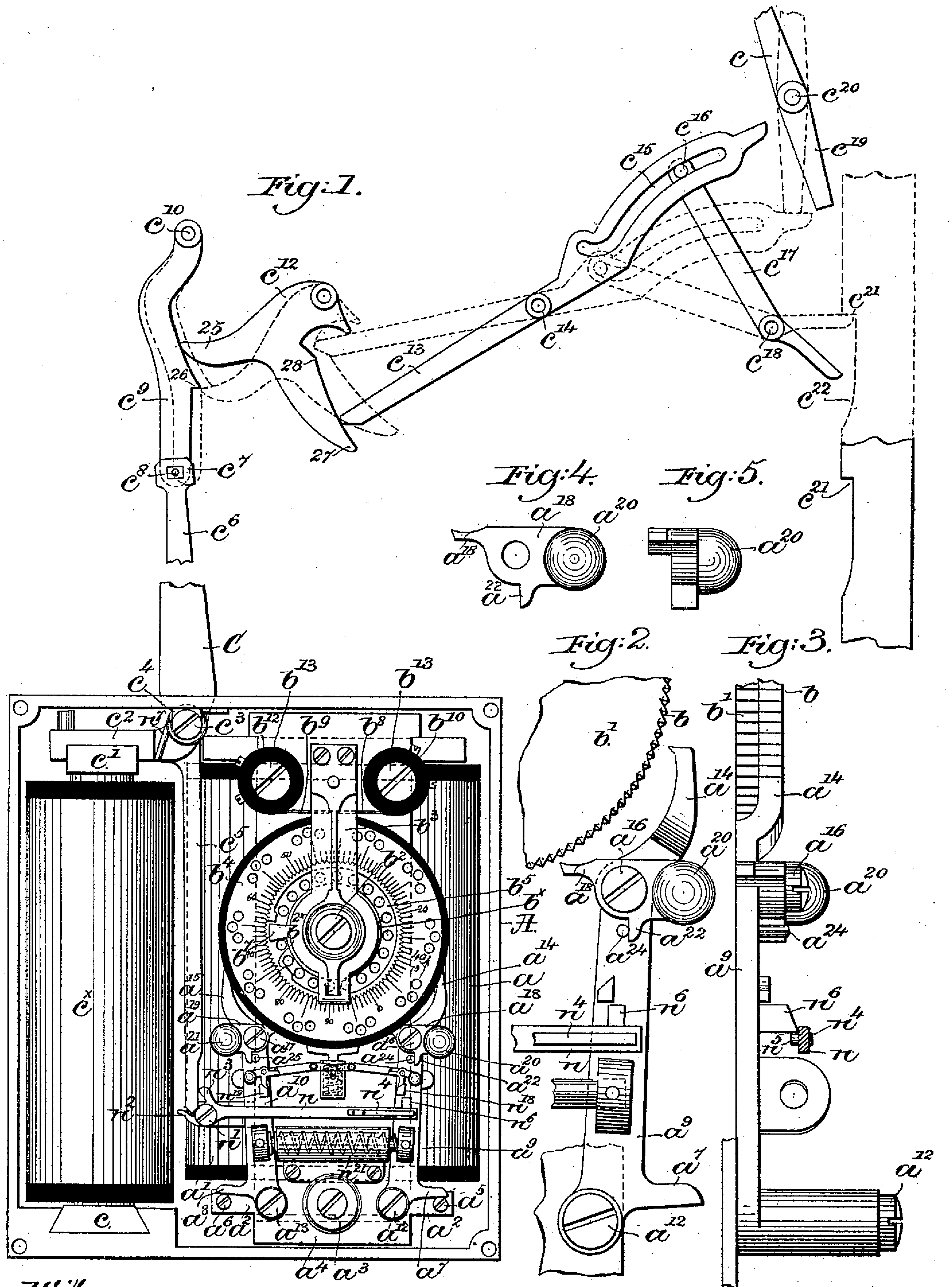
(No Model.) 4 Sheets—Sheet 1.

F. S. HOLMES.
ELECTRIC LOCK.

No. 467,465. Patented Jan. 19, 1892.



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(No Model.) 4 Sheets—Sheet 2.

F. S. HOLMES.

ELECTRIC LOCK.

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Fig: 6.

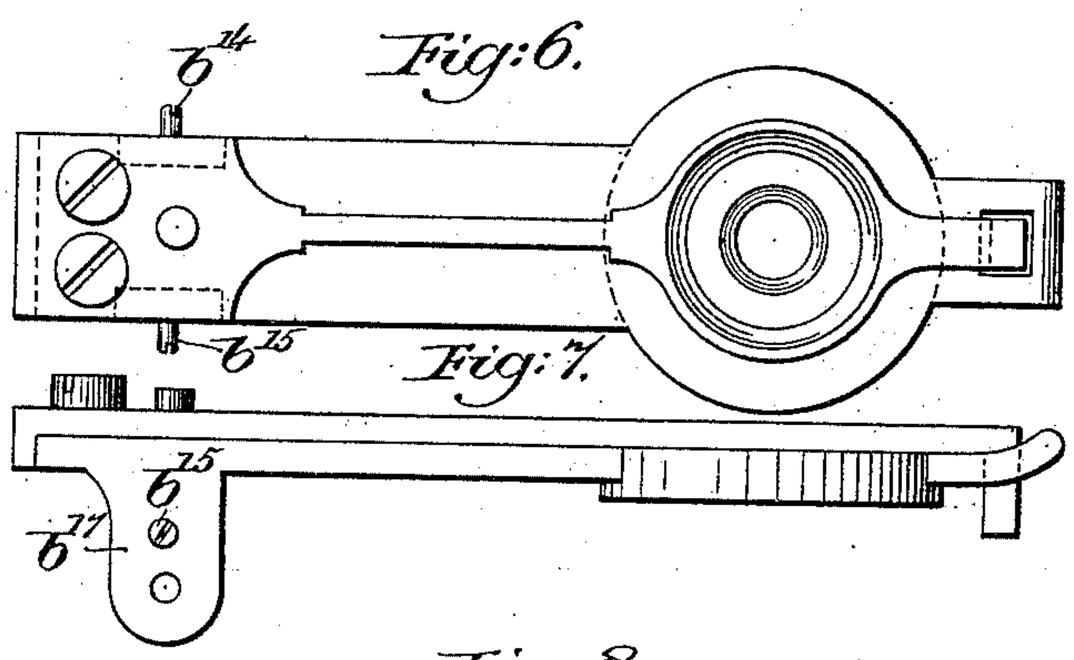


Fig: 7.

Fig: 8.

