

No. 702,409.

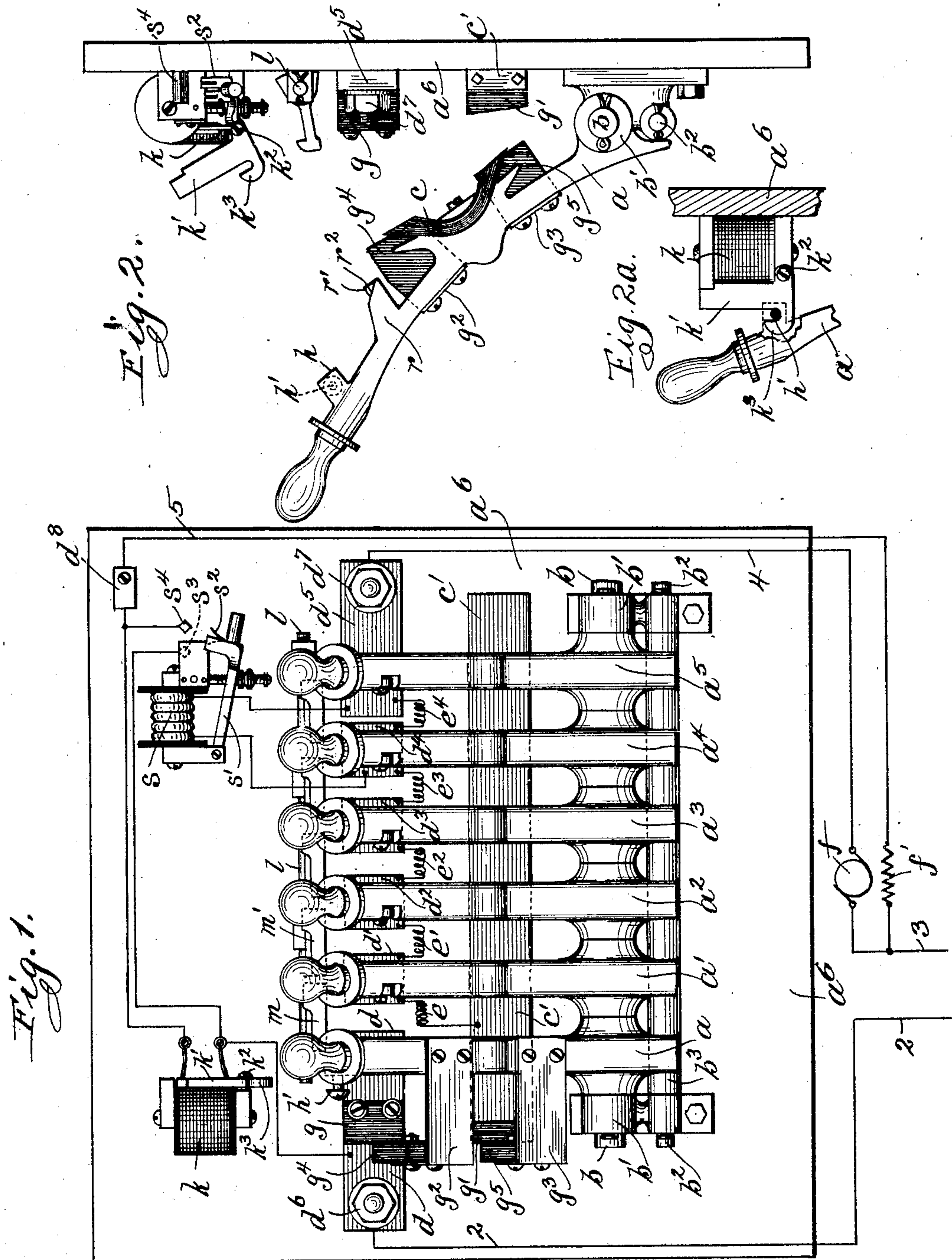
Patented June 17, 1902.

H. H. CUTLER.
MULTIPLE SWITCH.

(Application filed Apr. 17, 1901.)

(No Model.)

2 Sheets—Sheet 1.



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2 Sheets—Sheet 2.

Fig. 3.

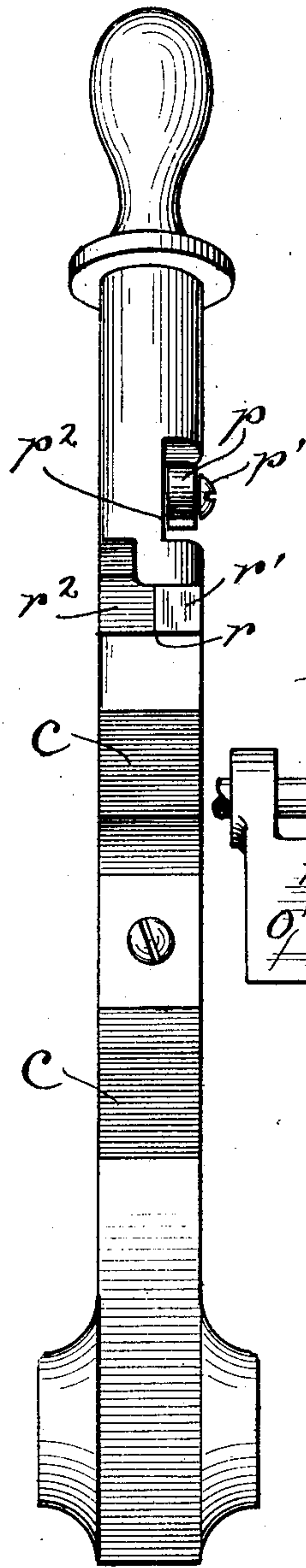


Fig. 4.

