3 Sheets--Sheet 1.

F. TOMMASI.

Hydrostatic and Electric Telegraph-Cables.

No. 143,597. Patented Oct. 14, 1873.

Fig. 1.

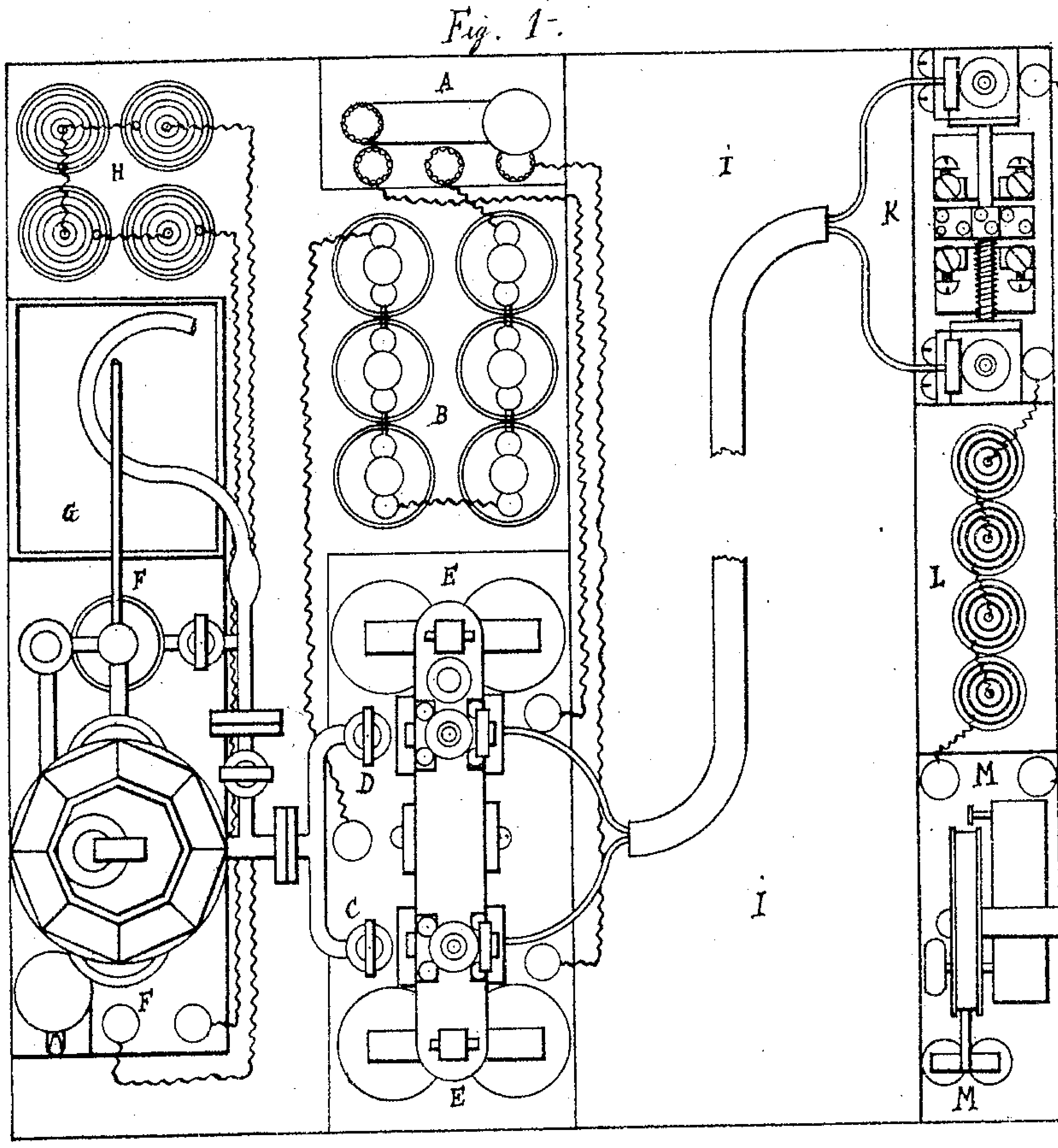


Fig. 2.