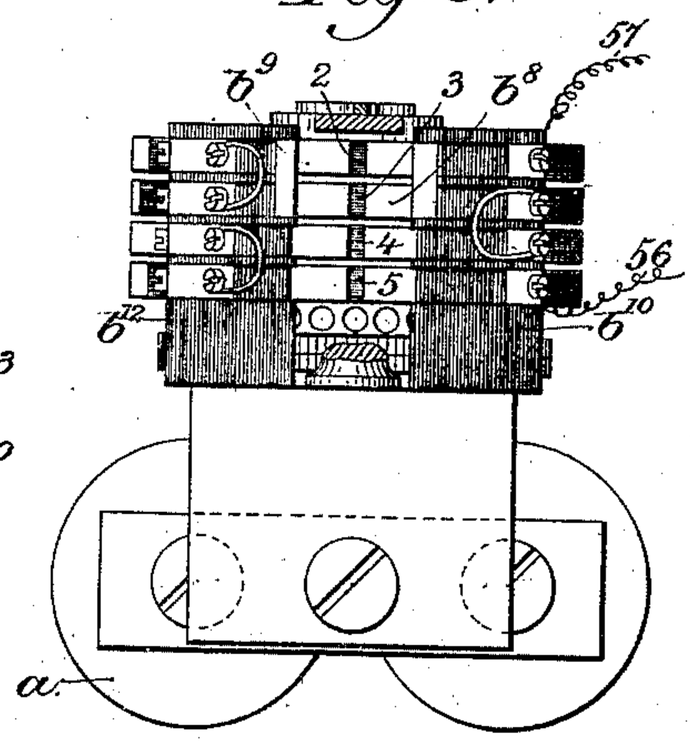


Fig: 9.

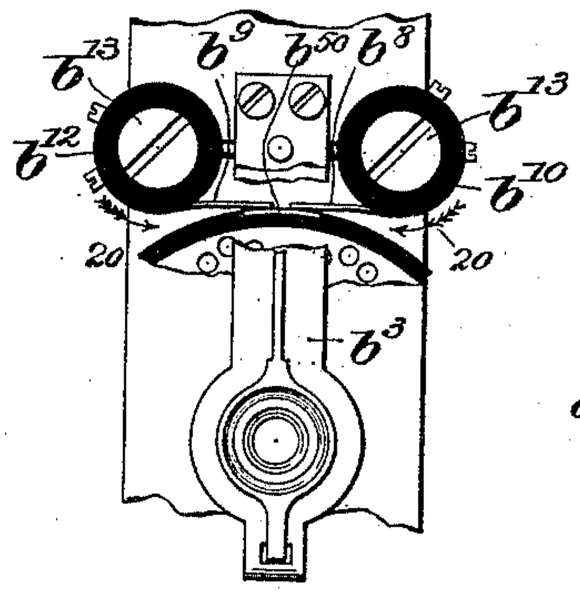


Fig: 11.

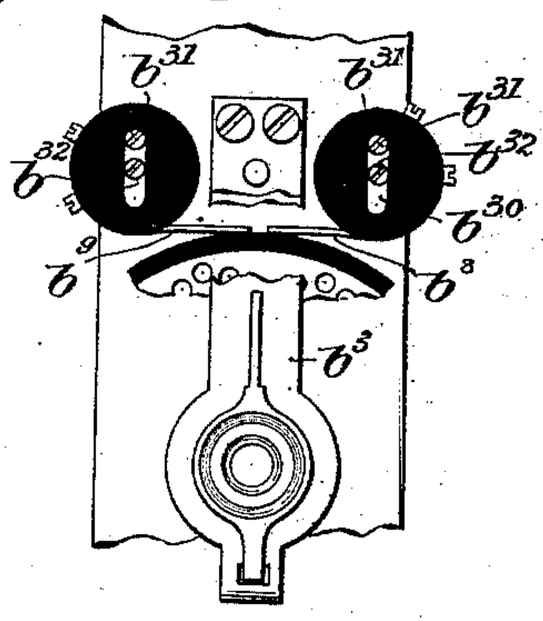


Fig: 10.

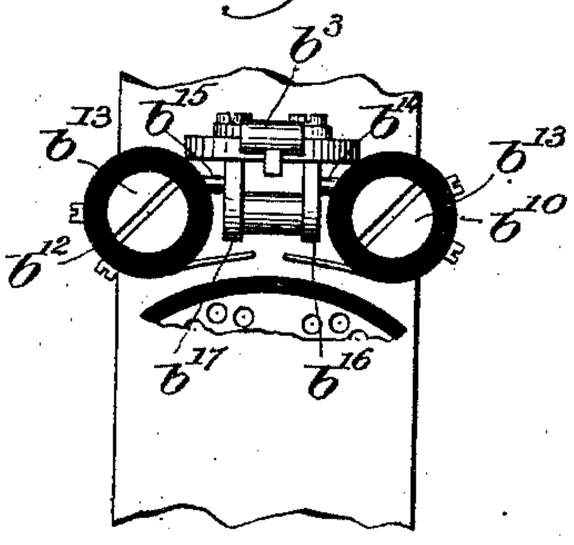


Fig: 13.

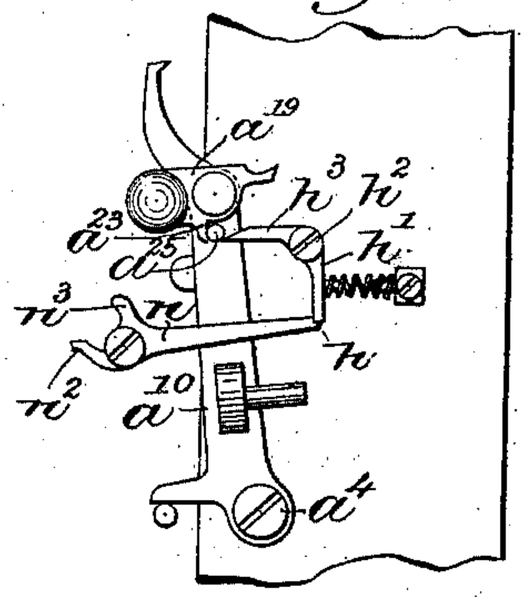
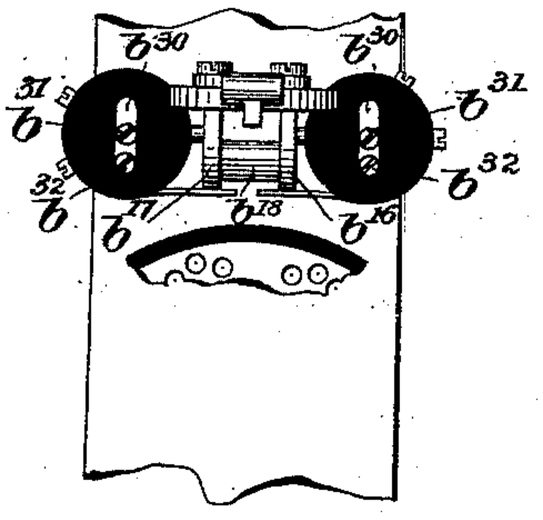


Fig: 12.



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F. S. HOLMES.

ELECTRIC LOCK.

No. 467,465. Patented Jan. 19, 1892.

Fig: 17.