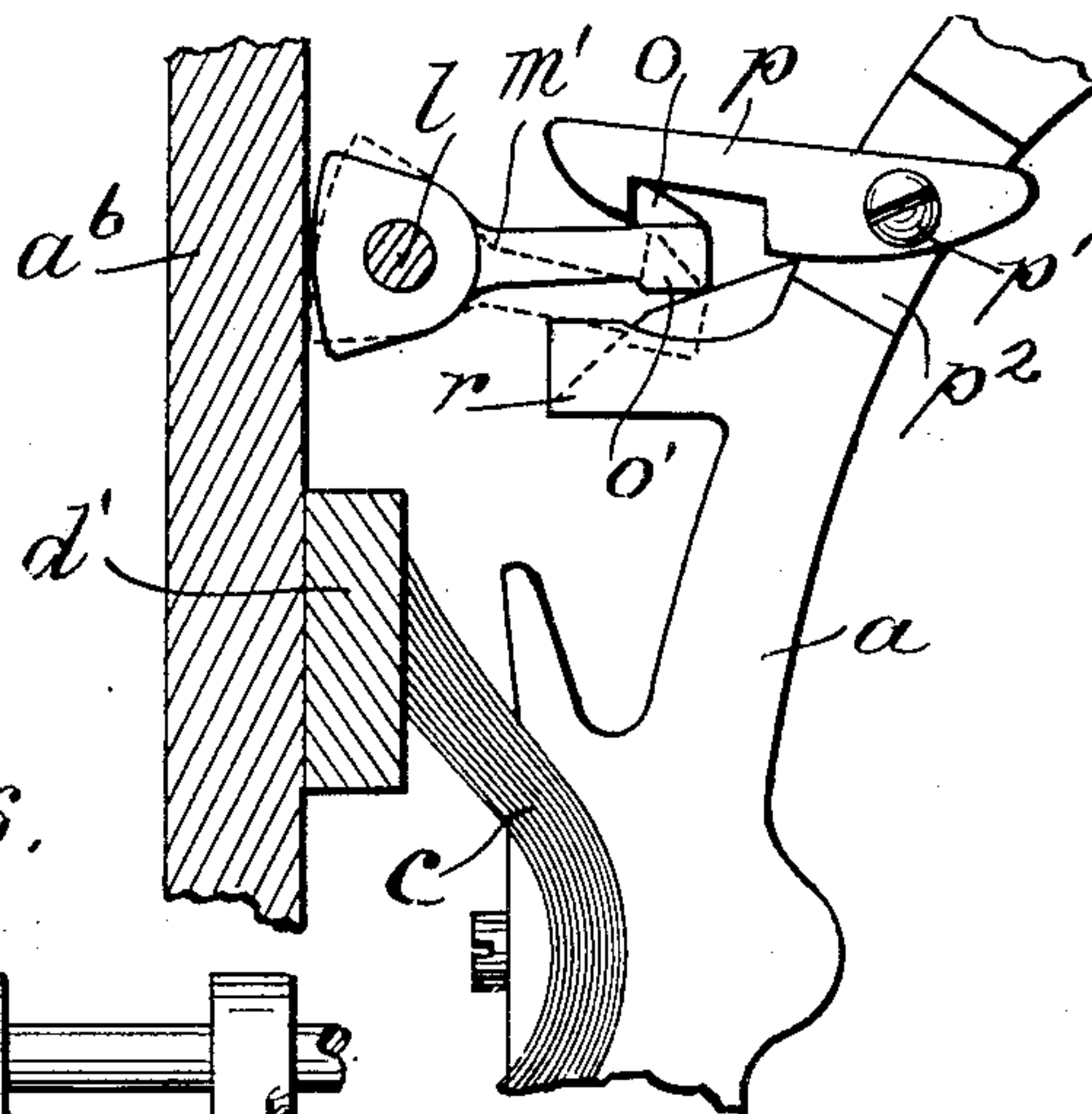


Fig. 6.

