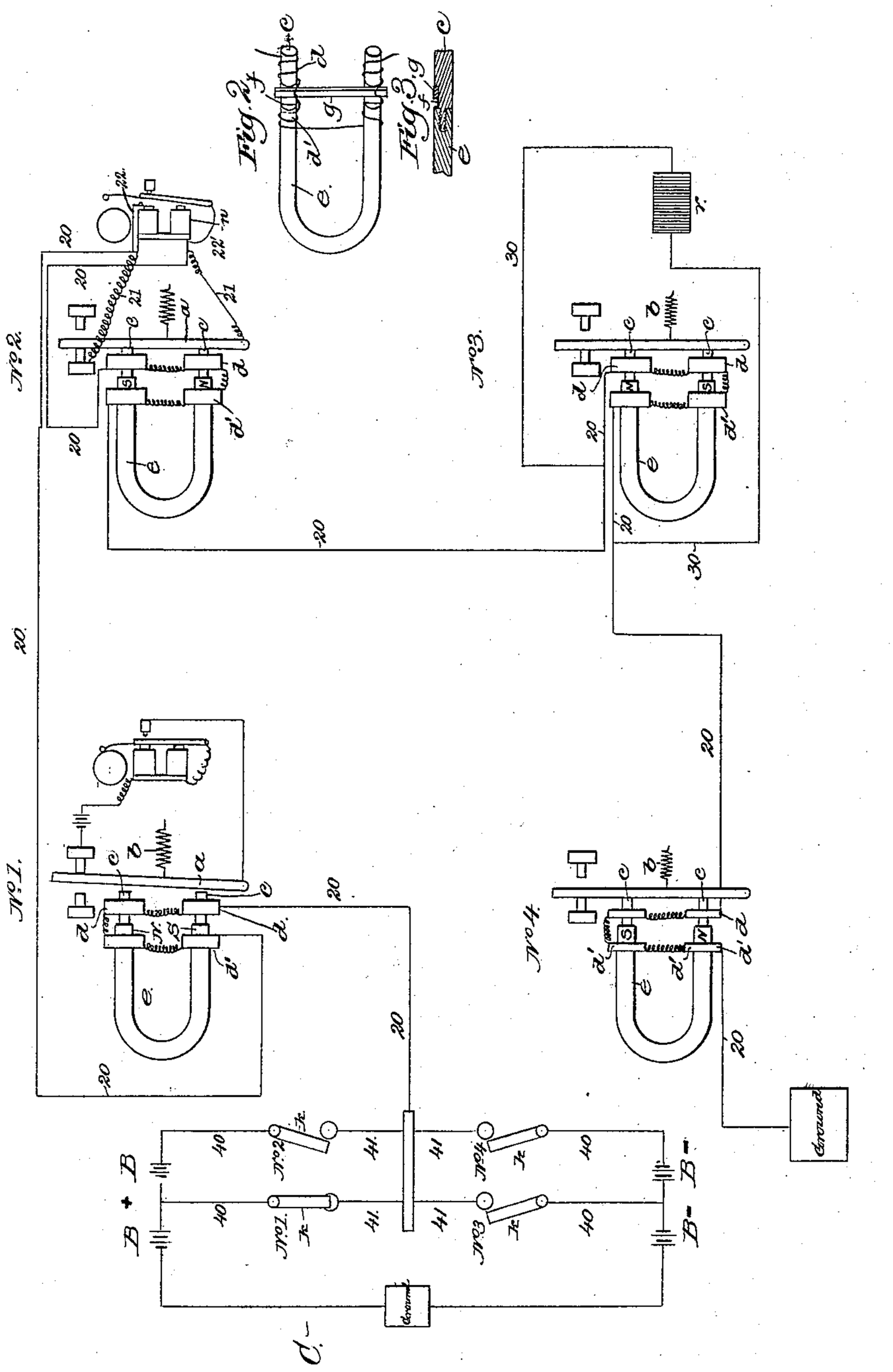
(No Model.)

J. C. WILSON.

TELEPHONE CALL.

No. 336,972. Patented Mar. 2, 1886.



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UNITED STATES PATENT OFFICE.

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TELEPHONE-CALL.

SPECIFICATION forming part of Letters Patent No. 336,972, dated March 2, 1886.

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To all whom it may concern:

Be it known that I, JOHN C. WILSON, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Electrical Apparatus, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to an electric apparatus in which a series of electro-magnetic instruments placed in a single electric circuit are capable of responding independently or individually each to a current of a certain definite character which will not affect the others.

