

No. 674,947.

Patented May 28, 1901.

F. J. TOLCHARD.  
AUTOMATIC REGULATING SWITCH.

(Application filed Oct. 29, 1900.)

(No Model.)

4 Sheets—Sheet 1.

Fig. 1.

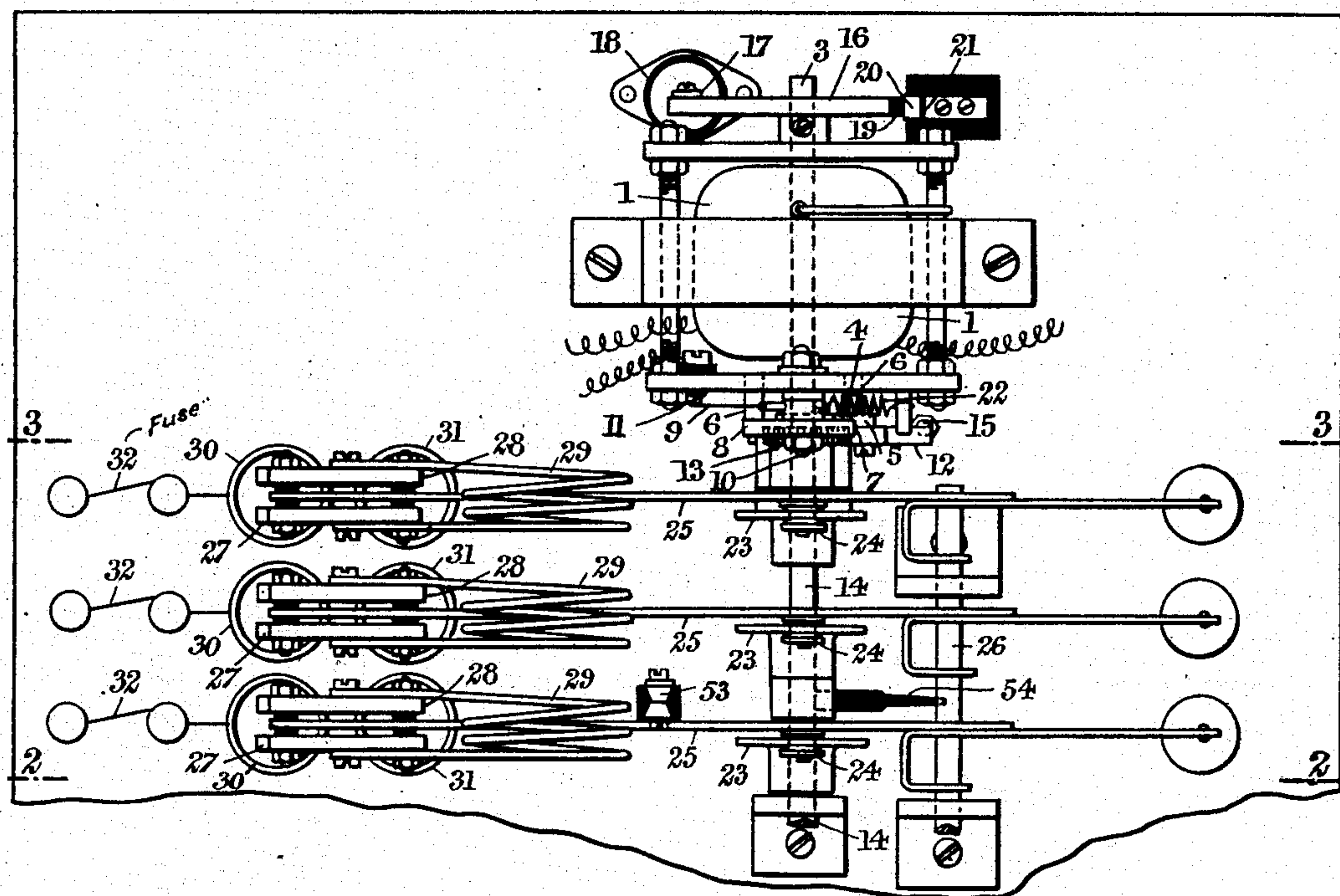
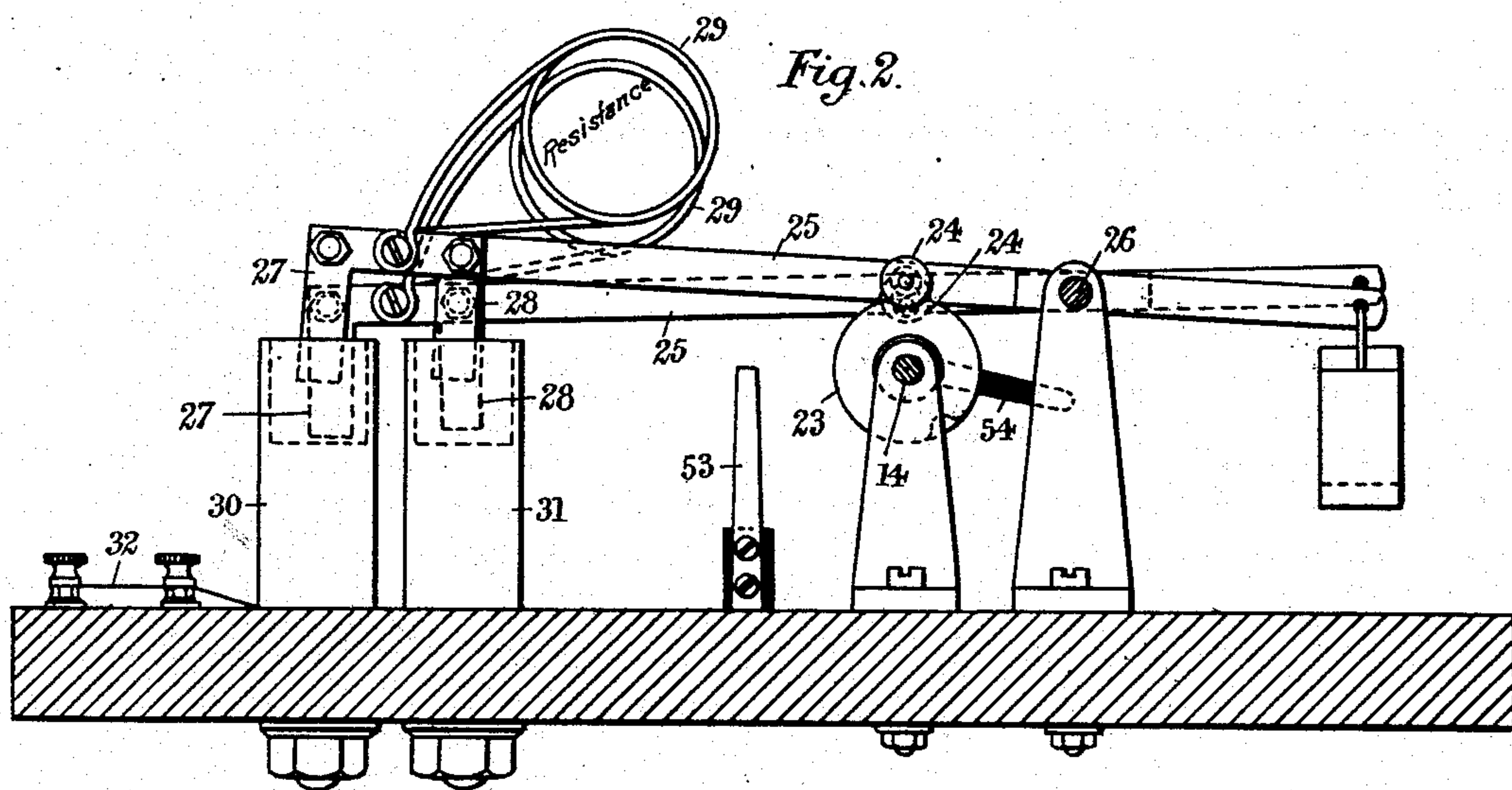


