No. 697,533. Patented Apr. 15, 1902.

W. E. PIMLOTT.

CIRCUIT BREAKER.

(Application filed Sept. 22, 1900.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

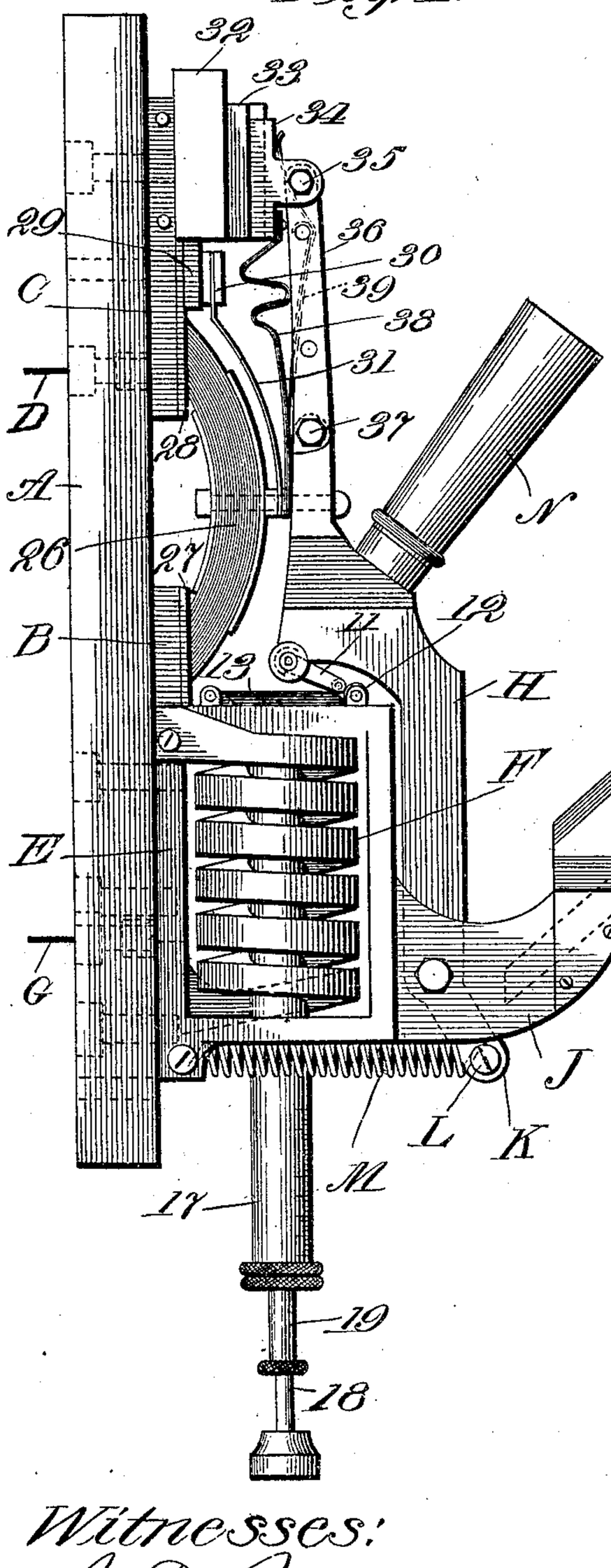

Fig. 2.

