No. 634,488. Patented Oct. 10, 1899.

M. WADDELL & C. LEGRAND.

ELECTRICAL INDICATOR.

(Application filed Feb. 18, 1899.)

(No Model.) 2 Sheets—Sheet 1.

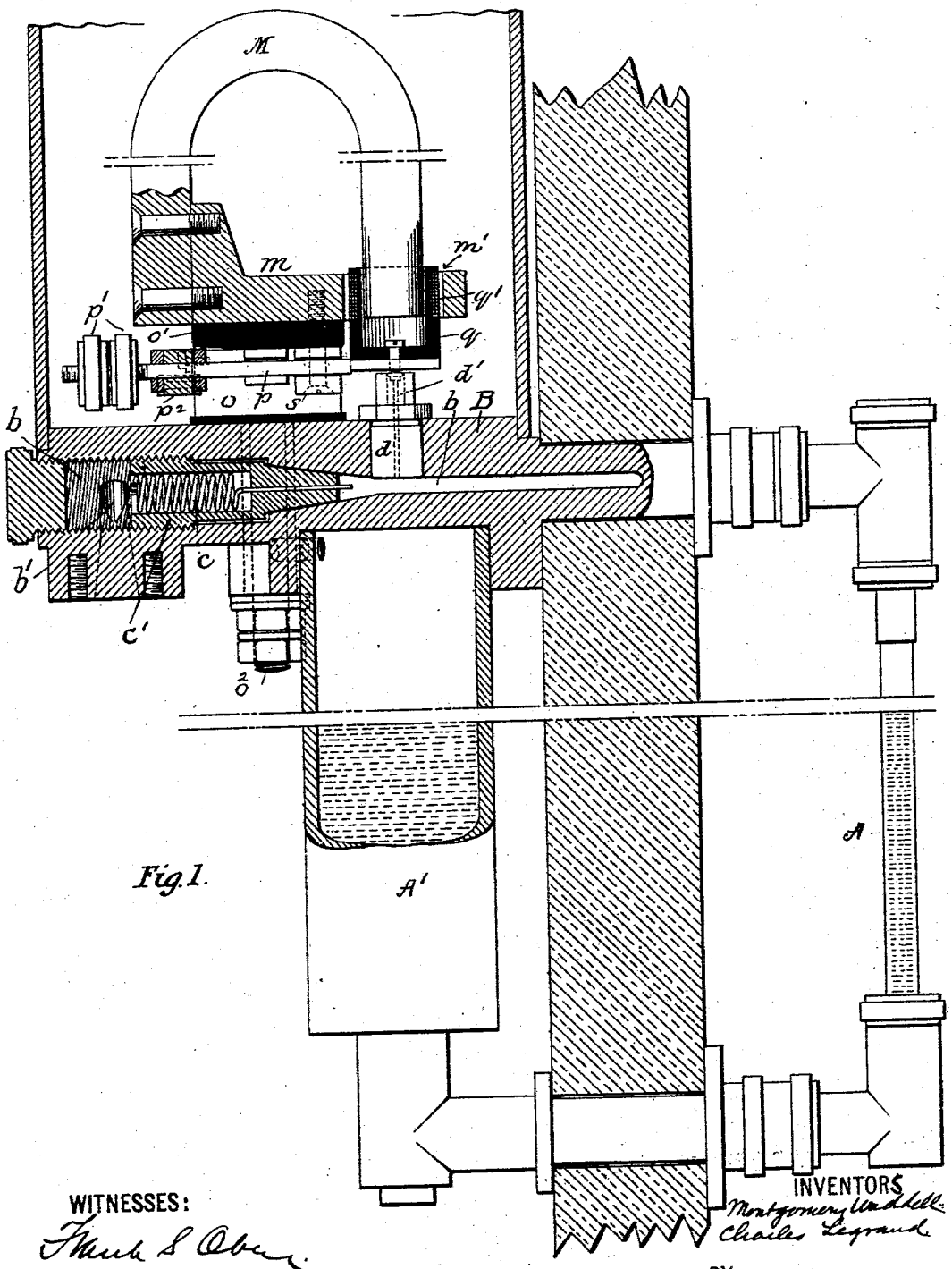


Fig. 1.

