No. 773,024. PATENTED OCT. 25, 1904.

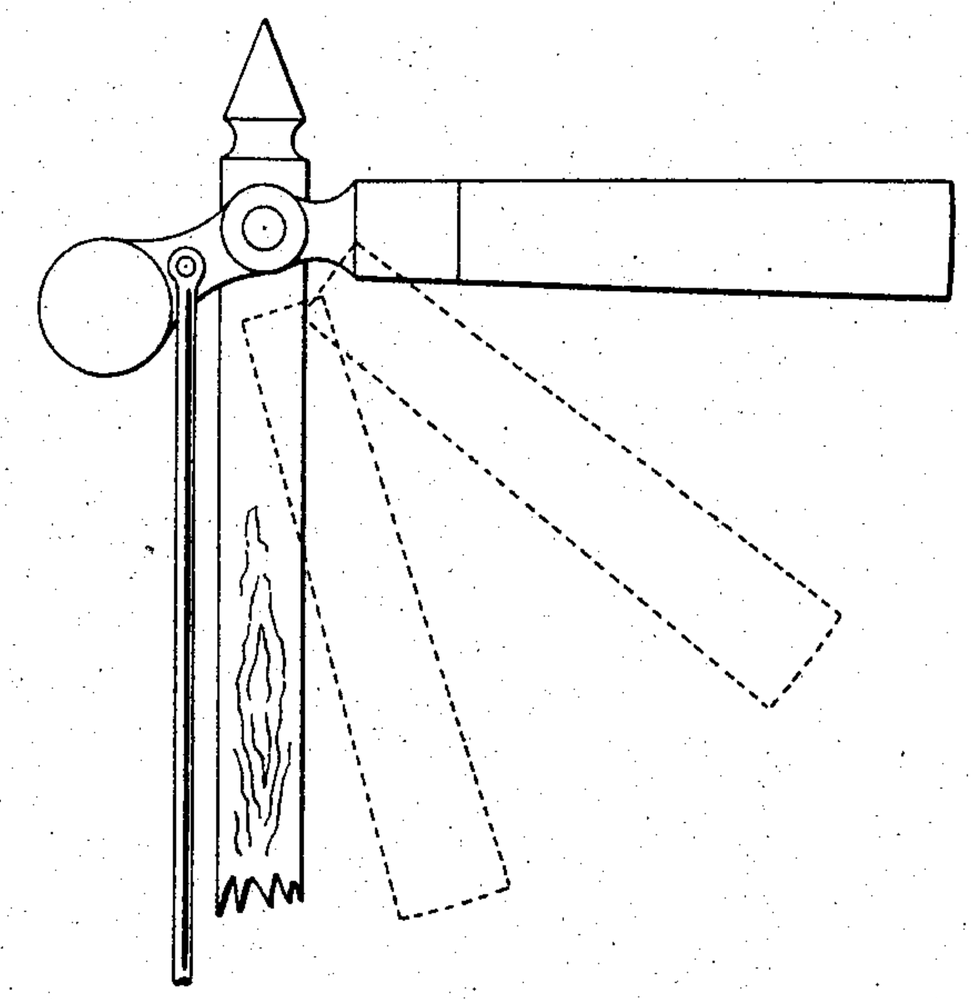
J. MILLAR.

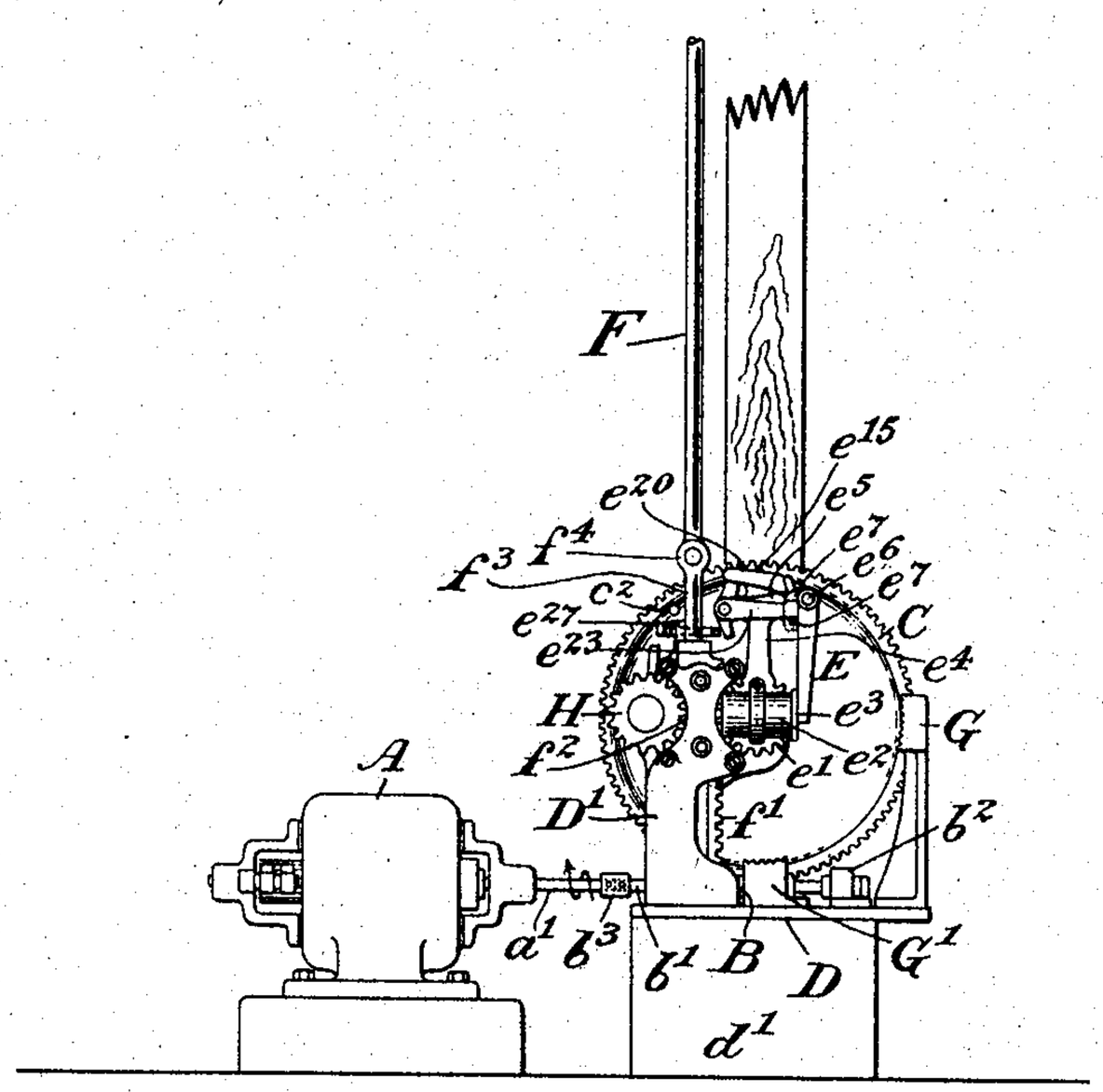
SIGNALING.

APPLICATION FILED OCT. 22, 1902.

NO MODEL. 7 SHEETS—SHEET 1.

*Fig. 1*



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NO MODEL. 7 SHEETS—SHEET 2.