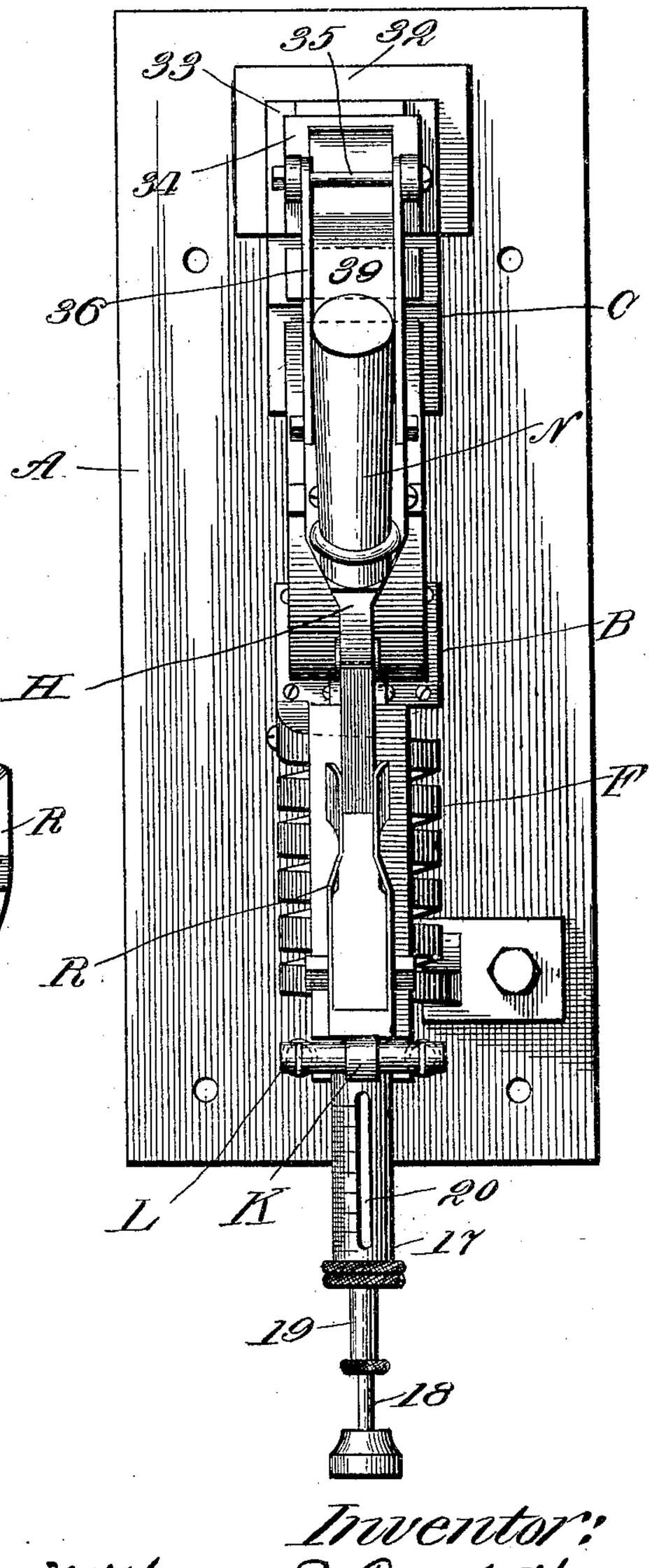

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Fig. 3.

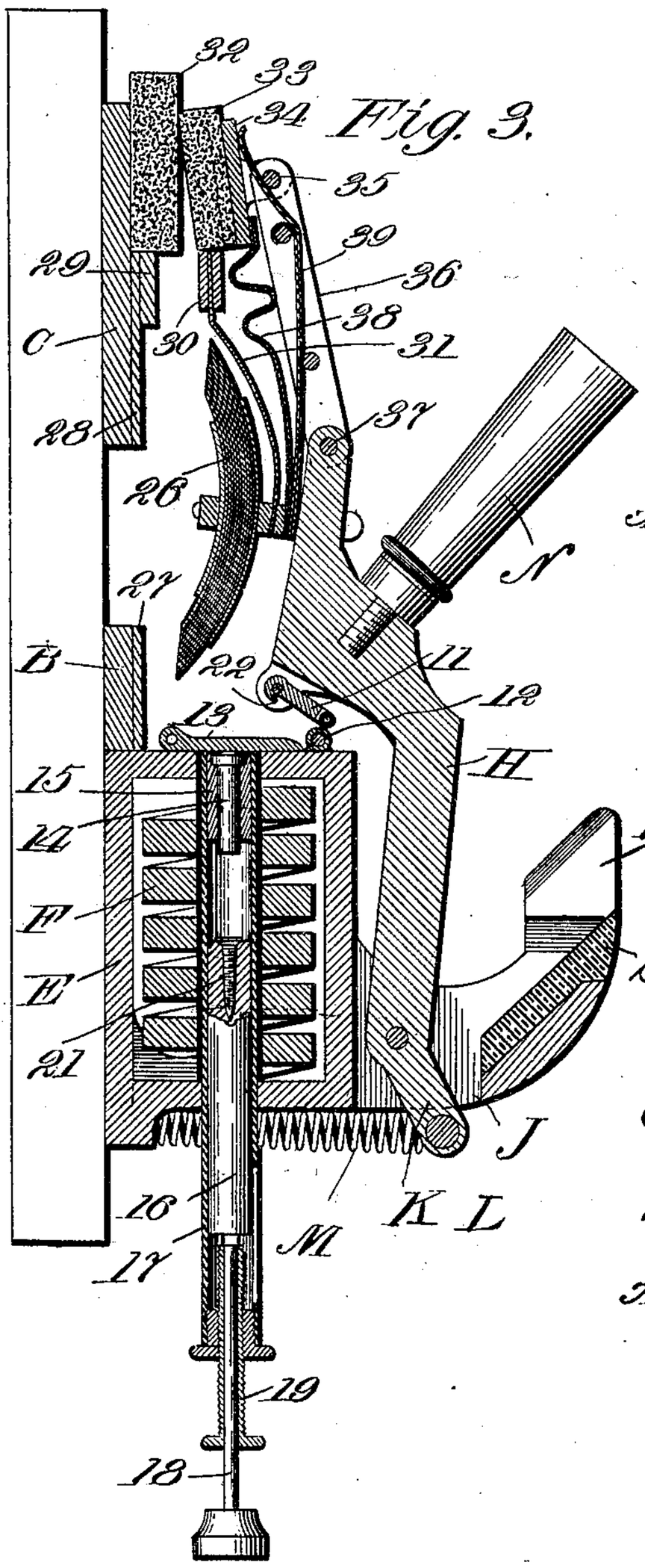

Fig. 4.