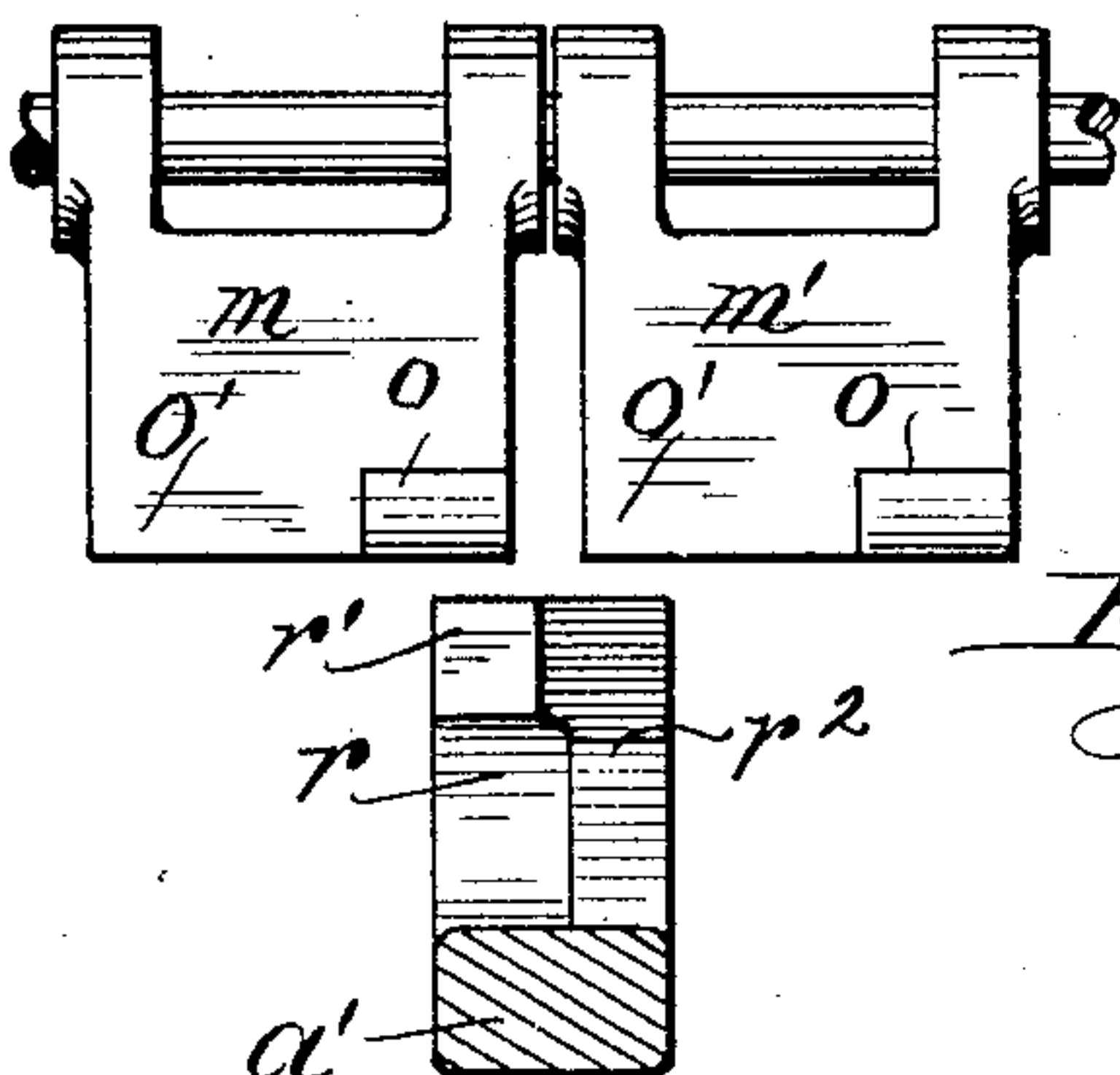
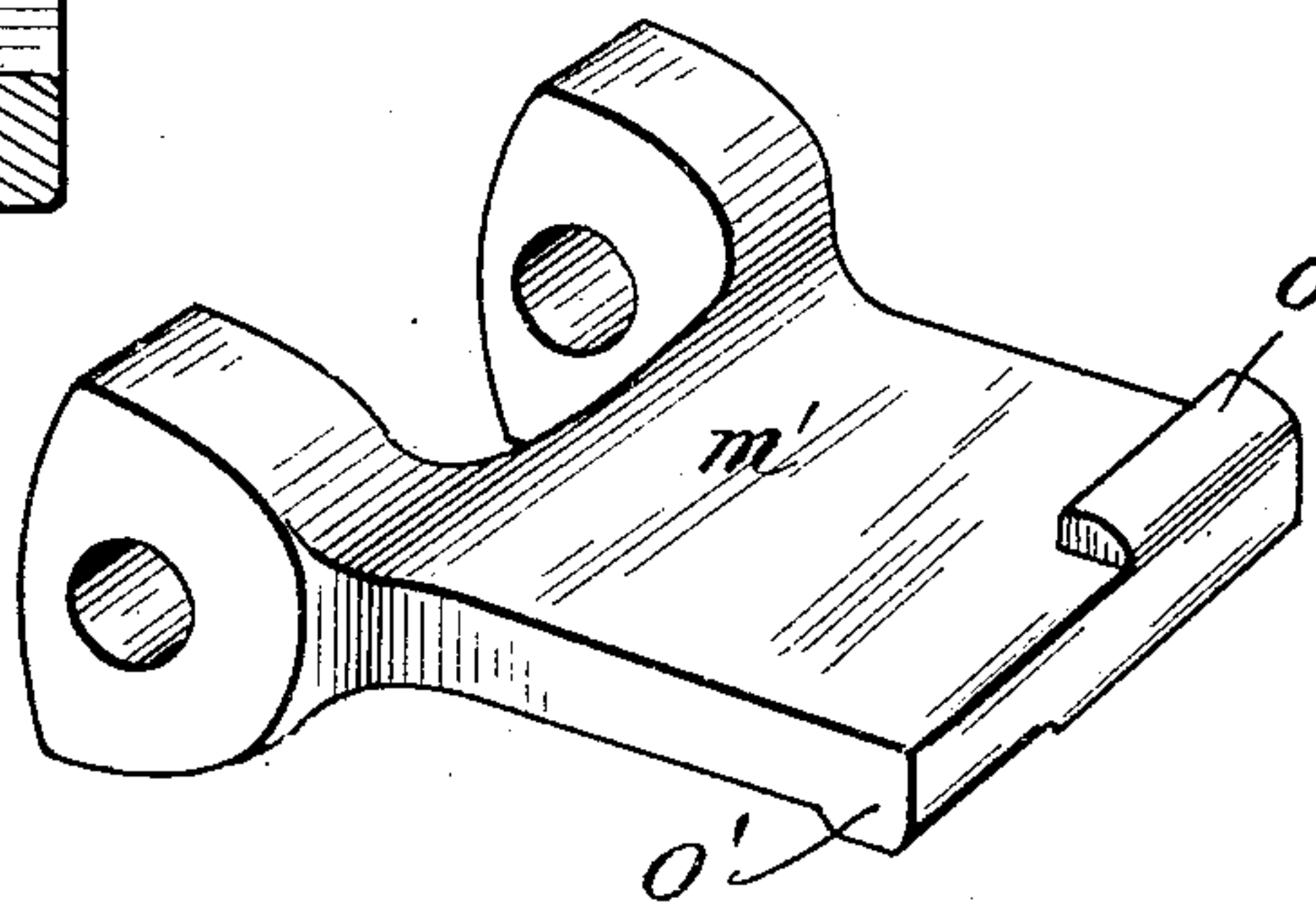


