No. 879,285. PATENTED FEB. 18, 1908.

W. C. MAYO & J. HOULEHAN.

AUTOMATIC MULTIPLE FUSE BLOCK.

APPLICATION FILED MAY 2, 1907.

4 SHEETS—SHEET 1.

Fig. 1.

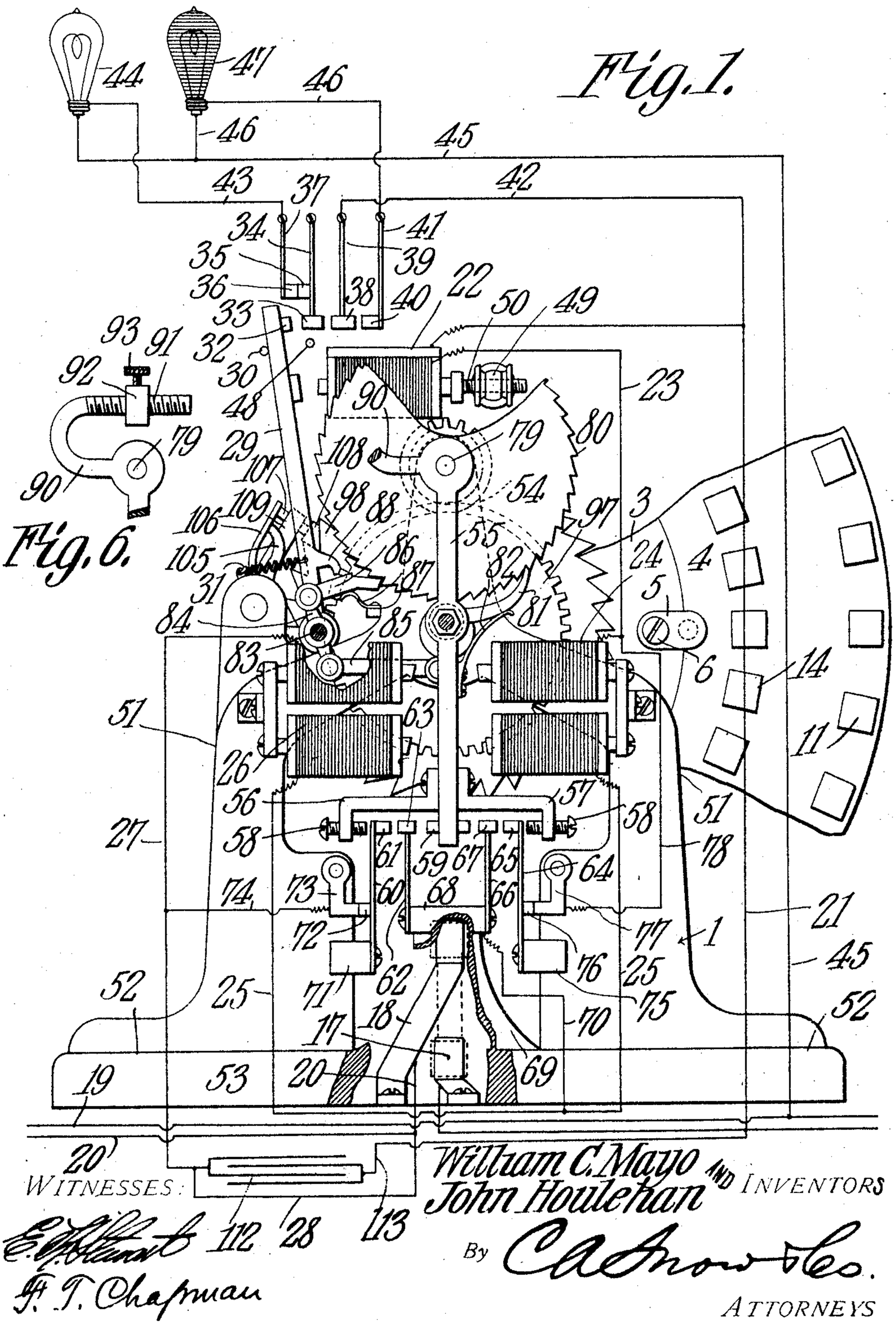

Fig. 6.

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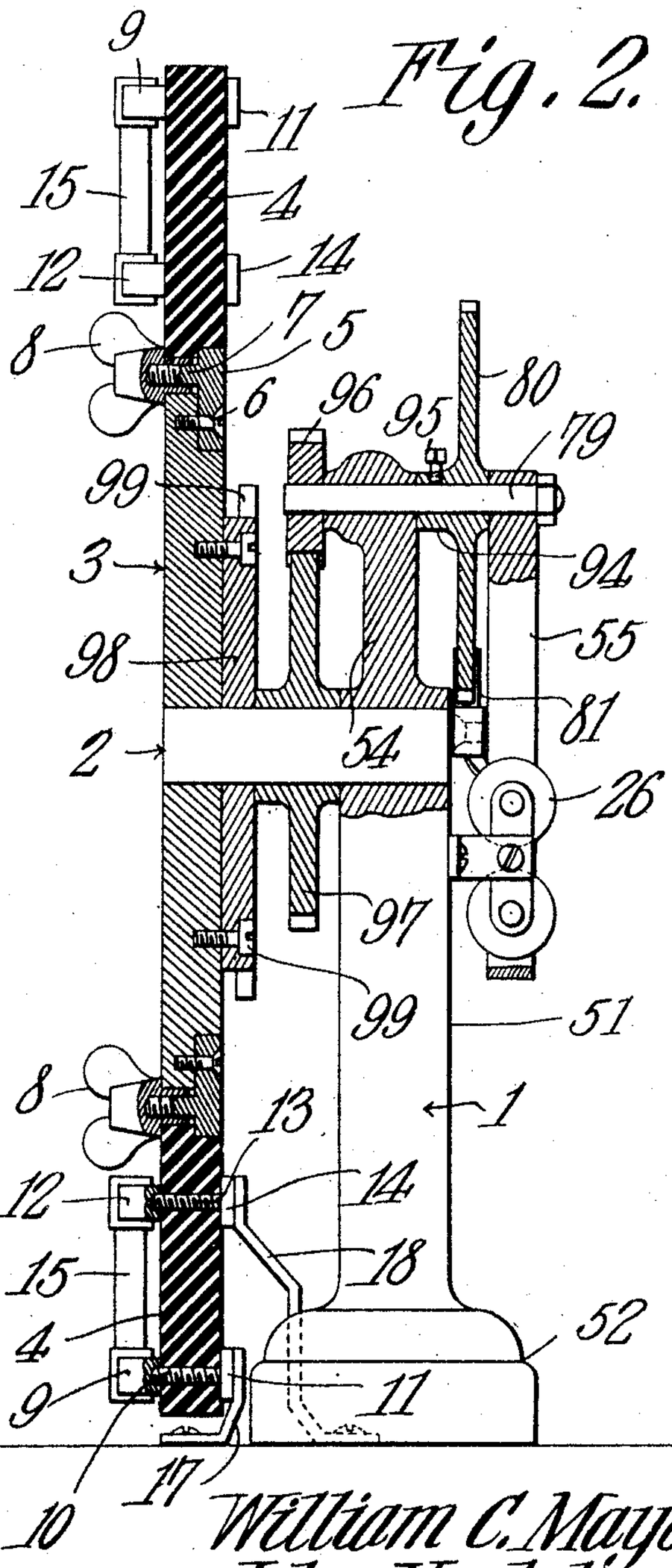
4 SHEETS—SHEET 2.

