No. 803,817. PATENTED NOV. 7, 1905.

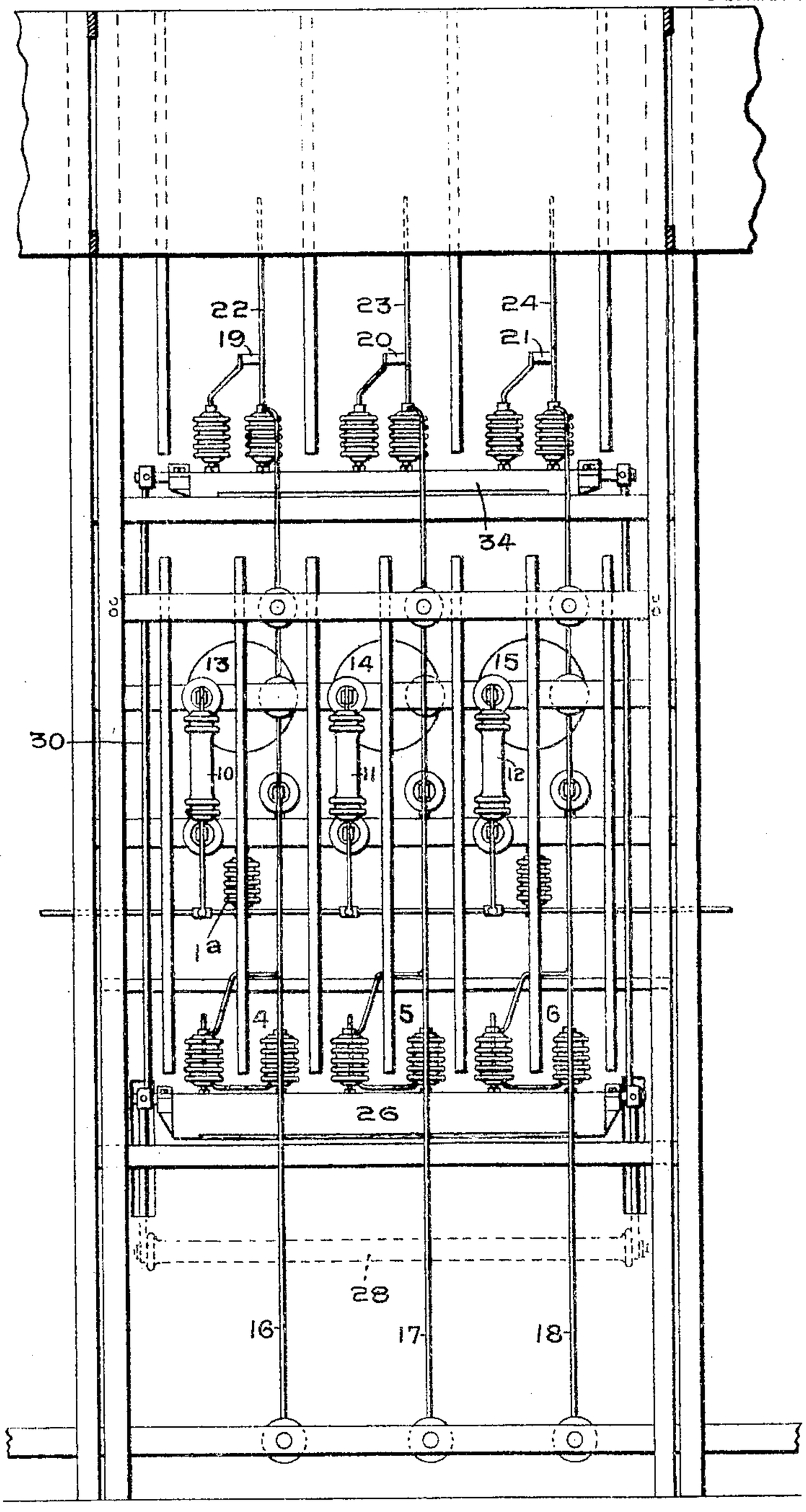
M. B. FIELD.

CIRCUIT BREAKER.

APPLICATION FILED MAR. 17, 1903.

3 SHEETS—SHEET 1.

Fig. 1.




Witnesses:
Marcus L. Byng.
Helen Alford

Inventor
Michael B. Field,
by Allen H. Gerhardt
Atty.