In a previous patent, No. 283,448, dated August 21, 1883, I have shown an individual signaling apparatus containing a main or central station, and a series of sub-stations containing instruments the controlling-magnets of which have their cores charged with permanent magnetism independent of that induced by the currents passing through the main circuit and inductive coils of the said magnets. The said permanent or independent charge is of different amount or polarity in all the different instruments, so that a current of proper strength and polarity to neutralize the charge of one of the said magnets will not effect the neutralization of the charges of any of the other magnets. This construction necessitates an accurate adjustment of the amount or strength of the permanent magnetic charge, and also, where there is a large number of instruments in a given circuit, necessitates a permanent magnetic charge of very great strength in some of the instruments; and I have found in practice that it is dfficult to maintain the strength of magnetization of steel magnets permanent or unchangeable when heavily charged.

The present invention has for its object to overcome this difficulty; and it consists, mainly, in a series of electro-magnetic instruments having their cores magnetized permanently or independently of the magnetism induced by the currents passing through the main circuit, the charge of permanent magnetism being of substantially uniform amount in the different instruments, which are provided with inductive coils constructed or arranged to have a different inductive effect upon the cores of the different instruments for a given current passing through them all. By this means a current which in passing through the coils of the instruments will produce an effect just sufficient to neutralize the permanent charge of magnetism in the cores of one of the said instruments will not be of proper amount to neutralize the permanent magnetism of any of the other instruments, which will consequently remain charged sufficiently to enable them to retain their armatures attracted, and thus prevent any signal from being given, the signals being produced by the backward movement of the armatures from the magnets.

The inductive capacity of the coils of the different instruments may be varied by varying the amount or resistance of the wire in the said coils, or by making the said coils all of uniform length and resistance, and providing shunts of different resistance, so that different definite portions of the current circulating through the circuit will pass through the inductive coils of each instrument.

I have found by experiment that when currents of considerable strength are passed through inductive coils the soft-iron cores of which are charged by permanent steel magnets the said currents will cause considerable variation in the magnetic condition of the said steel magnets, thus rendering it difficult to keep them of sufficient uniformity in a series of instruments. I have discovered that these variations in the condition of the permanent steel magnets can be obviated by winding inductive coils upon the poles or extremities of the steel magnets in the reverse direction to that of the coils on the iron cores, as by this construction the effect of the current passing through the two inductive coils is neutral on the permanent magnet, although its effect on the soft-iron cores is substantially the same as when no opposing coil is used on the extremity of the steel magnet.

Figure 1 is a diagram illustrating an electro-magnetic apparatus embodying this invention, and Figs. 2 and 3 details showing the construction of the electro-magnet. Fig. 1 shows the apparatus arranged to operate with a central station and four sub-stations, the instruments of which are intended to respond

each independently of the others to a current of a particular character sent from the central station over the circuit common to all the said instruments.

The instruments consist of magnets having a movable armature, *a*, provided with a retractor, *b*, and the said magnet consists of iron cores *c*, provided with inductive coils *d* wound about them, and co-operating with them to induce magnetism in the said cores, as is usual in electro-magnets. The said cores *c*, instead of being connected by the usual soft-iron back strap are connected by permament magnets *e*, which are made as nearly as possible of uniform strength in the different instruments, and which induce in the cores *c* charges of magnetism which may be called "permanent," as it is independent of that induced in the said cores by the electric currents passed through their inductive coils *d*. The said cores *c* are preferably made with threaded stems, as shown in Fig. 3, and are flattened slightly, as shown at *f*, to receive, if necessary, a sma'l soft-iron armature, *g*, by which a portion of the magnetism of the magnets *e* may be taken up or diverted from the cores, so that the effect may be adjusted so as to make the magnetic strength of the cores *c* substantially uniform in all the instruments.

Where a large number of instruments are to be used, and it is convenient to use currents of either polarity in the line, a portion of the instruments will have the permanent magnetism in the cores *c* of the same polarity as will be induced by a negative current or opposed by a positive current passing through the line and coils *d*, while in the remainder of the instruments the magnetism of the cores will be such as induced by a positive or opposed by a negative current passing over the line.

The instruments are numbered 1 2 3 4, and those having the odd numbers have their permanent magnetism of such character as to be opposed by a positive current in the line, and those with the even numbers (2 and 4) of such character as to be opposed by a negative current in the line or increased by a positive current.