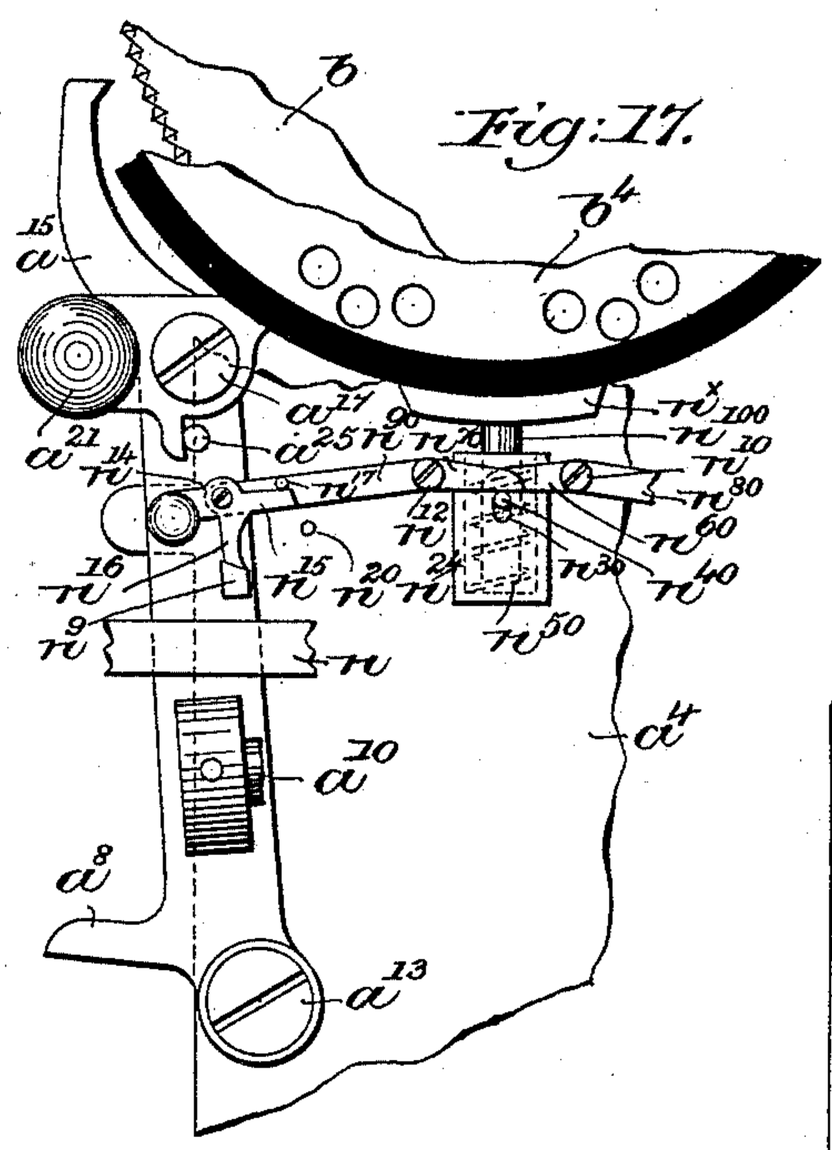

Fig: 14.

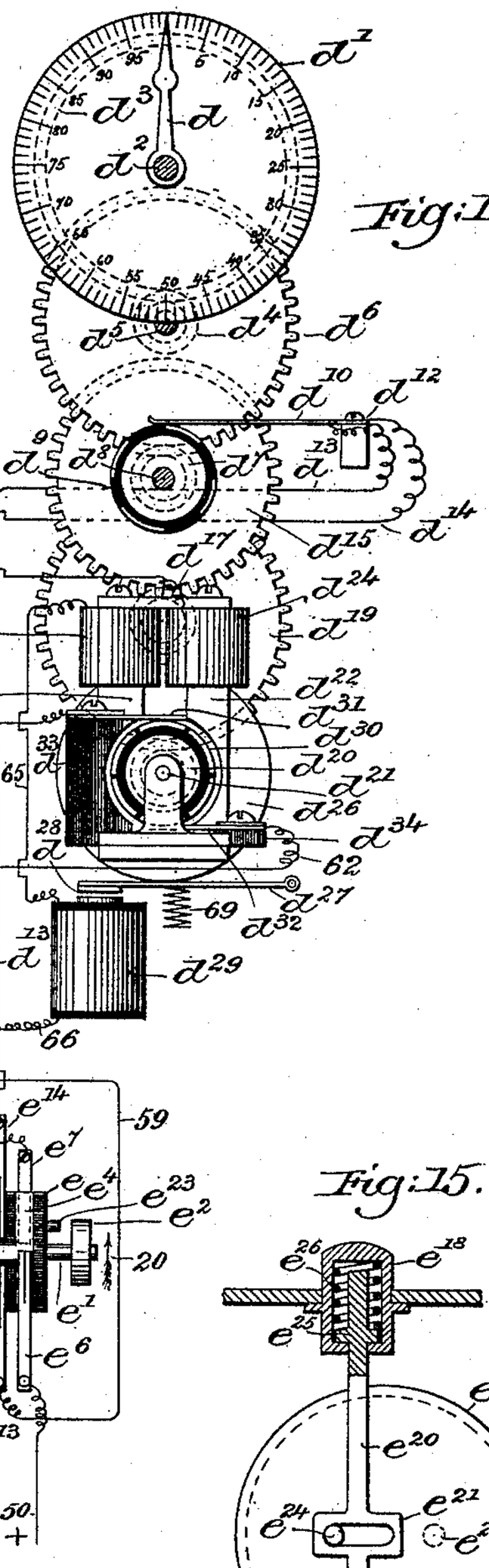

Fig: 16.

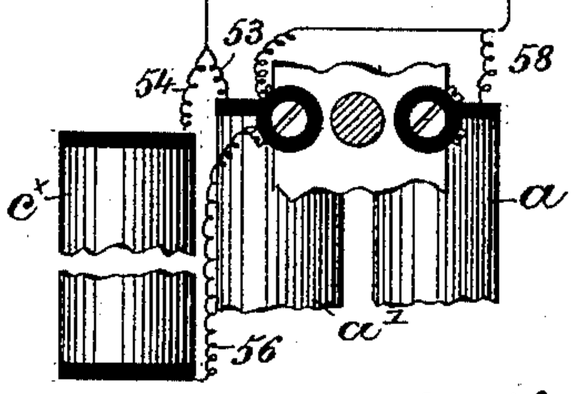

Fig: 18.

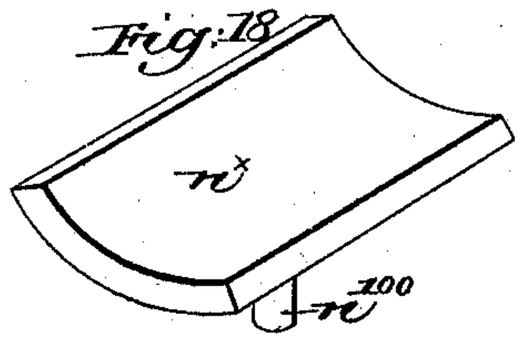

Fig: 15.

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F. S. HOLMES.

ELECTRIC LOCK.

No. 467,465. Patented Jan. 19, 1892.

Fig: 19.