Fig. 2

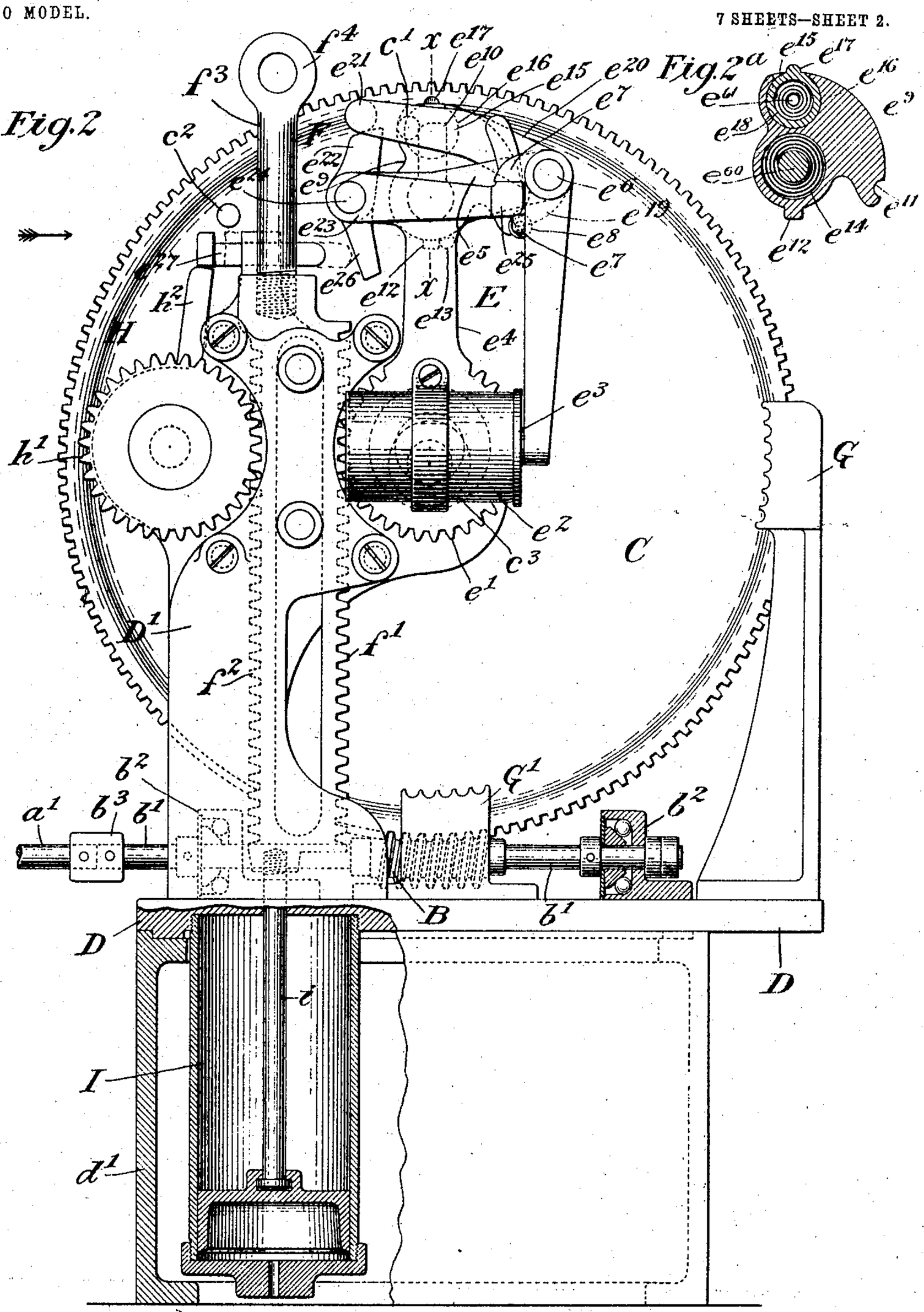


Fig. 2a




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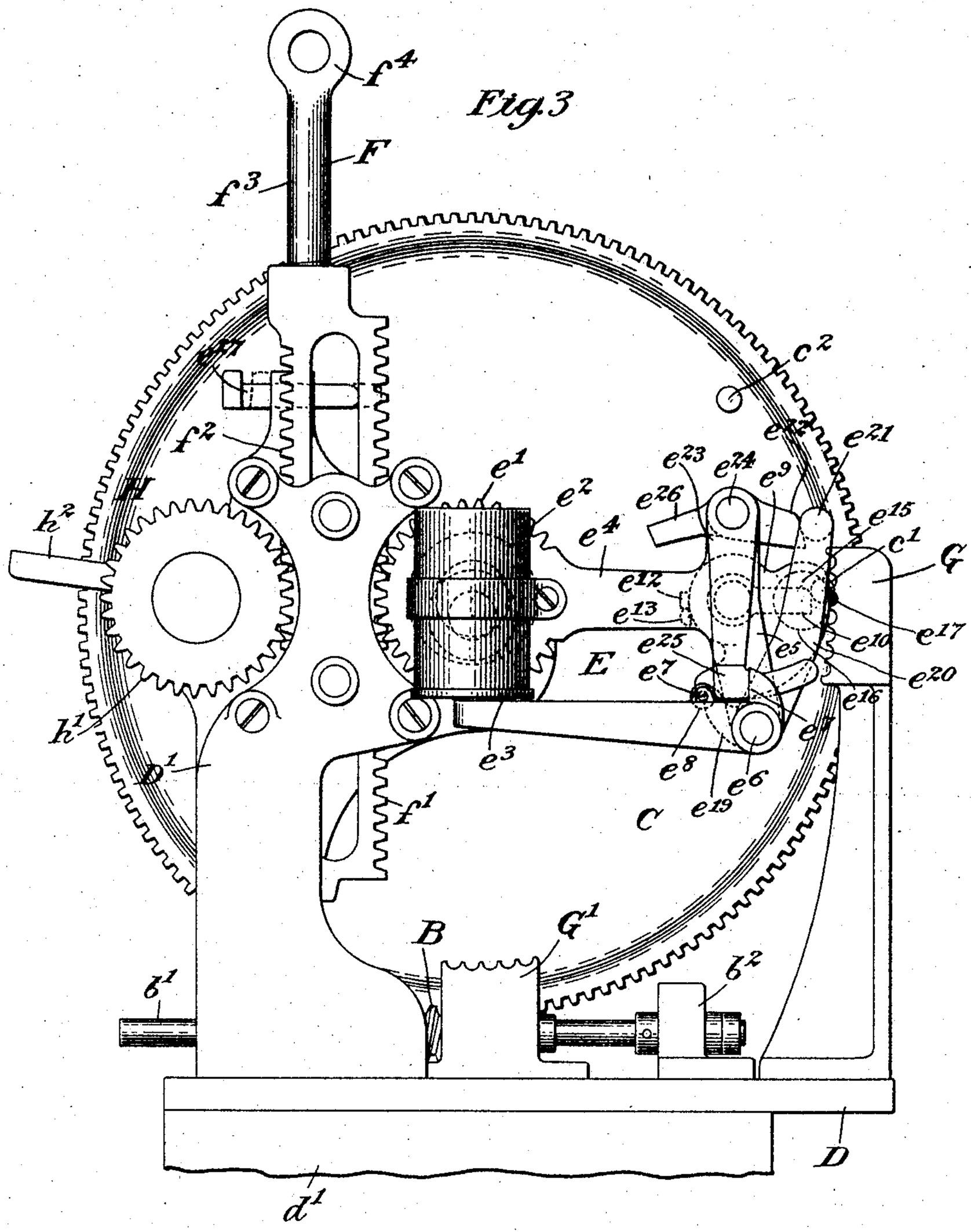
NO MODEL. 7 SHEETS—SHEET 3.

Fig. 3

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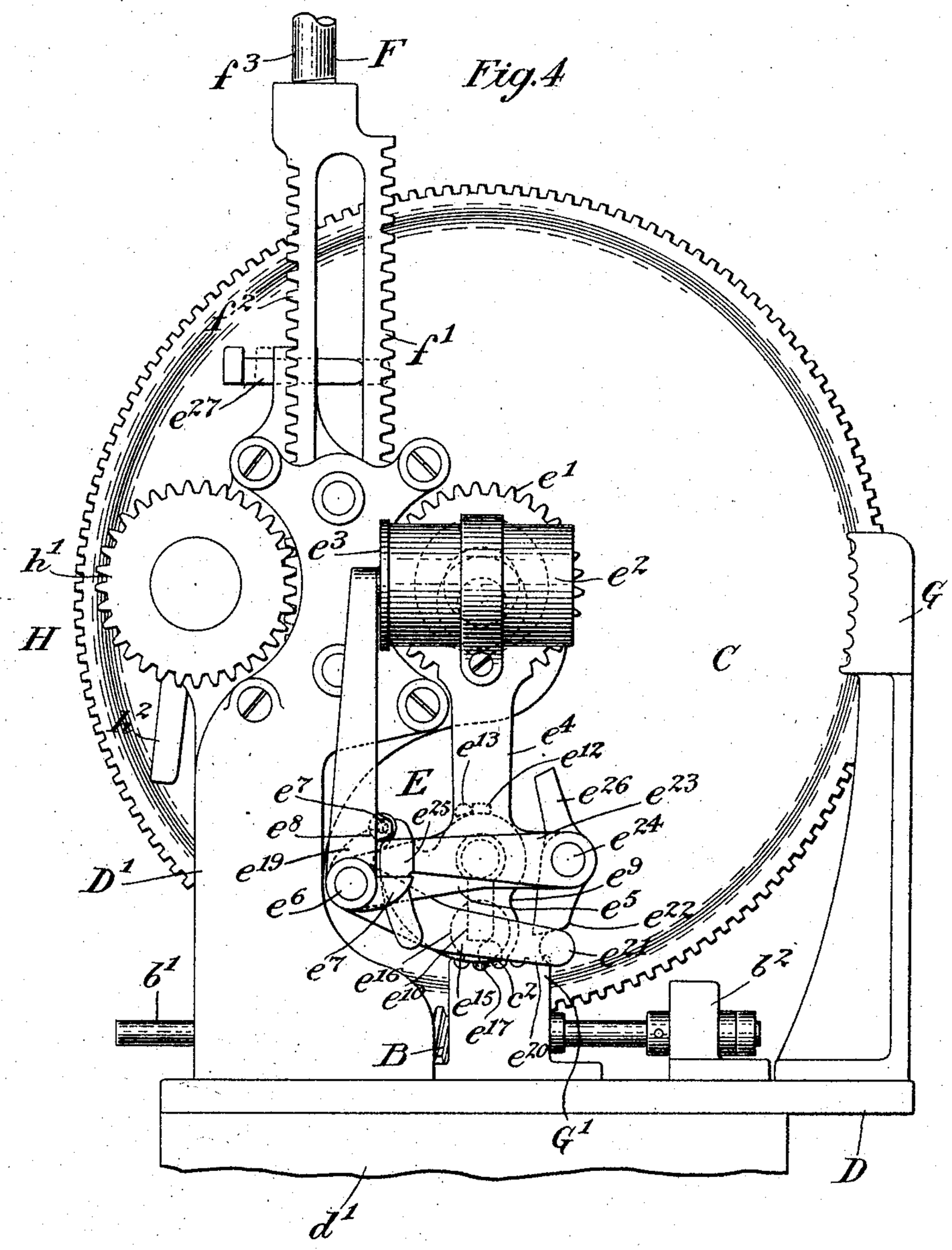
NO MODEL. 7 SHEETS—SHEET 4.

