No. 791,938. PATENTED JUNE 6, 1905.

G. E. PALMER.

SYSTEM OF ELECTRICAL DISTRIBUTION.

APPLICATION FILED JULY 5, 1904.

2 SHEETS—SHEET 1.

Fig: 1

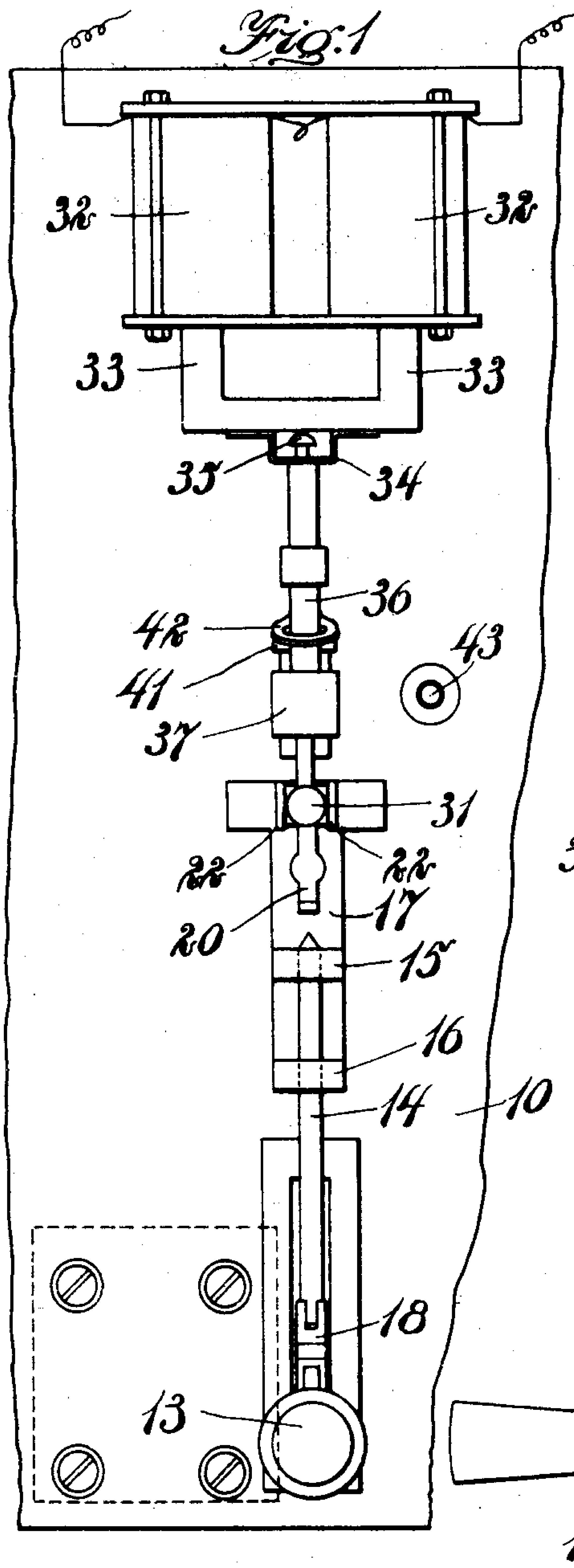
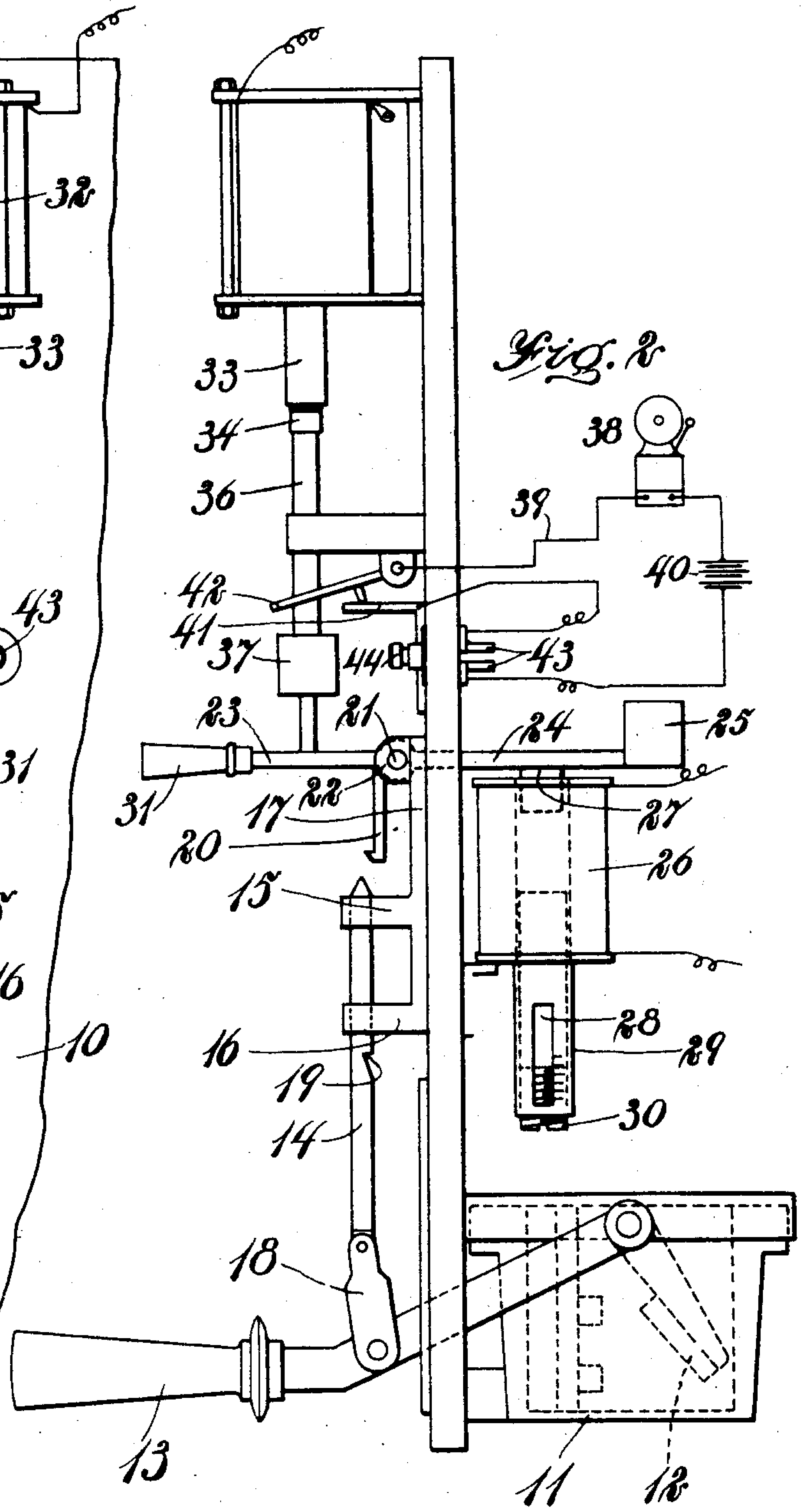