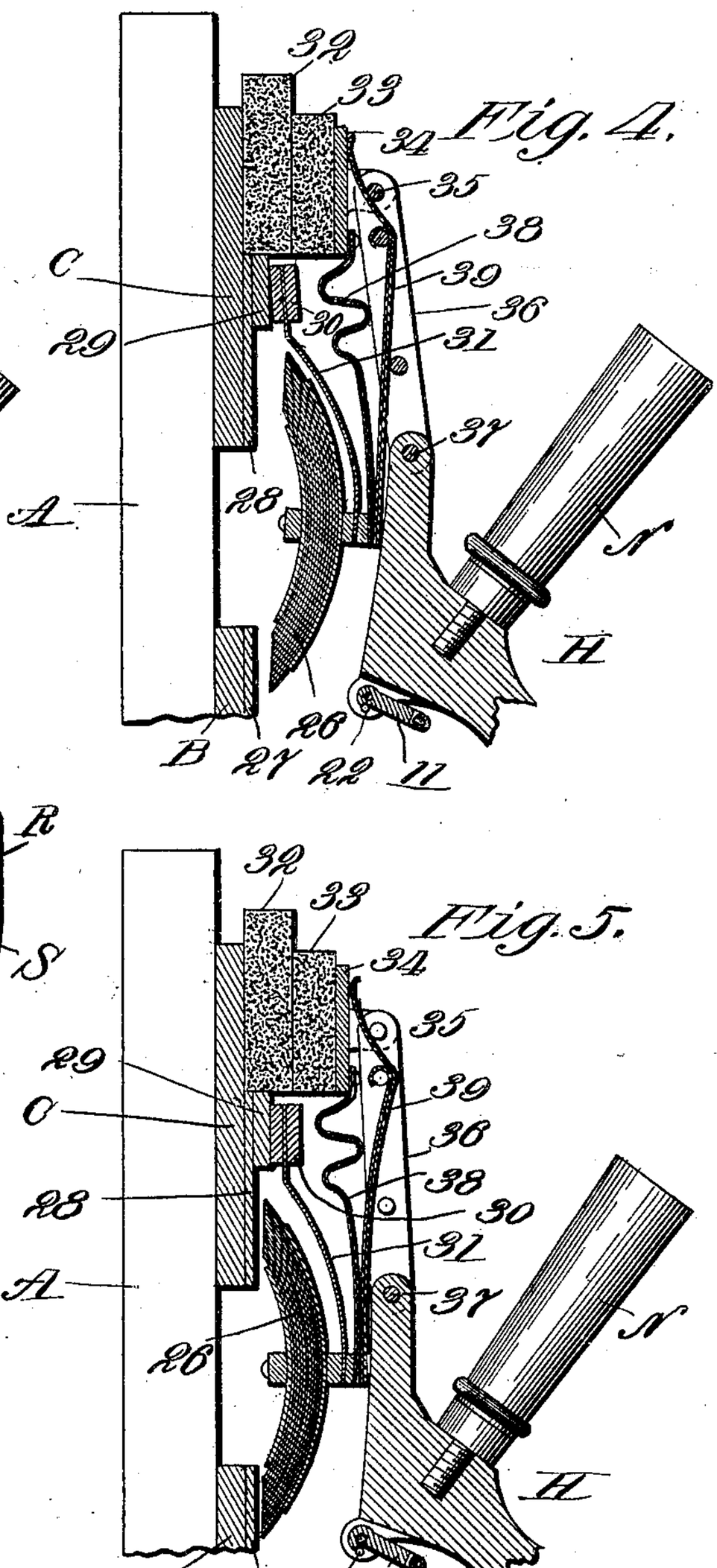

Fig. 5.

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(No Model.) 4 Sheets—Sheet 3.

Fig. 7.

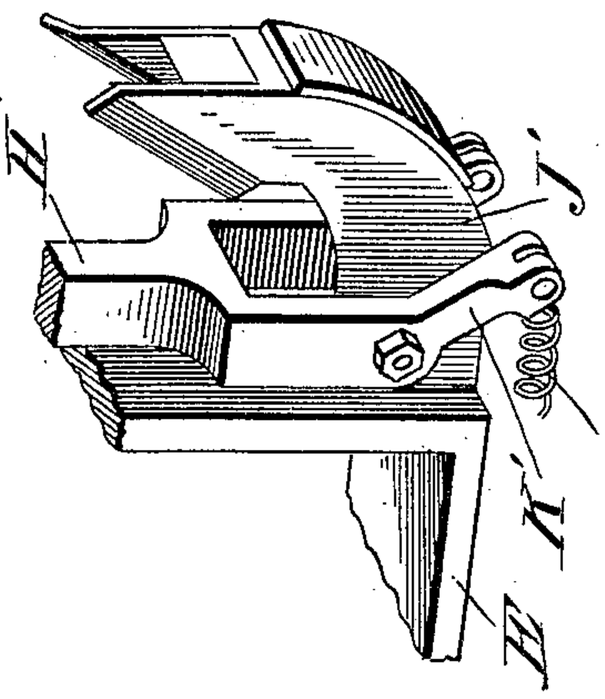


Fig. 8.

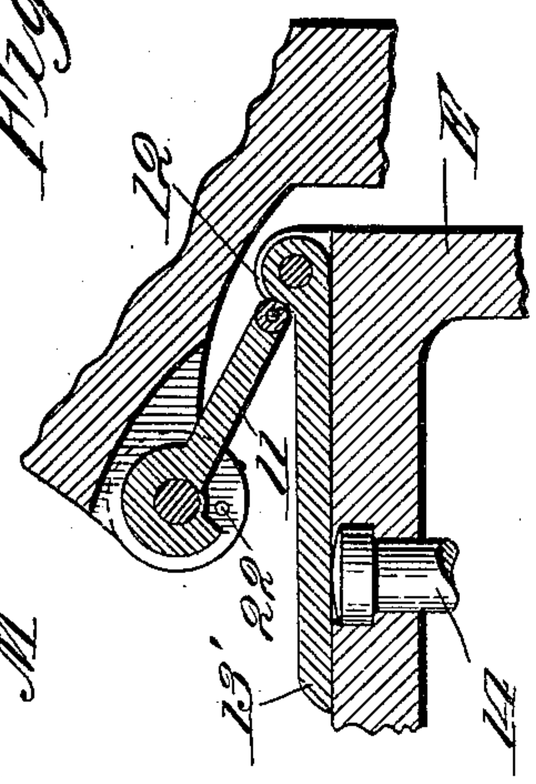


Fig. 9.