In the instruments 1 and 3, having a permanent charge of the same polarity, the coils *d* are shown as of the same inductive capacity, so that a given current, passing wholly through both of them, will produce the same inductive effect on the cores; but at the instrument No. 3 a shunt-circuit, 30, is connected with the main circuit 20 at either side of the coil *c*, the said shunt-circuit containing resistance-coils *r*, of about the same resistance as the portion of the circuit between the ends of the said shunt containing the coils *d*, so that by the well-known law only one-half of the current will pass through the coils *d* of the said instrument, and consequently a given current traversing the main circuit 20 will produce but one-half the inductive effect on the cores *c* of instrument No. 3 that it will have upon the cores *c* of instrument No. 1. In a like manner the cores of instrument No. 4 are adapted to produce but one-half as great inductive effect from a given current as those of instrument No. 2; but in this case the coils *d* of instrument No. 4 are of but one-half the inductive capacity of those of instrument No. 2, although they receive the whole current instead of, as in the case of instrument No. 3, being of equal capacity, but receiving only one-half the current.

The retractors *b* of instruments Nos. 3 and 4 are of such strength that when the magnets lose half their attractive power they are still able to retain their armatures, which are retracted only when the magnetic attraction is almost wholly neutralized or reduced to less than one-third or one-fourth of that produced by the permanent magnets *e*.

For convenience of illustration, two batteries are shown at the central or transmitting station C, the batteries being marked B + and B —, the former being adapted to have its positive and the latter its negative pole connected with the main circuit 20. The said batteries are divided into sections, each of which may be assumed as capable of producing a current of unit strength. The batteries between the different sections are connected by wires 40 with a series of keys or circuit-closers, *k*, the co-operating portions or anvils of which are connected by wires 41 with the main circuit 20, so that by closing any one of the keys *k*, which are numbered to correspond with the different instruments in the circuit, a definite portion of the battery will be connected with the line, so as to send a current of a certain number of units of strength and of either desired polarity through the different instruments.

As shown in the drawings, the key *k*, No. 1, is shown as closed, and one section of the battery is connected with the positive pole to the line, thus sending a current of unit strength over the circuit 20 and through the inductive coil *d* of the different instruments. The current, being positive, will tend to increase the magnetic charge in the cores *c* of the instruments Nos. 2 and 4, which will hold their armatures more powerfully in their normal attracted position, and the said current in passing through instruments No. 1 and No. 3 will tend to neutralize the permanent or independent magnetism of their cores, and in instrument No. 1 will be just sufficient to accomplish such neutralization.

Since, as before described, the current produces but one-half the effect on instrument No. 3 that it does on instrument No. 1, it will only partly neutralize the permanent magnetism of the core *c* of instrument 3, leaving about one-half of the original charge, which, as before mentioned, is insufficient to overcome the retractor *b*, so that the armature remains unmoved, and the instrument is not affected. If key *k*, No. 2, alone were closed, a positive current of two units' strength would be sent over the line, which would produce no move-

ment in the armatures of instruments Nos. 2 and 4, but in acting on instrument No. 3 would produce an effect of one unit strength in the coils *d*, which would be sufficient to just about neutralize the permanent magnetism of the cores *c*, permitting the armatures to be retracted. This current of two units of strength, in acting on instrument No. 1, will be double what is required to neutralize the charge of magnetism in the cores *c*, and consequently will induce an equal charge of opposite polarity, which will retain the armature *a* attracted, and the change in polarity of the magnetism will be effected so quickly that the armature will not have time to move while the magnetism is passing the neutral point. The operation will be substantially similar for currents of one and two units of strength on the instruments Nos. 2 and 4, the said negative currents merely increasing the strength of the instruments Nos. 1 and 3, and consequently producing no movement in their armatures.

It is obvious that instead of four instruments, or two instruments of like polarity, a greater number can be used, their coils being so constructed or connected in circuit as to receive different inductive effects from the same given current. In a set of eight, four of one polarity might have the inductive effect produced by a current of one unit strength equal to one in the first instrument, one-half in the second, one-fourth in the third, and one-eighth in the fourth, they being operated by currents of one, two, four, and eight units of strength, respectively.