Fig. 2.



Witnesses

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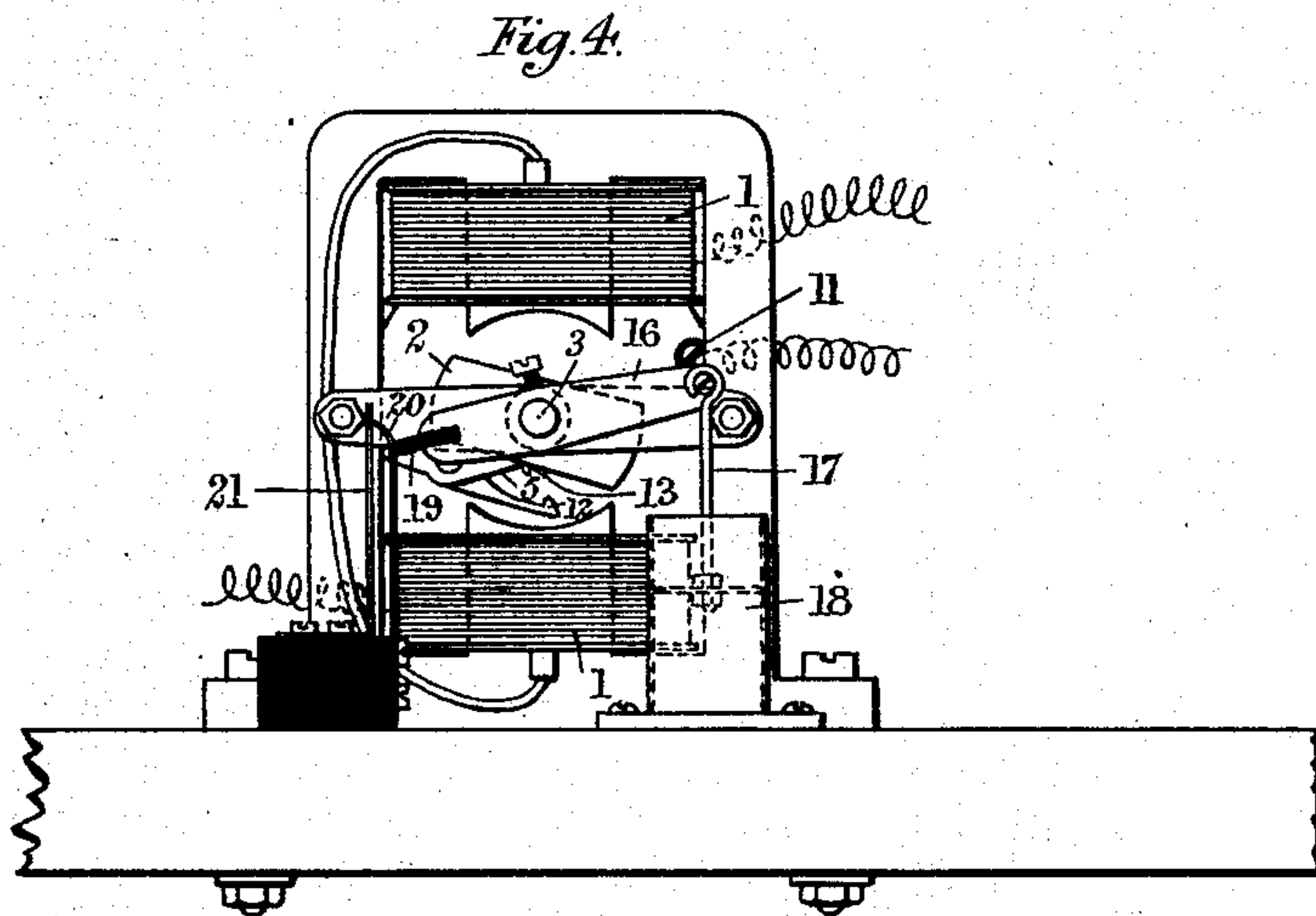
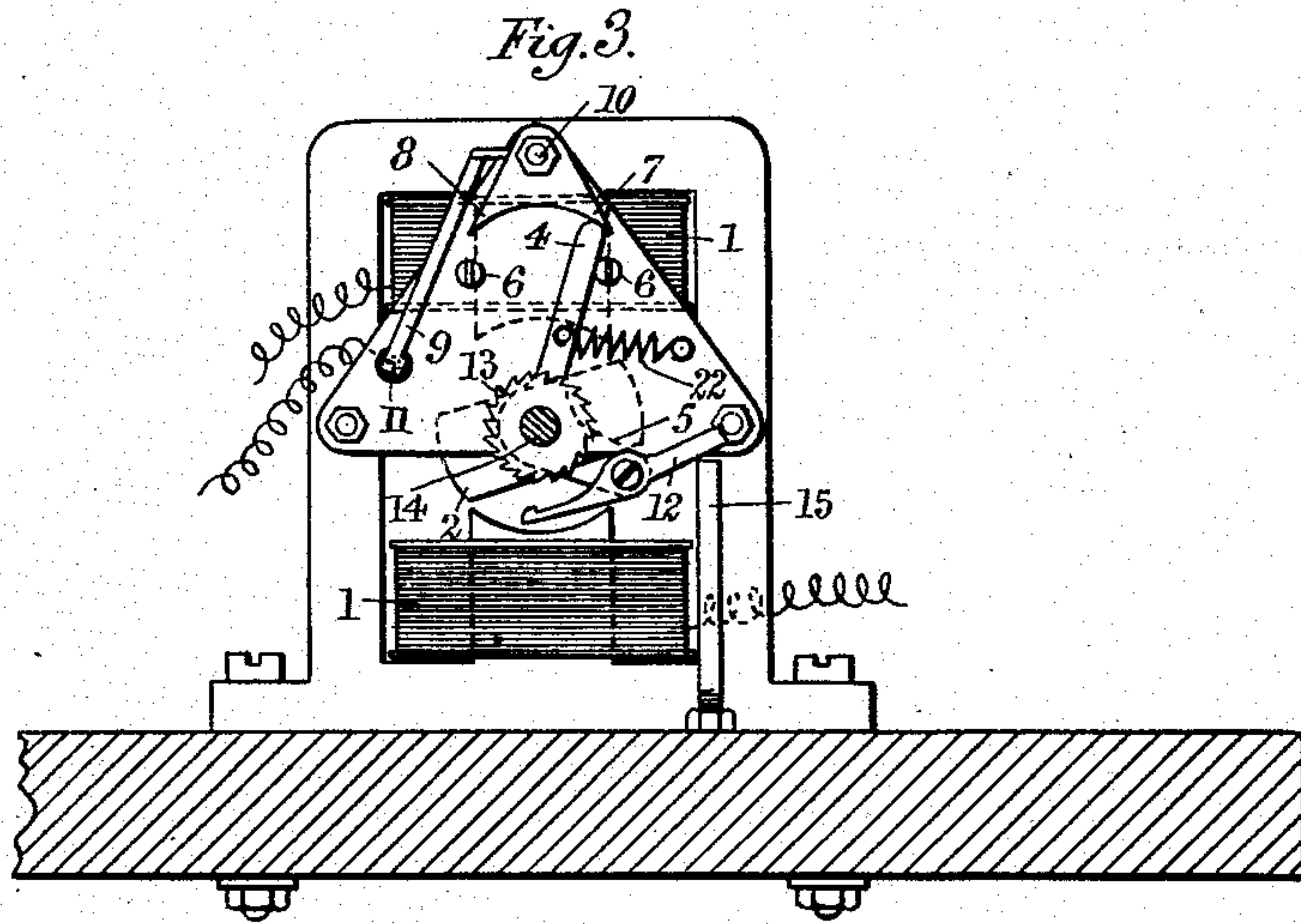
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(No Model.)