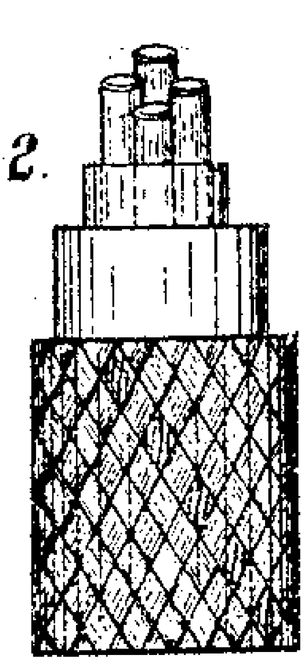
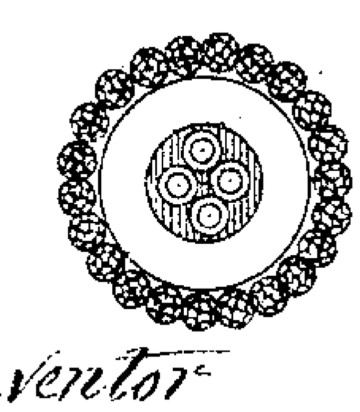


Fig. 2.



Witnesses.

Jean Baptiste Girard
83 bd Lafayette
Louis Robin
37 Rue Rochechouart

Inventor.

Ferdinando Tommasi

F. TOMMASI.

Hydrostatic and Electric Telegraph-Cables.

No. 143,597. Patented Oct. 14, 1373.