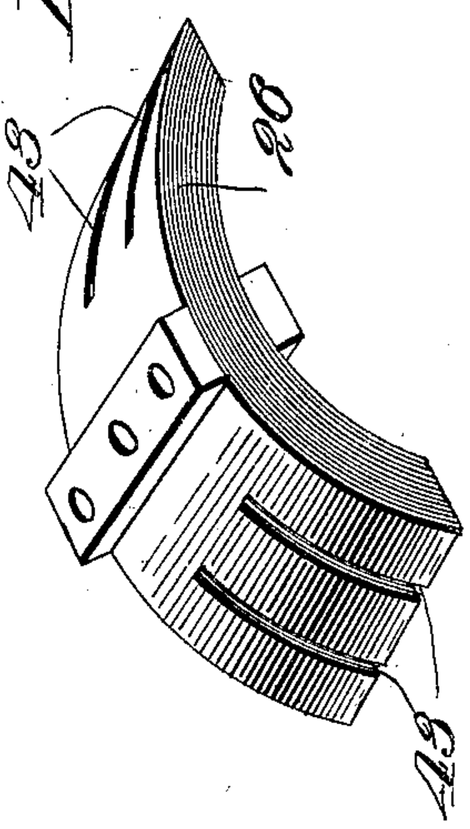
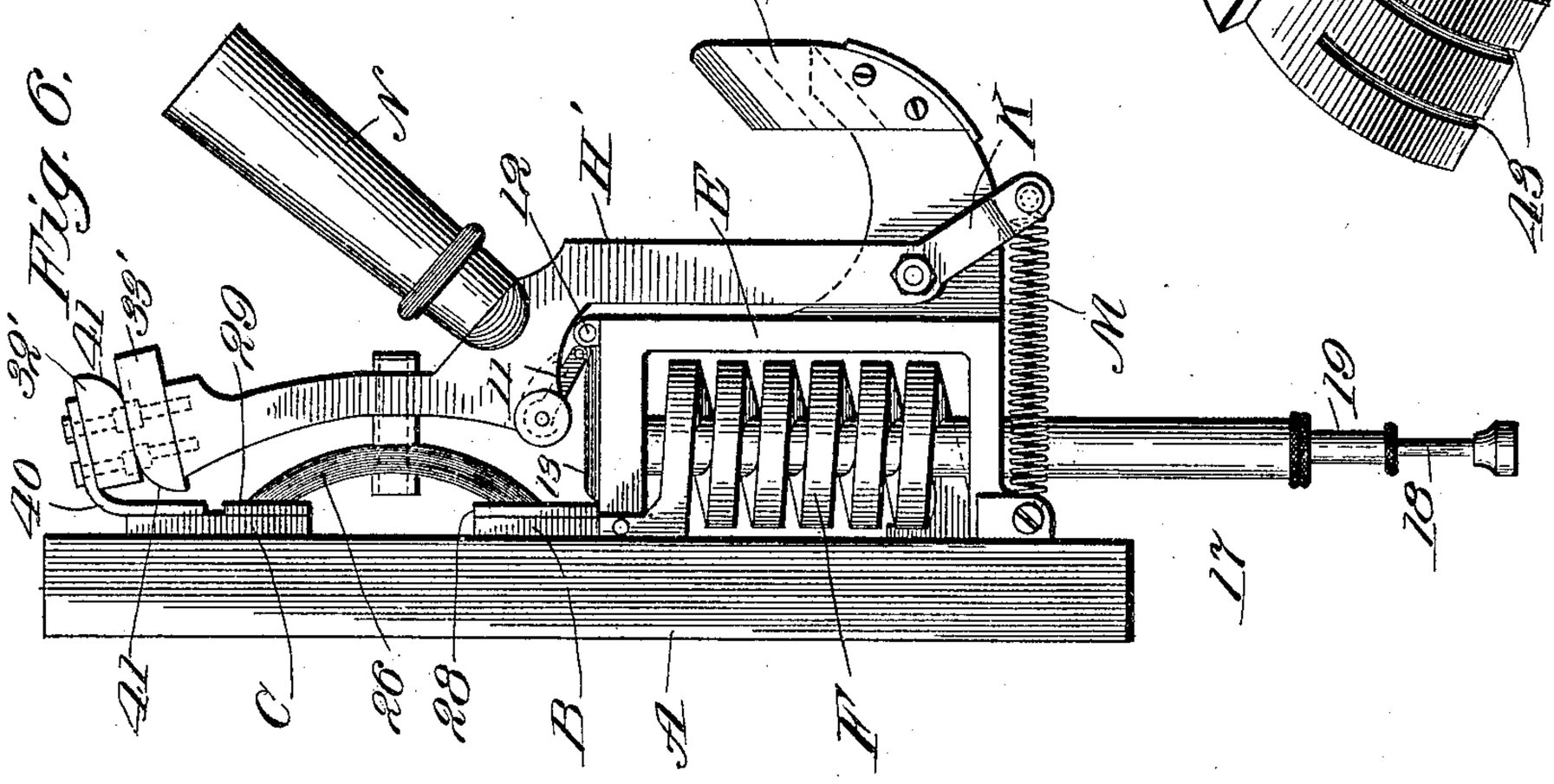


Fig. 6.