Fig. 4

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NO MODEL. 7 SHEETS—SHEET 5.

Fig. 5.

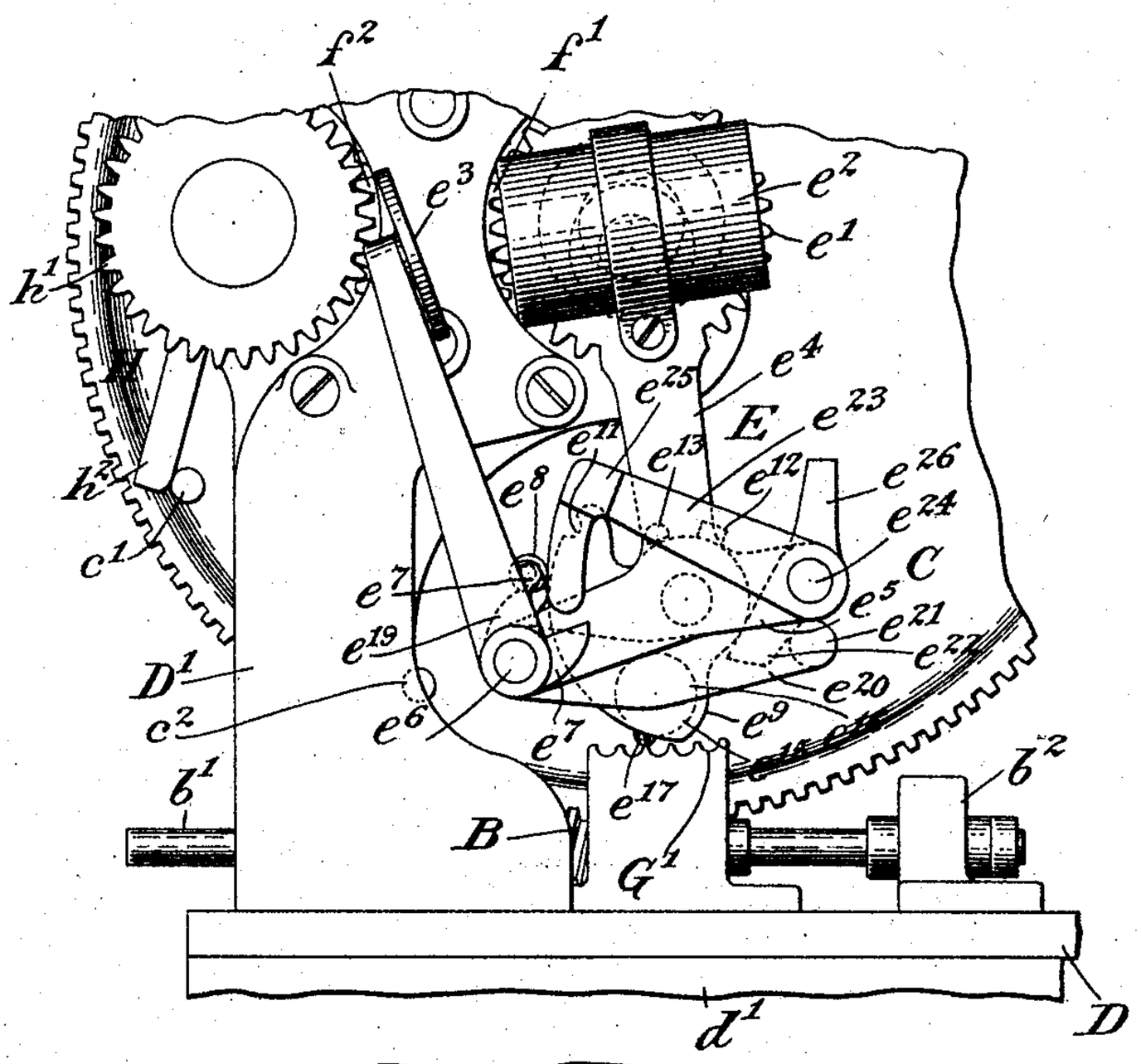
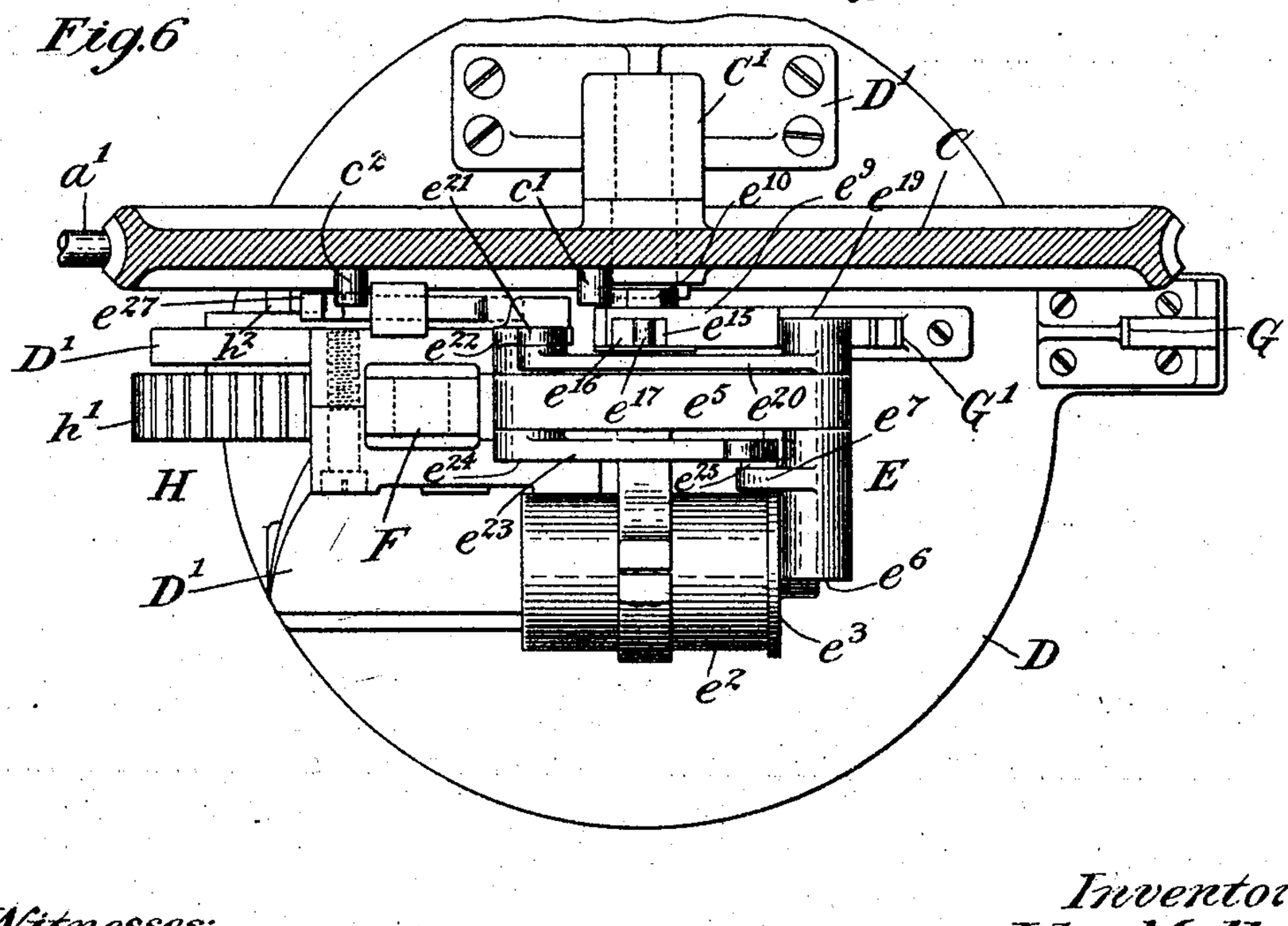



Fig. 6.

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NO MODEL. 7 SHEETS—SHEET 6.