Fig. 2.



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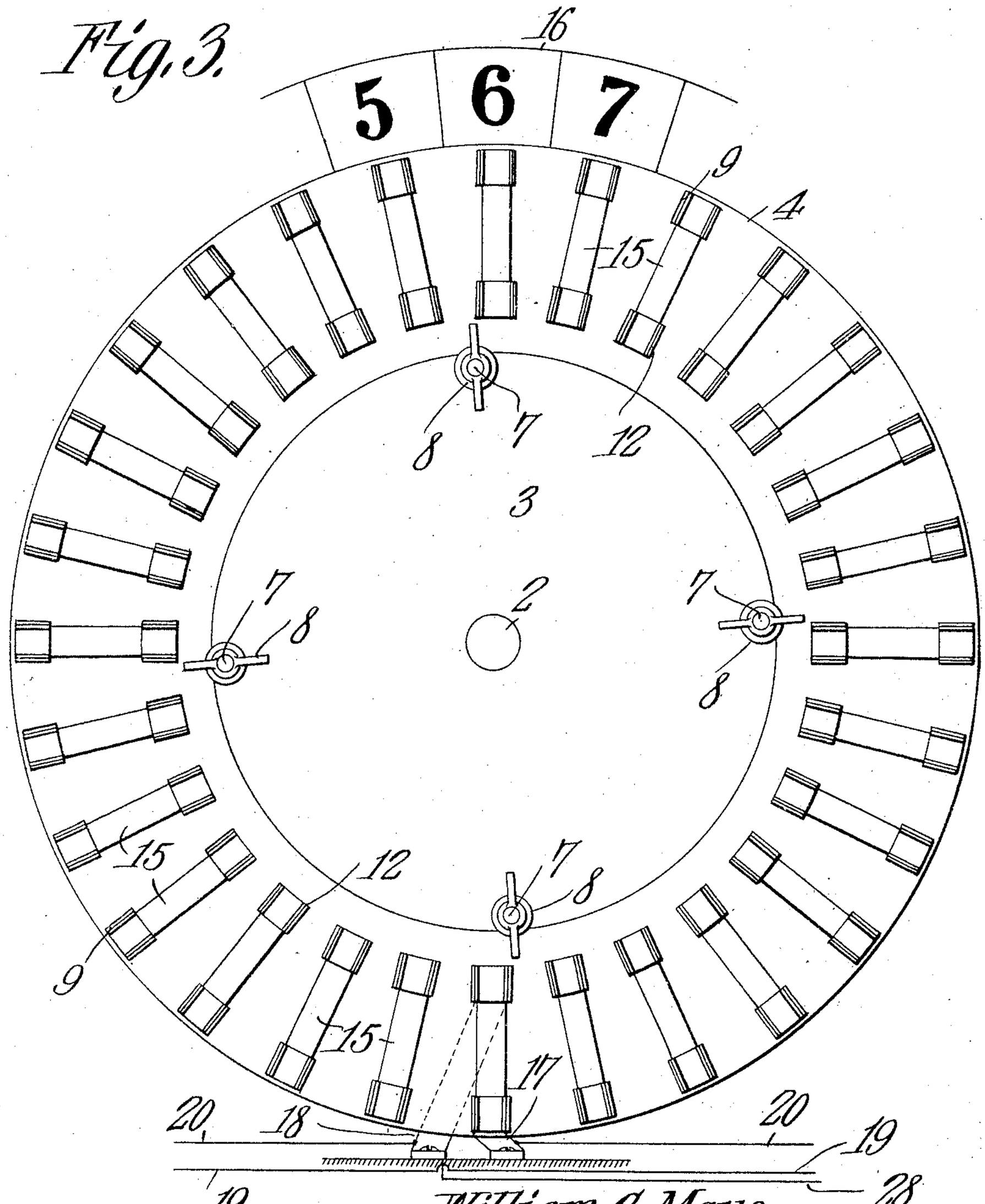
4 SHEETS—SHEET 3.

Fig. 3.



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4 SHEETS—SHEET 4.

Fig. 4.