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(Application filed Sept. 22, 1900.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 11.

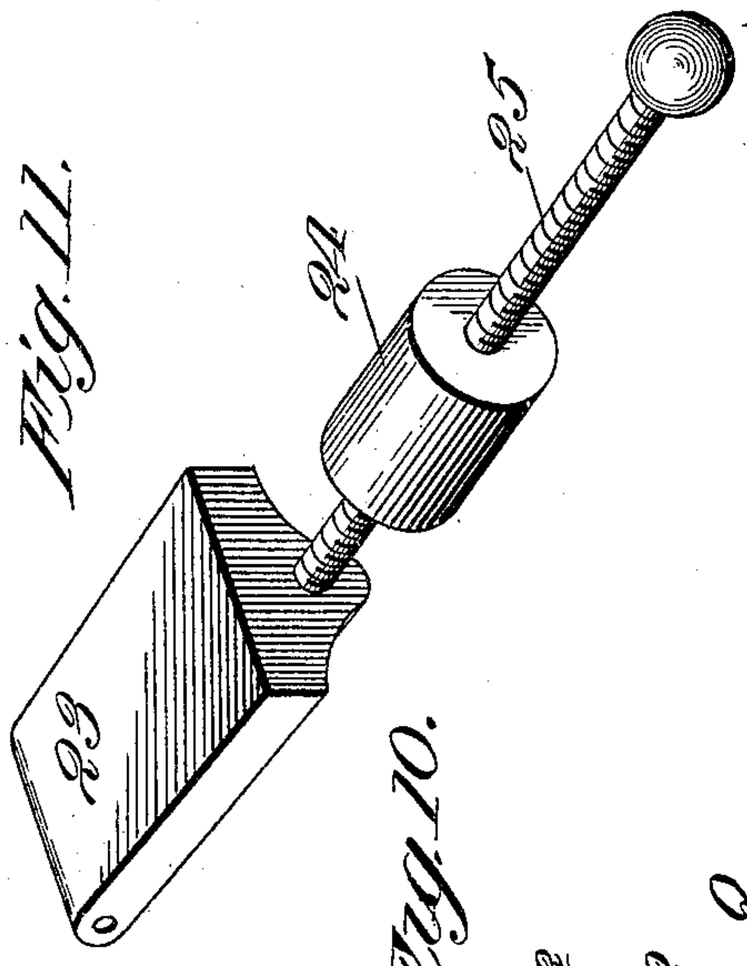

Fig. 10.

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UNITED STATES PATENT OFFICE.

WILLIAM E. PIMLOTT, OF CHICAGO, ILLINOIS, ASSIGNOR TO J. M. ATKINSON COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

CIRCUIT-BREAKER.

SPECIFICATION forming part of Letters Patent No. 697,533, dated April 15, 1902.

Application filed September 22, 1900. Serial No. 30,755. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. PIMLOTT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Circuit-Breakers, of which the following is a specification.

This invention relates to circuit-breakers.

The object of the invention is to provide a circuit-breaker which is simple and efficient.

A further object of the invention is to provide a construction of circuit-breaker which is arranged to operate to break the circuit automatically, and the invention includes means for adjusting the apparatus so as to break the circuit only when the current attains the desired strength.

A further object of the invention is to provide a circuit-breaker wherein the dangerous and destructive effects of arcing at the point of rupture are reduced to the minimum.

Other objects of the invention will appear more fully hereinafter.

The invention consists, substantially, in the construction, combination, location, and arrangement, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference-signs appearing thereon, Figure 1 is a view in side elevation of a construction of circuit-breaker embodying the principles of my invention. Fig. 2 is a front elevation thereof. Fig. 3 is a longitudinal central section of the construction shown in Fig. 1, the parts occupying their relative positions at the point of complete break of the circuit. Fig. 4 is a broken detail sectional view through the contacts, showing the parts in their relative positions at the second step in the circuit-breaking operation. Fig. 5 is a view similar to Fig. 4, showing the parts in their relative positions at the completion of the first step in the circuit-breaking operation. Fig. 6 is a view similar to Fig. 1, showing a modified form of the switch-lever and the modified arrangement of the contacts at the point where the final break occurs. Fig. 7 is a broken detail view in perspective of the form of switch-lever shown in Fig. 6. Fig. 8 is a broken detail view in section, illustrating a modified form of detachable latch for holding the circuit-breaker in closed position. Fig. 9 is a detached detail view in perspective of the main contact-brushes. Fig. 10 is a view similar to Fig. 1, parts being broken out, illustrating a modified construction of circuit-breaker embraced within the spirit of my invention. Fig. 11 is a detached detail view in perspective of the armature-lever employed in connection with the construction of circuit-breaker shown in Fig. 10.

The same part is designated by the same reference-sign wherever it occurs throughout the several views.