Fig. 7

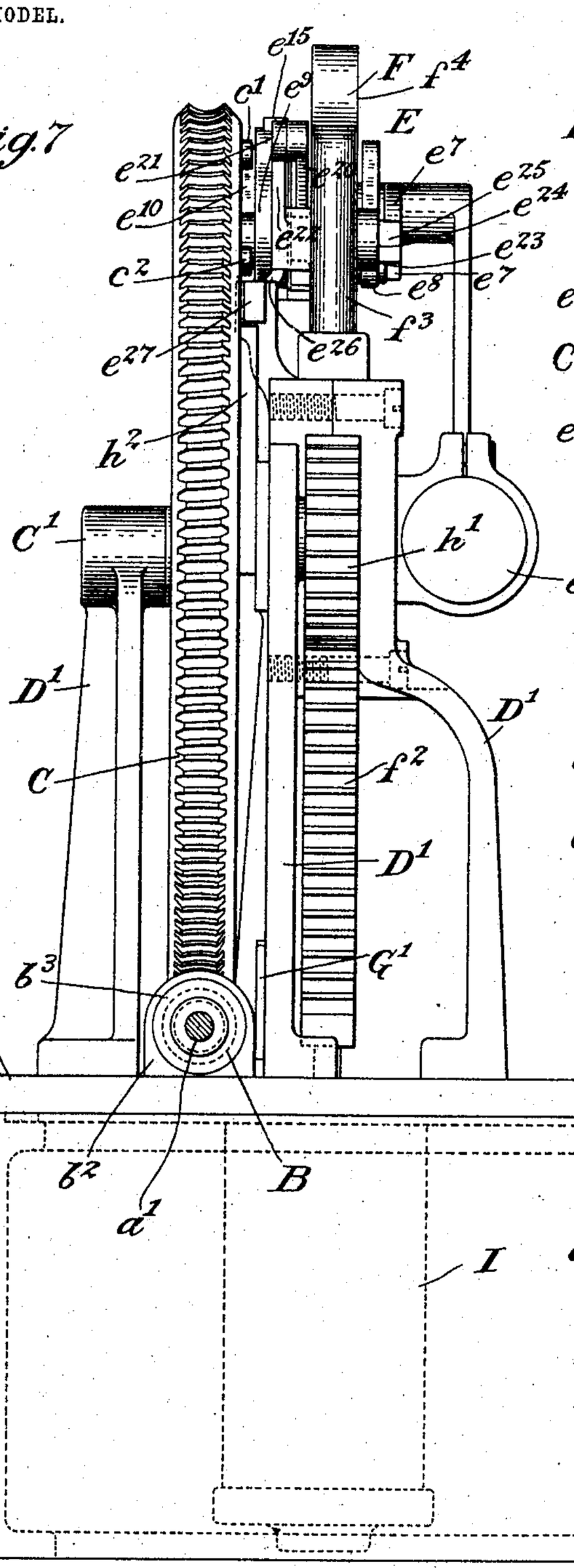



Fig. 8

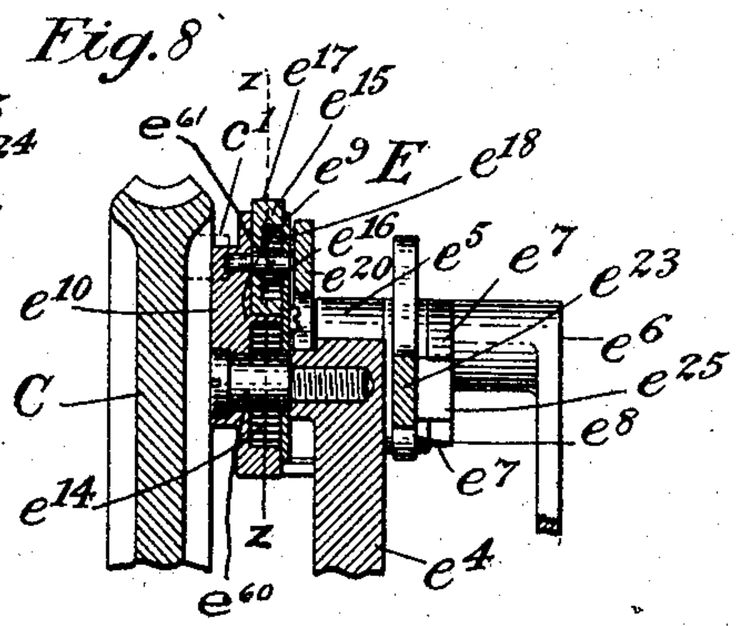
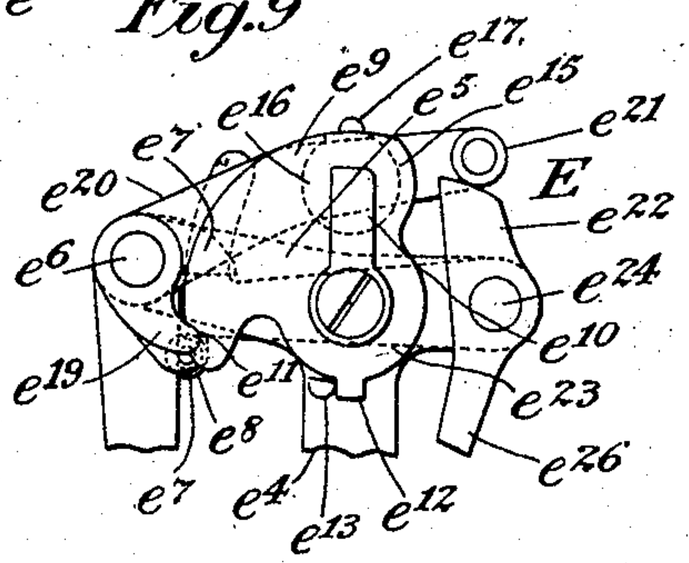



Fig. 9

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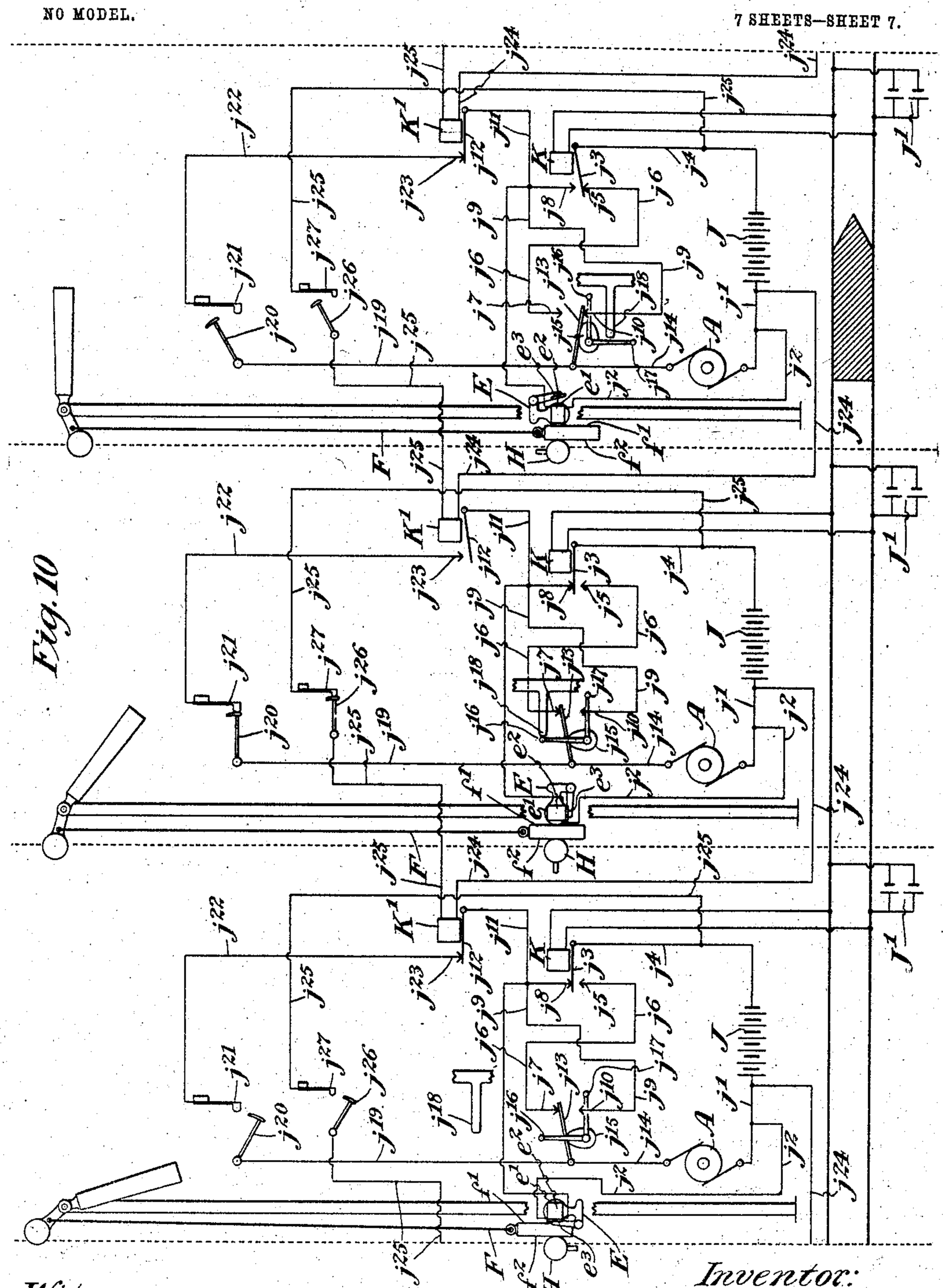
NO MODEL. 7 SHEETS—SHEET 7.

Fig. 10

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No. 773,024. Patented October 25, 1904.

# UNITED STATES PATENT OFFICE.

JOHN MILLAR, OF KEARNEY, NEW JERSEY.

## SIGNALING.

SPECIFICATION forming part of Letters Patent No. 773,024, dated October 25, 1904.

Application filed October 22, 1902. Serial No. 128,274. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN MILLAR, a subject of the King of Great Britain and Ireland, and a resident of Kearney, county of Hudson, and State of New Jersey, have invented certain new and useful Improvements in Signaling, of which the following is a specification.

My invention relates generally to signaling, and has more particularly reference to electric semaphores.