4 Sheets—Sheet 2.



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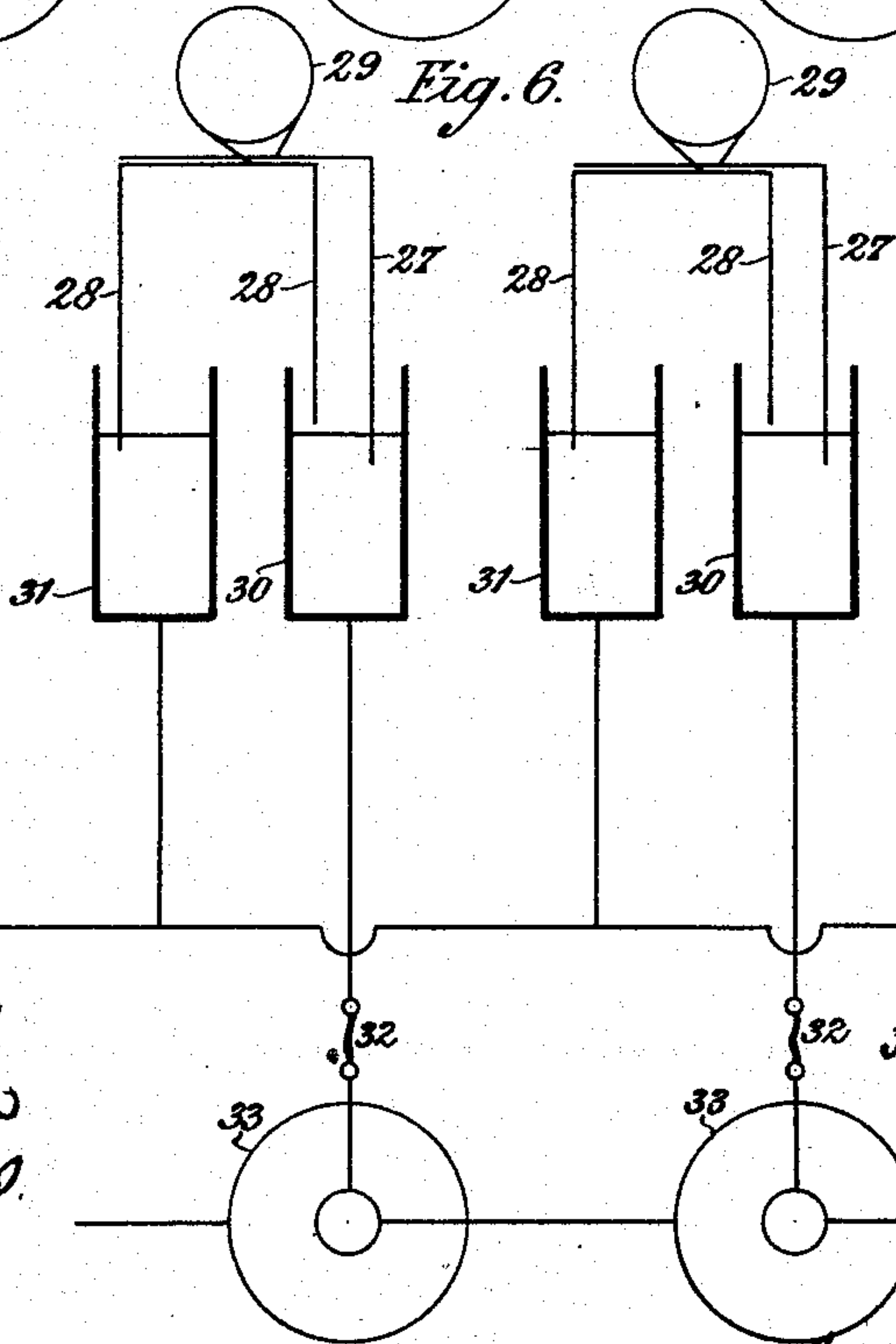
