now to be removed, and with a suitable tool the tube is pierced with openings coinciding with the passages *b* and *e* in the upper and lower heads, respectively. The required number of sections of wire W (somewhat exceeding the tube in length for convenience of fastening at their ends) is now to be cut from a reel or coil and given a preliminary stretching for straightening, and one end of each is then passed through a perforation in each of the two plugs N and N′, placed end to end, as shown in Fig. 4, but before these plugs are inserted in the tube. The former of these plugs, N, has its main portion *n* formed of a size to fit snugly within the normal bore of the tube A, while its other end flares to fit within the portion of said tube which is flared within the upper head, E. The plug N′, which is in fact only a half-plug, as will presently appear, is hollow, and is formed throughout its length to fit the bore of the tube, and is provided at one end (intended for its lower end) with an internal screw-thread, into which may be screwed a plug, *n*′, provided with a bail, *n*″.

After being passed through the plugs the ends of the wires are knotted or wound upon a pin or bar, to prevent them from being withdrawn from plug N′, and the plug *n*′ is then screwed into said plug, and a steel tape or ribbon, *o*, has then one end secured by a hook to the bail *n*″ on the end of plug *n*′, while the other end is passed down through the tube A under a pulley, *p*, mounted on the floor of the building, and thence to a windlass, P, to which it is secured. The two plugs N and N′ are then placed in the mouth of the tube, the plug N′ first, and by means of the windlass and tape this plug N′ is then drawn downward (and with it the wires) through the tube below the supply-pipe I. The plug *n*′ is then removed from plug N′, and a plug, N^2, the lower portion of which is flared to fit the flared end of the tube, is screwed into the bottom of said plug N′.

Our practice is to first draw upward through the tube a steel mandrel slightly larger than the tube, which expands it proportionately, and as it is under tension at the top, as hereinbefore explained, this operation gives it a uniformly slight stretch at every point of its length and renders it perfect at every point.

The wires may be threaded directly from a rack of spooled wires, and it may be found desirable to draw them upward instead of downward, putting the solid plug at the bottom and the plug in two parts at the top. The upper ends of the wires are knotted together and attached to the end of a rope, *r*, passing directly upward over a pulley, *s*, properly supported under the arch of the bail G, so as not to interfere with the movement thereof, and from this pulley the rope passes to a windlass, R, constructed and equipped in all respects similarly to the windlass H, heretofore described. By means of the windlass R and its rope the wires are now to be stretched upward to a degree of tension which has been found by previous experiment (with wires outside of a tube) to be sufficient to render them straight and taut, and they are maintained under the upward tensile strain by means of weights *w*′, attached to the hoisting-rope R″; or, instead of the weighted ropes, friction-clutches may be applied to the windlasses, as before stated.

The tube and wires having been thus placed under upward tensile strain, the reservoir J is filled with an insulating material in cakes or lumps of suitable size, and the cock *k*′ in the steam-pipe *k* is turned to admit steam from the steam-generator within the steam-jacket K. The steam soon causes the insulating material in the reservoir to melt and flow downward through fine strainers properly arranged in the supply-pipe. After it has been thoroughly melted and fills the pipe I more material is placed in the reservoir and allowed to melt until both reservoir and pipe are full, and then the cock *i*′ of the supply-pipe is turned to permit the molten material to flow into the tube A through the passage *b* and the coincident aperture in the tube, and as it rises in said tube the air is driven out before it and escapes through the pipe E′. The reservoir is supplied with more material as the level of that melted falls, and when the molten material reaches the top of tube A it flows into the pipe E′ and rises to the level of that in the reservoir, being kept melted in the pipe E′ by steam passing through the pipe *i* and the small steam-jacket K′. Thus it will be seen that the column of molten material within the tube A is brought under pressure of the columns in the pipes I and E′, respectively, so that any contraction by cooling is constantly compensated.