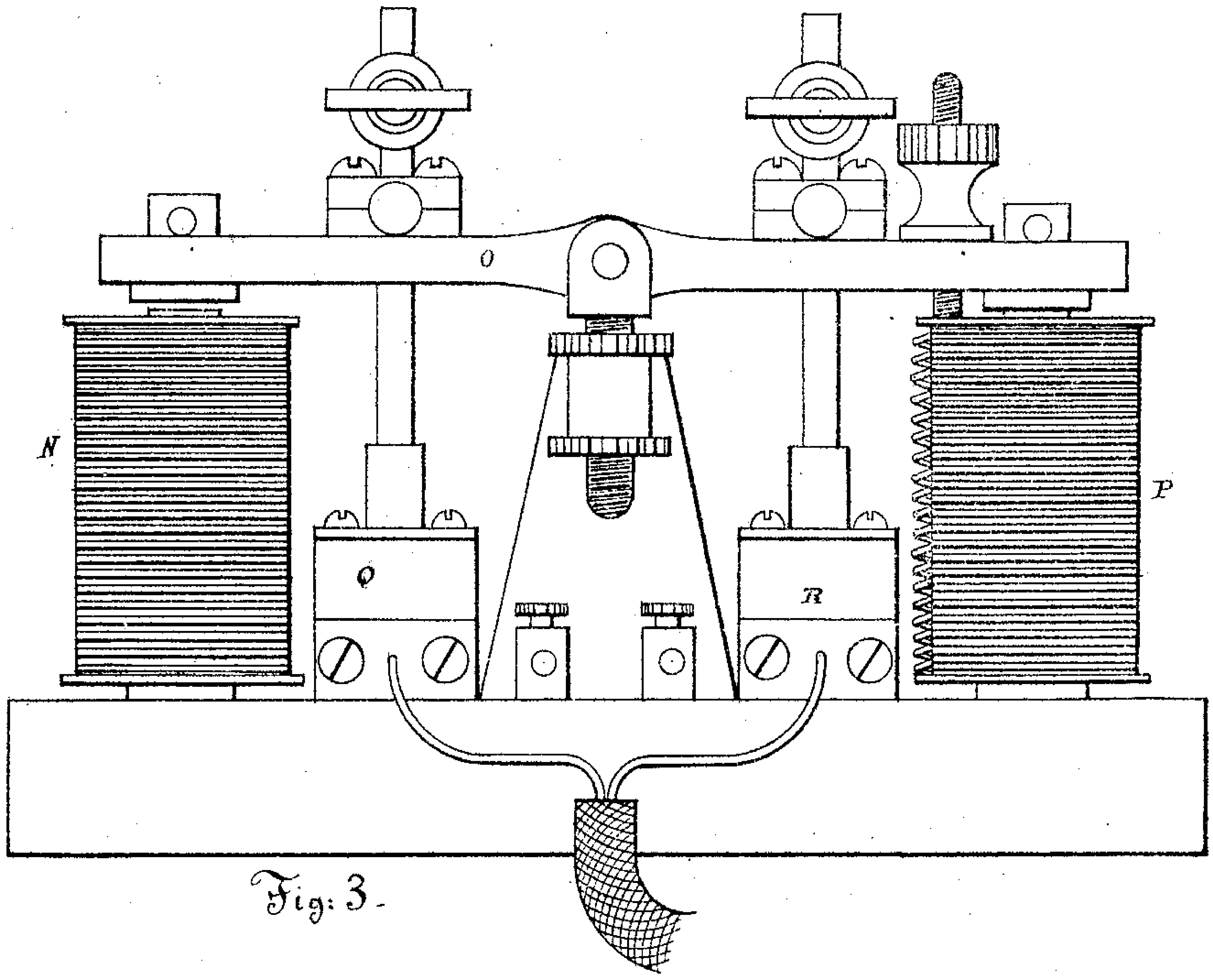


Fig: 3.