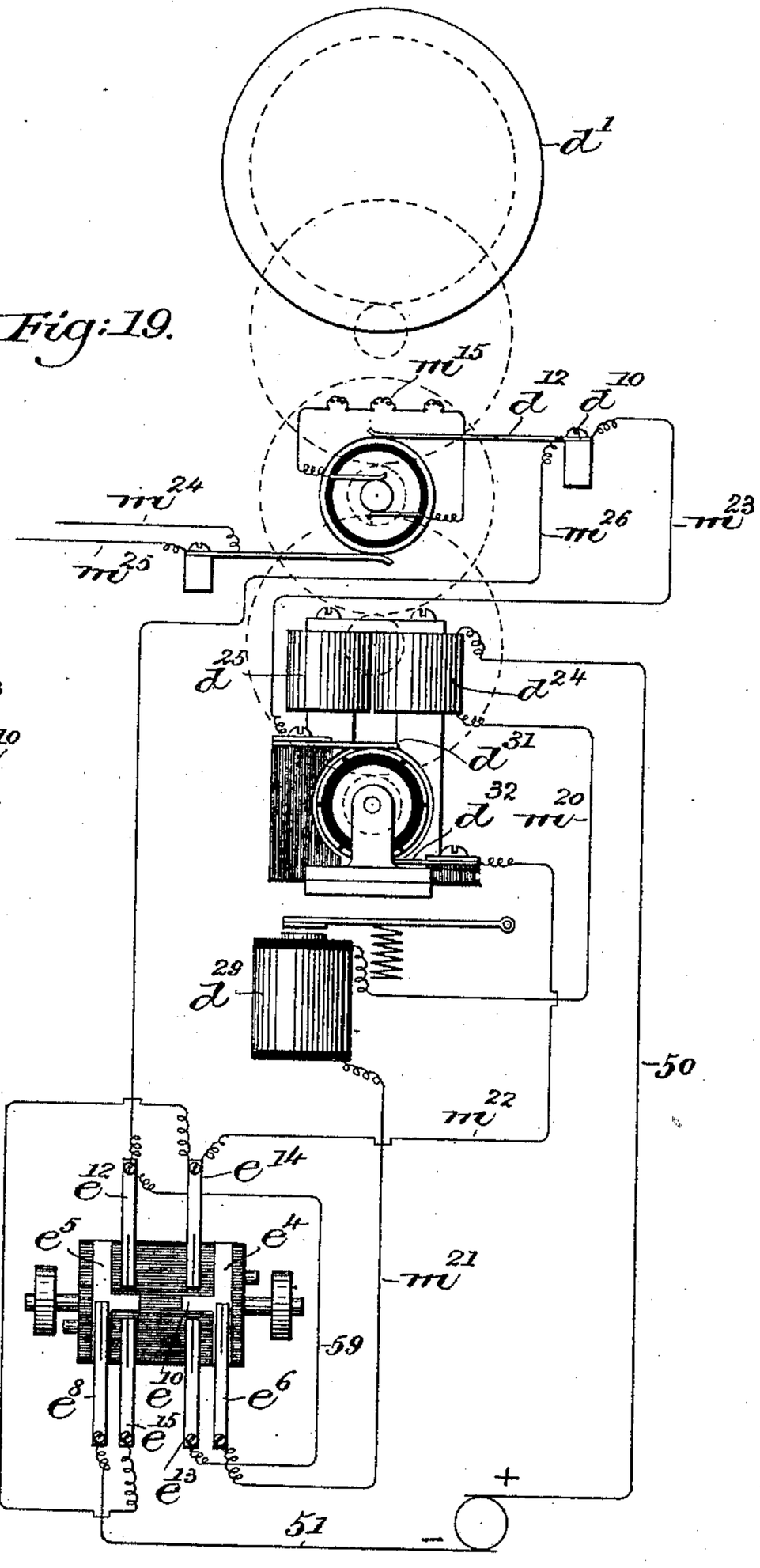
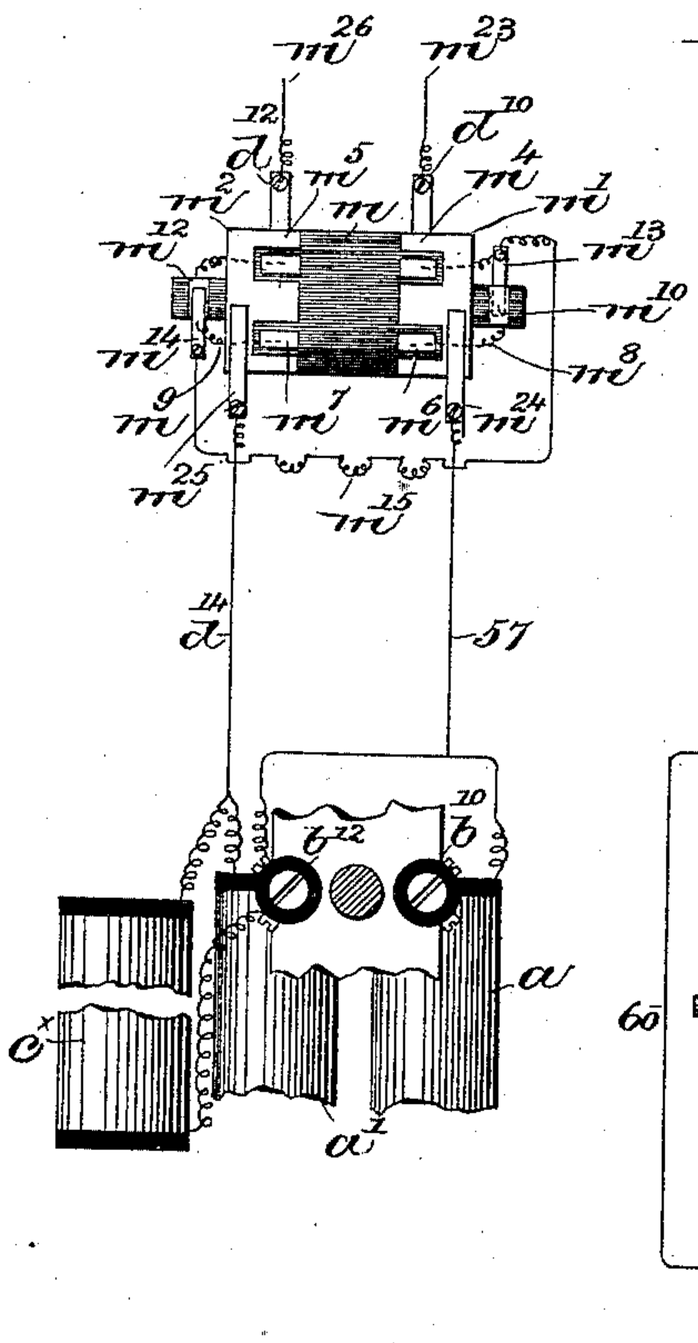


Fig: 20.



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UNITED STATES PATENT OFFICE.

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ELECTRIC LOCK.

SPECIFICATION forming part of Letters Patent No. 467,465, dated January 19, 1892.

Application filed February 3, 1891. Serial No. 380,018. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK S. HOLMES, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Electric Locks, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to apparatus by which a combination-bolt or other locking mechanism employed on safes, vaults, and other depositories for valuables may be electrically controlled at any given point or station, and has for its object to improve the construction of the electrically-controlled lock and the mechanism by which the said lock is operated.

The particular features in which my invention consists will be pointed out in the claims at the end of this specification.