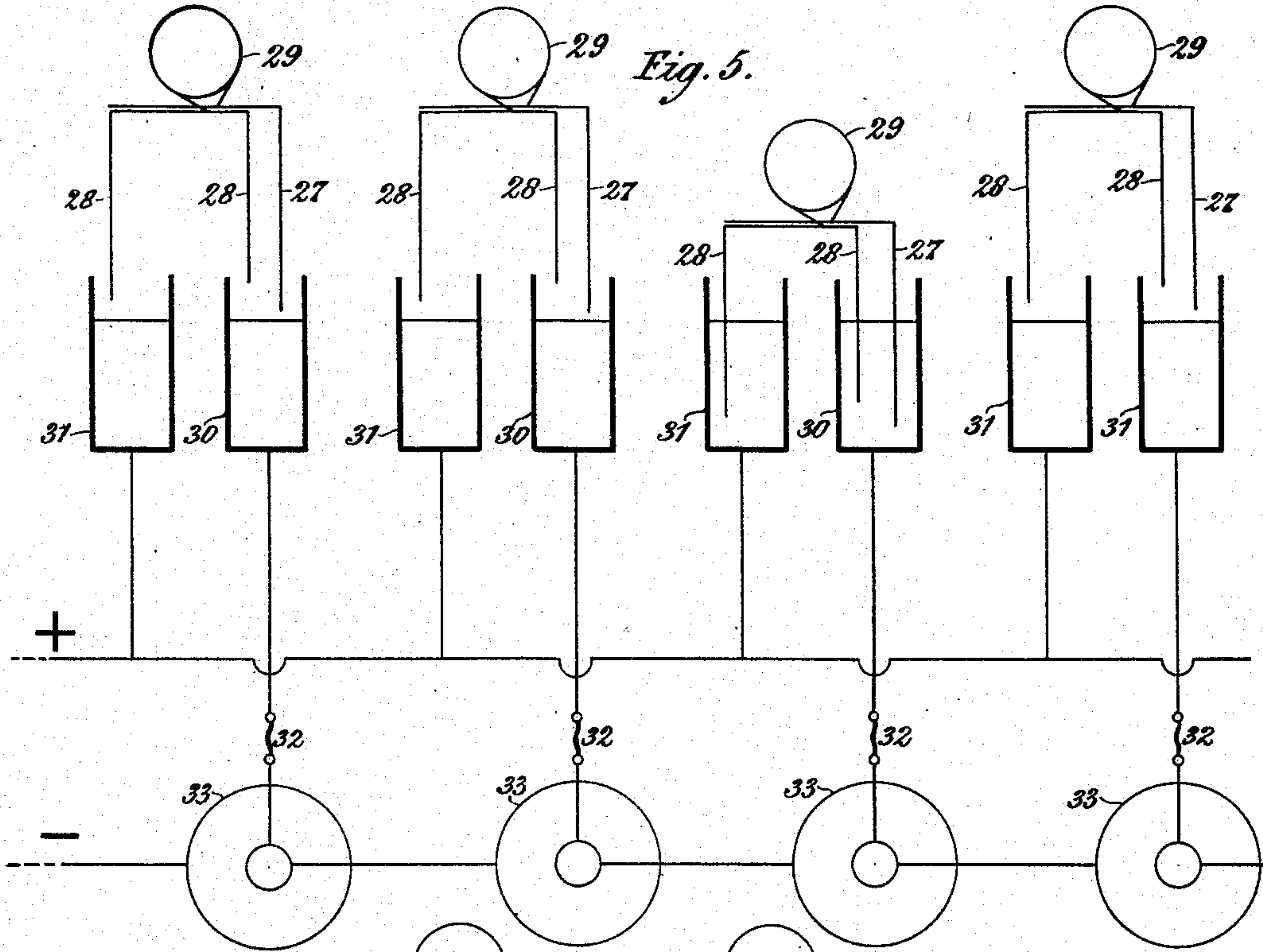


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4 Sheets—Sheet 3.

(No Model.)