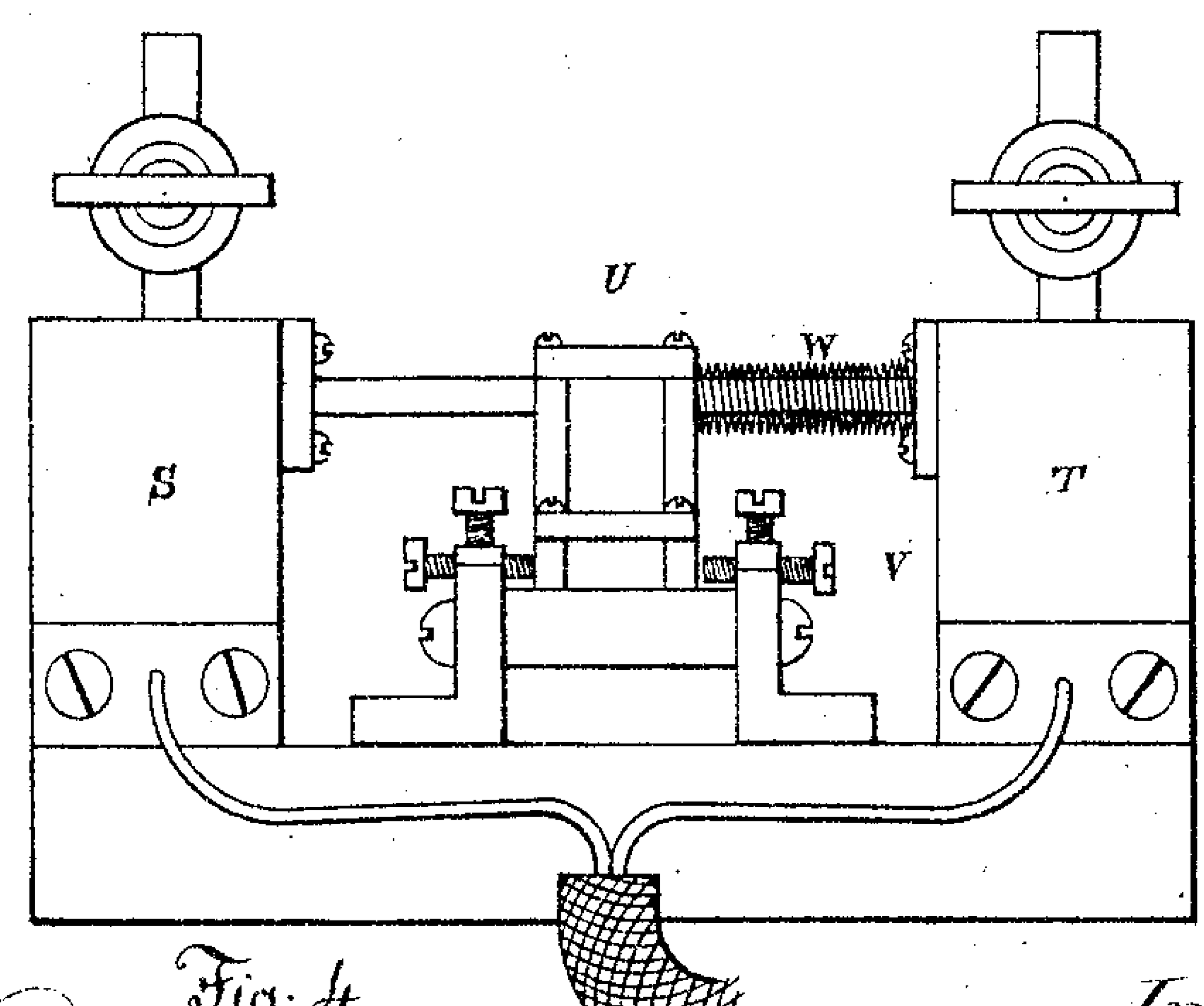


Fig: 4

Witnesses.

Jean Baptiste Girard
83 bis rue Lafayette
Louis Robin
37 Rue Rochechouart

Inventor

Ferdinando Tommasi

3 Sheets--Sheet 3.

F. TOMMASI.

Hydrostatic and Electric Telegraph-Cables.

No. 143,597. Patented Oct. 14, 1873.