Fig. 5.



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UNITED STATES PATENT OFFICE.

HENRY H. CUTLER, OF MILWAUKEE, WISCONSIN.

MULTIPLE SWITCH.

SPECIFICATION forming part of Letters Patent No. 702,409, dated June 17, 1902.

Application filed April 17, 1901. Serial No. 56,246. (No model.)

To all whom it may concern:

Be it known that I, HENRY H. CUTLER, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Multiple Switches, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a multiple switch, more particularly designed for use in connection with rheostats, although it is equally applicable to other structures where a multiple switch is desired.

It has been proposed heretofore to associate the resistance of a rheostat with a plurality of switches, whereby the switches may be closed one at a time and in a definite order to cut out the resistance of the rheostat. The present invention is particularly designed for employment in connection with such rheostats, although it is capable of a more general use, as will readily appear to any one skilled in the art.

In accordance with the present invention I arrange the multiple switches so that the same can be closed only in a definite order, and, furthermore, I provide means whereby the switches are adapted to be retained in the closed position and automatically opened at the desired time. I preferably employ electromagnetic retaining mechanism adapted to hold the switches in the closed position and adapted when actuated to release all of the contact-arms to thereby permit the same to reinsert the resistance. In practice I arrange the switch-arms so that the same will be automatically released in a definite order, and in the preferred embodiment of my invention I associate the first switch-arm of the series with an electromagnetic retaining device and associate the remaining switch-arms with the first switch-arm through the agency of interlocking mechanism, whereby the electromagnetic retaining device associated with the first switch-arm controls the whole series.

While I have illustrated and described the preferred embodiment of my invention, which I have worked out for practical operation, it will be understood that my invention is susceptible of various modifications.

I have illustrated my invention in the accompanying drawings, in which—

Figure 1 is a view of the switch of my invention, the circuits being shown in diagram. Fig. 2 is a side view thereof, all of the switch-arms except the first being removed. Fig. 2^a is a detail view of the retaining-magnet. Fig. 3 is a detail view of one of the switch-levers. Fig. 4 is a detail view of the latch mechanism for holding the levers in the closed position. Fig. 5 is a detail view of one of the swinging dogs employed. Fig. 6 is a sectional top view of one of the levers and a top view of one of the cooperating rocking dogs.

Like characters refer to like parts in the several figures.

The switch levers or arms a a' a^2 , &c., are suitably pivoted or journaled at one end and are provided at the opposite end with suitable handles. I have shown the several switch-levers as journaled upon a shaft or rod b , mounted in bearings upon the brackets b' b' . The brackets b' b' also support a rod b^2 , which is threaded through a rubber tube b^3 , which serves as a cushion or buffer against which the extended ends of the switch arms or levers are adapted to impinge when thrown open. Each of the levers carries a contact device c , made in the usual form from a number of strips of copper laid face to face, the free ends being adapted to engage the contact-surfaces to complete the circuit there-through. Upon the base-board a^6 is mounted a contact-bar c' , with which one end of the contact device c of each arm or lever is adapted to engage, the other end of said device being adapted to engage one of the contact-terminals d d' , &c., of the rheostat. Between the bars c' and the terminal d' is the resistance-coil e , while the resistance-coils e' e^2 e^3 e^4 are connected between the terminals d' d^2 , d^2 d^3 , d^3 d^4 , and d^4 d^5 , respectively. Upon the terminal d is provided a binding-post d^6 , which is connected with one side of the supply-circuit 2. Upon the terminal d^5 is provided a binding-post d^7 , which is connected, by means of conductor 4 through the armature f of the motor, to the opposite side 3 of the supply-circuit. Upon the terminal d is mounted a carbon block g , and a similar carbon block g' is mounted upon the end of the contact-bar c' . The first switch-arm a carries laterally-extend-