Electric semaphores at the present time are usually operated by a motor to move the signal-arm from the danger or stop position to the clear position, or if it be a three-position signal to "caution" and then to "clear." When in either position, the signal is controlled by a slot in the form of an electromagnet adapted to be energized and deënergized by the movement of trains over the tracks controlling an armature operating a suitable locking and releasing device. The return movement of the signal-arm to "danger" is effected by gravity, the slot releasing the signal when its magnet is deënergized by a train entering a certain block or section. It sometimes occurs that the armature refuses to move away from the electromagnet when the latter is deënergized, so that the signal is not free to drop by gravity. This adhesion of the armature to the magnet may be caused by frost or it may be due to the magnetization of the armature. When a condition of this character arises, the signal is effectually locked in the clear or caution position and cannot return to the danger position. The seriousness of such a state of affairs will be readily understood, and the chief object of my invention is to produce a device whereby when this improper adhesion takes place the armature will be automatically forced away from the magnet and the semaphore restored to "danger" by the motor, and whereby also the apparatus will be put in perfect working order again.

The electric semaphore, as just described, serves to illustrate the objections which can be raised against all semaphores in use at the present time, whether they be all electric, electropneumatic, or all pneumatic. In other words, there is no semaphore-signal at the present time which will be restored to "danger" by means of a motor, whether such motor be in the form of an electric motor or an air-pressure device. As has been stated, the chief object of my invention is to overcome this objection.

Other objects will appear as the specification proceeds.

I shall describe a semaphore, together with adjunctive and auxiliary devices relating to the same, embodying my invention, and afterward point out the novel features in the claims.

In my signal the slot-magnet is mounted on a pinion or gear segment which engages with a rack on the signal-rod. This pinion is in engagement with the rack on the rod at all times, so that an unbroken connection is maintained. The said pinion carries an arm or extension provided with a locking and releasing device controlled by the armature of the magnet. This locking and releasing device, together with the electromagnet and other means hereinafter more fully described, forms what I shall term a "double-lock slot." Adjacent to the slot-magnet and the rack of the signal-rod there is located a driving-gear having a pin or other means for engaging with an escapement-lock on the mechanical member of the slot. This driving-gear is placed eccentric with relation to the pinion of the slot. The motor is started up at the proper time by the passage of a train over the tracks from one block to another, thereby rotating the driving-gear. Simultaneously with this the slot-magnet is energized. The rotation of the driving-gear causes the pin carried by the same to contact with a primary locking device on the mechanical member of the slot which moves the armature into contact with the slot-magnet and also moves the escapement-lock of the slot into its locked position. The adhesion of the armature to the magnet prevents the primary locking device of the mechanical member from moving back, and thus keeps the escapement-lock, controlled by same, in its locked position, so that when the pin of the driving-gear reaches the said escapement-lock of the slot it will carry the latter with it as it rotates, thereby rotating the pinion meshing with the rack on the signal-rod, and thus drive the signal to the clear

position. If the slot-magnet is not energized, the pin on the driving-gear will escape past the escapement-lock on the slot and the signal will remain in the danger position. Owing to the eccentricity of the driving-gear with relation to the slot-pinion the pin on the said gear escapes by the escapement-lock of and releases itself from the mechanical member of the slot at a certain point, while the said mechanical member engages with retaining means for maintaining it in the position to which it has been carried. The movement of the signal-rod cuts off the motor, stopping its rotation. A train entering the block controlling the signal will deënergize the slot-magnet, and the mechanical member of the slot will free itself from the retaining means, whereby the signal will be at liberty to drop by gravity, and thus to return to "danger." The signal-rod is provided with two opposed racks, one of which has already been noted as engaging with the slot-pinion. The other of these two opposed racks engages with a restoring-pinion carrying a restoring-arm. When a train enters the block and deënergizes the slot-magnet, causing the signal to be free to return to "danger" by gravity, it also puts the motor in circuit. If the signal returns to "danger," the movement of same will cut the motor out of circuit again, thus preventing it from starting up; but if the armature should fail to leave the slot-magnet when the latter is deënergized, and thereby prevent the signal from being free to drop by gravity, the motor will start up and the pin or other engaging means on the driving-gear will come in contact with the restoring-arm, carrying the same with it and causing the restoring-pinion, which engages with the other of the two opposed racks on the signal-rod, to move the latter down. The movement of the signal-rod will cause the first of the opposed racks to turn the slot-pinion, thus forcing the armature away from the magnet, so as to release the mechanical member of the slot from the retaining means and in that way to restore the signal-arm to "danger" and also to restore the slot to its proper position and the parts to their normal working condition. As soon as the parts are restored the motor is cut out of circuit by the action of the signal-rod, thus stopping the said motor. The movement of the driving-gear to carry the signal from "danger" to "clear" is equal to half a revolution of the same. When a three-position signal is used, there will be two retaining means for the mechanical member of the slot, the first for the caution position and the second for the clear position. In that case the driving-gear will have two pins, one of which is nearer its center than the other and will carry the slot a distance of a quarter of a revolution, when the first pin will escape past the escapement-lock of the slot and the motor-stop. When the motor is started up again by the action of the train in the succeeding block, the second pin of the driving-gear will carry the slot another quarter of a revolution and then escape, leaving the signal in the clear position. The return movement to "danger" is then effected either by gravity or by the restoring device, as previously explained. When a two-arm signal is used, another slot and restoring mechanism is provided on the other side of the driving-gear, which latter is made to serve for both signal-arms. Only one pin on the driving-gear on each side will then be used. In this case, however, the restoring-arm is provided with a magnet and a spring to move it into and out of the path of the pin carried by the driving-gear at the proper time, as otherwise the rotation of the gear to operate one signal-arm would interfere with the other signal-arm. The mechanical member of the slot is constructed in the same way as in connection with the one-arm signal, as the slot will not be carried around with the pin on the gear unless locked by the action of the slot-magnet.

Other features of construction and improved combinations and arrangement of parts will be more fully described in the detailed description which follows.

In the present application I intend to cover my invention broadly and to cover more specifically the construction of the one-arm three-position signal. The specific claims for the one-arm two-position signals and the combination of two one-arm signals are contained in a sister application filed on the 22d day of October, 1902, Serial No. 128,275.

In the drawings I have embodied my invention in a suitable form; but changes may of course be made within the scope of the claims.

In the said drawings, Figure 1 is a general view of a signal embodying my invention. Fig. 2 is an enlarged detail view of the driving-gear, slot, connection for the signal-rod, and supplementary devices, showing the parts in the position occupied by them when the motor is about to drive the signal from "danger" to "caution." Fig. 2ª is a sectional view on the line *x x* of Fig. 8. Fig. 3 is a view similar to Fig. 2 and shows the disposition of the parts when the signal is in the caution position. Fig. 4 is a view similar to Figs. 2 and 3 and shows the parts as they appear when the signal is in the clear position. Fig. 5 is a view showing the mechanical member of the slot in the act of releasing itself from the retaining means and as it is about to return to "danger." Fig. 6 is a top view of Fig. 2, the driving-gear being shown in section. Fig. 7 is a side view of Fig. 2 looking in the direction of the arrow. Fig. 8 is a sectional view on the line *x x* of Fig. 2. Fig. 9 is a view of the mechanical member of the slot, viewed from the opposite side from that shown in Fig. 2. Fig. 10 is a diagrammatic view showing the signals in three blocks

and the wiring and circuits used in connection with my invention.

Similar letters of reference indicate corresponding parts in the different views.

In the specific description which follows I have described a complete signaling apparatus, including a restoring device and suitable wiring for operating the different parts of the mechanism. While the main object of this invention is to prevent the sticking of the armature to the magnet, I do not wish to be understood as limiting myself to a construction including as an essential part the said restoring device, as I have made several other specific improvements in different parts of the mechanism which are capable of being used in connection with other suitable mechanism arranged and constructed to operate in conjunction therewith. This is especially true of the slot mechanism and adjacent parts. This slot has been constructed with a twofold object in view—namely, to obtain a slot capable of being used in connection with a restoring device and to obtain a slot of the character which I have indicated by the term of "double-lock slot," in which the slot mechanism proper or the mechanism by means of which the motion of the driving-gear can be imparted to the mechanism for operating the semaphore is controlled by the slot-magnet and armature by a connection extending from the armature to the slot proper.