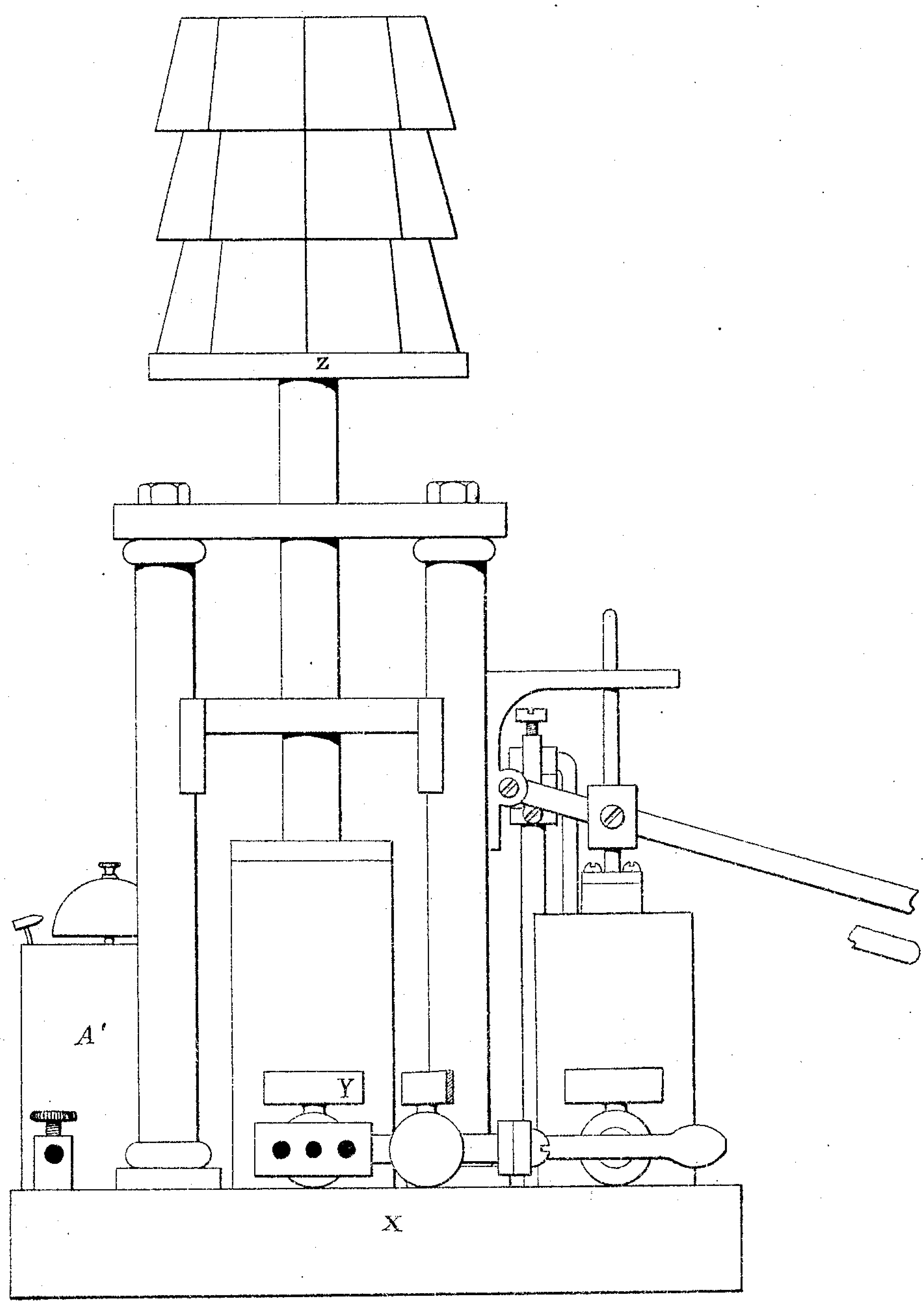


Fig: 5.

Witnesses.

Jean Baptiste Girard
85 bis rue Lafayette

Louis Robin
37. Rue Rochechouart.

Inventor.

Ferdinando Tommasi

UNITED STATES PATENT OFFICE.

FERDINANDO TOMMASI, OF PARIS, FRANCE.

IMPROVEMENT IN HYDROSTATIC AND ELECTRIC TELEGRAPH CABLES.

Specification forming part of Letters Patent No. **143,597**, dated October 14, 1873; application filed November 20, 1872.

To all whom it may concern:

Be it known that I, FERDINANDO TOMMASI, of the city of Paris, Department of the Seine, in the Republic of France, have invented an Improved Hydro-Electric Cable, and improved apparatus in connection therewith, of which the following is a specification:

Suppose a pipe, of any diameter and length, to be filled with a liquid, and to have at its extremities two movable pistons of equal bore; further, that the pipe is curved until both extremities are brought close to each other, and that the pistons are united by an oscillating lever common to both, so that one operator, acting at the same time on both oscillating extremities of the lever, may lower one of the pistons while lifting the other. Suppose, also, that, previous to the stroke of the lever, the liquid has been compressed in such a way that, relatively to the resistance to be overcome to displace the liquid with a given speed, this liquid can no longer be compressed, nor the capacity of pipe which holds it be increased. Everything being thus arranged, it is incontestable, first, that the pressure exercised upon the descending piston is communicated immediately to the whole mass of liquid contained in the pipe and to the ascending piston; second, that the liquid will occupy in the second piston as much space as it has vacated in the first; third, that the speed of this displacement will be in proportion to the active power of the operator, or of any other auxiliary power at his command.

My hydro-electric cable is but a natural application of the above data. In principle, it is a pipe filled with liquid, and working under the conditions above set forth.

The following description will set forth the manner in which the reciprocating displacements of this liquid operate to set in motion ordinary electric telegraphing apparatus.

My hydro-electric cable is composed of an optional number of small pipes of pure copper. They are collected in bundles or sheaves, are coated with gutta-percha, and inclosed in cork cylinders or jackets placed end to end, these cylinders being tightly compressed by means of a coating composed of strong tarred hemp rope applied in crossed spires. These ropes or cords may be replaced by iron or steel wire coated with tarred hemp or other suitable material. The cork cylinders or jackets might also be suppressed, if deemed desirable—for example, if it be considered more advantageous to have a strong than a light cable. The inside diameter of these small pipes is from the one-twelfth to one-eighth of an inch, (two to three millimeters,) and the outer diameter from one-eighth to one-sixth of an inch, (three to four and a half millimeters.) They are drawn in one piece, and without any welding in the direction of their length. Each end piece may have a length of eight hundred and twelve feet six inches, (two hundred and fifty meters;) but whatever may be their length, they are screwed end to end inside of a small cylinder or clutch-box tapped in the interior, and are afterward copper-soldered. The small cylinders or clutch-boxes are also made of pure copper. As to the number of these small pipes, there are as many couples of pipes in the cable as there are dispatches to be simultaneously forwarded or received.