The steam is allowed to flow through the steam-jackets for some minutes after the filling is completed, to insure a perfect setting of the material, and when it is cut off the force-pump M^2 is put in operation to force water through pipe m^3 into the lower end of the water-jacket or section M′, in which it is caused to gradually rise around the tube A, cooling it gradually upward, so that the contraction of all the members of the cable is downward, and the insulating material assumes its ultimate condition and position in proper relation to the wires and tube to obviate its separation from the same and to insure the perfect filling of the former. After the water-jacket has become filled the water is allowed to overflow through the waste-pipe until the cable is cold.

A modification (perhaps preferable) of the mode of operation consists in admitting the insulating material within the tube at the bottom, and at the same time admitting water or a cooling compound within a jacket surrounding the same, and permitting the material forced in at the bottom to overflow through the opening in the upper movable head. The action of the water or cooling compound is to gradually line the tube with the solid insulating material from the circumference to the center, and the presence of the surrounding liquid removes any vibration that might be communicated from the earth, and renders possible the manufacture of the tube in lengths of one hundred feet and upward.

When the material ceases to overflow at the top, the upper column, above spoken of, is attached and remains until the water is withdrawn. The overflow is replaced in the reservoir.

After the cable has cooled, the lower section, M′, of the water-jacket is, by means of suitable handles, unscrewed from the head B and flange *m*, and elevated so that its upper thread can engage with flange *m*′ and its lower thread with flange *m*, and it is thus supported out of the way. The section of cable is then sawed off at a convenient distance above the head B, and a fly-wheel, as at Z^3, Fig. 11, slipped on and clamped firmly, and the upper end of the tube being tightly clamped in the upper head, E, the entire cable is twisted as much as may be desired—say by turning the wheel about fifteen revolutions. The wheel is then removed, the tube sawed off at the upper end, (the head E being raised for this purpose,) and lowered, by means of rope and windlass, to the joining-table, the wires being left projecting properly at each end to facilitate the joining of sections together.

In joining sections they are so placed that the wires lap about three-fourths of an inch, and each two adjacent lapping wires are then soldered together, commencing first to solder the lowermost wires as the cable lies. Before commencing to solder the wires a rather close-fitting sleeve with slightly-flaring ends, of the same metal as the tubes, (indicated by V, Fig. 6,) is passed over the end of one of the sections. While the wires are being soldered they are supported in proper position by very thin perforated plates or templets *v* and *v*′, of hard rubber or mica, or cast in hardened shellac or other insulating compound, the templets *v* having their perforations somewhat farther apart than the wires in the tubes. After the wires are then soldered the joint is inclosed by a mold, U, Fig. 9, composed of two semi-cylindrical sections hinged together at two of their longitudinal edges and provided with latching devices u at their opposite edges. From the middle of one of these sections leads a pipe, U′, curving and extending above the other section, and terminating in a funnel, u'. From the middle of the other section a short straight pipe, U″, projects vertically. This mold is of a proper length to overlap and of a proper diameter to snugly embrace the ends of both sections of cable—say about three inches—and when applied thereto both the pipes U′ and U″ extend upward, the former serving as a filling-pipe and the latter as an air-vent. Molten insulating material is then poured into the funnel u', and, flowing through the pipe U′, rises in the mold, surrounding the wires and forcing the air out through the tube U″. When it begins to overflow the vent-tube the pouring is stopped, and it is allowed to cool. When cold the mold is removed, the joint is wiped with a non-hardening insulator, such as balsam of fir, to prevent any capillarity, the sleeve V is drawn over the joint, overlapping the ends of both sections, and is compressed upon said ends and the joint by means of the clamp X, (shown in Fig. 10,) the construction and operation of which will be readily understood from the drawings.

Care should be taken to avoid compressing the flared ends of the sleeve. When the sleeve has been compressed a plumber's wipe-joint, V′, should then be formed at each end of said sleeve, the metal of the joint extending into and also inclosing the flaring ends of the sleeve, as shown. This forms a very strong connection between the cable-sections.

While the wipe-joints are being formed cold water, preferably ice-water, should be caused to flow or be poured around the tube and sleeve at each side of said joints, in order to prevent the wires from settling.

Any of the known insulating materials now used in cables of this class may be used in filling the tubes by our process. The construction of the apparatus may be, of course, varied to suit different circumstances and already-constructed buildings in which it is desired to arrange it without departing from the essential principles of our invention.