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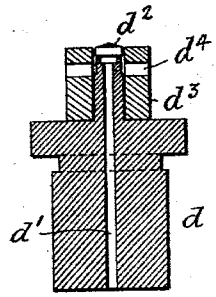


Fig. 2.

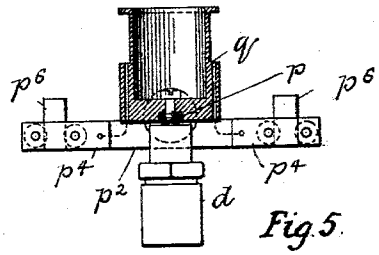


Fig. 5.

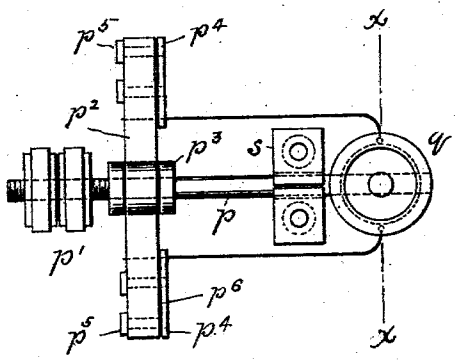


Fig. 3.

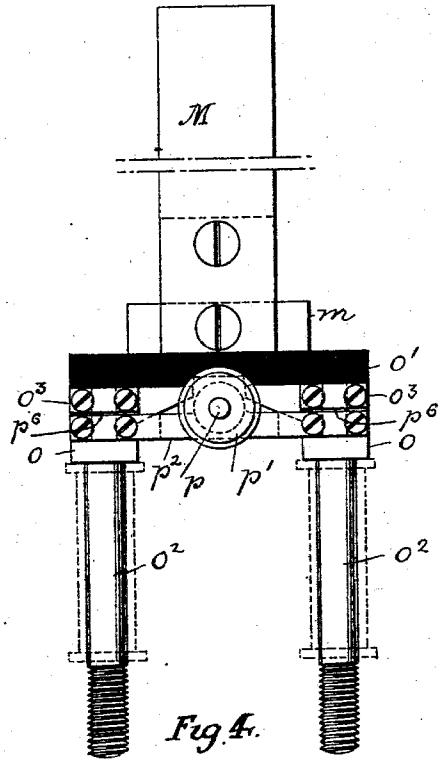


Fig. 4.

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UNITED STATES PATENT OFFICE.

MONTGOMERY WADDELL, OF NEW YORK, N. Y., AND CHARLES LEGRAND, OF WESTFIELD, NEW JERSEY; SAID LEGRAND ASSIGNOR TO SAID WADDELL.

ELECTRICAL INDICATOR.

SPECIFICATION forming part of Letters Patent No. 634,488, dated October 10, 1899.

Application filed February 18, 1899. Serial No. 705,978. (No model.)

To all whom it may concern:

Be it known that we, MONTGOMERY WADDELL, a subject of the Queen of Great Britain, residing in the city of New York, State of New York, and CHARLES LEGRAND, a subject of the King of Belgium, residing at Westfield, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Electrical Indicators, of which the following is a full, clear, and exact description.

This invention relates to electrical indicators or instruments whose function is to show at any time the condition of the current flowing in an electric circuit or circuits.

The invention consists of certain improvements over the invention of Montgomery Waddell, described in his application filed January 10, 1899, Serial No. 701,597. In that application is described an instrument wherein the condition of the current flowing in a circuit is indicated by the height of a column of liquid, such height being raised or lowered by the pressure of air or gas, which in turn is controlled by the current being indicated. The principle of operation described in said application is used in the instrument described in the present case; but the improvement herein consists in counterbalancing the valve controlling the pressure of air, whereby it will require less current to operate the instrument, and the instrument is easier to adjust. In the present instrument the mercury-contacts described in the previous application are dispensed with and a novel construction substituted for them. The details of construction also form a part of the present invention.