Figure 1, Sheet I, is a plan view of a telegraphing apparatus embodying my invention, drawn to a scale of twenty-five one-hundredths. Fig. 2, Sheet I, is an elevation of a cable made according to my invention, drawn full size. Fig. 2*, Sheet I, is a section of same. Fig. 3, Sheet II, is an elevation of electro-manipulating apparatus, drawn to a scale of five-tenths. Fig. 4, Sheet II, is an elevation of relay apparatus, drawn to a scale of five-tenths; and Fig. 5, Sheet III, elevation of hydraulic press.

A indicates a Morse's manipulator; B, pile; C, tap; D, tap; E, electro-manipulating apparatus; F, hydraulic press; G, basin to receive the water discharged from the hydraulic press; H, pile; I, space between the two corresponding telegraph-offices; K, relay apparatus; L, pile; M, Morse's receiver; N, electro-magnet; O, lever; P, electro-magnet; Q R, vertical pump-barrels; S T, horizontal pump-barrels; U, piece dependent upon the two pistons S and T, and which, in moving from left to right, comes in contact with screw V; W, spiral spring; X, union-joint; Y, tap; Z, weighted piece or plate; A′ electric bell or alarm.

Figs. 2 and 2* show, in elevation and section, a cable containing four pipes, and consequently suitable to the simultaneous expedition or reception of two dispatches. These pipes are entirely filled with distilled water, freed from air and mixed with alcohol. Each couple ends on one side in the electro-manipulating apparatus, Fig. 3, and on the other side in the relay apparatus, Fig. 4. The vertical pump-barrels Q and R, Fig. 3, and those placed horizontally, S and T, Fig. 4, are also filled with the same water, which forms, consequently, two liquid veins, one of which begins under the vertical piston Q, and ends under the horizontal piston S, the other beginning under the vertical piston R, and ending under the horizontal piston T.

When by means of an ordinary manipulator—for example, Morse's, A, Fig. 1—the current of the pile B (same figure) is passed into the electro-magnet N, Fig. 3, the lever immediately forces piston Q to lower and piston R to rise. The effect of this maneuver is, that piston S, Fig. 4, is pushed, while piston T is pulled, and consequently the piece U, dependent on those two pistons, moves from left to right, and comes in contact with screw V.

When by means of the aforesaid manipulator the current of pile B, Fig. 1, passes through the electro-magnet P, Fig. 3, the lever O at once compels piston R to lower and piston Q to rise. The effect of this maneuver is, that piston T, Fig. 4, is naturally pushed, while piston S is pulled; consequently piece U moves in the opposite direction—that is, from right to left—and breaks the contact with the screw V.

Piece U and screw V, Fig. 4, being the two poles of a local pile connected with an ordinary apparatus of telegraphic reception, (dial, Morse's, Hugues', &c.,) it is obvious that the current of this pile, being alternately intercepted and renewed, will work that apparatus in the ordinary conditions.

Each one of the two pump-barrels Q and R, Fig. 3, has a tap placed in front of the junction where the pipe of the cable ends. (See C and D, Fig. 1.) Both taps are united by means of a bent pipe to a single pipe, and to the junction or union-joint X, Fig. 5, of the hydraulic press. When there are no dispatches to be forwarded, tap Y, Fig. 5, and taps C and D, Fig. 1, are turned on. The weight with which piece Z, Fig. 5, is charged then exercises an equal pressure upon all the liquid mass contained in the pump-barrel of the press, in the pump-barrels of both apparatus, and in both pipes, and consequently on the inside walls of those pump-barrels and pipes. It follows from this that if the weight acting upon piece Z, Fig. 5, is sufficient to compress the water and increase the capacity of the pipes, so that the water needs no more to be compressed, or the capacity of the pipes to be increased under the pressure of the descending piston, the oscillation operated by the electro-manipulating apparatus, Fig. 3, will be immediately transmitted to the relay apparatus, Fig. 4, whatever the diameter and length of the pipes may be. For this it will be sufficient to close the taps Y, Fig. 5, and taps C and D, Fig. 1, and to send successively into the electro-magnets N and P, Fig. 3, a current strong enough to enable the electro-magnets—each in its turn—to draw lever O instantaneously, in spite of the resistance opposed by the liquid column that must be displaced through the effect of the oscillation of that lever.