Reference-sign A designates a suitable base-board, upon which are supported the various parts of the circuit-breaker. This base-board may be of any suitable material, but preferably of non-conducting material, such as marble, fiberite, wood, or the like. Upon this base-board are mounted contact-plates B C, of conducting material—such, for instance, as copper. With contact C communicates one of the leading wires or conductors, (indicated at D, Fig. 1, and D′, Fig. 10.) Also suitably bolted or otherwise secured to the base-plate A is a casting or frame E, of magnetic material—such, for instance, as iron—and in this frame is mounted a solenoid-coil F, having one of the ends thereof in electrical connection with contact-plate B and the other end in suitable electrical connection with the other leading wire, (indicated at G, Fig. 1, and at G′, Fig. 10.) By this arrangement it will be observed that when the circuit-breaker is in closed position, with the space between contact-plates B and C properly bridged, the current flowing through the circuit will also traverse the coils of the solenoid F.

Reference-sign H designates a switch-lever suitably pivoted upon an extension or bracket J of casting or frame E, and which lever carries the several contacts hereinafter to be more fully described. In the form shown in Figs. 1, 2, and 3 the lever H is provided with an extension K, in which is mounted a pin L, and suitable springs M are connected at the ends thereof, respectively, to the ends of said pin L and to a convenient part of the base-

board or frame, the tension of said springs being constantly exerted to rock or swing lever H in a direction to open the circuit-breaker. If desired and as shown in Figs. 6 and 7, the switch-lever H′ may be bifurcated at its lower end and arranged to straddle the extension J′ of the bracket or frame E, and the springs M may be directly connected to the extensions K′ of lever H′, as clearly shown. This manner of mounting the lever H or H′ is somewhat more economical in manufacture than the construction above described, in which a transverse pin L is employed, and is therefore for some purposes a more desirable arrangement.

The switch-lever H or H′ may be provided with a handle N for the proper manipulation thereof in closing the circuit-breaker.

In some cases—where, for instance, the circuit-breaker is arranged in a position which is inconvenient to reach by hand to effect a closure thereof—it may be desirable to provide means for closing the circuit-breaker more conveniently than by grasping the handle N, as in the construction above described. As an embodiment of means to this end I have shown a construction in Fig. 10 wherein the switch-lever H^2 is pivotally mounted, as at O, upon an extension J^2 of the casting or frame E′, and a spring M′ is arranged to exert its tension upon said lever H^2 in a direction to throw said lever into open position, and upon said extension J^2, I pivot a bell-crank lever P and connect one arm thereof by means of a toggle-link Q to lever H^2, the arrangement being such that when the bell-crank lever P is rocked the switch-lever H^2 is returned to its closed position. Pivotally mounted upon the switch-lever H is a latch 11, arranged when the circuit-breaker is in closed relation to engage behind a stop 12, suitably mounted on or secured to the casting or frame E or E′, and pivotally mounted upon the casting or frame E is a lever or arm 13, (see Figs. 1 and 3,) with the end thereof arranged in suitable relation with respect to stop 12 to form a support for the end of the latch 11 when said latch is in engaging relation with respect to said stop, as clearly shown in Fig. 1, the relative arrangement being such that when the latch 11 is resting upon the end of pivoted arm 13 and in engaging relation with stop 12 the point of engagement of latch 11 with said stop will be in a line from the center of said stop to the pivotal axis of the latch, or else slightly below such line, as will be readily understood. The arm 13 is freely pivoted and rests in normal position over a pin 14, (see Fig. 3,) freely mounted in a magnetic plug or head 15. This magnetic plug or head is preferably of iron or other suitable magnetic material and constitutes a pole-piece adapted to be energized by the current flowing through the solenoid F. Operating within and through the solenoid-coil is a freely-movable core-piece 16, adapted when the current traversing the solenoid-coil attains any desired strength to be moved upwardly to engage the pin 14 and project the same sufficiently to rock arm 13, thereby effecting a disengagement of latch 11 with stop 12, as clearly shown in Fig. 3. Provision may be made whereby the core 16 is adjusted to move when any desired strength of current is attained. This result may be effected by arranging said core to operate within a casing 17 and to rest upon a stem 18, carried in a hollow threaded sleeve 19, adapted to be adjustably mounted in the end of casing 17, as clearly shown. By suitably adjusting the support for the core said core may be primarily projected into or withdrawn from the coil, more or less, so as to require a less or a greater strength of current to actuate the same, and I provide the casing 17 with a longitudinal slot or opening 20 (see Fig. 2) and calibrate the casing adjacent to said slot or opening, so that the core may be set to operate at any desired strength of current.

From the foregoing description it will be readily understood that when the core 16 is set to operate at any desired or particular strength of current and the current attains that desired strength the core will be actuated and will impinge against pin 14 and cause the same to automatically detach the latch, and hence permitting the springs, the tension of which is exerted upon the switch-lever, to throw said lever into open position. It may sometimes occur that the residual magnetism in the casting or frame in which the solenoid-coil is mounted and in the pole-piece 15 thereof will exert an attractive force upon the solenoid-core 16, which constitutes a part of the magnetic circuit, and hence hold the same suspended by said pole-piece. In order to avoid such contingency, I prefer to mount a non-magnetic pin or screw 21 (see Fig. 3) in that end of the core which abuts against the pole-piece 15 or pin 14, thus permitting the head of said non-magnetic screw 21 to form a break in the magnetic circuit. It is obvious that this break in the magnetic circuit may be effected in many other ways, and I do not desire my invention limited or restricted in this respect.