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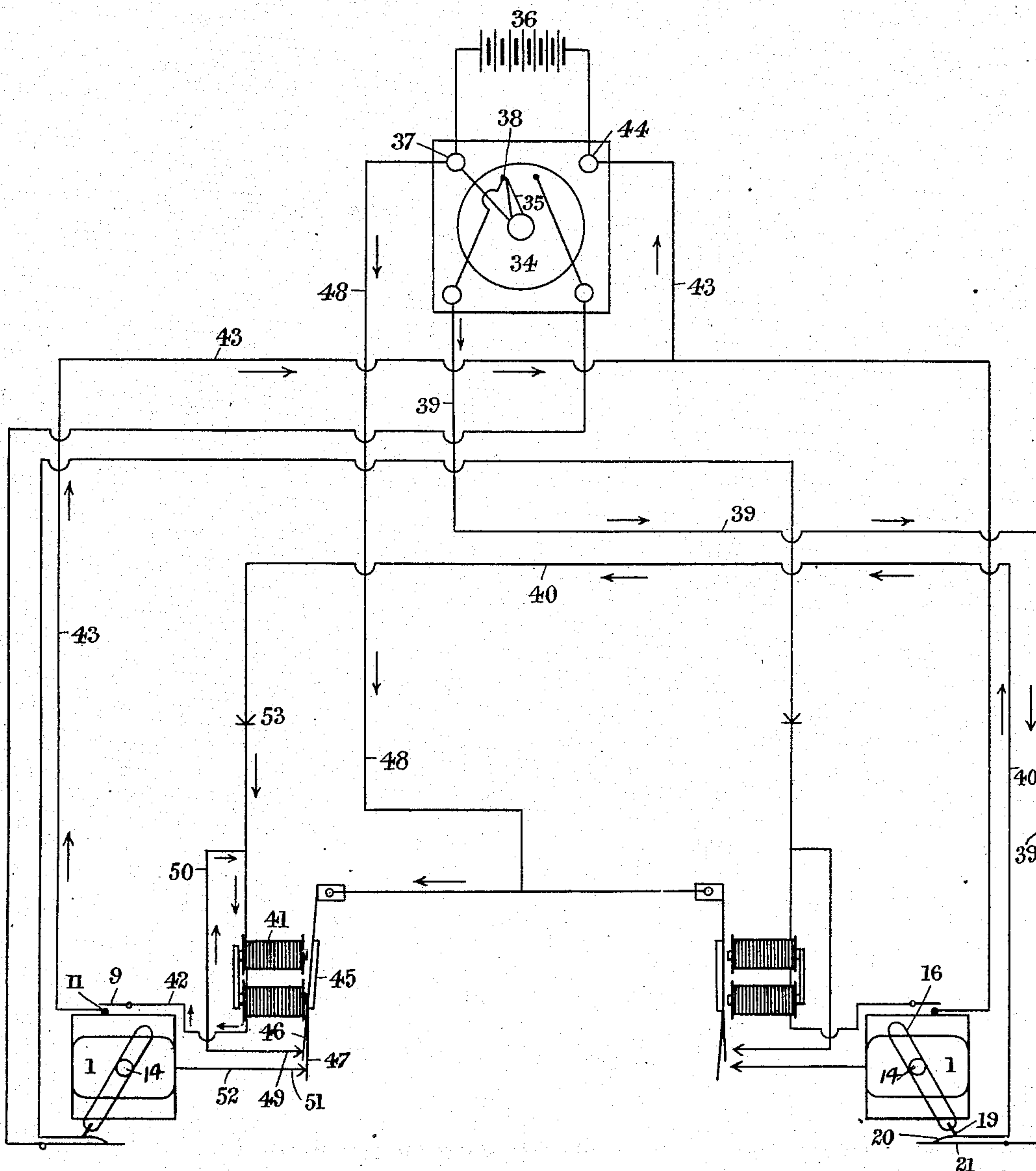
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4 Sheets—Sheet 4.

Fig. 7.



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# UNITED STATES PATENT OFFICE.

FREDERICK JAMES TOLCHARD, OF PAIGNTON, ENGLAND.

## AUTOMATIC REGULATING-SWITCH.

SPECIFICATION forming part of Letters Patent No. 674,947, dated May 28, 1901.

Application filed October 29, 1900. Serial No. 34,786. (No model.)

*To all whom it may concern:*

Be it known that I, FREDERICK JAMES TOLCHARD, electrician, a subject of the Queen of Great Britain, residing at Warwick Lodge, Paignton, in the county of Devon, England, have invented a certain new and useful Automatic Regulating-Switch, of which the following is a specification.

The apparatus consists of a voltmeter arranged to close two relay-circuits, one for an increase and the other a decrease of any pre-arranged normal pressure. The relays close the circuits of two independent motors, which are situated one at each end of a shaft. The separate movements of the motors cause the shaft to move in opposite directions through a certain angle. The shaft carries as many cams as there are cells to be used for regulating, and they are arranged helically along the length of the shaft and operate the same number of levers. The movements of each of the levers in turn make or break connection with their particular cell by means of a switch placed at their ends.

Figure 1 is a part plan of the apparatus; and Figs. 2 and 3 are sections on the lines 2 2 and 3 3, Fig. 1. Fig. 4 is an end view. Figs. 5 and 6 are diagrams of the battery-cells and switches, and Fig. 7 is a diagram of the circuits.