A is a motor having a non-reversible armature and provided with the armature-shaft $a'$. F indicates a signal-rod to which the motion of this motor is imparted at the proper times through the instrumentality of suitable means, as the driving-gear C and the slot E. The signal-rod carries a semaphore of the usual construction, counterweighted so as to have a bias to the danger position. The driving-gear C will preferably be in the form of a worm-gear, receiving its motion from the worm B, mounted on the shaft $b'$, which is coupled to the armature-shaft $a'$ by means of the coupling $b^3$. Suitable means for supporting the driving-gear C is provided in the form of a bushing $c^3$ of the framework $d'$, which rises on both sides of the said driving-gear from the base D. In the present form the semaphore will conveniently be operated through one of two opposed racks $f'$ and $f^2$, whose faces turn away from each other, attached to the signal-rod F. To correspond with this construction, a pinion or gear segment $e'$ is provided. The slot mechanism as a whole is indicated by the reference-letter E and is conveniently carried by the said pinion $e'$, which carries a rigidly-fixed arm and extension $e^4$, provided at its upper end with the cross-piece $e^5$, which forms a support for mounting the different parts of the slot. The slot proper comprises an escapement-lock $e^9$, mounted on the pivot $e^{60}$ of the cross-piece $e^5$ and normally held yieldingly by means of the clock-spring $e^{14}$. To transfer the motion of the driving-gear to suitable mechanism or means for operating the signal-rod, such as the pinion $e'$ and the rack $f'$, I provide two pins $c'$ and $c^2$, one of which is located nearer the center of the said gear than the other and attach a projection $e^{10}$ on the said escapement-lock, with which the said pins are adapted to engage. The pinion $e'$ is mounted eccentric with relation to the gear C for reasons which will hereinafter appear. $e^2$ is the slot-magnet, conveniently mounted on the pinion $e'$ and controlling the armature $e^3$, mounted loosely on one side of the pin $e^6$. The escapement-lock is further provided with a notch $e^{11}$, with which engages the dog $c^{19}$, also loosely mounted on the pin $e^6$, so as to move independently of the armature. This dog has the effect when the magnet is energized of holding the escapement-lock rigidly by engaging in the notch $e^{11}$ of the latter, so that when the gear C turns and the pin $c'$ engages with the projection $e^{10}$ the pinion $e'$ will receive the motion of the said gear, thereby operating the signal-rod. To prevent undue movement of the escapement-lock, the latter is provided with a stop $e^{12}$, engaging with the pin $e^{13}$ on the extension $e^4$.

$e^{15}$ is a retaining-lock in the form of a member $e^{16}$, mounted on the pivot $e^{61}$ of the escapement-lock $e^9$ and carrying the yielding projection $e^{17}$ by the spring $e^{18}$. G is a notched standard with which the said retaining-lock will engage when the pinion $e'$ has been turned a sufficient distance. At that point the pin $c'$ will escape past the projection $e^{10}$ of the escapement-lock, owing to the eccentricity of the pin $e'$ with relation to the driving-gear. The signal has now been moved from "danger" to "caution," and the action of the motor will therefore cease, while the magnet remains energized. When the motor starts up again, the pin $c^2$, being nearer the center than the pin $c'$, will engage with the projection $e^{10}$, thereby turning the pin $e'$ another distance, engaging the retaining-lock with the second notched standard G', which latter is located a distance equal to an arc a quarter of a circle from the standard G. The signal is now at "clear." When the next train comes along and moves into the block controlling the said signal, it will short-circuit the track-circuit and deënergize the magnet, so that the escapement-lock is no longer held in its rigid position by the dog $e^{19}$, but is held yieldingly only by the spring $e^{14}$. The counterweight of the semaphore will therefore be free to act upon the escapement-lock, which, turning upon the pivot $e^{60}$, will free the retaining-lock from the retaining means or notched standard G', thereby permitting the rack $f'$ to drive the pinion $e'$, carrying the slot back to its original position. To effect initial or primary movement of the armature into contact with the magnet, I provide a pri-

mary locking device consisting of two jaws $e^7$, one of which carries the friction-roll $e^8$, attached to the pivoted armature, and the intermediate member $e^{23}$, pivoted at $e^{24}$ and located substantially at right angles to the armature and engaging with the jaws $e^7$ of the same by means of the arm $e^{25}$ to turn the armature on the pivot $e^6$.

$e^{26}$ is an arm moving with the member $e^{23}$ and adapted to be engaged by the pushing-pin $e^{27}$, which in turn is operated by the pin $c'$ to move the armature into contact with the magnet through the above means prior to the said pin $c'$ reaching the projection $e^{10}$. If the magnet is not energized, the armature will of course move away from the same again as soon as the pin $c'$ is past the pushing-pin $e^{27}$, so that the escapement-lock will not be held rigidly by the dog $e^{19}$, thereby allowing the said pin $c'$ to escape past the projection $e^{10}$. The dog $e^{19}$ is controlled by the armature by means of the cam $e^{22}$, moving with the intermediate member $e^{23}$, on which cam rests the roll $e^{21}$ of the arm $e^{20}$, moving with the dog $e^{19}$. In this way the armature and magnet will control the dog $e^{19}$ through the escapement-lock $e^9$, so that after the magnet is energized and the armature has been moved into contact with the same the connection between the driving-gear and the means for operating the signal-rod is controlled absolutely by the said magnet and armature, and the slot cannot be released except by deënergizing the magnet. The reason for using this double-lock slot is to distribute the strain more evenly. If, for instance, the dog $e^{19}$ and the armature $e^3$ were mounted so as to move in unison by being both fast on the pin $e^6$, the strain would fall on this pivot only. By interposing the intermediate member $e^{23}$ and arm $e^{20}$ I can get the benefit of two levers, which tends to distribute the strain.

H is a restoring device in the form of a pinion $h'$, engaging with the rack $f^2$ of the signal-rod and provided with an arm or member, as $h^2$, which is moved into the path of the pins $c'$ and $c^2$ when the signal is in the caution or clear positions and out of the path of the pins when the slot is restored to the danger position. The opposed racks $f'$ and $f^2$ may be carried by the signal-rod or by a connection or extension of same. In the present instance they are carried by the connection $f^3$, adapted to be secured at $f^4$ to the signal-rod proper and connecting at its lower end with the piston-rod $i'$ of the dash-pot I. The base D is secured removably to a hollow support $d'$ and carries the dash-pot I, which is removably secured to the said base and projects inside the hollow support. By disconnecting the signal at $f^4$ and the coupling $b^3$ of the shafts $a'$ and $b'$ the entire operating mechanism can be removed and replaced, which is of great advantage.

In Fig. 10 is shown a diagrammatic view of the signals in three blocks, together with the wiring and circuits for operating the mechanisms properly, a train being indicated in the last block. In each signal the motor is connected with the battery J at all times by the wire $j'$, while the slot-magnet is connected with the said battery through the wire $j^2$. K is a relay energized by the track-circuit coming from the battery J′ and controlling the finger $j^3$, forming a switch connected with the battery J through wire $j^4$. When the relay is deënergized, the finger $j^3$ is in contact with the electrode $j^5$ of the wire $j^6$, terminating in the electrode $j^7$, and when the relay is energized it attracts the finger $j^3$ and moves it into contact with the electrode $j^8$, connecting with the slot-magnet, thereby putting the said magnet in circuit, and also with the wire $j^9$, terminating in the electrode $j^{10}$, and with the wire $j^{11}$ of the electrode or finger $j^{12}$. The finger $j^{13}$ is connected with the motor by means of the wire $j^{14}$ and is adapted to be operated mechanically between the two electrodes $j^7$ and $j^{10}$ by the fluctuation of the signal-rod through the instrumentality of the cam $j^{15}$, on which the finger $j^{13}$ rests at all times, carrying the two arms $j^{16}$ and $j^{17}$, engaging with the projection $j^{18}$ of the signal-rod to turn the said cam and so arranged that when the semaphore is at "danger" the finger $j^{13}$ is in contact with the lower electrode of $j^{10}$, but is moved into contact with the other finger, $j^7$, when the semaphore is in the caution position and remains there while the signal moves to "clear." From the motor runs another wire, $j^{19}$, terminating in the movable electrode $j^{20}$, which is adapted to move with the semaphore and when the latter is at "caution" to come in contact with the electrode $j^{21}$ of the wire $j^{22}$, terminating at its other end in the electrode $j^{23}$. K′ is a second relay connected by line-wires $j^{24}$ and $j^{25}$ with the battery J of the succeeding block, the circuit to energize the said relay being closed through the electrodes $j^{26}$ and $j^{27}$ when the signal of the said succeeding block moves to "caution," so as to put the motor and slot-magnet in circuit to drive the signal to "clear." When the signal is at "clear," the finger $j^3$ will be in contact with the electrode $j^8$, so that the slot-magnet is in circuit, thereby maintaining the slot locked, so that the retaining-lock $e^{15}$ is held in engagement with the notches on the standard G′ while the motor is out of circuit, owing to the fact that the finger $j^{13}$ has been moved into contact with the electrode $j^7$ by the fluctuation of the signal-rod F. As a train now enters the block it short-circuits the track-circuit of the battery J′, thereby deënergizing the relay K, causing the arm $j^3$ to drop into contact with the electrode $j^5$. This, it will be observed, puts the slot-magnet out of circuit, thereby releasing the slot and leaving the signal free to return to "danger" by gravity, and puts