Figure 1 is a front elevation of an electrically-controlled lock embodying my invention, the face-plate or cover of the lock being removed and the said lock connected to a sufficient portion of the bolt-operating mechanism to enable the operation of the lock to be readily understood; Fig. 2, a detail in elevation, on an enlarged scale, of a ratchet-wheel and the pawl to operate the same; Fig. 3, a side elevation of the pawl shown in Fig. 2, looking toward the right; Figs. 4 and 5, details to be referred to; Fig. 6, a detail, on an enlarged scale, of the tumbler-locking lever, to be referred to; Fig. 7, a side elevation of the lever shown in Fig. 6; Fig. 8, a top or plan view of the tumblers and the wipers or brushes connected thereto; Figs. 9 and 10, details, on an enlarged scale, to more clearly show the construction of the tumblers and their co-operating brushes; Figs. 11 and 12, details of a modified form of brush-operating mechanism; Fig. 13, a detail to be referred to; Fig. 14, a diagram of circuits to more clearly show the operation of the mechanism, the transmitting apparatus being shown in elevation and section and the mechanism for operating the transmitter being shown in plan view, the circuit-breaker or commutator being in multiple arc with the motor and brake-magnet; Fig. 15, a detail to be referred to; Fig. 16, a detail in plan view to enable the operation of the transmitting apparatus to be more readily understood; Fig. 17, a detail, on an enlarged scale, of a portion of the lock mechanism to more clearly show the tumbler-brake and the devices for operating it; Fig. 18, a detail of the tumbler-brake shoe; Fig. 19, a diagram of circuits shown, the transmitting apparatus and the magnets for operating the same arranged in series; and Fig. 20, a detail of the form of circuit-breaker employed with the series arrangement of circuits shown in Fig. 19.

Referring to Fig. 1, the case A, preferably of metal, contains within it preferably a polarized electro-magnet consisting of two coils a a', provided with an armature a^2, pivoted, as at a^3, to a plate or bar a^4. The armature a^2 is provided at or near its opposite end, as herein shown, with studs or pins a^5 a^6, which engage lugs or ears a^7 a^8 on pallet-bars a^9 a^{10}, pivoted, as at a^{12} a^{13} to the plate or bar a^4. The pallet-bars a^9 a^{10} are provided at their upper ends with fixed pawls a^{14} a^{15} and have pivoted to them, as at a^{16} a^{17}, movable pawls a^{18} a^{19}, provided, as herein shown, (see Fig. 2,) with enlarged portions a^{20} a^{21}, constituting weights for the said pawls to normally keep them in engagement with ratchet-wheels b b', having oppositely-inclined teeth, one pawl, as a^{18}, being in engagement with the teeth of one wheel, as b, and the other pawl a^{19} with the teeth of the other wheel, as b'. The pawls a^{18} a^{19} are provided, as herein shown, with lugs or ears a^{22} a^{23}, which co-operate with stops or pins a^{24} a^{25} on the pallet-bars to limit the downward movement of the said pawls. The ratchet-wheels b b' are secured together or are made as a single disk having two sets of oppositely-inclined peripheral teeth, so that the said ratchet-wheels move simultaneously. The ratchet-wheels are mounted on a stud or post on the plate a^4, the said post being provided with a screw-threaded socket, into which is inserted a set-screw b^2, which serves to fasten a locking-lever b^3 for tumblers b^4, loosely mounted on the said stud or post, (see Fig. 8,) there being four tumblers herein shown, and marked, respectively, 2 3 4 5 in Fig. 8.

The tumblers b^4 may be of any usual or well-known construction, such as commonly

used on combination-locks, they being provided on one side with a substantially circular groove b^5 and on the other side with a projection, (not shown,) which in practice enters the groove b^5 of an adjacent tumbler and is adapted to move said adjacent tumbler when the said projection is brought into engagement with a shoulder b^7 in said groove, the said shoulder in the present instance being shown as a lug on a ring $b^\times$, the said ring and lug fitting loosely in the groove b^5 and the lug b^7 adapted to play between two shoulders $b^{2\times}$. The tumbler b^4 (marked 5) is firmly secured to the ratchet-wheels $b\,b'$, to be moved simultaneously therewith. The tumblers b^4 are provided on their periphery with contact-plates b^{30}, preferably set into the said tumbler to be flush therewith. (See Fig. 9.) The contact-plates b^{50} on the tumblers have co-operating with them two sets $b^8\,b^9$ of contact pens or brushes secured to movable insulated supports, herein shown as hollow sleeves $b^{10}\,b^{12}$, of insulating material, secured to the plate or bar a^4 by screws or rods b^{13}, threaded at their lower ends. The hollow insulating-sleeves b^{10} b^{12} are loose on the rods b^{13} and are made movable thereon to engage and disengage the contact-brushes $b^8\,b^9$, with the contact-plates on the tumblers, preferably by means of studs $b^{14}\,b^{15}$, eccentrically placed on ears $b^{16}\,b^{17}$ on the under side of the lever b^3, the said lever being pivotally mounted on a pin or shaft, (not shown,) but which is extended through the ears b^{16} b^{17} and through a hub b^{18}, secured to or forming part of a post (not shown) fastened to the plate or bar a^4. The eccentric studs or pins b^{14} b^{15} enter slots extended in the direction of the length of the sleeves, so that by lifting the lever b^3 from the position shown in Fig. 1 to one substantially at right angles thereto the sleeves b^{10} b^{12} will be revolved on the rods b^{13} in the direction indicated by arrow 20, Fig. 9, to remove the contact-brushes b^8 b^9 from their co-operating contact-plates on the tumblers, thereby breaking the electric circuit at the tumblers and at the same time permitting the said tumblers to be removed from their stud or post or to be revolved thereon by hand.

Instead of revolving the insulating-sleeves b^{10} b^{12} to remove the contact-brushes from their co-operating contact-plates, the said sleeves may be moved bodily toward and from the tumblers, they being each provided with a slot b^{30}, (see Figs. 11 and 12,) through which is extended two pins or rods $b^{31}\,b^{32}$, upon which the sleeves slide when the lever b^3 is turned on its pivot. The case A also contains within it an auxiliary magnet $c^\times$, connected, as by wire 56, in circuit with the contact-brushes b^8 b^9, the said electro-magnet being herein shown as provided with a dovetailed base c, fitted into a dovetailed slot in the bottom of the case A. The electro-magnet $c^\times$ has co-operating with it an armature c', secured to or forming part of an arm c^2 of a bolt-controlling lever C, pivoted, as at c^3, in suitable lugs c^4 on the under side of the top of the case A. The lever C has an arm c^5 extended down within the case A, and an arm c^6 extended through a suitable slot or opening in the top of the said case. The arm c^6 is herein shown as provided at its upper end with a slot or opening c^7, into which is extended a pin c^8 on a lever c^9, pivoted as at c^{10}, the lever c^{10} co-operating with and forming part of a bolt-controlling mechanism consisting, as herein shown, of a pivoted cam or plate c^{12}, provided with an arm 25 to engage a shoulder 26 on the lever c^9 and with an arm 27, having a shoulder 28, which is normally engaged by the end of a compound lever consisting of a lever c^{13}, pivoted as at c^{14}, and having one arm provided with a slot c^{15}, in which moves a pin or stud c^{16} on a lever c^{17}, pivoted as at c^{18}. The lever c^{13} has co-operating with it a lever c^{19}, pivoted as at c^{20}, and the lever c^{17} engages a shoulder c^{21} on a bar or rod c^{22}, forming part of the bolt mechanism.

In practice the bolt mechanism c^{22} is usually placed in operative position (indicated by full lines, Fig. 1) immediately after the door of the vault or receptacle is opened. This is accomplished in usual manner by means of a pinion and rack-bar, and being of such ordinary construction and not forming any part of my present invention they are not herein shown.

When the door is closed and the combination-lock is set, the parts shown in Fig. 1 occupy the position indicated by dotted lines, the bolt-operating bar c^{22} being supported by the lever c^{17}, the lever c^{13} being held in its dotted-line position by the lever c^{21}, the cam-plate c^{12} being engaged by the lever c^{13}, and the shoulder 26 of the lever c^9 being engaged by the arm 25 of the cam-plate c^{12}.