As the mechanism at the two ends of the apparatus is similar, only one end is shown.

1 is a motor consisting of a pair of electromagnets, whose armature 2 is mounted on a shaft 3, to one end of which are fixed arms 4 and 5. The rotation of the arm 4, and therefore of the armature 2, is limited by stops 6. The upper end of the arm 4 acts against horns 7 and 8, fixed to a contact-arm 9, pivoted at 10. When the arm 4 is against the horn 7, as shown in Fig. 3, the arm 9 closes a circuit through the contact 11; but when it is against the horn 8 the circuit is broken. The arm 5 on the motor-shaft 3 has pivoted to it a pawl 12, gearing with a ratchet-wheel 13, fixed on the shaft 14, which is in a line with the shaft 3. When, however, the parts are in the positions shown, the pawl is held out of gear by reason of its tail end resting on the stop 15. On the other end of the shaft 3 is fixed a lever 16, one end of which is connected by the rod 17 to the piston of a dash-

pot 18 and whose other end carries a piece of insulating material 19, which when the parts are in the positions shown bears upon a contact-spring 20 and presses it against a second contact-spring 21, closing a circuit at this point.

22 is a spring acting on the arm 4 and tending to keep the parts in the positions shown.

The shaft 14 has fixed to it a number of cams 23, the depressions in which are arranged around the shaft in a helix of one complete turn.

24 represents rollers pivoted to levers 25 and bearing on the cams 23.

26 is a fixed shaft forming the pivot for the levers 25. Each lever 25 has fixed to but insulated from it contacts 27 and 28, connected by a resistance 29. The contact 27 is L-shaped and the contact 28 is U-shaped, their legs dipping into mercury-cups 30. The leg of the contact 27 projects lower than the legs of 28, and the inner leg of the latter projects lower than the outer leg. The levers 25, with their contacts, form switches for throwing the cells of the regulating-battery into and out of circuit. Each cup 30 is connected through a fuse 32 with one of the cells 33 of the regulating-battery, diagram Fig. 5, and the cups 31 are connected together. The cells 33 are connected in series, and the number of them is the same as the number of teeth in the ratchet-wheels 13. Owing to the helical arrangement of the cams 23 the circuit is only closed (except at the moment of making a change) through one of the switches at the same time, and the number of battery-cells in circuit depends on the position of this switch. Diagram 6 shows one of the switches in the act of breaking the circuit, while the adjacent switch is in the act of closing it, both switches being in mid-position. At this time the circuit is closed through the resistance 29. This arrangement prevents a dead short circuit between the two cells when a change is being made from one to the other and at the same time prevents a complete break in the circuit.

Diagram 7 explains the working of the apparatus. 34 is a voltmeter whose arm when the pressure rises above or falls below the proper point closes a circuit from the battery 36, terminal 37, arm 35, contact 38, wire



39, spring-contacts 20 and 21, (of the motor at the other end of the shaft 14, which is not shown in Figs. 1 to 4,) wire 40, electromagnet 41, wire 42, contact-arm 9, contact 11, wire 43, terminal 44, back to the battery 36. Closing the circuit through the magnet 41, as above described, causes it to attract its armature. This armature carries two spring-contacts 46 and 47. The contact 46 closes a circuit from the battery 36, terminal 37, wire 48, armature 45, spring-contact 46, contact 49, wire 50, electromagnet 41, wire 42, contact-arm 9, contact 11, wire 43, terminal 44, back to the battery. The electromagnet 41 therefore continues to attract its armature 45 even if the first-described circuit is broken by reason of the voltmeter-arm 35 oscillating away from the contact 38. The spring-contact 47 closes a circuit from the battery 36, terminal 37, wire 48, armature 45, contact-spring 47, contact 51, wire 52, electromagnets 1, wire 43, terminal 44, back to the battery 36. Closing the circuit the magnets 1 cause their armature 2 to revolve from right to left, Fig. 3, and from left to right, Fig. 4, throwing the pawl 12 into gear and turning the ratchet-wheel 13 through one tooth and thus raising the lever 25, which is depressed, and depressing the next lever, putting a battery-cell into circuit or taking one out. Immediately the armature 2 begins to move the insulating material 19 comes away from the spring 20, and the latter separating from the spring 21 breaks the circuit of the other motor, thus rendering it impossible for both motors to work simultaneously, however quickly the voltmeter-arm 35 may oscillate. At the end of the movement of the armature 2 the arm 4 comes against the horn 8 and carries the arm 9 away from the contact 11, thus breaking the circuits through the magnet 41, which, ceasing to attract its armature 45, breaks the circuit through the magnets 1. The arm 9 works with sufficient friction on its pivot 10 to cause it to remain in any position in which it may be put, and therefore the circuits remain broken until the arm 4 at the end of its return movement comes against the horn 7 and again brings the arm 9 back to the contact 11.