the motor in circuit. If the signal returns to "danger" by gravity, the movement of the signal-rod will cause the finger $j^{13}$ to move into contact with the electrode $j^{10}$, thus putting the motor out of circuit; but if the armature refuses to leave the slot-magnet, and thereby maintains the signal in the clear position, (shown in Fig. 4,) the motor being in circuit will start up, and the pin $c'$ coming in contact with the restoring-arm $h^2$ will cause the pinion $h'$ to move the signal-rod down, the power breaking the armature away from the slot-magnet, thus restoring the signal to "danger." The motor then stops, being cut out of circuit by the movement of the signal-rod, as just described. The train upon leaving the block and entering the one next succeeding causes the track-circuit to be restored, energizing the relay K, bringing the arm $j^3$ in contact with the electrode $j^8$, thus putting both the motor and the slot-magnet in circuit. The slot is now in the relative position shown in Fig. 2. As the motor starts up the pin $c'$ will engage with the primary locking device, pushing the pin $e^{27}$ against the arm $e^{26}$, thereby causing the armature to move into contact with the slot-magnet and the dog $e^{19}$ to lock the escapement-lock $e^9$. As the gear C rotates the pin $c'$ will next engage with the projection $e^{10}$ of the escapement-lock, (this is the exact position of the parts in Fig. 2,) causing the rotation of the pinion $e'$ and the fluctuation of the signal-rod. This movement will continue until the signal has been driven to the caution position, when owing to the eccentricity of the gear and the pinion carrying the projection $e^{10}$ the pin $c'$ will escape past the latter and the retaining-lock $e^{15}$ engage with the notched standard G, causing the signal to be maintained in the position to which it has been moved. The movement of the signal-rod F in carrying the signal from "danger" to "caution" will cause the arm $j^{13}$ to move into engagement with the electrode $j^7$, thereby putting the motor out of circuit, while leaving the slot-magnet in circuit, so as to maintain the slot locked. The movement of the signal to "caution" also causes the arm $j^{20}$ to move into contact with the electrode $j^{21}$. Upon the farther advance of the train into the third block, as shown in the diagram in Fig. 10, the signal in the second block will move to "caution" in the same manner as just described and in so doing will close the circuit at $j^{26}$ and $j^{27}$, and thus send a current back to the relay K', causing it to put the motor in circuit by bringing the arm $j^{12}$ into engagement with the electrode $j^{23}$, and the slot being already in circuit the rotation of the gear will cause the second pin, $c^2$, which is nearer its center, to engage with the projection $e^{10}$ of the escapement-lock, so as to drive the signal to "clear." When the signal arrives in that position, the retaining-lock $e^{15}$ will engage with the notches on the standard G', while the pin $c^2$ escapes past the projection $e^{10}$, the slot meanwhile locking the signal. The movement of the semaphore, however, has caused the arm $j^{20}$ to move out of contact with the electrode $j^{21}$, thus cutting off the motor. The arm $j^{13}$, on the other hand, does not change its position. The signal then remains in this position until another train enters the block and releases the slot.

It will of course be understood that the system of wiring can be changed very materially so long as the motor and slot are put into and out of circuit at the proper moment.

Obviously the signal can be used both on the normal danger and normal safety plan by changing the wiring to correspond therewith.

Instead of line-wires the so-called "wireless system" could be used.

The various mechanisms comprising the slot, driving-gear, and motor, &c., will, as is usual, be inclosed in a suitable casing, and the signal-rod will preferably be inside a hollow iron signal-post.

In place of the gear C a simple disk could be used, and other engaging means instead of the pin could of course also be employed. The gear C could of course be the last in a train of gears; but the construction shown here is very much preferable, as with a worm and worm-gear an even and steady movement is obtained. When a two-position signal is used, the notched standard G and pin $c^2$ will be omitted and the extra circuit through the wire $j^{19}$, arm $j^{20}$, wire $j^{22}$, relay K', and line-wires running to the succeeding battery J, together with the electrodes $j^{26}$ and $j^{27}$, done away with entirely. In that event, also, the arm $j^{13}$ will be so adjusted that the movement from one electrode to another will take the full length of time which it takes to move the signal from "danger" to "clear," or vice versa.

My invention may of course also be used with an interlocking system, whether manual or power, if such should be desired. The coupling for connecting the armature with the worm-shaft will preferably be a friction-clutch. The opposed racks of the signal-rod can be formed on the signal-rod proper or on a connection in another plane, if so desired. Furthermore, the signal could be constructed so as always to be moved to "danger" by the motor by simply balancing the weight of the signal rod and arm. The semaphone will of course carry the usual spectacles to show differently-colored lights at night.

The arm $j^{13}$ can be constructed so that it will break the circuit for the motor as soon as the armature leaves the signal, or it can be constructed so that it will not break the circuit until the semaphore-arm has assumed the horizontal position.

Instead of the construction of primary locking device shown the pushing-pin $e^{27}$ could be omitted and pins $c'$ and $c^2$ made to engage di-

rectly with the arm $e^{26}$. Likewise the retaining-lock $e^{15}$ could be made in the form of spring-catches on the framework in place of the notched standards, and a means for engaging with such spring-catches carried by the slot.

Having thus described my invention, what I claim is—

1. In a signal, the combination with a semaphore counterweighted so as to have a bias to the "danger" position, of a motor, a slot, a slot-magnet, a restoring device operated by the motor, connections and circuits arranged so that the semaphore is moved by the rotation of the motor when the magnet is energized successively from "danger" to "caution," and then to "clear," the slot and magnet when locked preventing its return from either "caution" or "clear" to "danger," and the restoring device restoring the semaphore by the action of the motor to "danger" if the magnet when deënergized fails to release the semaphore so as to allow it to return by gravity, and retaining means for holding the slot in the "caution" and "clear" positions.

2. In a signal, the combination with a semaphore counterweighted so as to have a bias to the "danger" position, of a motor having a non-reversible armature and rotating in one direction only, a slot, a slot-magnet, a restoring device operated by the motor, connections and circuits arranged so that when the magnet is energized the rotation of the motor moves the semaphore from "danger" to "caution," and whereby the continued rotation of the motor moves the semaphore to "clear" unless previously restored, the slot and slot-magnet when locked preventing its return to "danger" from both "caution" and "clear," and the further rotation of the motor operating the restoring device to restore the semaphore to "danger" if the magnet when deenergized fails to release the semaphore so as to allow it to return by gravity, and retaining means for holding the slot in the "caution" and "clear" positions.

3. The combination with a semaphore counterweighted so as to have a bias to the "danger" position, of a motor, a slot, a slot-magnet, a restoring device operated by the motor, connections and circuits for putting the slot and motor in circuit to drive the semaphore from the "danger" position to the "caution" position, and for putting the motor out of circuit when the semaphore arrives at said "caution" position, and for putting the motor in circuit again to drive the semaphore to "clear" and for putting it out of circuit when it arrives at "clear" unless previously restored, and for putting the slot-magnet out of circuit, and the motor in circuit, to restore the semaphore to "danger" through the instrumentality of the restoring device, in case the said semaphore does not return to "danger" by gravity when the magnet is put out of circuit, and retaining means for the slot for holding it in "caution" and "clear" positions.

4. The combination with a semaphore counterweighted so as to have a bias to the "danger" position, and a motor for moving the semaphore to "caution" and then to "clear," of a restoring device operated by the motor to restore the semaphore to "danger," and means for operating said restoring device in case the semaphore fails to return to "danger" by gravity.

5. In a signal, a connection for operating the semaphore, a rack on said connection, a driving-pinion engaging with said rack adapted to remain in constant mesh with the same, a slot and slot-magnet carried by the driving-pinion, a motor, and connections for operating the pinion from the motor.

6. In a signal, a signal-rod, a rack on the same, a driving-pinion engaging with said rack adapted to remain in constant engagement with the same, a slot and slot-magnet carried by the driving-pinion, a motor, and connections for operating the pinion from the motor.

7. In a signal, a connection for operating the semaphore, a rack on said connection, a driving-pinion engaging with said rack, a slot and slot-magnet carried by the driving-pinion, a motor, and connections for operating the pinion from the motor.

8. In a signal, a signal-rod, a rack on the same, a driving-pinion engaging with the said rack, a slot and slot-magnet carried by the driving-pinion, a motor, and connections for operating the pinion from the motor.

9. In a signal, a semaphore counterweighted so as to have a bias to the danger position, a connection for operating the said semaphore provided with two opposed racks, a pinion in constant mesh with one of said racks to move the semaphore down, a slot and slot-magnet carried by said pinion, and a second pinion in constant mesh with the other rack to move the semaphore up in case the slot does not release the signal when the magnet is deënergized.

10. In a signal, a semaphore counterweighted so as to have a bias to the danger position, a signal-rod provided with two opposed racks, a pinion in constant mesh with one of said racks to move the semaphore down, a slot and slot-magnet carried by said pinion, and a second pinion in constant mesh with the other rack to move the semaphore up in case the slot does not release the signal when the magnet is deënergized.

11. In a signal, the combination with a slot mechanism mounted to turn, of an eccentrically-located driving-gear having two pins one of which is nearer its center than the other, whereby the rotation of the driving-gear causes the slot mechanism successively to turn a distance with it when the pins encounter the said slot mechanism.

12. In a signal, the combination with a slot

mechanism mounted to turn, of a driving-gear having a pin, whereby the rotation of the gear causes the slot mechanism to turn a distance with it when the pin encounters the said slot mechanism.

13. In a signal, the combination with a slot mechanism mounted to turn, of a gear placed eccentric with relation to the same, and a pin on said gear adapted to engage with the said slot mechanism to turn it a distance, when it escapes past the said slot mechanism owing to the eccentricity of the said gear with relation to the slot mechanism.

14. The combination with a semaphore, a slot, a slot-magnet, a motor, a restoring device and connections, of means for putting the slot-magnet and motor in circuit to drive the semaphore from the "danger" position to "caution" and for putting the motor out of circuit when the semaphore arrives at "caution," means for putting the motor in circuit again to drive the semaphore to "clear" and for putting the motor out of circuit when the semaphore arrives at "clear," and means for putting the slot-magnet out of circuit and the motor in circuit to drive the semaphore back to "danger."