Fig. 2



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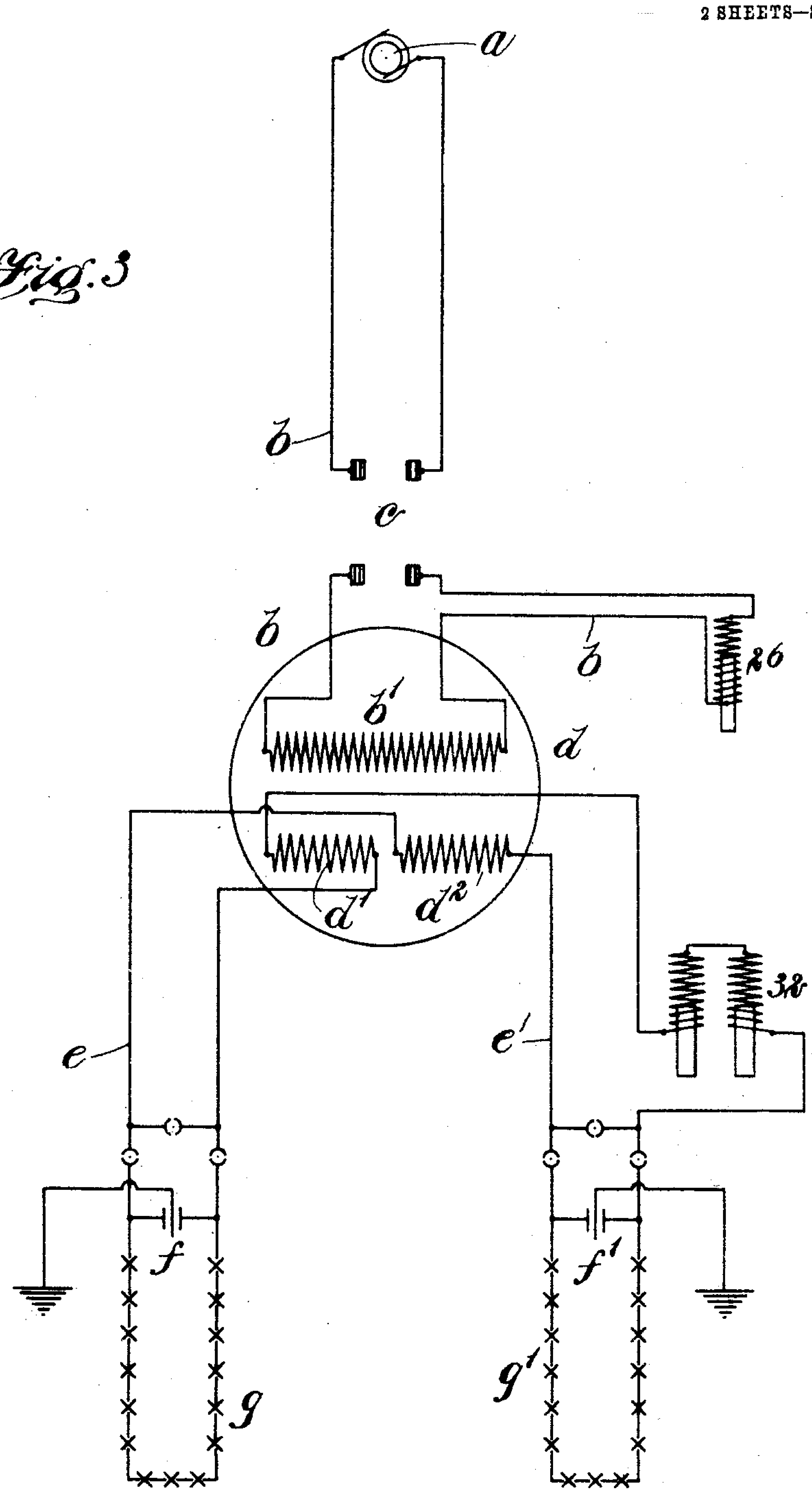
2 SHEETS—SHEET 2.

Fig. 3



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UNITED STATES PATENT OFFICE.

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SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 791,938, dated June 6, 1905.

Application filed July 5, 1904. Serial No. 215,251.

To all whom it may concern:

Be it known that I, GRANVILLE E. PALMER, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Systems of Electrical Distribution, of which the following is a specification.

This invention has relation to systems of electrical distribution in which alternating currents of high voltage are employed for lighting or other purposes.

The object of the invention is to safeguard the public from danger of live wires and to protect against injury the apparatus forming a part of the system in case of a broken wire or a short circuit. This in a general way is accomplished by automatically devitalizing open or broken circuits and by automatically cutting out from the generator those circuits in which there is an overload injurious to the generator or other apparatus.

The invention may be embodied in a system having a single or multiphase alternating-current circuit of two or more wires operating in connection with a system of series alternating-current arc-lamps in which constant-current transformers are interposed between the generator and the lamps.

Where open-circuit or short-circuit conditions occur in distributing systems, such as hereinbefore referred to, special apparatus is necessary to insure the protection of the translating devices forming part of the system. The present invention is in part designed to produce a combined overload and underload circuit-breaking device in which the use of springs and a multiplicity of levers and intricate locking devices is avoided and in which the switch or make-and-break devices are in their simplest form and are sufficient in themselves to open circuits of practically any potential, amperage, and power factor with which the engineer has to deal in the operation of high-tension alternating-current circuits.