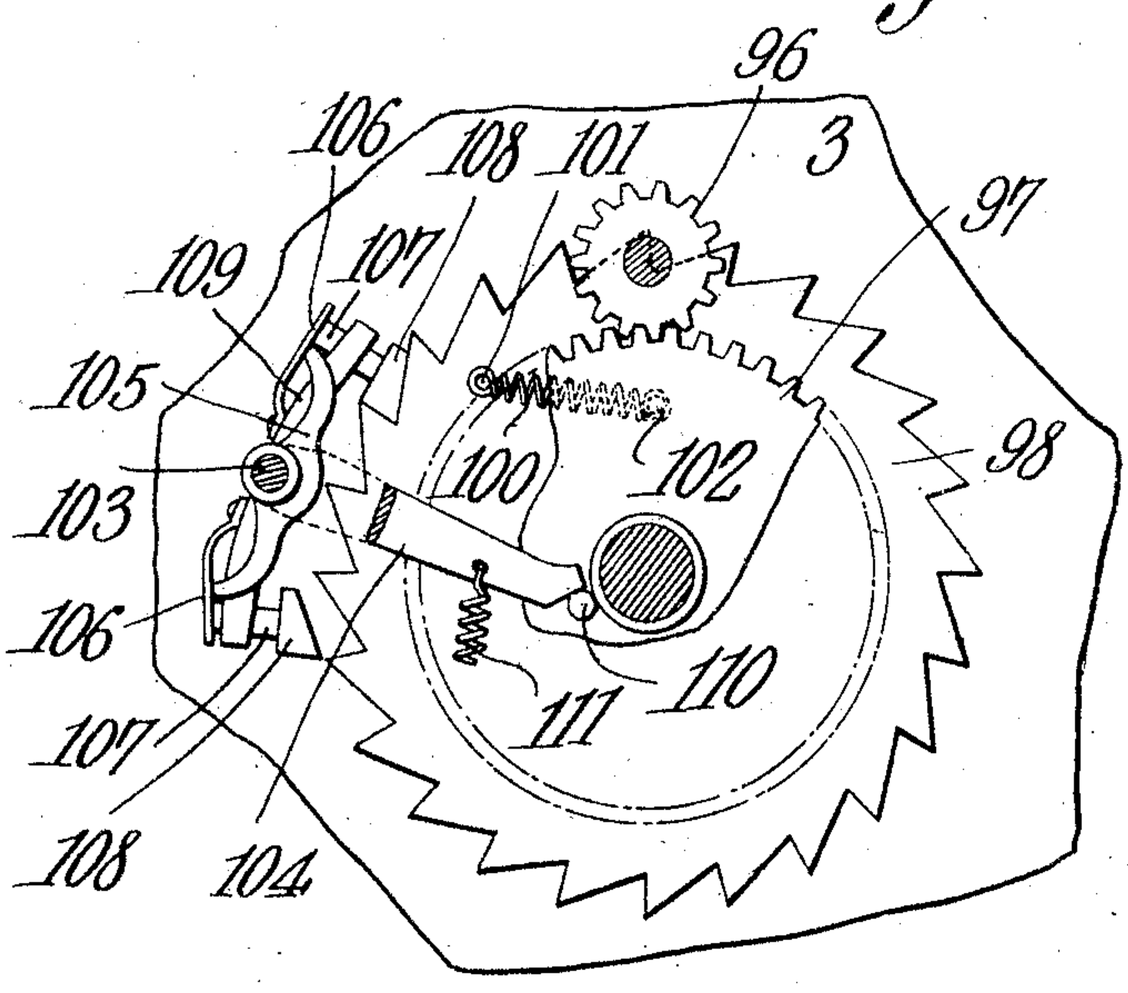
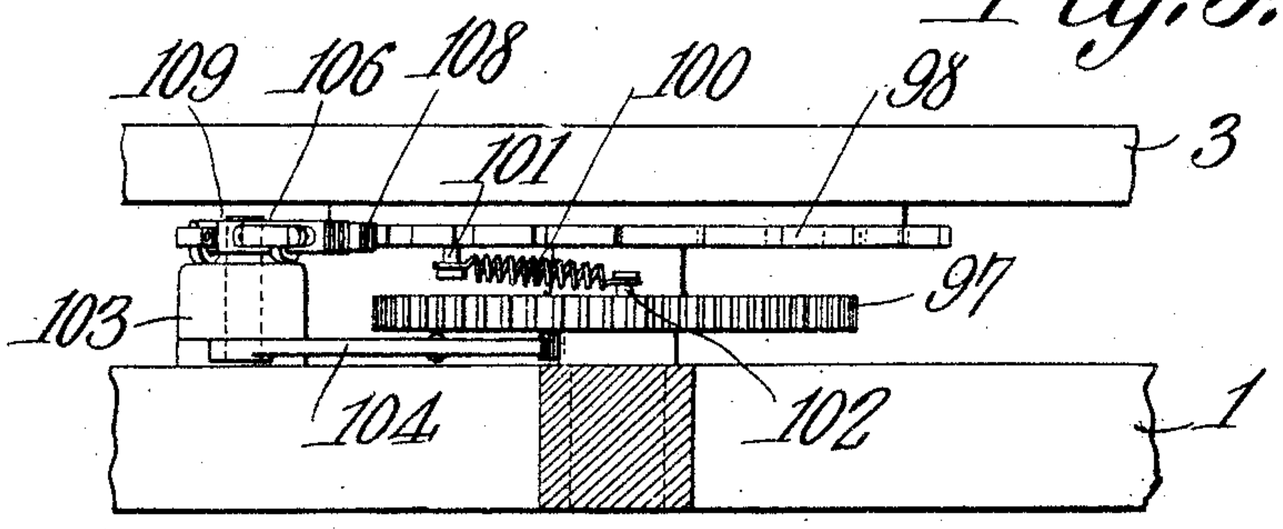


Fig. 5.



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UNITED STATES PATENT OFFICE.

WILLIAM C. MAYO AND JOHN HOULEHAN, OF EL PASO, TEXAS, ASSIGNORS OF ONE-THIRD TO GEORGE E. BRIGGS, OF BARSTOW, TEXAS.

AUTOMATIC MULTIPLE FUSE-BLOCK.

No. 879,285. Specification of Letters Patent. Patented Feb. 18, 1908.

Application filed May 2, 1907. Serial No. 371,498.

To all whom it may concern:

Be it known that we, WILLIAM C. MAYO and JOHN HOULEHAN, citizens of the United States, residing at El Paso, in the county of El Paso and State of Texas, have invented a new and useful Automatic Multiple Fuse-Block, of which the following is a specification.

This invention has reference to improvements in automatic multiple fuse blocks or cut-outs for electric circuits, and its object is to provide a device wherein a number of blow-out fuses are provided so that when one fuse is blown by a heavy current charge other fuses will be cut in as needed.

In accordance with the present invention there is provided a normally inactive shunt circuit through which, when a fuse is blown, the current is diverted to an electro-mechanical means which, when the rush of current causing the fuse to blow is of but momentary duration, will operate to bring a new fuse into the circuit. The motive power in this case is supplied entirely by the diverted current.

The invention comprises also means whereby any type of fuse may be used, and the magazine, when burned out, may be removed and new fuses inserted and then the entire magazine replaced in the machine, or a fresh, filled magazine substituted for the magazine of burned out fuses. This may be done by an unskilled person without danger.