In order to prevent the strong currents employed from changing the permanent magnetic strength of the steel magnets *e* by the inductive effect of the magnetism in the iron core *c*, a second inductive coil, *d'*, of about the same capacity as the one *d*, is placed on the poles or extremities of the said steel magnets in such direction as to produce the opposite inductive effect to that of the coil *d*, acting on the core *c* and through the latter on the magnet *e*. The current in the coil *d'* on the end of the steel magnet produces but little effect on the soft-iron pole-piece, and the current in the coil *d* acts substantially unopposed on the said pole-piece to magnetize the latter, its effect on the pole-piece being superimposed upon or opposed to that produced by induction from the permanent magnet, and the pole-piece in turn reacts upon the steel magnet, and might, if unopposed, reverse or change the permanent magnetism thereof. The coil *d'*, however, acting wholly on the permanent magnet, opposes the inductive effect from the pole-piece, so that although a change in magnetic condition takes place at the extremity of the pole-piece, due to the action of the coil *d* upon it, there is practically no change in magnetic condition at the extremity of the permanent magnet, which is effected by the equal and opposite inductive forces derived from the pole-piece and coil thereon and the coil *d'* on the permanent magnet. By this arrangement currents sufficiently strong to neutralize or reverse the magnetism at the end of the pole-piece may be used without materially affecting or reversing the charge of permanent magnetism in the steel magnet, while if the coils *d'* were omitted the magnetism induced by the coils *d* in the pole-pieces might act by induction upon the steel magnets so strongly as to reverse or destroy the permanent magnetism.

The instruments are shown as adapted to be used for signaling any one of the sub-stations of a telephone-circuit without signaling the others, and as shown in connection with instrument No. 1, the signal is a vibrating bell placed in a local circuit closed by the movement of the armature *a* from its magnet, the said signal thus remaining in operation as long as key No. 1 at the central office is closed. At station No. 2 the signal-magnet *m* is shown as placed in the main circuit 20, but has a short circuit or shunt, 21, of practically no resistance, connected with the main circuit at either side of the said magnet and controlled by the armature *a*, the said shunt being closed and diverting the currents from the magnet *m*, while the armature *a* is attracted.

The armature of the magnet *m* may be arranged to close a shunt, as 22, for the said magnet when it is attracted, so as to cause it to operate as a vibrator without opening the main circuit.

Instead of using steel magnets to change the cores *c* of the instrument they may be charged by local currents passing through inductive coils.

I claim—

1. The combination, with an electric circuit, of a series of electro-magnetic instruments having their cores charged with magnetism of substantially equal amounts in the different instruments and independent of that induced by currents in the said circuit, and electro-magnetic devices in the said circuit which produce a different amount of magnetic change in the different instruments when affected by a given current in the circuit, substantially as described.

2. In an electric circuit, a series of electro-magnetic instruments having their cores charged with magnetism of substantially equal amount and independent of that induced by currents in the said circuit, electro-magnetic devices which produce unequal magnetic changes in the different instruments when the circuit is traversed by a current of given strength, combined with means for transmitting currents of different definite strengths, whereby the desired inductive effect may be produced in any desired one of the said instruments, and in that one only, substantially as described.

3. An electric circuit and series of electro-magnetic instruments therein having inductive coils of substantially equal capacity, and in a portion of the said instruments a shunt for the said coils of definite resistance, where-

by unequal inductive effect is produced in the different instruments by a current of given strength in the circuit, combined with means for transmitting currents of different definite strengths over the said circuit, substantially as described.

4. An electric circuit and series of electro-magnetic instruments therein having their cores charged with magnetism of substantially equal amount, and part of one and part of the other polarity, and having electro-magnetic devices which produce unequal magnetic changes in the different instruments of like polarity, combined with means for transmitting currents of different definite strengths and of either desired polarity, substantially as described.

5. An electric circuit and series of electro-magnetic instruments therein, a part having their cores charged with magnetism of one polarity and a part with the other polarity, and inductive coils on the said cores, and in a portion of the instruments shunts of definite resistance, whereby unequal inductive effect is produced in the different instruments by a current of given strength, combined with means to transmit currents of different strengths and polarity, substantially as and for the purpose described.

6. An electro-magnetic instrument consisting of a permanent steel magnet and soft-iron cores attached to the poles or extremities thereof and magnetized thereby, combined with inductive coils upon the extremities of the steel magnet and upon the soft-iron cores, arranged to produce opposite inductive effect upon the poles of the steel magnet when traversed by a current, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN CORNELIUS WILSON.

Witnesses:

JOS. P. LIVERMORE,

B. J. NOYES.