Piece U, Fig. 4, is only displaced the two hundred and fiftieth part of an inch, (one-tenth of a millimeter.) This is sufficient for a contact or an interruption. Both pistons S and T, Fig. 4, have a diameter of about one-fourth of an inch (six millimeters) each. Therefore the quantity of water displaced at each oscillation does not go beyond the volume of three cubic millimeters.

When taps Y, Fig. 5, and C D, Fig. 1, are turned on, the water-pressure on both pistons S and T is equal. Then the piece U is as much subject to be farther off as nearer screw V. In that case the spiral spring W always keeps it at a distance from screw V, with which this piece can only come in contact through the effect of the oscillations of lever O, Fig. 3.

The function of the hydraulic press is not only to preserve a constant pressure in the water-pipes and apparatus, as I have above shown it; but it serves also to compensate automatically the variations of volume that the water-pipes and apparatus may undergo, according to the changes of temperature. Indeed it is obvious that, when taps Y, Fig. 5, and C D, Fig. 1, are turned on, the increase or the diminution of the water-volume can produce no other result than the rising or lowering of the piston of the hydraulic press. Thence the volume of water contained in both pipes and in the apparatus must always and forcibly remain the same. The electric bell A′, Fig. 5, calls automatically the office-clerk every time the piston comes to the upper or lower extremity of its course. The clerk, by giving passage to a certain quantity of water in the first case, and by giving a few strokes of the piston with the feed-pump of the press in the second case, sets the piston in its normal state.

Advantages with the hydro-electric cable: First, as many simultaneous dispatches may be transmitted as there are couples of pipes inside the cable in connection with the three apparatus above described. Second, the speed of transmission of each dispatch can easily exceed ten oscillations per second, and this represents an average of twenty words per minute. Third, the rupture of the cable is not to be apprehended, especially that resulting from oxidation. A breakage produced by the weight of a cable provided with cork cylinders or their equivalent is almost impossible. Fourth, any existing system of telegraphy may be worked with equal speed and precision—for instance, a Morse or Hugues system of dial. Fifth, as the weight in the sea of a cable with cork jacket does not exceed from forty to eighty pounds per mile, the laying of it is exceedingly easy. Sixth, in the almost impossible case of a breakage, the place where the rupture has occurred can be easily ascertained, and, thanks to its lightness, the cable can be easily pulled on board a ship to be rapidly repaired. Seventh, at an expense of about sixty-four pounds for every four furlongs, (one thousand six hundred francs per kilometer,) two simultaneous dispatches may be forwarded, and each one of them with a speed of twenty words per minute—say forty words per minute—and that even if the length of the cable be of two thousand miles, (four thousand kilometers.) The result is, that, at an equal expense, the hydro-electric cable gives a receipt at least ten times larger than that of ordinary cables, and that the capital expended in the construction and laying is not liable to be lost, as is often the case with ordinary cables.

Another advantage: The hydro-electric cable can be constructed so that, if required, it may be worked like an ordinary electric cable, without having, on that account, to make any modifications after it is laid. All that is required is, that, at the time of its construction, the copper pipes are to be isolated by the means in actual use to insulate the copper wire of ordinary cables, and with equal care.

What I claim as my invention is—

1. The combination of a system of double hydrostatic signaling-tubes with the reciprocating armature of double electro-magnets at each end of the line, substantially as and for the purpose hereinbefore set forth.

2. The combination of the same with the ordinary receiving apparatus of the electric telegraph, substantially as hereinbefore set forth.

3. The application of metallic or electrically-conducting tubes to a system of hydrostatic signaling-lines, so as to enable such cables to be employed either as mechanical or electrical telegraph-lines, as desired.

FERDINANDO TOMMASI.

Witnesses:

JEAN BAPTISTE GIRARD,

LOUIS ROBIN.