In accordance with the present invention there is also provided an electric motor mechanism by means of which one after another of the magazine fuses are brought into the circuit as each preceding fuse is destroyed by being burned out; the current for operating the motive mechanism being supplied from a shunt from the main power circuit, which shunt becomes active only when the main circuit is broken.

This invention also comprises means whereby the fuse-magazine is held inactive until the electric driving means for the same has stored up sufficient power to cause the magazine to be quickly moved the necessary distance, thus preventing overheating of the contacts.

Provision is also made whereby an observer, whether skilled or unskilled, is apprised of the presence of an abnormally heavy current upon the line after a fuse has been blown, and under such conditions provision is made for rendering the fuse-changing mechanism inactive.

The invention likewise comprises the several forms of apparatus hereinafter described for the performance of the functions ascribed to them.

All this will fully appear from the following detailed description, taken in connection with the accompanying drawings forming part of this specification, in which,—

Figure 1 is an elevation of the multiple fuse block and operating mechanism therefor, as seen from the rear, with certain parts broken away and the circuit connections and parts included therein shown diagrammatically; Fig. 2 is a vertical section, partly in elevation, of the mechanism shown in Fig. 1 with the circuit connections and certain parts omitted; Fig. 3 is a face view of the fuse-magazine and certain coacting parts; and Figs. 4, 5 and 6 are detail views of a portion of the mechanism for causing quick, step-by-step movement of the magazine.

Referring to the drawings, there is shown a standard 1 near the top of which is secured a horizontally projecting stud 2 upon one end of which is mounted a disk 3, which may or may not be of insulating material. This disk 3 carries upon its periphery an annulus 4 of insulating material, and in order that the annulus may be readily removed from the disk the latter is recessed at certain points on its rear face and there receives small metal plates 5 countersunk therein and into corresponding recesses in the contiguous edge of the annulus 4. Each of these plates is held to the disk 3 by a screw 6 and is also provided with a threaded stud 7 projecting to the other side and beyond the front face of the annulus where it receives a wing-nut 8, the shoulders of which latter engage both the disk 3 and the annulus 4 and so clamp the annulus to the disk, in such manner, however, that on the removal of the wing-nuts 8 the annulus 4 may be removed bodily from the disk.

Near the periphery of the annulus 4 and on its front face, which is the face seen in Fig. 3 and is toward the left in Fig. 2, there is a circular series of spaced, clip blocks 9 having nuts formed in their rear ends, which nuts receive the threaded shanks 10 or bolts, the heads 11 of which constitute contact blocks to be hereinafter referred to. Near the inner circumference of the annulus 4 is another series of clip blocks 12 receiving the threaded

shanks 13 of bolts, the heads 14 of which constitute contact blocks to be hereinafter referred to. The clips 9 of one series are equal in number to the clips 12 of the other series and these clips are radially disposed to receive blow-out fuses 15, which latter may be of any desired type, and the clips may be shaped in accordance with the type of fuse determined upon.

The annulus 4 constitutes the removable fuse-magazine of our improved automatic fuse block, and in order that it may be apparent to an observer what fuse of an entire series is at that particular time included in the circuit, so that he may determine how many fuses have been blown out and how many fuses, if any, remain to be used, we arrange, preferably around the outer periphery of the annulus 4, a regular series of numbers 16 which may be brought, by the rotation of the fuse-magazine, in regular sequence in front of a window (not shown) in the casing of the machine. Such casing has been omitted in the drawings, but it will, of course, be understood, that in the practical embodiment of the invention a suitable casing may be employed whereby unauthorized tampering with the machine and danger from accidental contact with live circuits therethrough, is prevented.

At the base of the machine, in the path of the circular series of contact blocks 11, there is a brush 17 constituting one terminal of an electric circuit, and in the path of the circular series of contact blocks 14 there is another brush 18, constituting the other terminal of the electric circuit. These two brushes, as will hereinafter appear, constitute the terminals of a gap in one side of a power circuit, which gap is bridged by a fuse 15 included between the contact blocks 11 and 14 then in electrical connection with the brushes 17 and 18. In practice these brushes will be made to bear with sufficient pressure upon the contact blocks 11 and 14 to insure good electrical connection therewith, and when any current of abnormal strength, greater than that which the fuses are intended to carry, passes through a fuse, the latter is blown and the circuit between the brushes 17 and 18 is broken.

The main power circuit is by way of conductors 19 and 20, the conductor 20 connecting to the brush 17 and leaving the brush 18, so that a fuse is inserted in this conductor 20. There is branched off from the conductor 20 before it reaches the brush 17 another conductor 21 leading to an electro-magnet 22, which is shown in Fig. 1 in a position which is to be considered simply as diagrammatic. It will be understood that this magnet 22 will be supported upon a fixed portion of the machine. The circuit from the magnet 22 is by a conductor 23 to another electro-magnet 24, thence by a conductor 25 to still another electro-magnet 26 facing the magnet 24, and from this magnet 26 the circuit passes by still another conductor 27 to a conductor 28, either directly connected to the brush 18 or to the conductor 20 after it leaves said brush. The magnets 22, 24 and 26 are in series one with the other but are in shunt around the fuse inserted, but as the resistance of this fuse is practically negligible and as the resistance of these several magnets is purposely made large as compared with that of the fuse, the current flowing through these magnets will, under ordinary conditions, be practically infinitesimal, and they will therefore remain inoperative.

Suppose, now, that the current flowing over the conductors 19—20 should become sufficiently heavy to blow the fuse then in circuit. Immediately the shunt circuit, through the magnets 22, 24 and 26, receive such proportion, though small, of the full current from the main circuit as their combined resistances permit, and the magnet cores are therefore energetically magnetized to an extent depending upon the current strength in the shunt circuit to which they are connected.

In operative relation to the magnet 22 there is an armature lever 29 held normally against a stop 30 by a spring 31. Upon the free end of this lever is a head 32 in the path of which is a conducting block 33 of ordinary carbon or graphite, or of any other suitable conducting material. This block 33 is carried by the end of an elastic arm 34 and this arm carries another conducting block 35 which is normally in engagement with still another conducting block 36 upon the free end of a spring arm 37. In the path of the block 33 is another conducting block 38 on the free end of a spring arm 39, and in the path of the last-named block 38 is still another block 40 upon the free end of an elastic arm 41.