In the operation of constant-current transformers an open circuit in the secondary or lamp circuit will cause a rise of potential in said lamp-circuit far in excess of the maximum full-load voltage, and a short circuit, particularly if it be of a periodic nature, will cause a violent oscillation of the movable members of the constant-current transformer that is highly detrimental to said transformer. To promptly protect these distributing systems against open circuits, it is necessary that the breaking apparatus be so constructed that that element which performs the function of releasing the locking mechanism has no other function that may interfere with this service, and it must be likewise so designed that no magnetic lag interferes with its proper operation, and it must also be capable of such arrangement that it will operate at the moment the charge of the line falls below the capacity thereof, whereby the primary side of the line may be opened before the secondary is discharged at an increasing potential. To accomplish this, it has been found desirable to use an electromagnetic mechanism with the fewest possible number of ampere-turns compatible with the work it is desired to perform. The relative position of the armature to the solenoid is such that practically the full current strength of the circuit is necessary to primarily attract said armature and the magnetic relation between the solenoid and armature is then such that a predetermined diminution of the current strength will so reduce the magnetic field that the armature will fall and perform its functions.

I regard it as desirable and practically essential in disconnecting a constant-current transformer from its source of supply in the event of open or short circuit condition in its secondary circuit that the primary side be broken before the secondary is discharged.

Referring to the drawings, which illustrate several embodiments of the invention, Figure 1 represents in front elevation a portion of the switchboard and represents the mechanical features of an apparatus embodying the invention. Fig. 2 represents a side elevation of the same. Fig. 3 represents, diagrammatically, a system of electrical distribution employing a constant-current transformer located

between the source of supply and the arc-lights or other translating devices.

Referring first to Figs. 1 and 2, 10 indicates a switchboard or base-plate upon the rear of which is supported a make-and-break device consisting of an oil-switch, (indicated as a whole at 11.) The movable contacts 12 are operated by a handle-lever 13. The raising of the lever closes the switch and its dropping opens it. 14 represents a vertically-movable catch-bar arranged to slide in guides 15 16, projecting forwardly from a plate 17, secured to the front face of the switchboard 10. This catch-bar is connected to the handle-lever 13 by a link 18. The inner face of the catch-bar 14 is notched to form a shoulder 19, which when the handle-lever 13 is raised may be engaged by the hooked end of a latch 20. The said latch projects downwardly from a shaft 21, journaled in ears or lugs 22, formed in the plate 17. Secured to said shaft 21 are two arms projecting horizontally in opposite directions, the forwardly-projecting arm being indicated at 23 and the rearwardly-projecting arm at 24. The latter passes through an aperture in the switchboard 10 and is provided with a weight 25, which holds the catch 20 forwardly, so that it may engage and support the catch-bar 14. The upper end of the catch-bar is beveled and the hooked end of the latch is beveled, so that when the handle 13 is raised the latch will be forced rearwardly until it registers with the notch in the catch-bar, upon which the hooked end of the latch will slip under the notch of the latch 19 and prevent the catch-bar and the handle from dropping by gravity. When the latch is moved rearwardly to release the catch-bar, the weight of the handle and the catch-bar are sufficient to immediately open the switch by moving the movable contacts away from the stationary contacts. Supported upon the rear face of the switchboard 10 there is an electromagnetic actuator comprising a solenoid 26. It is located immediately below the arm 24, so that a projection 27 on said arm extends part way into the cylindrical aperture therein. The plunger or core 28 when the current through the solenoid increases beyond a given strength rises and engages the projection 27 of the arm 24 with a sharp hammer-blow and disengages the latch 20 from the catch-bar 14.

The plunger 28 when in its lower position rests in a tubular casing 29, attached to the solenoid and having in its lower end an adjustable abutment 30. The solenoid or electromagnet and its core or armature constitute an overload-release or switch-controlling mechanism, as will be explained, which acts directly upon the integral structure which constitutes the latch for releasing the switch-lever 13 and the catch-bar 14 connected thereto.

Located directly over the arm 23, which has a handle 31, by which it may be manually operated, is an electromagnetic switch-controller. It consists of two solenoids or coils 32 32, the plungers 33 of which are connected together in the form of a yoke. Loosely connected to the plungers or armatures 33 by a strap 34 and screw 35, so as to have a certain amount of lost motion relatively thereto, is a plunger 36, weighted as at 37. This plunger is directly over the arm 23, so that when it is permitted to drop it engages the arm 23 with a hammer-blow and disengages the latch 20 from the catch-bar 14.