In the accompanying drawings, Figure 1 is a central vertical section of the improved instrument, parts being shown in elevation. Fig. 2 is an enlarged detail of the valve. Fig. 3 is a plan of the spool and its balancing-support. Fig. 4 is a rear view of the magnet and counterbalancing devices. Fig. 5 is a section on line x x of Fig. 3.

Referring first to Fig. 1 for a general understanding of the instrument, A represents the indicating-column, communicating at the lower end with a stand-pipe A′, the liquid contained therein flowing freely from one to the other. B is a base-plate having an internal chamber b divided into forward and rear parts by an air-flow resistance consisting of a capillary tube c. Air or other gas under pressure is supplied to the rear portion of the chamber through the openings b' by an air-pump or other suitable source, whence it leads through the capillary tube into the forward portion of the chamber and then to the surface of the liquid-column in A. The means for inserting the capillary tube is a feature of the present invention. In the former application referred to the tube was wound around the outside of a plug, whereas in the present case the tube is coiled inside of a hollow plug c', one end of which is solid and tapered to make a tight fit with the walls of the air-chamber. One object in using a hollow plug is to be able to use various other kinds of air-flow resistance, as well as the capillary tube, the preferred resistance being easily contained in the chamber of the plug.

To control the pressure in the forward portion of the air-chamber, which, as before stated, acts upon the surface of the column of liquid, a plug d, with a passage d' leading from the chamber to the atmosphere, is used. This plug is shown in detail in Fig. 2, wherein it will be seen that the single passage d' is covered at the top by a very small and light disk valve d^2, which is held in place by a sleeve d^3, having lateral openings d^4, through which the air or gas which is allowed to escape from the passage has an exit. The under surface of the valve makes a smooth even fit with the top of the plug, which at that point is merely a flange surrounding the escape-passage.

Mounted above the base-plate B is a permanent magnet M, of horseshoe form, the legs being partially connected by an iron plate m, having a circular vertical opening m' in one end, through which a leg of the magnet passes. The end of the leg is made cylindrical and of less diameter than the opening m', so as to leave an annular space forming a field of force. The magnet is supported above the plate by means of two brass blocks o, upon which is placed a plate of hard rubber or other insulating material o', to which the cross-piece of the magnet is se-

cured, the rubber plate being also rigidly secured to the blocks *o*. This arrangement insulates the magnet from the blocks. The latter carry metallic studs o^2, which pass downward through the base-plate and are fitted with suitable binding devices for the electrical conductors, through which the current flows to actuate the instrument. The blocks *o* and the studs o^2 are insulated from the base-plate in the manner shown. In the space immediately beneath the magnet and between the blocks we arrange a balancing-arm *p*, screw-threaded at its rear end to receive threaded weights p' in the form of nuts and at its forward end carrying a spool or frame *q*, of hard rubber or other material, the upper diameter of which receives a coil of wire q'. The arm *p* rests on the valve-disk and determines by its pressure thereon the pressure in the forward chamber. The balancing-arm carries a cross-bar p^2, of hard rubber or other insulating material, which is firmly secured thereto by nuts p^3. At each extremity of the cross-bar is provided a clamp consisting of a metallic plate p^4, held against the side of the cross-bar by screws p^5. In each of these clamps is fixed a very thin strap or ribbon p^6, of metal, projecting upward and passing into clamps o^3 on the blocks *o*, similar in construction to those on the cross-bar. These straps of metal support the balancing-arm and the devices which it carries, forming a pivot on which the arm may turn through its very slight working angle without substantial resistance or friction. The terminals of the coil *q* lead, respectively, to the clamping-plates p^4, and the steel straps serve to connect said clamps with the brass blocks *o*, thus establishing a complete circuit between the binding-posts of the instrument through the coil *q*. To prevent derangement of the balancing-arm thus delicately mounted, we embrace its forward portion in a pair of blocks *s*, in which it has sufficient play to perform its functions, but being so confined as to prevent displacement. These blocks are secured to the under side of the magnet.