The block 38 is in electric connection with the conductor 21 through a branch conductor 42 connected to the spring arm 39. The block 36 is in electrical connection through the arm 37 with a conductor 43 leading to one terminal of an electric lamp 44, the other terminal of which is connected by a conductor 45 to the main line conductor 19. Branched off from the conductor 45 is another conductor 46 in the circuit of which is included an electric lamp 47, and this conductor 46 leads to the arm 41 carrying the block 40.

When the magnet 22 is energized it exerts a pull upon the arm 29 against the action of the spring 31 and the arm 29 is thereby caused to move toward the magnet. The head 32 of the armature lever 29 will first come in contact with the block 33 and move the same into contact with the block 38. During this movement the blocks 35 and 36 remain in contact because the arm 37 is normally under tension and will follow up the

arm 34 as the block 33 is pushed into contact with the block 38. As soon as contact is made between the blocks 33 and 38 a branch circuit is completed from the main conductor 20 to the conductor 21, thence through the conductor 42, the arm 39, blocks 38 and 33, the arm 34, blocks 35 and 36, the arm 37, the conductor 43, the lamp 44 and the conductor 45 back to the main conductor 19. This will cause the lamp 44 to light up. This lamp 44 is a clear or white lamp, and it will remain lighted so long as the movement of the armature 29 has been no greater than sufficient to bring the blocks 33 and 38 in contact. However, if the pull of the magnet 22 is sufficient to move the armature 29 until it comes into contact with a stop 48 in its path, the blocks 33 and 38 are moved until the latter is in contact with the block 40, at which point the contact between the blocks 35 and 36 is broken since the spring arm 37 has been so adjusted that the block 36 will not be caused to follow the block 35 any further. Under these conditions the circuit coming from the main conductor 20 through the conductor 21 will branch off by conductor 42, arm 39 and block 38 to block 40, since block 33 is now dead, thence to arm 41 and by conductor 46 to lamp 47 and back to the main conductor 19 by the branch conductor 45. Under these conditions the lamp 44 is cut out and the lamp 47 will be lit up. This latter lamp is a red lamp, and, as will hereinafter appear, it is intended to indicate the presence of an abnormally heavy and dangerous current upon the main line 19—20, and it also indicates, as will hereinafter appear, that the cut-out mechanism will not operate to introduce a new fuse into the circuit so long as this red lamp glows.

The white and red lamps are located on the outside of the casing, or at least in position to be clearly visible. When the white lamp glows, it indicates one of two things: first, if the light fluctuates, it shows that the machine is in operative condition and that a new fuse is about to be and will be cut in; and second, if the white light burns steadily, it indicates that there is some fault in the machine itself which must be remedied before a new fuse will be cut in. If the red light burns, it indicates that there is still maintained upon the line a current so abnormally heavy that it would continue to blow the fuses as rapidly as they might be inserted and that the fuse-inserting mechanism is not operating but is remaining inactive. The conditions under which the red light will burn are such as would prevail should there be a short circuit in the main line or a cross with another circuit more heavily charged than the normal charge of the main line, or more heavily charged than even the occasional overcharge to which the circuit 19—20 is sometimes subjected.

The magnet 22 is mounted upon a post 49 by means of a threaded stem 50 fast on the yoke of the magnet and passing through said post and receiving suitable clamp screws on each side of the post. This structure, which is a common one for the purpose, permits the ready adjustment of the magnet 22 with relation to the armature lever 29 so that the pull of the magnet may be varied at will. By this means it is possible to initially adjust the machine by putting in the circuit a fuse that will blow at a certain amperage and then putting a like load upon the circuit and cutting out the fuse; then adjusting the magnet 22 until with this current it will just close the contacts 33 and 38 to complete the circuit to the lamp giving the white light. It is evident that with this adjustment any condition which will cause a greater flow of current through the magnet 22 when the fuse blows will also cause the magnet to pull the armature until the circuit through the blocks 38 and 40 is closed and the red light burns. If this condition prevails and the red light keeps on burning it is evident that the operator must open the main switch, and, if inexperienced in remedying faults in electric circuits, must await the arrival of a skilled workman. This is an important feature of this invention in that the machine gives warning automatically of the condition of the circuit and does not completely break the circuit, as would occur with the ordinary circuit breaker, which latter can be again closed against a short circuit or other abnormal overload and may even be held closed by an ignorant attendant until irreparable injury has been done. This invention provides means whereby the blowing out of a fuse does not break the circuit but introduces the resistances of the magnets 22, 24 and 26 and thus limits the current to a very low value, and if the overload is slight or of short duration a new fuse is automatically inserted; but if the overload is abnormally heavy or prolonged, a warning is given that the circuit should be broken at once.

In the foregoing description of the operation of the magnet 22 and coacting parts the magnets 24 and 26 and their coacting parts have been ignored. These two magnets 24 and 26 have their pole pieces opposite each other but spaced apart. The magnets 24 and 26 are supported upon the upper ends of standards 51—51 rising from a base 52 secured to the base plate 53 of the machine and constituting component parts of the main supporting standard 1. The standards 51 are extended above the point where they carry the magnets 24 and 26 and there approach and unite in a central post 54 to the top of which is pivoted a pendent lever arm 55 which also constitutes the common armature for both magnets 24 and 26. To this armature lever 55, near its lower end, are se-

cured two oppositely-extending brackets 56—57 bent at their ends at angles, as shown, and there receiving screws 58, one for each bracket and passing through nuts formed in the angle ends of these two brackets so that the inner ends of the screws are in line with and point toward each other. Below the brackets 56—57 the armature lever 55 carries two oppositely-projecting studs 59, or, if desired, one stud may be passed through this end of the lever and project from both sides thereof. The studs 59 are in line with the screws 58 carried by the brackets 56—57. Between the screw 58 carried by the bracket 56 and the corresponding stud 59 on that side of the armature lever 55 there is a spring arm 60 carrying a conducting head 61 and another spring arm 62 carrying a conducting head 63. Between the screw 58 carried by the bracket 57 and the corresponding stud 59 on the armature lever 55 there is a spring arm 64 carrying a conducting head 65 and another spring arm 66 carrying a conducting head 67. The location of these several conducting heads and the coacting parts is such that if the armature lever 55 is swung, say, to the left, the stud 59 will engage the head 63 and carry it into contact with the head 61 and at the same time the screw 58 on the bracket 57 will move the head 65 into contact with the head 67. When the armature lever is swung to the right the corresponding stud 59 will engage the head 67 and move it into contact with the head 65 and the screw 58 on the bracket 56 will engage the head 61 and move it into contact with the head 63.