The electrically-actuated lock has co-operating with it a transmitting or actuating mechanism, which in practice may be located at any desired place or station outside of the safe or vault. The transmitting mechanism consists, as herein shown, of a pointer d, (see Fig. 14,) registering with a dial d', provided with graduations equal in number to the number of teeth on the ratchet-wheels of the electrically-actuated lock. The pointer d is fast on a shaft d^2, having mounted thereon a gear d^3. (Indicated by dotted lines, Fig. 14.) The gear d^3 meshes with a pinion d^4 on a shaft d^5, having mounted on it a gear d^6 in mesh with a pinion d^7 on a shaft d^8, upon which is mounted a commutator or circuit-breaker d^9, the said commutator having co-operating with it brushes d^{10} d^{12}, to which circuit-wires d^{13} d^{14} are respectively connected. The shaft d^8 has mounted on it a gear d^{15} in mesh with a pinion d^{17} on a shaft provided with a gear d^{19} in mesh with a pinion d^{20} on the armature-shaft d^{21} of an electric motor of any usual construction, but preferably having its field-magnets composed of soft-iron cores d^{22} d^{23} and coils d^{24} d^{25} wound thereon. The armature-shaft d^{21} has mounted on it a disk d^{26},

forming part of an electrical-brake mechanism, the co-operating part of which is a lever d^{27}, provided with an armature d^{28} for an electro-magnet d^{29}. The armature-shaft d^{21} has mounted on it a commutator d^{30} of any usual construction, with which co-operates brushes d^{31} d^{32}, mounted upon suitable insulating-supports d^{33} d^{34}.

The operation of the electric motor is controlled by a suitable switch or pole-changer, herein shown in Fig. 14 as a drum e, of insulating material, mounted on a shaft e', supported in uprights e^2 on a suitable base or support, the said drum having secured to it near its opposite ends contact-strips e^4 e^5, extended substantially around the circumference of the drum, as indicated by dotted lines, Fig. 15. The contact-strips e^4 e^5 have co operating with them, as shown in Fig. 14, two sets of contact-brushes e^6 e^8 e^7 e^9, and the said strips are provided, as herein shown, with contact-arms e^{10} e^{12}, extended, as shown, substantially at right angles to the contact-strips e^4 e^5. The arms e^{10} e^{12} have co-operating with them two sets of contact-brushes e^{13} e^{15} e^{14} e^{16}. The drum normally occupies the position shown in Fig. 14, with the contact-brushes e^{13} e^{15} e^{14} e^{16} out of contact with the arms e^{10} e^{12}. The contact-arms e^{10} e^{12} may be brought into contact with the brushes e^{14} e^{16} or with the brushes e^{13} e^{15} by revolving the drum e first in one direction, as indicated by the arrow 20, or in the opposite direction by means of push-buttons e^{18} e^{19}, having co-operating with them rods e^{20}. Only one of such is shown in Fig. 15, provided with slots e^{22}, fitted over crank pins or studs e^{23} e^{24} on the ends of the drum e. The pins e^{23} e^{24} are set on opposite sides of the center. Each rod e^{20} is extended up into its push-button and is provided with a collar e^{25}, which rests upon the bottom of the push-button when the drum is in its normal position. The rod e^{20} within its push-button is encircled by a spring e^{26}, which acts against the collar e^{25} and brings the drum e to its normal position. (Shown in Fig. 14.) The upper end of the rod e^{20} does not extend to the top of the push-button, but is removed therefrom a sufficient distance to allow of the upward movement of the said rod when the latter is raised by the movement of the drum to complete the electric circuit. Each rod e^{20} at its lower end is extended through a suitable guide e^{30}. (See Fig. 15.)

The contact-brushes e^6 e^8, as shown in Fig. 14, have connected to them the positive and negative wires 50 51 of a dynamo, battery, or other generator. (Not herein shown.)

The brush e^{14} is joined by wire d^{13} to the contact-brush d^{10}, co-operating with the commutator d^9, and the other brush d^{12} by wire d^{14} to one end 53 of the coil of the polarized electro-magnet, and to one end 54 of the coil of the auxiliary magnet $c^{\times}$. The other end 56 of the auxiliary magnet-coil is connected to the contact pen or brush b^8, which co-operates with the tumbler marked 5, (see Fig. 8,) and the contact-pen b^8, co-operating with the tumbler marked 2, is connected by wire 57 to the brush e^{16}. The wire 57 has joined to it the opposite end 58 of the coil of the polarized electro-magnet. The brush e^{13} is connected by wire 59 with the brush e^{16}, and the brush e^{15} is joined by wire 60 to the brush e^{14}. The brush e^7 is connected by wire 61 to the commutator-brush d^{31}, and the other commutator-brush d^{32} is connected by wire 62 to the brush e^9. The brush e^{16} is also connected by wire 64 to the field-coils d^{24} of the electric motor, and the other ends 65 of the field-coils are joined to the end of the coil of the brake-magnet d^{29}, the other end 66 of the said magnet-coil being connected to the wire d^{13}. The brake-lever d^{27} is normally kept in engagement with the brake-wheel d^{26} by a spring 69.

When one push-button, as e^{18}, is operated, the pointer d will be rotated in one direction—as, for instance, toward the right—and when the button e^{19} is operated the pointer will be revolved to the left, and consequently I have, for sake of distinction, marked the said buttons in Fig. 16 "right" and "left." When the push-button e^{18} is depressed, the drum is revolved until the contact-arms e^{10} e^{12} are brought into engagement with the brushes e^{14} e^{16}, at which time the circuit through the polarized electro-magnet is completed, the said circuit being traced in Fig. 14 as follows, viz: positive wire 50, brush e^6, contact-strip e^4, contact-arm e^{10}, brush e^{14}, from which point two paths are open to the current—one by wire 66 through brake-magnet d^{29}, energizing it and attracting the brake-lever d^{27} away from its brake-wheel d^{26}; thence by wire 65 to field-magnet coils d^{24} d^{25} of the electric motor; thence by wire 64 to contact-brush e^{16}, contact-arm e^{12}, strip e^5, brush e^8, and negative wire 51 to the negative pole of the generator. The other path from the brush e^{14} is as follows, viz: wire d^{13}, pen d^{10}, conducting-segment of the commutator d^9, pen d^{12}, wires d^{14} 53, through the coils a' a of the polarized electro-magnet, wire 58, wire 57, to brush e^{16}, and thence as described to the negative pole of the generator. The current passing through the coil a' and then through the coil a will cause the coil a' to attract the armature a^2 and rotate its ratchet-wheel in the direction indicated by arrow 40, Fig. 1, and thus rotate the tumbler marked "5" until the projection on the said tumbler strikes the shoulder on the next tumbler. When the pointer d has been revolved to the required graduation, the push-button e^{18} is released and the push-button e^{19} pressed upon to revolve the drum e in the direction opposite to that indicated by arrow 20, thus bringing the contact-arms e^{10} e^{12} into engagement with the brushes e^{13} e^{15}. The circuit may then be traced as follows, viz: the positive wire 50, brush e^6, contact-arm e^{10} and brush e^{13}, wire 59, to contact-brush e^{16}, from which point two paths are open for the current, viz: one by wire 64 through the field-magnet coils d^{24} d^{25} of the electric motor, wire

65, brake-magnet coil d^{29}, wire 66, to contact-brush e^{14}; thence by wire 60 to contact-brush e^{15}; thence by arm e^{12}, contact-brush e^{8}, and negative wire 51 to the negative pole of the generator. The other path for the current from the contact-brush e^{16} may be traced as follows, viz: by wires 57 58 through the coils $a\ a'$ of the polarized electro-magnet; thence by wires 53 d^{14}, contact-pen d^{12}, conducting-segment of the commutator d^{9}, contact-pen d^{10}, wire d^{13} to the contact-brush e^{14}; thence, as above described, by wire 60, brush e^{15}, contact-arm e^{12}, brush e^{8}, and negative wire e' to the negative pole of the generator. The current passing through the coil a of the polarized electro-magnet causes the said coil to attract the armature a^{2} and move the pallet-bar a^{9} to rotate the ratchet-wheel, co-operating with the pawl a^{18} in a direction opposite to that indicated by arrow 40, Fig. 1.