The electromagnetic mechanisms comprising the coils 32, the armatures 33, and the weighted plunger 36 constitute an underload-release mechanism for effecting the automatic opening of the switch 11.

In conjunction with the underload-release mechanism I employ mechanism for automatically notifying the engineer or attendant of the opening of the switch. This mechanism consists of a signal 38, placed in a circuit 39, said circuit including a generator 40, a stationary contact 41, and a movable contact 42, so located as to be raised by the weight 37 upon the plunger 36. When the plunger drops, the two contacts close the circuit 39. Placed in the circuit are two opposed contacts 43 43, through which the circuit may be opened by a removable plug 44.

Referring to Fig. 3, which illustrates diagrammatically a system in which the mechanism as herein described is utilized, *a* indicates an alternating generator, and *b* the main or primary circuit in which is located the switch *c*, corresponding to that at 11 in Fig. 2. *d'* indicates a constant-current transformer having the primary coil *b'* and the secondary coils *d' d²*. The inner end of the coil *d'* and the inner end of the coil *d²* are connected in series with a working circuit *e*, having a lightning-arrester *f* and a series of translating devices, (as the arc-lamps at *g*.) The outer ends of the two coils *d' d²* are connected in series with a second working circuit *e'*, having a lightning-arrester *f'* with translating devices, (as the arc-lamps *g'*.) In series in the main circuit *b* is the overload-release magnet 26, and in the working circuit *e'*, is placed the underload-release magnet 32, these numerals 26 and 32 indicating conventionally in Fig. 3 the elements which are graphically shown and indicated by the same numerals in Figs. 1 and 2.

It will be noted that the coils of the overload-release magnet are interposed in the main or primary circuit *b*, whereas the coils of the underload-release magnet are in the secondary circuit, and that the underload-release mechanism and the overload-release mechanism operate directly upon the main switch or make-and-break device placed in the primary or main circuit to instantly disconnect the constant-current transformer *d*

from the source of supply, when the current falls to a predetermined point or rises above another predetermined point, so that the primary side is broken before the secondary is discharged.

In the systems herein described the switches are held in closed position by mechanical contrivances and not by a magnetic pull, so that the armatures do not in any manner hold the switches closed, but, on the contrary, operate only to effect their release. Again, in said system the armatures of both the underload and the overload release magnets operate directly upon elements connected rigidly to the latches, so that said armatures therefore act practically directly on said latches without the aid of springs or other uncertain or unstable media. The latch is also pivoted or mounted on a rock-shaft and engages the catch on the movable contact. The arms on the rock-shafts project in opposite directions and are each moved by a sharp or hammer blow, whereby the release of the switch is rendered certain.

Having thus explained the nature of the invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. In a system of electrical distribution, a primary alternating-current circuit, a secondary circuit, a constant-current transformer, a switch in the primary circuit, an underload-release mechanism in the secondary circuit, an overload-release mechanism in the primary circuit, and means by which each of said mechanisms causes the opening of said switch.

2. In a system of electrical distribution, a primary alternating-current circuit, a secondary circuit, a constant-current transformer, a switch in the primary circuit, an underload mechanism in the secondary circuit, and means by which said underload mechanism causes the opening of said switch upon the diminution of the current in the secondary circuit to a predetermined point.

3. In a system of electrical distribution, a primary alternating-current circuit, an induced-current or secondary circuit, a self-opening switch in said primary circuit, and an underload-release electromagnetic mechanism in series in said secondary circuit for causing said switch to open upon the diminution of the current in said secondary circuit to a predetermined point, said electromagnetic mechanism comprising a coil, a plunger extending into said coil, and a latch for the switch arranged in relation to the plunger, whereby it is given a hammer-blow to release the switch by said plunger when there is a sufficient diminution of current in the secondary circuit.

4. In a system of electrical distribution, a primary alternating-current circuit, an induced-current or secondary circuit, a self-opening switch in said primary circuit, an underload-release electromagnetic mechanism in series in said secondary circuit for causing said switch to open upon the diminution of the current in said secondary circuit to a predetermined point, and an overload-release mechanism in the primary circuit for causing said switch to open upon an excess of current in said primary circuit.

In testimony whereof I have affixed my signature in presence of two witnesses.

GRANVILLE E. PALMER.

Witnesses:
M. B. MAY,
C. C. STECHER.