The two arms 62 and 66 are secured to a conducting block 68 mounted on the upper end of a post 69 rising from the base 53 of the machine, and this block 68 is electrically connected with the conductor 25 by a branch conductor 70. The arm 60 is mounted upon a stud 71 fast on the corresponding standard 51 and carries between the point of connection with the said stud 71 and the head 61 a conducting block 72, in the path of which latter is a contact block 73 in circuit through a branch conductor 74 with the conductor 27 before referred to. The arm 64 is fast to and rises from a stud 75 near the standard 51, and between this stud 75 and the head 65 of the arm 64 there is a contact block 76 in the path of which is a contact bracket 77 electrically connected with the conductor 23 by a branch conductor 78.

When the current has been diverted, by the blowing of a fuse, through the branch circuit containing the magnets 22, 24 and 26, the latter magnets 24 and 26 are energized and attract the armature lever 55. This lever is in a state of unstable equilibrium and will move toward one or the other of the magnets 24 and 26. Let it be assumed that the pull of the magnet 24 prevails and that the armature lever is moved toward the right. The stud 59 will engage the head 67 and move it into contact with the head 65 while the screw 58 on the bracket 56 will engage the head 61 and move it into contact with the head 63, at the same time separating the contacts 72 and 73. The circuit may now be traced as follows: from the main conductor 20 to the branch conductor 21, magnet 22, branch conductor 23, branch conductor 78, contact-bracket 77, contact block 76, arm 64, contact heads 65 and 67, arm 66, conducting block 68, branch conductor 70, conductor 25 to the magnet 26, thence by branch conductor 27 to branch conductor 28 and to conductor 20 at or near the brush 18, the circuit being finally completed through the translating devices to the main conductor 19. This will short circuit the magnet 24 and the pull of the magnet 26 will then prevail and the armature lever 55 will be moved toward the left, when the circuit through the magnet 26 will be short circuited and the short circuit around the magnet 24 will be cut out.

It will be seen that the arrangement just described is such that there will be a continuous reciprocation of the armature lever 55 so long as sufficient current flows through the circuit including the magnets 24 and 26 to energize them to such an extent as to exert a pull upon the armature lever 55.

Upon an arbor 79 mounted in the top of the post 54 and constituting the pivot support of the armature lever 55 there is a toothed ratchet wheel 80 and the teeth of this wheel are engaged by a pawl 81 carried by the armature lever below its pivot point and in proper position to engage said teeth, being held in normal contact with the teeth by means of a suitable spring 82.

The armature lever 29 has a fixed pivotal support 83 below the ratchet wheel 80 and to one side thereof, and upon this pivotal support there is mounted a rock arm 84 extending to both sides of the support 83. On one side of the pivotal support the rock arm 84 is connected by a link 85 to the armature lever 55 below the point where it carries the pawl 81. On the other side of the pivotal support the rock arm 84 carries a pawl 86 normally held by means of a spring 87 in the path of and in engagement with one of the teeth on the ratchet wheel 80. The armature lever 29 is provided with a finger 88 so located as to engage the pawl 86 when this armature lever is pulled toward magnet 22 and to move the pawl 86 away from engagement with the teeth of the ratchet wheel 80. This, however, does not occur until the armature lever 29 has moved to such an extent as to put the red light in circuit.

When the armature lever 55 is swung toward the right as viewed in Fig. 1, the pawl 81 engaging the teeth of the wheel 80 will rotate the latter a certain distance. At the same time the link 85 and rock arm 84 have

been so moved as to cause the pawl 86 to pass to and into engagement with a tooth back of the tooth it had been first in engagement with. When the armature lever 55 is swung in the reverse direction, that is, toward the left, the pawl 81 is retracted over one or more teeth and remains inactive, while the pawl 86 is moved into engagement with the teeth on the wheel 80 and moves the latter forward a certain distance. It will be seen that the pawls coact to move the ratchet wheel 80 always in the same direction when the armature lever 55 is reciprocated under the action of the magnets 24 and 26.

Now, let it be assumed that an abnormally heavy current flows through the magnets 22, 24 and 26. The armature lever 29 is pulled over against the stop 48 and the red light is put in circuit. At the same time the finger 88 on this armature lever 29 engages the pawl 86 and moves it against the action of the spring 87 out of the path of the teeth on the ratchet wheel 80. Now, since the ratchet wheel, as will hereinafter appear, is under the control of a spring tending to move it in a direction the reverse of the direction in which it is moved by the pawls 81 and 86, the reciprocation of the armature lever 55 and the action of the pawl 81, with the pawl 86 inactive, will simply cause the ratchet wheel 80 to oscillate about its axis. The purpose of this will hereinafter appear.

The armature lever 55 has a U-shaped extension 90 extending above its pivotal point and the free end 91 of this extension 90 is threaded and there receives a nut 92 carrying a clamp screw 93. By screwing the nut 92 in the appropriate direction on the threaded end 91 of the extension 90 and there clamping it by the clamp screw 93, the armature lever may be suitably balanced as required.

The ratchet wheel 80 is provided with a hub 94 and through this hub 94 there is passed a set-screw 95 by means of which the ratchet wheel is made fast upon the arbor 79. This arbor is rotatable in the standard 54 and extends beyond the latter where it carries a pinion 96. Meshing with this pinion 96 there is a gear wheel 97 mounted to rotate upon the stud 2 between the coalescing ends of the uprights 51 of the main standard 1 and a ratchet disk 98 secured by screws 99 to the inner face of the disk 3. The gear wheel 97 and ratchet disk 98 are most clearly shown in Figs. 4 and 5. The ratchet disk 98 has as many teeth as there are fuses upon the annulus 4. This disk is connected to the gear wheel 97 by a spring 100, one end of which is secured to a stud 101 on the ratchet disk, and the other end to a stud 102 on the gear wheel, the arrangement being such that when the gear wheel is rotated toward the right as viewed in Fig. 4, the spring will be extended and tend to rotate the ratchet disk 98 and with it the disk 3 and annulus 4 in the same direction.