The water-jacket may, in some cases, be dispensed with and good results still obtained.

The plug N^2 may have its screw-thread omitted and be perforated to correspond with plug N′, and after the latter is drawn to its place at the lower end of the tube the ends of the wires may be straightened and passed through said plug N^2, and wrapped around a cross-bar or ring to prevent their withdrawal, the plug N^2 being then inserted in the flaring end of the tube and drawn snugly therein when the wires are tightened. When this arrangement is used the cap B′ should be screwed upon the head B, to prevent leakage of the composition or insulating material. The cap may also be left off the lower head, B, and the wires may pass through a perforated flaring plug and be secured below said head to a ring in the floor or to other permanent fastening.

If the tube should be much battered or indented, it would be well to draw a steel cylinder through it by means of the steel ribbon and windlass.

Instead of simply soldering the wires together in forming the joint, as heretofore explained, the lapping ends of each two wires may be inclosed in a light copper sleeve, and the sleeve and wires soldered together, as shown in Fig. 7, in which s^2 designates the sleeve, and w^4 w^5 the wires. If the solder should break, the sleeve still connects the wires.

In cables where the wires are close together the wires do not lap, but simply abut end to end, and the sleeve which connects them is circular, as shown at s^4, Fig. 8, except a small aperture in the top, and has thickness equaling the mass (in cross-section) of the wires to be joined. The sleeves are also tinned on the inside, in order to insure good electrical connection with the wires.

What we claim is—

1. The herein-described improvement in the process of manufacturing insulated and protected telegraphic cables, the same consisting in keeping a metallic tube and an inclosed wire or wires under upward longitudinal tensile strain, and at the same time introducing a molten insulating material into the lower end of said tube and causing it to gradually rise and fill the same and surround the inclosed wire or wires, the tube and contained insulating material being then cooled and prepared for use in any desired manner.

2. The herein-described improvement in the process of manufacturing insulated and protected telegraph-cables, the same consisting in keeping a metallic tube and an inclosed wire or wires under yielding upward tensile strain, and at the same time introducing a molten insulating material into the lower end of said tube and causing it to gradually rise therein and fill the same, and subsequently keeping the insulating material within the tube under pressure while cooling by means of columns of similar molten insulating material bearing against the opposite ends of the column with the tube, essentially as and for the purpose set forth.

3. The improved method of introducing a series of wires into the tube, the same consisting in threading the ends of the wires through the two perforated or templet plugs, securing them to the plug adapted to pass through the tube, and then forcing said plug through the tube, substantially as described.

4. The improvement in the process of manufacturing insulated and protected telegraph-cables, consisting in filling the tube with molten insulating material while said tube and its inclosed wire or wires are under a yielding upward tensile strain, and then cooling said tube and its contents gradually from their lower ends upward, substantially as set forth.

5. The combination of the elevated reser-

voir, the supply-pipe leading downward therefrom, the stationary lower head, B, connected with said pipe and adapted to receive and retain the lower end of the tube, the upper vertically-movable head adapted to receive and retain the upper end of the tube, and a suitable mechanism for moving said head upward, substantially as described.

6. The combination of the elevated reservoir, its supply-pipe leading downward, the stationary lower head connected with said pipe, the upper movable head and mechanism for moving it upward, and devices for supporting a wire or wires under tensile strain through a tube supported by said heads, substantially as set forth.

7. The combination of the upper head, E, the lower head, B, the plugs N and N′, the tube A, and means for forcing the plug N′ through said tube, substantially as described.

8. The combination of the upper and lower heads for holding the ends of the tube, means for forcing molten insulating material into the lower end of the tube, and a device for cooling the tube gradually from its lower end upward, substantially as set forth.

9. The herein-described improvement in the process of manufacturing insulated and protected telegraph-cables, consisting in twisting the tube and inclosed wires and column of insulating material after the section of cable has cooled, substantially as and for the purpose set forth.

In testimony that we claim the foregoing we have hereunto set our hands this 4th day of December, 1879.

MARCUS M. MANLY.
ROBERT P. MANLY.

Witnesses:
D. S. LINDSAY,
THOMAS MCGOWAN.