ing arms $g^2 g^3$, supporting upon the ends the carbon blocks $g^4 g^5$, respectively. When the switch-arm a is moved to close the circuit, the block g^5 engages block g' and the block g^4 engages block g , thereby closing circuit from terminal d to terminal c' . The further movement of the switch-arm a causes contact device c thereof to directly close together terminals d and c' . Likewise when switch-arm a is moved outward the contact device c leaves terminals d and c' before the carbon blocks separate, so that any arc which may be formed by the opening of the circuit will take place between the carbon blocks instead of between the metallic surfaces. Near the upper end of the switch-arm a lug h is provided, which carries a laterally-extending rod h' , which may take the form of a screw. Mounted upon the base-board a^6 above the arm a is a retaining-magnet k , having an armature k' , pivoted at k^2 . The armature k' carries a laterally and upwardly extending lug k^3 , and when arm a is moved to close the circuit rod h' engages the side of armature k' to move the same against the magnet-pole, and the magnetism of magnet k retains the armature k' in this position. The swinging of the armature k' carries the lug k^3 upon the exterior of the rod h' , so that said rod h' will rest in the slot formed between the lug k^3 and the face of the armature k' . So long as the magnet k remains energized the arm a will thus be held in the closed position. When, however, the magnet k is deenergized, armature k' will be released, and the weight of the arm a will carry the same into the position shown in Fig. 2, thereby rocking the armature k' upon its pivot, as shown. One end of the winding of magnet k is connected with binding-post d^6 , and the other end is connected with binding-post d^8 , which latter binding-post is connected, by means of conductor 5 through the shunt field-winding f' , to the supply-conductor 3.

Mounted upon a rod or shaft l , supported in suitable bearings upon the base-plate a^6 , are the rocking dogs $m m'$, &c. Each of the dogs has the rear so shaped as to engage the base-plate a^6 and limit the downward movement of the dog when free. Upon the end of the dog to the right-hand side an upwardly-extending lip o is provided, which has its front edge curved and its rear edge perpendicular to the upper surface of the dog. The under side of the dog has a lip o' extending throughout its whole length, which lip is rounded off at the left-hand edge. The levers a' to a^5 , inclusive, are each provided with a latch p , pivoted to the arm at p' and set in a slot p^2 . The first lever a upon the left has no latch. The wall of the slot limits the vertical movement of the latch relatively to the arm. Below the latch and formed integral with the lever is a lug r , projecting toward the base-plate and consisting of two parts r' r^2 . The part r' is square in section and flat upon the end, and when the lever is in a position to close circuit presents a vertical sur-

face. The upper part of the part r^2 is inclined or chamfered at an acute angle.

The operation of the structure as above described is as follows: Assuming that it be desired to start the motor, switch-arm a is closed to first close circuit between the carbon blocks and finally to close together terminals d and c' directly through the contact device c . The armature k' is engaged and moved against the pole of the retaining-magnet k , and the retaining-magnet thus serves to maintain the switch-arm in the closed position. Current may be traced from supply-conductor 2 to terminal d , thence through the switch-arm a to terminal c' and through the resistance $e e'$, &c., in series to binding-post d^7 , thence by conductor 4 through the armature f to the opposite side 3 of the supply-circuit. A small portion of the current passes from terminal d through the retaining-magnet k , conductor 5, and shunt field-winding f' . Circuit is thus closed through the armature with all the armature resistance in circuit. In moving arm a to the closed position the oblique wall r^2 of lug r engages the under face of the first rocking lug of dog m and springs the same into the position shown in full lines in Fig. 4. The second switch-arm a' is now closed, and as the dog m is in its raised position the latch p of the arm a' will ride over the lip o of the dog m and will engage the vertical wall thereof, and switch-arm a' will thus be held in the closed position. The wall r^2 of arm a' will engage and lift the second rocking dog m' , so that when the arm a^2 is closed the latch p thereof will be engaged and held by the lip o of the dog m' . In a similar manner each switch-arm when closed raises the next rocking dog to thereby permit the latch of the next succeeding switch-arm to engage the lip of the corresponding dog. As each of the switch-arms a' to a^5 , inclusive, is closed a corresponding coil of the resistance is short-circuited, and the resistance through the armature-circuit is thus cut out step by step. When the last switch-arm has been closed, current passes from switch-arm a to terminal c' , thence by switch-arm a^5 to terminal d^5 , so that the intervening switch-arms do not have to carry current during the normal operation of the device.