Instead of pivoting the arm 13 so as to permit the latch 11 when in engaging relation with respect to stop 12 to rest upon the free end of said arm 13 said arm (as indicated at 13′, Figs. 6 and 8) may be pivoted concentric with the stop 12, and the free end of said arm may be arranged to rest upon the head of pin 14. In other words, the arm 13 may be changed from a lever of one order to a lever of another order, and this modification is designed to be included within the spirit and scope of my invention. If desired, the latch 11 may be provided with a suitable limit-stop, as indicated at 22.

If desired and in order to reduce friction, the latch 11 or the stop 12, or both, may be in the form of antifriction-rollers, as clearly indicated, or, if desired, these rollers may be omitted, as indicated at 11′, Fig. 10.

In each of Figs. 1, 2, 3, and 6 I have shown a construction wherein a movable solenoid-core 16 is employed, which when the coil is energized to the desired degree is actuated to impinge or strike against the pin 14 to effect a disengagement of the latch. The power developed in the solenoid for actuating the core being dependent upon the ampere-turns, the construction illustrated in said figures of the drawings may not always be suitable, and especially in the case of very weak currents or very strong currents, for in such cases, and particularly where it is desired to avoid unnecessary expense, the solenoid for effecting a disengagement of the latch may be dispensed with and a magnet substituted, and in the case of strong currents the same effect may be produced by employing a coil of comparatively few turns. Therefore in Fig. 10 I have shown a modified arrangement in these regards wherein the coil F′ comprises a comparatively few turns and is inclosed within a casing E′, the latter being of magnetic material, and I provide the coil F′ with a stationary core 16′, thus in effect forming an electromagnet adapted when energized to exert an attractive force upon an armature 23, suitably pivoted to the casting and arranged to support a pin 14′, arranged to extend loosely through the core 16′ and upon which the latch-detaching arm 13′ rests. From this construction it will be seen that when the electromagnet is sufficiently energized to effect an attraction of armature 23 the pin 14′ will be projected, thereby enabling the arm 13′ to effect a detachment of the latch. The desired adjustment of the armature, to be actuated according to the strength of the current flowing, may be effected by means of an adjustable weight 24, carried upon a threaded arm 25, supported by said armature. Thus by adjusting the position of the weight 24 upon arm 25 the point at which the armature will be actuated may be regulated and varied according to the desired strength of current.

I will now describe the construction and arrangement of contact-points carried by the switch-lever and which coöperate with the contact-plates B and C.

Suitably supported upon lever H is the main contact 26, which is designed to make and break circuit between said plates B and C. This main contact comprises a series of laminated spring-plates suitably secured together, the ends of which are planed off to make contact with the contact-plates, as clearly shown. These laminated plates are built up in the form of segments of circles, the diameters of which are normally such as to cause a slight flattening out of the segment against the normal resiliency of such contact-plates or laminations when the circuit-breaker is in extreme closed position, thus not only securing an efficient contact, but also storing up, so to speak, the resilient energy of these segments to aid in effecting a quick opening of the switch or circuit-breaker when the latch holding the same in closed position is detached. In order to avoid the injurious effects of burning or blistering the contact-surfaces of plates B and C, thereby necessitating the frequent replacement and renewal thereof, I prefer to provide said plates with removable facings, (indicated at 27 28,) which facings may be removed and replaced whenever occasion requires without removing or replacing the contact-plates B and C. This I have found a desirable feature in practice. In the construction of apparatus of this class it is desirable to impose a gradually-increasing resistance in the circuit to be broken up to the point where the final break occurs. It is also desirable to effect the final break not at the main contact-point, but at a point removed therefrom, in order to relieve the main contacts of danger and injury due to sparking or arcing at the moment of break. I provide a construction and arrangement of auxiliary contacts which, together with the purpose and function thereof, I will now describe, referring particularly to Figs. 1, 3, 4, and 5.

The contact-plate C may be provided with a raised surface 29, or said raised surface may be in the form of an additional contact plate or facing, which operates to raise the contact-surface thereof above the surface with which the main contact 26 coöperates, and coöperating with such raised surface 29 is an additional or auxiliary contact 30, carried by a spring 31, suitably secured to the operating-lever H, and said auxiliary contact and its supporting-spring 31 are so relatively arranged that when the circuit-breaker is in completely closed position said auxiliary contact will have a flat bearing upon its coöperating contact-surface 29, as shown in Fig. 1, and that said flat bearing continues until after the first step in the breaking operation—that is, until after the main contact 26 leaves its coöperating contact-surface, as clearly shown in Fig. 5. The continued movement of the circuit-breaker toward open position causes the auxiliary contact 30 to slightly rock from a position of a flat contact and relatively to its coöperating contact-surface, as clearly indicated in Fig. 4, thus interposing increasing resistance in the circuit at the point where the break is to be effected and also gradually transferring the point of final break away from the main contact.

Associated with the main and auxiliary contacts above referred to are blocks of carbon or other suitable conducting material, (indicated at 32 33,) the block 32 being mounted upon or in electrical relation with respect to contact-plate C, and the block 33 being carried in a holder 34, which holder is suitably pivoted, as at 35, in the end of a frame 36, which frame is suitably pivoted, as at 37, to the lever H. The springs 38 39 serve to maintain frame 36 and holder 34 normally in such relation that when the circuit-breaker is in completely closed position, as indicated in

Fig. 1, the carbon blocks 32 33 will have flat bearing upon each other, and which flat bearing will continue during the movement of lever H toward open position until after both the main contact 26 and the auxiliary contact 30 have left their coöperating contact-surfaces, as clearly shown in Figs. 5 and 4, respectively, and thereafter said main contact 26 and auxiliary contact 30, having left their coöperating contact-surfaces, the continued movement of lever H toward open position will cause or permit the holder in which carbon block 33 is carried to rock or swing about its pivotal axis, so as to cause the carbon block 33 to leave its position as a flat contact with carbon 32 and to rock or swing upon end, as clearly shown in Fig. 3, thus increasing the resistance in the circuit at the point of contact and decreasing the amount of contact-surface during the final break, and hence also reducing the danger and liability of sparking or arcing to the minimum, and in case an arc should be made such arc is transferred from the more costly main contact to the carbon blocks, which are cheap and may be easily and readily removed and replaced.