Mounted upon a stud 103 secured to one of the uprights 51 of the main standard 1 is a lever arm 104 fast to which is a T-head 105. The ends of the arms of this T-head are bent, as shown, to engage under the free ends of flat springs 106 which, in turn, bear upon and are connected to the spindles 107 of dogs 108 arranged to move into and out of the path of the teeth of the ratchet disk 98. The spindles 107 of the dogs 108 are arranged to move longitudinally through suitable bearings in an arc-shaped head 109 mounted on the stud 103 and carrying also the springs 106. The tendency of the springs 106 is to project the dogs 108 toward the ratchet disk 98 and the arms of the T-head, engaging these springs, will permit considerable movement of one of the dogs toward the teeth before the other dog has been moved away from the disk. The structure is such that when the arm 104 is engaged by a pin 110 on the gear wheel 97 and moved against the action of a spring 111, one dog 108 will be moved into the path of a tooth of the ratchet disk 98 before the latter has been released by the other dog, but when the pin 110 has escaped from contact with the lever arm 104, which it will do after a partial rotation of the gear wheel 97, the dogs will permit this ratchet wheel to move forward a distance of one tooth, after the manner of an ordinary escapement mechanism, and this forward movement of the ratchet disk 98 and the parts controlled thereby will be sudden, since it is under the action of the spring 100.

As soon as the pin 110 has moved the lever 104 and has escaped therefrom it will be seen that a new fuse is inserted, and under these conditions there is no longer sufficient current to energize the magnets 24 and 26, and, consequently, the rotation of the gear wheel 97 through the action of the magnets upon the armature 55 imparting a rotary motion to the ratchet wheel 80, now ceases.

Let it be supposed that the new fuse is blown. Immediately the rotation of the ratchet wheel 80 is again set up and through the arbor 79 and pinion 96 the gear wheel 97 is again rotated to put the spring 100 under tension, when another appropriately located pin 110 will engage and operate the lever 104 in the manner already described. In the drawings, but one pin 110 has been shown but it will be understood that there will be as many pins 110 as are necessary for the proper operation of the device; and these pins are not of necessity located as shown in the drawings, but will be appropriately located as the proportionate sizes of the parts may demand.

In order to prevent sparking at the several contacts included in the shunt circuit around

the fuse, it is advisable to introduce a condenser 112 in a circuit 113 which may be branched between the conductors 21 and 27.

The manner in which the current diverted through the magnets 22, 24 and 26 on the blowing out of a fuse will cause a new fuse to be inserted in the circuit has already been set forth, but such description has been under the assumption that the rush of current which caused the fuse to blow out has been only sufficient to draw the armature lever 29 to a position to close the circuit to the lamp 44 giving the white light.

While the motive magnets 24 and 26 have been operating to vibrate the armature lever 55 and so store up power that ultimately causes the rotation of the fuse-magazine to bring a new fuse into action, the alternate short circuiting of these two magnets 24 and 26 causes a fluctuation of current in the branch around the burned out fuse and the white light given by the lamp 44 has been correspondingly fluctuated in brightness. This fluctuation of the light is an indication to either the skilled or unskilled observer that the machine is performing its functions properly and that a new fuse will be automatically inserted into the circuit, the operation taking an appreciable time. If, however, there is so powerful an abnormal current upon the line as to not only blow the fuse but to energize the magnet 22 sufficiently to pull the armature lever 29 to a position to cut out the white light and cut in the red light, the pawl 86 is moved out of operative relation to the ratchet wheel 80 and then this ratchet wheel will simply oscillate about its axis and will be unable to put the spring 100 under tension or to produce a continuous rotation of the gear wheel 97. The machine will therefore, under these conditions, be inoperative to introduce a new fuse into the circuit. If the abnormally heavy current continues the red light will remain lighted and the observer will understand thereby that the main switch must be opened, and if the observer be unskilled he must await the arrival of skilled help.

If the abnormally heavy current upon the line be of short duration, the red lamp will be cut out of circuit and the white lamp will be again cut in and the pawl 86 will then be moved into operative relation to the ratchet wheel 80, when the normal operation of the machine will proceed and the next fuse will be inserted. If, however, the white lamp should glow with a constant light and show no fluctuations, it is evident that while the current which caused the blowing of the fuse was not abnormally heavy, or had returned to normal strength, there is something wrong with the fuse-replacing mechanism, and, therefore, this must be repaired before a new fuse can be introduced by the machine. Suppose, however, that the last fuse of the magazine has been blown. This will, of course, be shown by the numeral visible at the window in the machine casing provided for the purpose, but it will also be shown by the continued and uninterrupted action of the fuse-replacing mechanism which will be apparent from the continued and uninterrupted blinking of the white lamp.

When the magazine is exhausted the fuse-carrying annulus may be removed from the machine by unscrewing the wing-nuts 8 and pulling off the annulus 4, after which the burned out fuse-carriers may be removed and new ones inserted, or an already charged annulus 4 may be placed in the machine as soon as the one carrying the burned out fuses has been removed.

It will, of course, be understood that it is only when a temporary rush of current has blown the fuse that a new one is inserted by the machine, for the magnet 22 is to be so adjusted that a current sufficient to damage the translating devices in the power circuit will energize this magnet to an extent sufficient to move its armature so far as to put the red light in circuit and hold the fuse-changing mechanism against action. It will also be understood that the windings of the several magnets will be appropriate for their intended operation, and will also be of such resistance as to cut down the current diverted through them, when a fuse is blown, to such an extent as to protect the translating devices in the main circuit during the continuance of the temporary, abnormal charge on the line, or during the time a permanent, abnormal current is on the line, before the main switch is thrown.

We claim:—

1. In an automatic fusible cut-out system for electric power circuits, a series of fuses interposable in succession into the power circuit, a shunt circuit around the fuse in the power circuit for maintaining the latter intact when a fuse is blown and during the introduction of a fresh fuse, and means operated by the current diverted into the shunt circuit by the blowing of a fuse to automatically cut in a fresh fuse.

2. In an automatic fusible cut-out system for electric circuits, a series of fusible cut-outs arranged for successive introduction into the power circuit, a shunt circuit around the fusible cut-outs, and means included in said shunt circuit for introducing a new fuse, said means being responsive to and operated by the current diverted into the shunt circuit by the blowing out of the fuse.