If it be desired to cut in the resistance and open the circuit through the motor, the retaining-magnet k may be deenergized in any suitable manner, and the arm a will be released and fly outward to the position shown in Fig. 2. In moving outward the first rocking dog m is permitted to fall, and the latch of the second switch-arm a' is thus released, and said switch-arm likewise flies outward. The switch-arm a' permits the second rocking dog to fall, thereby releasing the third switch-arm. In a similar manner each switch-arm releases the next succeeding switch-arm until all of the switch-arms have been released. The carbon blocks associated with switch-arm a are so mounted that each of the

switch-arms will move away from their contact-terminals after the carbon blocks have separated. In this manner the rupture of the circuit will take place between the carbon blocks, and the arc produced by the breaking of the circuit will thus be confined to the carbon surfaces.

Any attempt to close one of the switch-arms out of its regular order will be prevented, due to the fact that the flat face r' will engage the end of the rocking dog when in the lowered position, and it is only when the dog has been raised into the upper position that the flat face r' is permitted to pass beneath the end of the rocking dog. Moreover, unless the rocking dog is in the upper position latch p will not engage the lip o upon the dog, and the rocking dog will be held in the upper position only when the immediately-preceding switch-arm has been closed. The accidental or intentional closing of one of the switch-arms out of its regular order is thus effectively prevented.

It may happen that an operator after closing a part of the switch-arms will neglect to close the remainder, and as the resistance-wires are usually made of sufficient capacity to carry the current for a short time while the motor is being started they are not usually of sufficient capacity to carry the current for a considerable period of time. Consequently if the operator neglects to close all of the switch-arms the heating of the resistance-coil may result. To obviate any danger from this cause, I employ the cut-out magnet s , which is preferably connected between the last two terminals $d^4 d^5$, being thus in parallel with the last coil e^4 of the resistance. The magnet s controls an armature s' , carrying upon the end a contact device s^2 , adapted when the armature is attracted to bridge together contacts $s^3 s^4$, connected, respectively, with the opposite ends of the windings of retaining-magnet k . If for any reason the last switch-arm is left open, current passing through resistance-coil e^4 will heat the same, thereby increasing the resistance and sending a continually-increasing current through the winding of magnet s , which is in parallel with the coil e^4 . When the heating has progressed to the prearranged extent, the magnet s will become energized to raise the bridging contact s^2 into contact with terminals $s^3 s^4$, and thus short-circuit the retaining-magnet k to release arm a , and consequently the other arms, which have been closed. The magnet s thus serves automatically to open the circuit before the current has traversed the resistance for a sufficient length of time to injuriously heat the same.

The switches are arranged in a series—that is, a plurality of substantially like switch elements are provided which are adapted to cooperate in the manner described.

While I have illustrated my invention in connection with a rheostat, it will be understood that multiple switches may be employed

for controlling any other circuit or apparatus without departing from the spirit of my invention.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with a plurality of independently-actuated manual switches arranged in a series, of means for preventing the closure of the same except in a definite order, and means for automatically opening the same, substantially as described.

2. The combination with a plurality of independently-actuated manual switches arranged in a series, of means for preventing the closure of the same except in a definite order, and means for automatically opening the same in a definite order, substantially as described.

3. The combination with a plurality of independently-actuated manual switches arranged in a series, of means for preventing the closure of the same except in a definite order, and means for opening all of said switches, substantially as described.

4. The combination with a rheostat, of a plurality of independently-actuated manual switches for controlling the resistance thereof, means for preventing the closure of said switches, except in a definite order, and means for automatically opening said switches, substantially as described.

5. In a rheostat, the combination with a plurality of independently-actuated manual switches for controlling the resistance thereof, of means for preventing the closure of said switches except in a definite order, and means for opening said switches in a definite order, substantially as described.

6. The combination with a plurality of switches arranged in a series, of retaining mechanism for holding said switches in the closed position, and means for releasing the said retaining mechanism, substantially as described.

7. The combination with a plurality of manual switches arranged in a series, of electromagnetic retaining mechanism for holding the same in the closed position, and means for actuating said electromagnetic retaining mechanism to cause the release of said switches, substantially as described.

8. The combination with a plurality of switches arranged in a series, of means for preventing the closure of the same except in a definite order, retaining mechanism for holding said switches in a closed position, and means for automatically actuating said retaining mechanism to release said switches, substantially as described.

9. The combination with a plurality of switches arranged in a series, of interlocking mechanism whereby each switch controls the next succeeding switch and an electromagnetic retaining device for the first switch of the series, substantially as described.

10. The combination with a plurality of

switches arranged in a series, of interlocking mechanism whereby each switch controls the next succeeding switch, a retaining-electromagnet for holding the first switch of the series in a closed position, and means for controlling said retaining-magnet, substantially as described.

11. The combination with a plurality of switches, of a plurality of independent interlocking devices for preventing the closure of the switches except in a definite order, substantially as described.

12. The combination with a plurality of switches, of a plurality of independent interlocking devices for preventing the closure of the switches, except in a definite order, and means carried by the switches for operating the interlocking devices, substantially as described.

13. The combination with a plurality of switches, of a plurality of independent interlocking devices for preventing the closure of the switches except in a definite order, and means carried by each switch for operating the interlocking device associated therewith to permit the closure of the succeeding switch, substantially as described.