No. 803,817. PATENTED NOV. 7, 1905.

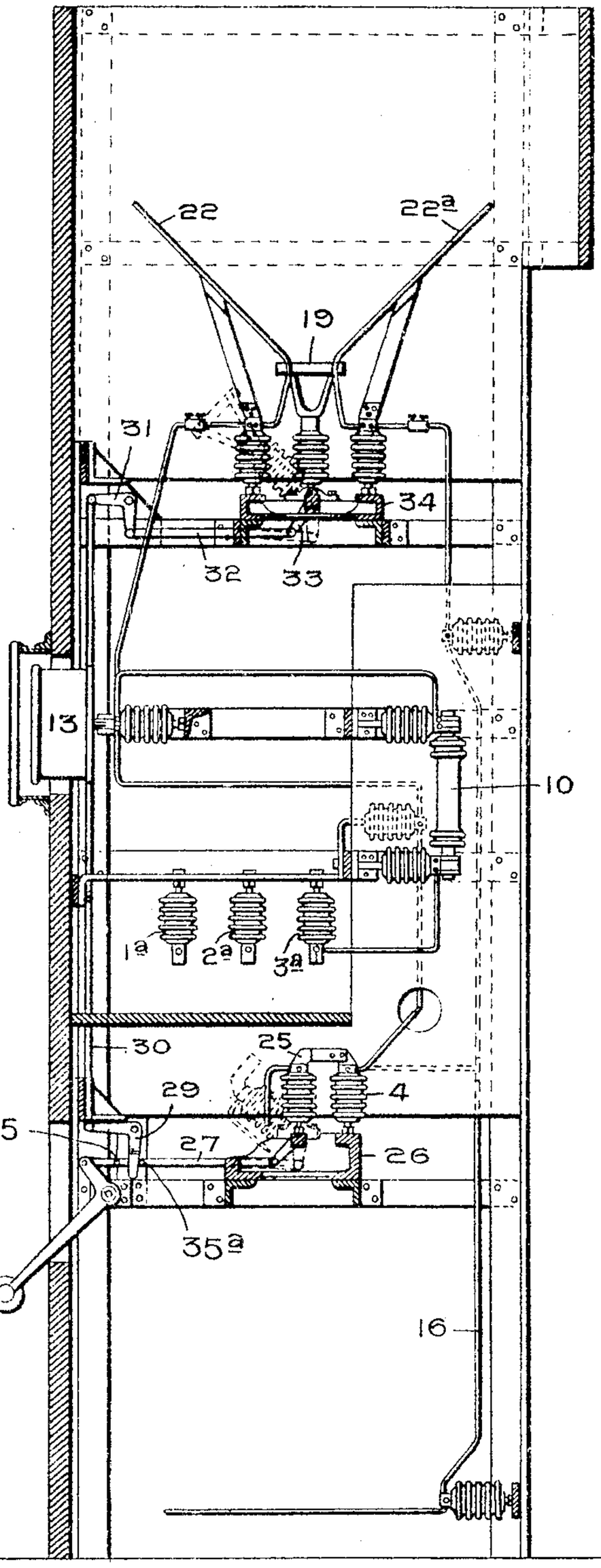
M. B. FIELD.

CIRCUIT BREAKER.

APPLICATION FILED MAR. 17, 1903.

3 SHEETS—SHEET 2.

Fig. 2.




Witnesses:
Marcus L. Byng.
Helen Alford

Inventor:
Michael B. Field,
by Allen A. G. Dann
Atty.

No. 803,817. PATENTED NOV. 7, 1905.