The action of the motor at the other end of the shaft 14 is identical to that above described, except that it turns the shaft 14 in the opposite direction. Its circuits are clearly shown in Diagram 7. They are the exact duplicate of those above described.

To prevent the apparatus from working beyond the limits for which it is designed, circuit-breakers may be provided. These consist of springs 53 in the circuits, which are normally in contact, but which at one point in the revolution of the shaft 14 are separated by an arm 54, of insulating material, fixed to the shaft.

What I claim is—

1. The combination of a battery connected in series, a shaft, two motors rotating the

shaft in opposite directions, a voltmeter putting one or other of the motors into action according as the voltage rises above or falls below the proper point, cams on the shaft, levers successively operated by the cams, and switches operated by the levers and each putting into circuit a different number of the battery-cells.

2. The combination of a battery connected in series, a shaft, two motors rotating the shaft in opposite directions, a voltmeter putting one or other of the motors into action according as the voltage rises above or falls below the proper point, circular cams on the shaft each having in it a single depression, the depressions being arranged helically around the shaft, levers supported by the cams, and switches operated by the depression of the levers and each putting into circuit a different number of the battery-cells.

3. The combination of a battery connected in series, a shaft, two motors rotating the shaft in opposite directions, a voltmeter putting one or other of the motors into action according as the voltage rises above or falls below the proper point, cams on the shaft, levers successively operated by the cams, and double contact-switches with resistances between the contacts operated by the levers and each putting into circuit a different number of the battery-cells.

4. The combination of a battery connected in series, a shaft, two motors rotating the shaft in opposite directions, a voltmeter putting one or other of the motors into action according as the voltage rises above or falls below the proper point, circular cams on the shaft each having in it a single depression, the depressions being arranged helically around the shaft, levers supported by the cams, and double contact-switches with resistances between the contacts operated by the depression of the levers and each putting into circuit a different number of the battery-cells.

5. The combination of a battery connected in series, a shaft, two ratchet-wheels fixed to the shaft, pawls engaging with the ratchet-wheels, electromagnets, armatures to the electromagnets reciprocating the pawls, a voltmeter closing a circuit through one or other of the electromagnets according as the voltage rises above or falls below the proper point, cams on the shaft, levers successively operated by the cams, and switches operated by the levers and each putting into circuit a different number of the battery-cells.

6. The combination of a battery connected in series, a shaft, two ratchet-wheels fixed to the shaft, pawls engaging with the ratchet-wheels, electromagnets, armatures to the electromagnets reciprocating the pawls, a voltmeter closing a circuit through one or other of the electromagnets according as the voltage rises above or falls below the proper point, circular cams on the shaft each having in it a single depression, the depressions being arranged helically around the shaft, levers supported



by the cams, and switches operated by the depression of the levers and each putting into circuit a different number of the battery-cells.

7. The combination of a battery connected  
5 in series, a shaft, two ratchet-wheels fixed to the shaft, pawls engaging with the ratchet-wheels, electromagnets, armatures to the electromagnets reciprocating the pawls, a voltmeter, two relays one or other of which is operated by the voltmeter according as the voltage rises above or falls below the proper point, each of such relays closing a circuit through itself and through one of the electromagnets, switches in each electromagnet-circuit operated by the first part of the movement of the armature of the other electromagnet, switches in each electromagnet-circuit operated by the last part of the movement of the armature of that electromagnet, and switches successively operated by the shaft and each putting into circuit a different number of the battery-cells.

8. The combination of a battery connected in series, a shaft, two ratchet-wheels fixed to the shaft, pawls engaging with the ratchet-wheels, electromagnets, armatures to the electromagnets reciprocating the pawls, a voltmeter, two relays one or other of which is operated by the voltmeter according as the voltage rises above or falls below the proper point, each of such relays closing a circuit through itself and through one of the electromagnets, switches in each electromagnet-circuit operated by the first part of the movement of the armature of the other electro-  
35 ment of the armature of the other electro-

magnet, switches in each electromagnet-circuit operated by the last part of the movement of the armature of that electromagnet, cams on the shaft, levers successively operated by the cams, and switches operated by the levers and each putting into circuit a different number of the battery-cells. 40

9. The combination of a battery connected in series, a shaft, two ratchet-wheels fixed to the shaft, pawls engaging with the ratchet-wheels, electromagnets, armatures to the electromagnets reciprocating the pawls, a voltmeter, two relays one or other of which is operated by the voltmeter according as the voltage rises above or falls below the proper point, each of such relays closing a circuit through itself and through one of the electromagnets, switches in each electromagnet-circuit operated by the first part of the movement of the armature of the other electromagnet, switches in each electromagnet-circuit operated by the last part of the movement of the armature of that electromagnet, circular cams on the shaft each having on it a single depression, the depressions being arranged helically around the shaft, levers supported by the cams, and switches operated by the depression of the levers and each putting into circuit a different number of the battery-cells. 50 55 60

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