3. In an automatic fusible cut-out system for electric circuits, a main power circuit, a series of fuses introduceable in succession into said power circuit, a shunt circuit around the active fuse included in the power circuit, means for introducing a new fuse into the power circuit in place of a burned out fuse

[redacted]

and operated by current diverted into the shunt circuit by the burning out of a fuse, and means for indicating the condition of the circuits also operated by the current in the shunt circuit.

4. In an automatic fusible cut-out system for electric circuits, a main power circuit, a series of fuses introduceable in succession in the main power circuit, a shunt circuit around the active fuse and carrying a very small part of the power current when the fuse is blown, means for introducing fresh fuses into the power circuit operated by the current in the shunt circuit, indicating devices in said shunt circuit, and means operated by the current in said shunt circuit and sensitive to variations therein to operate the indicating devices.

5. A multiple fuse block comprising a circular series of fuse-carriers, electric circuit terminals in the path thereof, and means for rotating the fuse-carriers to bring the fuses in succession to bridge the electric circuit terminals, comprising a pivoted armature, electro-magnets arranged to pull the armature in opposite directions, circuit terminals under the control of the armature for diverting the current in succession to the magnets in proper sequence to oscillate the said armature between the magnets, gearing operated by said armature, and a timed escapement between said gearing and the fuse-carrier for holding the latter against a rotative force and then releasing the said fuse-carrier.

6. A multiple fuse block comprising a rotatable fuse-carrier, electric circuit terminals in the path of said fuse-carrier and bridged by fuses carried thereby, and means for rotating said fuse-carrier comprising actuating mechanism, and a detent between the actuating mechanism and the fuse-carrier for holding the latter against motion until the actuating mechanism has moved a predetermined distance, and then releasing the fuse-carrier.

7. A multiple fuse block comprising a rotatable fuse-carrier, oppositely-located electro-magnets, an armature under the control of each, an electric circuit including said magnets, contacts under the control of the armature for diverting current to the magnets in succession, a train of gearing coupled to and actuated by said armature, a detent between the armature actuated mechanism and the fuse-carrier, power-storing means between the armature actuated mechanism and the fuse-carrier, and means for holding the fuse carrier against motion until the gear train has acted upon the power-storing means and for then releasing the fuse-carrier to the action of said power-storing means.

8. A multiple fuse block comprising a rotatable fuse-carrier, a series of fuses thereon, and an actuating means for rotating said fuse-carrier comprising oppositely-located electro-magnets, an armature between the same and acted on by both magnets, circuit terminals controlled by said armature for diverting current to the magnets in succession, pawls carried upon said armature, a ratchet wheel in the paths of the pawls and rotated by the oscillatory movement of the armature, gearing connected to the ratchet wheel, a ratchet wheel on the fuse-carrier, a spring connection between the gearing and the ratchet wheel on the fuse-carrier, and an oscillating detent engaging the ratchet wheel on the fuse-carrier and engaged by one or more stop pins on the gearing whereby the ratchet wheel on the fuse-carrier is held against motion until the spring connecting the same to the gearing is put under tension.

9. In a multiple fuse block, a rotatable fuse carrier comprising a disk, means for rotating the same, and an annulus carrying a circular series of fuse supports and removably connected to said disk.

10. In a multiple fuse block, a fuse-carrier comprising a central supporting disk, an annulus coupled to and carried thereby, and fuse supports on one side of said annulus and having circuit terminals on the other side of said annulus.

11. In an automatic fusible cut-out system for electric circuits, a power circuit, a fuse block having a series of fuses includable one at a time in said power circuit, a shunt circuit around the active fuse in the power circuit, an electro-magnet in said shunt circuit, indicating devices, and circuit terminals for the said indicating devices under the control of the magnet included in said shunt circuit for including said indicating devices in the shunt circuit.

12. In an automatic fusible cut-out system for electric circuits, a power circuit, a series of fuses includable in succession in said power circuit, a shunt circuit around the active fuse included in said power circuit, an electro-magnet in said shunt circuit, an armature for said electro-magnet, means for adjusting the electro-magnet to said armature, indicator circuits including indicators and branched from said shunt circuit, and circuit terminals successively under the control of the magnet armature for closing the indicator circuits in succession.

13. In an automatic fusible cut-out system for electric circuits, a power circuit, a series of fuses, means for successively including the fuses in said power circuit, a shunt circuit around the active fuse in said power circuit, electric actuating means for the fuse-introducing mechanism included in said shunt circuit, an electro-magnet also included in said shunt circuit and controlling the actuating means for the fuse-introducing mechanism to place the latter into or out of operative condition.

14. In an automatic fusible cut-out sys-

tem for electric circuits, a power circuit, a rotatable fuse-carrier arranged to introduce fuses in succession in said power circuit, means for rotating said fuse-carrier, a shunt circuit around the active fuse in said power circuit, electro-magnets included in said shunt circuit, operating mechanism for the fuse carrier actuated by said electro-magnets, another electro-magnet in said shunt circuit controlling said operating mechanism for the fuse-carrier to place the same into and out of action, indicating devices included in said circuits branched from said shunt circuit, and circuit closing means through said branched circuits under the control of the last-named magnet.

15. In an automatic fusible cut-out system for electric circuits, a power circuit, a series of fuses includable in said power circuit, a shunt circuit around the active fuse in said power circuit, a series of electro-magnets in said shunt circuit of such resistance as to remain inactive until the fuse is blown, an actuating mechanism for introducing the fuses in succession into the power circuit and operated and controlled by the electro-magnets in the shunt circuit, indicating devices of different character in separate circuits branched from the power circuit, and means under the control of one of the electro-magnets in the shunt circuit for closing the branched circuit to one or the other of the indicating devices.

16. In a fusible cut-out system, a main power circuit, a series of fuses includable in succession in said main circuit, a shunt circuit around the active fuse in said main power circuit, an electic motor mechanism in the shunt circuit for introducing the fuses into the power circuit in succession and causing a fluctuation of current strength in the shunt circuit, and indicating devices responsive to said fluctuating currents for indicating that the electro-motive device is in operation.

In testimony that we claim the foregoing as our own, we have hereto affixed our signatures in the presence of two witnesses.

WILLIAM C. MAYO.
JOHN HOULEHAN.

Witnesses:
W. A. WARNOCK,
WM. W. GILLEN.