14. The combination with a plurality of switches arranged in a series, of interlocking mechanism for preventing the closure of the switches except in a definite order, and retaining means for holding the switches in the closed position, substantially as described.

15. The combination with a plurality of switches, of interlocking devices for preventing the closure of the switches except in a definite order, and means associated with the interlocking devices for retaining the switch in its closed position only when the immediately-preceding switch has been closed, substantially as described.

16. The combination with a plurality of switches, of an interlocking device controlled by each switch and adapted upon the closure of said switch to serve as a retaining device for the next succeeding switch, substantially as described.

17. The combination with a plurality of switch-arms, of a mechanical retaining device adapted to hold the switch in the closed position and constructed to release said switch unless the immediately-preceding switch has been closed, substantially as described.

18. The combination with a plurality of switches, of a plurality of rocking dogs adapted to be moved into the retaining position by the closure of one switch to thereby retain the next succeeding switch in the closed position, substantially as described.

19. The combination with a plurality of switches each carrying a latch, of a retaining device adapted to be engaged by said latch to hold the switch-arm in a closed position, and means controlled by the closure of a preceding switch for placing said retaining device in position to be engaged by said latch, substantially as described.

20. The combination with a plurality of switches arranged in a series, of a retaining-magnet for holding the first switch in the closed position, and interlocking devices controlled by said first switch for retaining the succeeding switch in position, substantially as described.

21. The combination with a plurality of switches, of a retaining-magnet for holding the first switch in the closed position, and a plurality of interlocking devices for holding the remaining switches in the closed position, substantially as described.

22. The combination with a plurality of switches arranged in a series, of a retaining-magnet for holding the first switch in position, means controlled by said first switch for holding the remaining switches in position, and means for automatically opening all of the switches when released by said retaining-magnet, substantially as described.

23. The combination with a plurality of switches, of a plurality of pivoted blocks or dogs limited in their movement and provided with an upwardly-extending lip at one end of the front edge thereof and having the lower opposite corner thereof cut away, substantially as described.

24. The combination with a plurality of switches, of a plurality of interlocking devices preventing the closure of the switches except in a definite order, and means controlled by each switch for placing said interlocking devices in position to retain the next succeeding switch in the closed position, substantially as described.

25. The combination with a plurality of switches, of means for opening the circuit therethrough when part of the switches remain unclosed for a time longer than a predetermined period, substantially as described.

26. The combination with a plurality of switches, of electromagnetic retaining means for holding the same in a closed position and means for releasing said switches when a part of the switches remain unclosed for a time longer than for a predetermined period, substantially as described.

27. In a rheostat, the combination with a plurality of switches, of means operated by the abnormal heating of the resistance for opening the switches when part of the same remain unclosed for a longer time than a predetermined period, substantially as described.

28. In a rheostat, the combination with a plurality of switches, of electromagnetic retaining mechanism for holding the same in the closed position, and means responsive to an abnormal heating of the resistance for actuating said electromagnetic retaining device to cause the release of said switches, substantially as described.

29. In a rheostat, the combination with a plurality of switches, of electromagnetic retaining mechanism for holding the same in the closed position and an electromagnet

device connected in parallel with a portion of the resistance of the rheostat for controlling said retaining device, substantially as described.

30. The combination with a plurality of like manual switches adapted to be independently actuated, of means for preventing the closure of the same except in a definite order, and means for automatically opening all of said switches, substantially as described.

31. The combination with a plurality of like switches, of means for preventing the closure of the same except in a definite order, retaining mechanism for holding said switches in a closed position, and means for automatically operating said retaining mechanism to release said switches substantially as described.

32. The combination with a rheostat, of a plurality of like manual switches for controlling the resistance thereof and adapted to be independently actuated, means for preventing the closure of said switches except in a definite order, and means for automatically opening said switches, substantially as described.

33. The combination with a base-board, of a series of switches mounted in alinement upon said base-board, and interlocking mechanism whereby each switch controls the next succeeding switch of the series and means for automatically opening said switches, substantially as described.

34. The combination with a base-board, of a plurality of independent manual switches mounted in alinement thereon, a rheostat having its resistance controlled by said switches, and means to prevent the closure of said switches except in a definite order, and further means for automatically opening said switches, substantially as described.

35. The combination with a base-board, a plurality of switches mounted thereon, a common bar for said switches upon which they are loosely journaled, suitable supports for said bar, and means to prevent the closure of the switches except in a definite order, and means for opening all of said switches, substantially as described.

36. The combination with a base-board, brackets mounted thereon, a common pivot-bar extending between the brackets, a plurality of switches pivoted upon said bar, and a common stop-bar also carried by said brackets with which said switches are adapted to engage to limit their outward movement, substantially as described.

37. The combination with a vertical base-board, of a plurality of like levers mounted in alinement upon one face thereof and adapted to move in planes perpendicular to the said face, means for preventing the closure of the same, except in a definite order, a retaining means for holding said switches in closed position, and means to automatically open said switches, substantially as described.

38. The combination with a base-board, of a plurality of switches mounted in alinement on the face of said board and adapted to be moved perpendicularly thereto, a common circuit-terminal on said board and extending beneath all of said switches, an individual terminal for each switch also mounted upon the board, and bridging contact members carried by the switches and each adapted to electrically connect the common terminal with the proper individual terminal when the switches are closed, substantially as described.