The push-button e^{19} is operated to maintain the closed circuit at the switch or pole-changer until the pointer d has been rotated to the desired or required graduation on the dial d'.

The operator first closes the circuit by means of the push-button e^{18} and then with the push-button e^{19} causes the ratchet-wheels to be revolved first in one and then in the other direction until the tumblers d^{4} have all been arranged so as to bring their metallic or conducting surfaces b^{50} underneath and in contact with the pens or brushes $b^{8}\ b^{9}$, and when in this position the circuit, through the auxiliary magnet $c^{\times}$, is completed from the wire 51 through the pens $b^{8}\ b^{9}$ and the conducting-surfaces of the tumblers to the pen to which the wire 56 of the auxiliary magnet is connected, the current passing through the said auxiliary magnet, through the wire 56, and out therefrom by the wire 54 to the wire d^{14}. When the circuit of the auxiliary magnet $c^{\times}$ is completed, as described, the said magnet attracts its armature c' and moves the lever C on its pivot from its dotted to its full line position, thereby removing the toe 26 of the lever c^{9} out of engagement with the arm 25 of the cam-plate c^{12} (see Fig. 1) and permitting the bolt-operating bar c^{22} to descend by gravity and unlock the bolts, the said bar in its descent turning the lever c^{17} on its pivot from the position indicated by dotted lines to that indicated by full lines, the pin or stud c^{16} on the said lever traveling up in the slot c^{15} and turning the lever c^{13} into its full-line position. The lever c^{13} acts on the arm c^{27} of the cam-plate and turns the said plate on its pivot into its full-line position.

In practice it is customary to raise the bolt-operating bar c^{22} immediately after the safe-door has been opened, and in order that the bolt-operating mechanism may not be locked while the bolt mechanism is in operative position, until it is desired to so lock the same, the lever C has co-operating with it a locking device which retains the said lever in its full-line position until it is desired to lock the safe.

The locking device, as shown in Fig. 1, consists of a lever n, pivoted as at n', and provided with forks $n^{2}\ n^{3}$, between which is extended the end of the arm c^{5} of the lever C. The lever n at its opposite end has secured to it a spring n^{4}, (see Fig. 2,) which acts upon a pin or stud n^{5}, extended loosely through a hole in the end of the lever n. The pin n^{5} co-operates with a cam or projection n^{6} on the pallet-bar a^{9}. When the circuit of the auxiliary magnet $c^{\times}$ is completed and the bolt-operating mechanism has been released to open the safe, the arm c^{5} acts upon the forks n^{3} and turns the lever n into its position shown in Fig. 1, so that the pin n^{5} will come behind and in line with the projection n^{6} when the pallet-bar a^{9} is in its normal position. (Shown in Fig. 1.) When the combination is mixed up to lock the door, the pallet-bar a^{9} is operated to move the ratchet-wheel, co-operating with its pawl a^{18} until the circuit of the auxiliary magnet through the tumblers and pens $b^{8}\ b^{9}$ is broken, and as soon as it is broken a spring n^{7} on the pivot c^{3} of the lever C restores the said lever to its normal or dotted-line position, thereby causing its arm c^{5} to act on the fork n^{2} and turn the lever n upward on its pivot. The locking device or lever n co-operates with the pallet-bar a^{9}; but, if desired, the locking device or lever n may co-operate with the pallet-bar a^{10}, and in this case the construction shown in Fig. 13 may be used, wherein the lever n is notched at its end, as at h, to receive the end of the arm h' of an elbow-lever pivoted as at h^{2}, the other arm h^{3} of the elbow-lever being beveled on its upper surface to engage the stop a^{23} for the pawl a^{19}, so that when the pallet-bar a^{10} is moved forward the stop a^{25} will ride up on the arm h^{2} and turn the elbow-lever on its pivot, and remove the end of the arm h' from the notch h of the locking-lever n, thus putting the lever C in condition to be moved when the circuit of the magnet $c^{\times}$ is completed through the contact-plates on the tumblers.

In Fig. 14 the circuit-breaker d^{9} is shown in multiple arc with the motor and brake-magnet, while in Fig. 19 the circuit-breaker d^{9} is shown in series with the motor and brake-magnet.

When the parts are arranged in series, the circuit-breaker d^{9} will preferably be made as shown in Fig. 20, it consisting of a cylindrical body m, of insulating material, having conducting bands or strips $m'\ m^{2}$ encircling it, and provided with contact-arms $m^{4}\ m^{5}$, extended from the said bands or strips. The insulating-body m has secured to it between the contact-arms of the conducting strips or bands $m'\ m^{2}$ contact plates or pieces $m^{6}\ m^{7}$, which are respectively connected by wires m^{8} m^{9} to conducting-rings $m^{10}\ m^{12}$ on extended journals of the body m. The rings $m^{10}\ m^{12}$ have co-operating with them contact-brushes $m^{13}\ m^{14}$, connected to suitable resistances m^{15}, which are substantially equal to the resistance of the lock-magnets and the circuit con-

necting the circuit-breaker with said lock-magnets. The contact-plates m^6 m^7 are insulated from the contact-arms m^4 m^5 and are used to maintain the circuit of the motor closed when the contact-brushes d^{10} d^{12} are not in contact with the arms m^4 m^5, and the resistance m^{15} is interposed at such time to prevent the motor from being burned out.

With the parts arranged in series the circuit may be traced as follows, viz., (it being supposed that the right push-button has been operated:) from the positive wire 50 to the field-magnet of the motor, thence by wire m^{20} to brake-magnet d^{29}, wire m^{21}, to brush e^6 of pole-changer, contact-strip e^4, contact-brush e^{14}, wire m^{22}, to brush d^{32}, through the armature of the motor, brush d^{31}, wire m^{23}, to brush d^{10}, contact-arm m^4, band or strip m', contact-brush m^{24} co-operating therewith, wire 57, polarized electro-magnet, wire d^{14}, contact-brush m^{25} co-operating with the contact band or strip m^2, contact-arm m^5, brush d^{12}, wire m^{26} to brush e^{16} of pole-changer, contact-arm e^{12}, strip e^5, brush e^8, and wire 51.

When in the revolution of the circuit-breaker the contact-brushes d^{10} d^{12} are in contact with the plates m^6 m^7, the lock-magnets are cut out of circuit and the circuit of the motor is completed through the resistances m^{15}, the circuit through the circuit-breaker being traced as follows, viz: from the positive pole to the brush d^{10}, as described, contact-plates m^6, wire m^8, ring m^{10}, brush m^{13}, resistances m^{15}, brush m^{14}, ring m^{12}, wire m^9, contact-plate m^7, brush d^{12}, wire m^{26}, thence, as above described, to the negative pole of the generator.