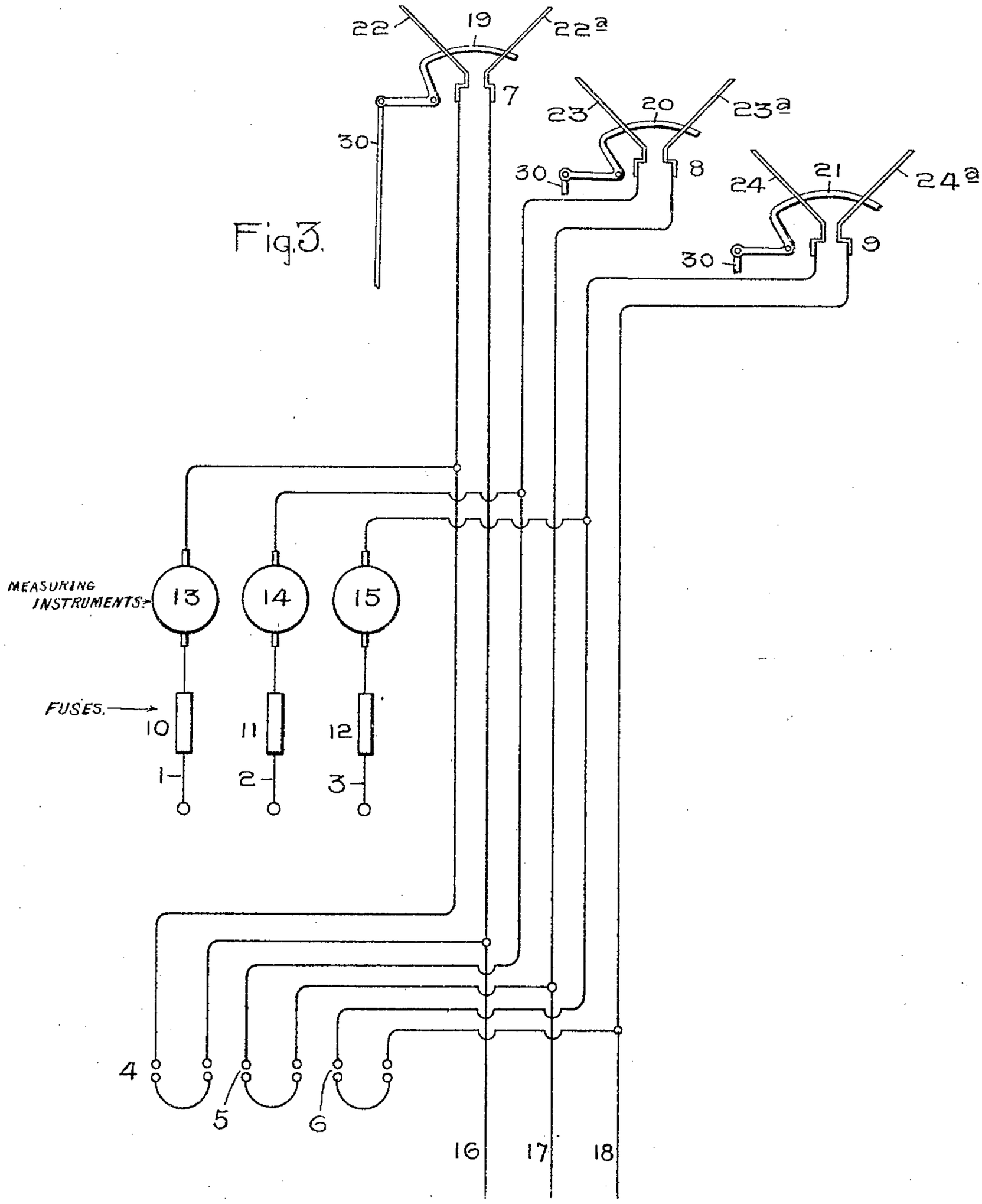
M. B. FIELD.

CIRCUIT BREAKER.

APPLICATION FILED MAR. 17, 1903.

3 SHEETS—SHEET 3.

Fig. 3.




WITNESSES:

Robt. L. Lockwood

Helen Arford

INVENTOR,

Michael B. Field,

by Allen A. Lockwood

Atty.

# UNITED STATES PATENT OFFICE.

MICHAEL B. FIELD, OF SEVENOAKS, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## CIRCUIT-BREAKER.

No. 803,817. Specification of Letters Patent. Patented Nov. 7, 1905.

Application filed March 17, 1903. Serial No. 148,174.

*To all whom it may concern:*

Be it known that I, MICHAEL B. FIELD, an electrical engineer, residing at St. John's House, Sevenoaks, county of Kent, England, have invented certain new and useful Improvements in Circuit-Breakers, of which the following is a specification.