The spool *q* projects into the annular field of force of the magnet sufficiently to bring the entire coil under the magnetic influence.

The operation of the instrument is substantially the same as that of the instrument described in the former application; but in brief it may be stated that when the air-pressure is admitted to the chamber above the surface of the liquid-column the latter is forced downward to the zero-point of the scale, which is determined by the air-pressure in the forward chamber and the opposing pressure upon the valve-disk. It will be observed that if for any reason the liquid-level does not coincide with the zero-mark on the scale adjacent to the column it may readily be made to do so by adjusting the position of the counterweights p', and thereby adding to or decreasing the pressure of the arm upon the valve. This is one of the advantages claimed.

When the zero-point is properly adjusted, the current of proper polarity may be allowed to flow through the coil Q', whereupon a tendency will be developed to lift the coil and spool, depending upon the strength of current flowing. As the pressure on the upper side of the valve is thus relieved the air-pressure on the under side that is necessary to balance it becomes less and an increased flow of air takes place. The level of the liquid-column accordingly rises to a point corresponding to the strength of current flowing. A decrease in the current reverses these actions.

Since the weight of the spool and coil is offset to any degree desired by the counterweight, it is obvious that the instrument may be operated with very small expenditure of current, and it is also evident that the valve will be more sensitive than the one described in the previous application, for that valve was held down by the entire weight of the coil and spool and it was necessary to provide a larger capacity of escape-port for a given air-pressure. Dispensing with the mercury-contacts is also an important advantage.

Having described our invention, we claim—

1. In an electrical indicator, the combination of a column of liquid whose level indicates the condition of the current flowing, an air-supply acting upon the liquid to change its level, a valve controlling the pressure of the supply, a counterbalanced weight resting upon the valve and means whereby the pressure of the weight upon the valve is varied in accordance with variations in the current flowing, substantially as described.

2. In an electrical indicator, the combination of an indicating element, an air-supply actuating the same, and a counterbalanced valve controlling the pressure of the supply of air, said valve being operated by variations in the current flowing.

3. In an electrical indicator, the combination of an indicating element, an air-supply actuating the same, a valve controlling the pressure of the supplied air, a spool carrying a coil of wire through which the indicated current flows, a magnetic field of force in which said coil is located, a counterbalance for the weight of the spool and coil, the valve being controlled by said spool and coil, substantially as described.

4. In an electrical indicator, the combination of means for creating a field of force, a coil of wire and its spool located therein, a tilting arm by which said spool and coil are carried, a counterweight therefor, a valve upon which the arm bears, said valve controlling pressure of air, and an indicating element operated by the pressure, substantially as described.

5. In an electrical indicator, the combination of means for creating a field of force, a spool and coil located therein a tilting arm carrying at one end the spool and coil and at the other end a counterweight therefor, a pair

of metallic straps suspending said arm and permitting it to tilt, the terminals of said coil being electrically connected respectively with the straps whereby current is conveyed through them to the coil a valve upon which one end of the arm rests, said valve controlling the pressure of fluid, and an indicating element operated by said fluid-pressure.

6. In an electrical indicator operating by differences of fluid-pressure, a body containing a fluid-flow resistance consisting of a hollow plug adapted to be inserted in and to seal a fluid-chamber, the fluid-flow resistance being contained inside the plug and communicating through both ends thereof with the fluid-chamber, substantially as described.

In witness whereof we subscribe our signatures in presence of two witnesses.

MONTGOMERY WADDELL.
CHARLES LEGRAND.

Witnesses:
FRANK S. OBER,
GEO. S. KENNEDY.