When the left push-button on the pole-changer is operated, the circuit may be traced as follows, viz: positive wire 50, field-coil of the motor, wire m^{20}, brake-magnet d^{29}, wire m^{21}, brush e^6, strip e^4, arm e^{10}, brush e^{13}, wire 59, to brush e^{12}, thence by wire m^{26}, brush d^{12}, band m^2, brush m^{25}, wire d^{14}, polarized magnet in the opposite direction, wire 57, brush m^{24}, band m', brush d^{10}, wire m^{23}, armature-brush d^{31}, armature of motor, armature-brush d^{32}, wire m^{22}, to brush e^{14}, thence by wire 60 to brush e^{15}, strip e^5, brush e^8, negative wire 51.

In order that the tumblers of the lock may be held immovable after each movement of either of the pallet-bars a^9 a^{10}, I have provided a brake mechanism which is brought into engagement with the tumblers after each demagnetization of the polarized electro-magnet, and which is disengaged from the said tumblers by the movement of the pallet-bars effected by the magnetization of the said polarized electro-magnet. The brake mechanism referred to consists, as herein shown, of a shoe $n^{\times}$, (see Fig. 18,) shaped to conform to the periphery of the tumblers and provided on its under side with a stud or post n^{100}, vertically movable in a socket in a guide n^{24}, provided with a slot n^{30}, through which is extended a pin n^{40}, the said post or stud being encircled by a spiral spring n^{50}, which acts to normally keep the shoe in engagement with the tumblers. The pin n^{40} is engaged on its upper side by the arms n^{60} n^{70} of levers n^{80} n^{90}, pivoted, as at n^{10} n^{12}, to the plate a^4. The levers n^{10} n^{12} have pivoted to them, at or near their opposite ends, weighted elbow-levers n^{13} n^{14}, having arms n^{15} n^{16}, the arms n^{15} of the elbow-lever engaging pins n^{17} on the levers n^{80} n^{90}, and the arms n^{16} being herein shown as beveled on their under side to engage the beveled or inclined upper face of cams or projections n^{18} n^{19} on the pallet-bars a^9 a^{10}, so that when either pallet-bar is moved forward to engage its pawl with its ratchet-wheel the lever n^{80} n^{90}, operated by the actuated pallet-bar, will be turned on its pivot and its small arm will be depressed, thus forcing the brake-shoe downward out of engagement with the tumblers, leaving the latter free to be revolved. As soon as the pallet-bar has been moved inward far enough to have the arm n^{16} clear its operating-cam the spring n^{50} moves the brake-shoe up into engagement with the tumblers, the long arm of the lever being turned downward and limited in its downward movement by a stop or pin n^{20}. On the backward movement of the pallet-bar, effected in the present instance by the spring n^{21}, the cam on the said bar strikes the arm n^{16} of the elbow-lever and turns the same on its pivot without moving the lever to which it is pivoted, and when the pallet-bar has regained its normal position the weight on the elbow-lever turns the said lever back into its normal position, with the arm n^{16} in engagement with the cam on the pallet-bar—that is, into the position shown in Fig. 17. The levers n^{80} n^{90} and the elbow-levers n^{13} n^{14} form a releasing device for the brake mechanism.

I claim—

1. The combination, with an electrically-actuated combination-lock arranged within a safe or other receptacle and comprising a series of tumblers, a ratchet-wheel to operate them, and an electro-magnet located in said safe to rotate said ratchet-wheel, of a switch located outside of the safe and connected in circuit with said electro-magnet, an electric generator connected to said magnet through said switch, a circuit-breaker to control the operation of the said magnet, and an electric motor to produce movement of the circuit-breaker, substantially as described.

2. The combination, with an electrically-actuated combination-lock arranged within a safe or other receptacle and comprising a series of tumblers, a ratchet-wheel to operate them, and a polarized electro-magnet located in said safe to rotate said ratchet-wheel, of a pole-changer located outside the safe and connected in circuit with said polarized electro-magnet, an electric generator connected to said magnet through said pole-changer, a circuit-breaker to control the operation of the said magnet, and an electric motor to produce movement of the circuit-breaker, substantially as described.

3. The combination, with an electrically-actuated combination-lock arranged within a safe or other receptacle and comprising a series of tumblers, a ratchet-wheel to operate them, and an electro-magnet located in said safe to rotate said ratchet-wheel, of a controlling-instrument located outside the safe and consisting of a pole-changer connected in circuit with the said electro-magnet, a circuit-breaker in circuit with the pole-changer, a dial, a pointer, and an electric motor, and gearing connecting the said motor with the circuit-breaker and pointer, to operate substantially as described.

4. The combination, with an electrically-actuated combination-lock arranged within a safe or other receptacle and comprising a series of tumblers, a ratchet-wheel to operate said tumblers, a main electro-magnet located in said safe to rotate said ratchet-wheel, a bolt mechanism, and an auxiliary magnet energized through said tumblers to control said bolt mechanism, of an electric generator, a pole-changer located outside of said safe and connected to the main electro-magnet, a circuit breaker, and an electric motor to operate said circuit-breaker, substantially as described.

5. The herein-described electrically-actuated combination-lock for safes and other receptacles, it consisting of a series of tumblers, ratchet-wheels to operate said tumblers, a polarized electro-magnet, its armature, pallet-bars operated by the said armature and provided with pawls to engage said ratchet-wheels, a brake mechanism to engage said tumblers, and a releasing mechanism operated by movement of the pallet-bars to disengage the brake mechanism from the tumblers, substantially as described.

6. In an electrically-actuated combination-lock, the combination of the following instrumentalities, viz: a series of tumblers, ratchet-wheels to rotate them, a polarized electro-magnet, its armature, pallet-bars operated by movement of said armature and provided with pawls to engage said ratchet-wheels, a bolt-operating-lever, an auxiliary magnet to operate it, and a locking device to lock said lever, substantially as described.

7. In an electrically-actuated combination-lock, the combination of the following instrumentalities, viz: a series of tumblers, ratchet-wheels to rotate them, a polarized electro-magnet, its armature, pallet-bars operated by movement of said armature and provided with pawls to engage said ratchet-wheels, a brake mechanism to engage the tumblers, a releasing device for said brake mechanism operated by movement of the pallet bars, a bolt-operating lever, an auxiliary magnet to operate it, and a locking device for said lever, substantially as described.

8. The herein-described transmitting apparatus for electrically-actuated combination-locks, it consisting of a circuit-breaker, an electric motor, gearing connecting the said circuit-breaker and motor, and a pole-changer connected in circuit with the said motor and circuit-breaker, substantially as described.

9. The combination, with an electrically-actuated combination-lock arranged within a safe or other receptacle and comprising a series of tumblers, a ratchet-wheel to operate them, and an electro-magnet located in said safe to rotate said ratchet-wheel, of a transmitting apparatus arranged in series with the said electro-magnet and consisting of a circuit-breaker, an electric motor to operate it, a pole-changer, and a resistance normally out of circuit with the motor when the lock-magnet is in circuit therewith and in circuit with the motor when the lock-magnet is cut out of the motor-circuit, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FREDERICK S. HOLMES.

Witnesses:
BERNICE J. NOYES,
EDWARD F. ALLEN.