This invention relates to the rupture of currents, particularly those of high potential. In modern installations, particularly in cases of long-distance transmission, it frequently occurs that very high tensions, such as twenty thousand volts and upward, are necessary to meet commercial requirements, and the problem of dealing with the currents at such voltages is a serious one. Switching with these high voltages is usually accomplished by opening the circuit under oil, by which the arc is cooled and smothered.

An essential feature of my invention is not to suppress the formation of the arc, but to insure its forming between contacts so related that the arc must lengthen itself to the breaking-point, due to natural causes, and in a situation where it can do no damage by short-circuiting, burning, jumping to ground, or otherwise, however much it be extended. I effect the result by combining with the principal or bridging contacts of the switch shunt-contacts, which remain closed until the main contacts have opened, said shunt-contacts being so related that the arc will be driven outwardly and will be continuously lengthened during such change of position by reason of the shape of the contacts until it snaps. I prefer to mount the contacts so that they will stand vertically, thus permitting the natural buoyancy of the arc-gases to assist the electromagnetic influences in driving them over the terminals, the confronting edges of the terminals themselves being so related that they incline away from one another to stretch the arc. My arc-extinguishing device is constructed on the principle of the now well-known "Horn" lightning-arrester used extensively and most successfully on the Continent and known there under the name of the "Hornblitzschutzapparat." It comprises merely two stout conductors bent so as to approach at one point and with their upper ends receding and a bridging device to maintain the shunt-circuit complete across the proximate ends, which bridging device is movable so as to open the shunt-circuit a trifle later in point of time than the main contacts.

The novel features of my invention will be more particularly pointed out hereinafter and will be definitely indicated in the appended claims.

In the accompanying drawings, which illustrate the invention, Figure 1 is a rear elevation of a switchboard containing a switching apparatus embodying my improvements. Fig. 2 is a side elevation of the same, and Fig. 3 is a diagram of the circuit connections.

Referring first to the diagram in Fig. 3, 1 2 3 represent three bus-bars, from which the potential leading to any desired distribution-circuit is controlled through a switch 4 5 6 and an arc-interrupter 7 8 9. I have shown by way of example a three-phase circuit. The invention, however, is applicable to single-phase or even a direct current.

10 11 12 represent fuses, and 13 14 15 measuring instruments between the bus-bars and the switching apparatus. As will be seen, the arc-interrupters 7 8 9 are in parallel relation severally to the switches, each switch representing a double-pole break, one being used for each phase of the circuit. The distribution-circuit is shown at 16 17 18. In the normal condition of affairs when the switch or circuit-breaker is closed a carbon wiper 19 20 21 bridges the two horns or conductors 22 $22^a$ 23 $23^a$ 24 $24^a$ of the arc-extinguishing device. The parts are so arranged that when the switch opens the contacts at the switch-terminals are first separated, while the shunt-contacts at the extinguishing device 22 $22^a$, &c., are closed by the bridge of carbon. Immediately afterward, however, the carbon bridge is shifted laterally, thereby drawing an arc which bridges the terminals of the arc-extinguishing device. It is important that the leads to the arc-extinguishing device should be below the proximate points bridged by the carbon wiper. With this relation of parts when the arc is drawn between the adjacent conductors it is rapidly shifted upward by the combined action of the buoyancy of the arc-gases and the electromagnetic influences of the circuit, gradually stretching wider and wider as it approaches the divergent terminals and is finally snapped. This arrangement is particularly effective with circuits of very high potential.

It is well known that conductors under the influence of electric currents tend to arrange themselves in parallel positions, and to this action is due the tendency of the arc to rise, and thereby assist in extinguishing itself. This action is fully explained in United States Patent No. 566,011, granted August 18, 1896, to Oelschläger and Schrottke, and therefore is not described more in detail in the present case.