39. The combination with a vertical base-plate, a plurality of like switch-levers mounted upon said plate and adapted to swing outward from the face of the plate, each switch carrying a bridging contact member, a common circuit-terminal carried by the said plate and extending by all of said switches, individual circuit-terminals also carried by said plate beneath each of the said switches, the said bridging members being adapted to connect the common bar with the individual circuit-terminals, a retaining means to hold the said switches closed and means to cause the switches to fall outward from the base-board when the retaining means is released, substantially as described.

40. The combination with a vertical base-board, of a plurality of like switches pivoted in alinement at their lower ends upon said board and adapted to fall outward by gravity, retaining-catches for said switches to hold them against the face of the board and means for preventing the closure of said switches except in a definite order, substantially as described.

41. The combination with a pivoted lever, of a magnetic retaining means to hold the same in one position, said means comprising a catch member out of the field of the magnet when the switch is opened, but adapted to be brought within the field by the switch itself when the switch is closed and to thereafter retain the lever in closed position, substantially as described.

42. The combination with a base-board, of a plurality of levers mounted thereon interlocking retaining-catches for said levers, and a common bar on which said catches are mounted, substantially as described.

43. The combination with a vertical base-board, of a plurality of like levers pivoted at their lower ends upon said base-board, a catch for each lever extending out from the face of said board and adapted to engage the lever near its upper end, a common bar upon which said catches are mounted, and suitable stops carried by the catches and adapted to engage the face of the plate, whereby they are allowed a limited vibration, substantially as described.

44. The combination with a plurality of like switch-levers mounted in alinement, interlocking mechanism to prevent the closure of the same except in a definite order, means to automatically open said switches and carbon

terminals for the first switch of the series, substantially as described.

45. The combination with a rheostat, of a plurality of like switch-levers controlling the resistance thereof, said manual switches being independently actuated, means to prevent the closure of said switches except in a definite order, means for automatically opening said switches, carbon switching-terminals for the first lever of the set, and means to prevent the opening or closing of the circuit except through said first lever, substantially as described.

46. The combination with a rheostat, of a plurality of manual switches each controlling an individual section of the resistance thereof, means for preventing the closure of said switches except in a definite order and means for opening all of said switches within a short interval of time, substantially as described.

47. The combination with a rheostat, of a plurality of manual switches each controlling an individual section of the resistance thereof, means for preventing the closure of said switches except in a definite order, and means for effecting the rapid opening of all of said switches, substantially as described.

48. The combination with a rheostat, of a plurality of manual switches each controlling an individual section of the resistance thereof, means for preventing the closure of said switches except in a definite order, and electrically-controlled means for opening said switches, substantially as described.

49. The combination with a rheostat, of a plurality of switches, each controlling an individual section of the resistance thereof, means for preventing the closure of said switches except in a definite order and electrical means for effecting the opening of said switches when the current therethrough becomes abnormal, substantially as described.

50. The combination with a rheostat, of a plurality of switches, each controlling an individual section of the resistance thereof, means for preventing the closure of said switches except in a definite order, and electrical means for opening said switches when the current therethrough tends to abnormally heat the apparatus, substantially as described.

51. The combination with a rheostat, of a plurality of manual switches, each controlling an individual section of the resistance thereof, means for preventing the closure of said switches except in a definite order and electrical means for opening said switches when the current therethrough falls below a predetermined limit, substantially as described.

52. The combination with a rheostat, of a plurality of switches each controlling an in-

dividual section of the resistance thereof, means for preventing the closure of said switches except in a definite order, a magnet responding to a current tending to abnormally heat the apparatus for effecting the opening of said switches, and a magnet responding to an underload current for effecting the opening of said switches, substantially as described.

53. The combination with a plurality of like electrical elements to be connected in varying relations, of a plurality of switches each controlling one of said like elements, means for preventing the closure of said switches except in a definite order, and means for effecting the opening of said switches, substantially as described.

54. The combination with a suitable base-plate, of a plurality of switches mounted in alinement thereon, and adapted to move perpendicular to the face of said plate, and suitable means for breaking the shock upon the fall of said switches, substantially as described.

55. The combination with a base, of a plurality of switches mounted in alinement thereon, and adapted to move perpendicular to the face of said plate, and a rod carrying a rubber covering adapted to serve as a buffer to break the fall of said switches, substantially as described.

56. The combination with a base-plate, of terminals mounted thereon, a plurality of switches adapted to move perpendicular to the face of said plate and leaf-contacts carried upon each of said switches, said leaf-contacts being secured to the switch at the middle and having free ends adapted to engage said terminals and suitable retaining mechanism for normally maintaining said switches in a closed position, substantially as described.

57. The combination with a plurality of manual switches arranged in a series, means for preventing the closure of the same except in a definite order, and means for automatically opening the same, substantially as described.

58. The combination with a plurality of like manual switches arranged in a series, means for preventing the closure of the same except in a definite order, and means for automatically opening all of said switches, substantially as described.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

HENRY H. CUTLER.

Witnesses:

W. CLYDE JONES,

MELANCTHON R. NYMAN.