Of course it will be understood that the break above described is effected in all the steps thereof in an exceedingly short space of time, so short, in fact, that perhaps the senses could not follow nor comprehend the interval of time between the leaving of the main contact 26 of its coöperating contact-surface, the break at the auxiliary contact 30, and the final break at the carbon blocks 32 33. I have therefore slightly exaggerated the illustration of these three steps in the breaking operation in Figs. 5, 4, and 3, respectively, in order to clearly illustrate the action above described.

In Fig. 6 I have shown a modified arrangement designed for a cheaper construction of circuit-breaker which is included within the spirit and scope of my invention and wherein the auxiliary contact 30 above described is omitted and wherein the carbon block 32′ is carried in a bracket 40, which is in electrical connection with contact-plate C, and wherein the coöperating carbon block 33′ is rigidly mounted upon the end of lever H′. In this construction it will be observed that the final break is effected at the carbon blocks 32′ 33′ and which break does not occur until after the circuit through the main contact 26 is broken. It will also be observed in this construction that the break is effected through a relative sliding movement of the carbon blocks the one past the other, thus interposing increasing resistance in the circuit at the point of break. If desired and as shown in Fig. 6, the edges of the carbon blocks which move past each other may be beveled, as indicated at 41, Fig. 6.

In Fig. 10 I have shown a construction somewhat similar to that above described with reference to Figs. 3, 4, and 5, wherein the carbon block 32 is mounted on the contact-plate C and the carbon block 33 is carried in a holder 34, which holder is pivotally mounted, as at 35, upon a frame 36, which is pivotally mounted at 37 upon the end of lever H^2; but the auxiliary contact 30 is carried in the end of a link or arm 42, which is pivotally supported upon lever H^2. In this construction I omit the springs 31, 38, and 39; but it is obvious that such springs may be employed, if desired.

If desired and in order to secure an efficient resilient action of the main contact 26, said contact may, as above described, be built up of plates or laminations, and, as shown in Fig. 9, said laminations may be split at one or more places longitudinally thereof, as indicated at 43, in their ends.

Reference-sign R designates a stop or holder to receive the impact of the lever H or H′ when the circuit-breaker is released from closed position, and in order to avoid shock or jar said holder or stop may be provided with a rubber or other resilient packing or facing, as indicated at S.

It is obvious that many variations and changes in the details of construction and arrangement would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention. I do not desire, therefore, to be limited or restricted to the exact details shown and described; but,

Having now set forth the object and nature of my invention and various operative constructions embodying the principles thereof and having described such constructions, their function, purpose, and mode of operation, what I claim as new and useful and of my own invention, and desire to secure by Letters Patent, is—

1. In a circuit-breaker, a lever carrying contacts, means normally operating to rock said lever in a direction to break the circuit, a latch pivotally mounted on said lever, and a stop arranged to be engaged by said latch to lock said lever in position to complete the circuit through said contacts, a pivoted arm arranged to engage said latch for releasing the same, a solenoid arranged in the circuit of said contacts, a movable part adapted to be operated by the energization of said solenoid, only when the current traversing the coils thereof attains a predetermined strength, said movable part adapted to rock said arm to effect a release of said latch, as and for the purpose set forth.

2. In a circuit-breaker, a lever carrying contacts, means normally operating to rock said lever in a direction to break the circuit, a pivoted latch carried by said lever, a stop arranged to be engaged by said latch to lock said lever in position to complete the circuit through said contacts, a pivoted arm arranged in engaging relation with respect to said latch, a stud or bolt upon which said arm rests, a solenoid arranged in the circuit of said contacts, a movable core therefor, said core when

actuated adapted to engage said stud or bolt to rock said arm, thereby releasing said latch, as and for the purpose set forth.

3. In a circuit-breaker, a casting having a projection, a pivotally-mounted lever having a bifurcated end extending beyond the point of pivotal support of said lever and arranged to straddle said projection, said lever carrying contacts, springs connected to the extensions of said bifurcated end and to said casting, and normally operating to rock said lever in a direction to break the circuit, and a detachable latch for locking said lever in position to complete the circuit through said contacts, as and for the purpose set forth.

4. In a circuit-breaker, a lever carrying contacts, means normally operating to rock said lever in a direction to break the circuit, a pivoted latch carried by said lever, a stop arranged to be engaged by said latch to hold said lever in position to complete the circuit through said contacts, a solenoid arranged in the circuit, a movable core for said solenoid, a pivotally-mounted trip-arm arranged to be actuated by the movement of said core to release said latch from said stop when the current reaches a predetermined strength, and means for adjustably regulating the point at which said core is actuated, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 18th day of September, A. D. 1900, in the presence of the subscribing witnesses.

WILLIAM E. PIMLOTT.

Witnesses:
E. C. SEMPLE,
S. E. DARBY.