The mechanical arrangement by which the system illustrated in the diagram is carried out is shown in Figs. 1 and 2. Current enters the board by means of the bus-bars mounted on insulators $1^a$ $2^a$ $3^a$, passes through the fuses 10 11 12 and the instruments 13 14 15, and then in parallel to the arc-extinguishing device 22 $22^a$, &c., and the switches 4 5 6, the distribution-circuit being shown as leading out from the base of the board, as at 16 17 18. One pair of insulators on the switch carries a bridging-contact, as 25, the three pairs corresponding to the three phases being mounted on a common bar 26, connected by a link and connecting-rod 27 with an operating-handle 28. The switch is shown in dotted lines in an open position. The operating-handle is also connected through a bell-crank lever 29, link 30, bell-crank 31, connecting-rod 32, and link 33 with the carbon wipers, three of which, corresponding to the three phases, are mounted on separate insulators and secured to a common rock bar or shaft 34. In the closed position of the arc-extinguishing device this carbon wiper bridges the diverging conductors 22 $22^a$, as seen in Fig. 2. In the open position the wiper is shifted to the dotted position, first drawing an arc across the two conductors and then breaking connection with them. Two pins or studs 35 $35^a$ on the connecting-rod 27 permit a certain amount of lost motion between the opening of the switch-terminals and the movement of the wiping-contacts at the top of the board. The arc-extinguishing device should be placed at the top of the board, so that the hot gases expelled by the rupture of the circuit cannot establish short-circuit or do any damage to the apparatus.

The arrangement of the connections as indicated in Fig. 3, by which the circuit is connected below the point in the arc-extinguishing device at which the arc is drawn, is important, as in many instances it has been found that the magnetic and heating effects are comparable in magnitude, and if the magnetic component acts in opposition to the heating component or buoyancy of the gases a satisfactory operation of the switch is impaired. If improperly connected, the flaming between the diverging wires is wholly intermediate, whereas with the connections properly made I have not known of a single case of failure of the arc to travel upward. I have tested and used such extinguishing devices up to six thousand volts extensively and know that their action is satisfactory at far higher voltages. At voltages below two thousand volts, however, they are not to be recommended. Broadly speaking, the higher the voltage the more satisfactory the operation. The wires or conductors of the arc-extinguishing devices are not burned appreciably, even though the currents be large, as with short circuits. All the high-tension leads, contacts, switch-blades, and the like are supported in special glazed insulators, the terminal and stalk being cast in with lead or telegraph insulated cement. I have shown in the drawings the insulation throughout between any two lines as that of two insulators in series and the insulation between any line and earth as that given by one insulator. A material advantage is thus gained, in that all parts of the switchboard, ammeters, switch-blades, bus-bars, &c., are equally insulated, and this to any degree desired. As the arc travels upward and there are no bus-bars, ironwork, &c., above by which a short-circuit could be established, it is only a matter of adjusting the length of the diverging conductors to insure the arc extinguishing itself.

In the arrangement of the board as shown it will be seen that if the generator be shut down and the switches opened the only live points on the panel are the bus-bars and the terminals. The bus-bars, however, are out of reach and partitioned off, as indicated, from those wires which it would be necessary to disconnect in order to withdraw the switch and arc-extinguishers, which may easily be slid out at the back of the board, and similarly the protecting-covers having been removed from the ammeters these, too, may be withdrawn from the front of the board. The connections are so arranged that no two directly cross, and thus it is possible to remove and repair any piece of apparatus on the board without shutting down more than the one generator corresponding to the particular panel in question.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. An electric switch comprising a shunt in parallel to the switch-terminals, a pair of diverging conductors, a contact normally bridging their proximate ends, and means for laterally shifting the contact to draw an arc between the conductors after the switch-terminals have separated.

2. An electric switch comprising a shunt in parallel to the switch-terminals, a pair of diverging conductors, a movable contact normally bridging their proximate ends, an operating-handle for the switch, and a lost-motion connection between the operating-handle and the contact whereby said contact is shifted to form an arc between the conductors after the switch-terminals have separated.

3. An electric switch comprising a shunt in parallel to the switch-terminals, a pair of upwardly-diverging fixed conductors, a contact normally bridging the conductors at their proximate ends, and means for shifting the contact to form an arc from one fixed conductor to the other after the switch-terminals have separated.

4. An electric switch comprising a plurality of main terminals, a plurality of shunts in parallel relation severally to different pairs of said main terminals, a common operating-handle for simultaneously operating the movable main terminals, a pair of upwardly-diverging conductors for each shunt, means for starting an arc on the several shunt-conductors, and operating means for said starting means comprising a lost-motion connection with said handle whereby the arcs are started after the switch-terminals have separated.

In witness whereof I have hereunto set my hand this 18th day of November, 1902.

MICHAEL B. FIELD.

Witnesses:
CHAS. J. HELLAR,
JOHN WM. COLL.