15. The combination with a semaphore counterweighted so as to have a bias to the "danger" position, a slot, a slot-magnet, a motor, a restoring device and connections, of means for putting the slot-magnet and motor in circuit to drive the semaphore from the "danger" position to "caution" and for putting the motor out of circuit when the semaphore arrives at "caution," means for putting the motor in circuit again to drive the semaphore to "clear" and for putting the motor out of circuit when the semaphore arrives at "clear," and means for putting the slot-magnet out of circuit and the motor in circuit to drive the semaphore back to "danger" through the instrumentality of the restoring device in case it does not return by gravity.

16. In a signal, the combination with a slot-magnet, and an armature adapted normally to separate when the slot-magnet is deënergized, of means for positively forcing the armature away from the slot-magnet in case it adheres to the latter when the said slot-magnet is deënergized.

17. In a signal, a connection for operating the semaphore provided with two opposed racks, a pinion carrying a slot engaging with one of said racks, to move the semaphore down, a second pinion engaging with the other rack to move the semaphore up, and a single means for operating both pinions.

18. In a signal, a signal-rod provided with two opposed racks, a pinion carrying a slot engaging with one of said racks to move the semaphore down, a second pinion engaging with the other rack to move the semaphore up, and a gear having means for operating both pinions.

19. In a signal, the combination with a connection for operating the semaphore provided with two opposed racks having their faces turned away from each other, of a pinion engaging with one of said racks to move the semaphore down, a second pinion to move the semaphore up, and a single means for operating both pinions.

20. In a signal, a signal-rod provided with two opposed racks having their faces turned away from each other, a pinion engaging with one of said racks to move the semaphore down, a second pinion engaging with the other rack to move the semaphore up, and a gear having means for operating both pinions.

21. In a signal, a connection for operating the semaphore, means, carrying the slot and slot-magnet, to engage therewith to move the semaphore down, a second means also engaging with the said connection for moving the semaphore up, and a single means for operating both engaging means.

22. In a signal, a connection for operating the semaphore, provided with two opposed racks, a pinion carrying the slot and slot-magnet engaging with one of said racks to move the semaphore down, a second pinion to engage with the other rack to move the semaphore up, and a single means for operating both pinions.

23. In a signal, a signal-rod provided with two opposed racks, a pinion carrying the slot and slot-magnet engaging with one of said racks to move the semaphore down, a second pinion engaging with the other rack to move the semaphore up, and a gear having means for operating both pinions.

24. In a signal, a connection for operating the semaphore provided with two opposed racks whose faces turn away from each other, a pinion carrying the slot and slot-magnet engaging with one of said racks to move the semaphore down, a second pinion engaging with the other rack to move the semaphore up, and a single means for operating both pinions.

25. In a signal, a signal-rod provided with two opposed racks whose faces turn away from each other, a pinion carrying the slot and slot-magnet engaging with one of said racks to move the semaphore down, a second pinion to engage with the other rack to move the semaphore up, and a gear having means for operating both pinions.

26. In a signal, a signal-rod provided with two opposed racks, a pinion carrying the slot and slot-magnet engaging with one of said racks to move the semaphore down, a second pinion engaging with the other rack to move the semaphore up, and a single means for operating both pinions.

27. In a signal, a signal-rod provided with

two opposed racks whose faces turn away from each other, a pinion carrying the slot and slot-magnet engaging with one of said racks to move the semaphore down, a second pinion engaging with the other rack to move the semaphore up, and a single means for operating both pinions.

28. In a signal, a signal-rod provided with two opposed racks whose faces turn away from each other, a pinion engaging with one of said racks to move the semaphore down, a second pinion engaging with the other rack to move the semaphore up, and a single means for operating both pinions.

29. In a signal, a signal-rod provided with two opposed racks, a pinion carrying a slot engaging with one of said racks to move the semaphore down, a second pinion engaging with the other rack to move the semaphore up, and a single means for operating both pinions.

30. In a signal, a connection for the semaphore, means in constant engagement therewith to move the semaphore down, a slot and slot-magnet carried by said means, a second means also in constant engagement with the said connection for moving the semaphore up, and a single means for operating both engaging means.

31. In a signal, a signal-rod provided with two opposed racks, a pinion in constant mesh with one of said racks to move the semaphore down, a slot and slot-magnet carried by said pinion, a second pinion in constant mesh with the other rack to move the semaphore up, and a single means for operating both pinions.

32. In a signal, a signal-rod provided with two opposed racks, a pinion in constant mesh with one of said racks to move the semaphore down, a slot and slot-magnet carried by said pinion, a second pinion in constant mesh with the other rack for moving the semaphore up, and a gear having means for operating both pinions.

33. In a signal, a connection for operating the semaphore, provided with two opposed racks, a pinion in constant mesh with one of said racks adapted to move the semaphore down, and a second pinion in constant mesh with the other of said racks adapted to move the semaphore up, and a single means for operating both pinions.

34. In a signal, a signal-rod provided with two opposed racks, a pinion in constant engagement with one of said racks to move the semaphore down, a second pinion in constant engagement with the other rack to move the semaphore up, and a single means for operating both pinions.

35. In a signal, a signal-rod provided with two opposed racks, a pinion in constant mesh with one of said racks to move the semaphore down, a second pinion in constant mesh with the other rack to move the semaphore up, and a gear for operating both pinions.

36. In a signal, a slot comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member, forming a double locking means, adapted, when actuated by the primary locking device, to cause the armature to contact with the magnet and the escapement-lock to be locked, and adapted to maintain the escapement-lock in its locked position as long as the armature is in contact with the magnet.

37. In a signal, a driving-gear, a driving-pinion engaging with a rack of the signal-rod, a slot mounted on the driving-pinion comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member forming a double locking means from the armature to the escapement-lock when the magnet is energized, means carried by the driving-gear for engaging with the primary locking device to cause the armature to contact with the magnet and the escapement-lock to be locked, and for subsequently engaging with the escapement-lock thereby turning the pinion a certain distance.

38. In a signal, a driving-gear, a driving-pinion engaging with a rack of the signal-rod, a slot mounted on the driving-pinion comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member forming a double locking means from the armature to the escapement-lock when the magnet is energized, means carried by the driving-gear for engaging with the primary locking device to cause the armature to contact with the magnet and the escapement-lock to be locked, and for subsequently engaging with the escapement-lock thereby turning the pinion a certain distance, the arrangement being such that the means carried by the driving-gear releases itself from the escapement-lock after the pinion has traveled the proper distance.

39. In a signal, a driving-gear, a driving-pinion engaging with a rack of the signal-rod, a slot mounted on the driving-pinion comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member forming a double locking means from the armature to the escapement-lock when the magnet is energized, means carried by the driving-gear for engaging with the primary locking device to cause the armature to contact with the magnet and the escapement-lock to be locked, and for subsequently engaging with the escapement-lock thereby turning the pinion a certain distance, the arrangement being such that the means carried by the driving-gear releases itself from the escapement-lock after the pinion has traveled the proper distance, and retaining means for preventing the return of the pinion to its original position so long as the magnet remains energized and to maintain it in the position to which it has been carried.

40. In a signal, a driving-gear, a driving-

pinion engaging with a rack of the signal-rod, a slot mounted on the driving-pinion comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member forming a double locking means from the armature to the escapement-lock when the magnet is energized, means carried by the driving-gear for engaging with the primary locking device to cause the armature to contact with the magnet and the escapement-lock to be locked, and for subsequently engaging with the escapement-lock thereby turning the pinion a certain distance, the arrangement being such that the means carried by the driving-gear releases itself from the escapement-lock after the pinion has traveled the proper distance, and retaining means for preventing the return of the pinion to its original position so long as the magnet remains energized and to maintain it in the position to which it has been carried and a second means carried by the driving-gear to engage with the escapement-lock of the slot whereby the subsequent rotation of the gear will turn the pinion another distance.

41. In a signal, a driving-gear, a driving-pinion engaging with a rack of the signal-rod, a slot mounted on the driving-pinion comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member forming a double locking means from the armature to the escapement-lock when the magnet is energized, means carried by the driving-gear for engaging with the primary locking device to cause the armature to contact with the magnet and the escapement-lock to be locked, and for subsequently engaging with the escapement-lock thereby turning the pinion a certain distance, the arrangement being such that the means carried by the driving-gear releases itself from the escapement-lock after the pinion has traveled the proper distance, and retaining means for preventing the return of the pinion to its original position so long as the magnet remains energized and to maintain it in the position to which it has been carried, and a second means carried by the driving-gear to engage with the escapement-lock of the slot whereby the subsequent rotation of the gear will turn the pinion another distance, the arrangement being such that the second means carried by the driving-gear releases itself from the escapement-lock after the pinion has traveled the proper distance.

42. In a signal, a driving-gear, a driving-pinion engaging with a rack of the signal-rod, a slot mounted on the driving-pinion comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member forming a double locking means from the armature to the escapement-lock when the magnet is energized, means carried by the driving-gear for engaging with the primary locking device to cause the armature to contact with the magnet and the escapement-lock to be locked, and for subsequently engaging with the escapement-lock thereby turning the pinion a certain distance, the arrangement being such that the means carried by the driving-gear releases itself from the escapement-lock after the pinion has traveled the proper distance, and retaining means for preventing the return of the pinion to its original position so long as the magnet remains energized and to maintain it in the position to which it has been carried, and a second means carried by the driving-gear to engage with the escapement-lock of the slot whereby the subsequent rotation of the gear will turn the pinion another distance, the arrangement being such that the second means carried by the driving-gear releases itself from the escapement-lock after the pinion has traveled the proper distance, and retaining means for preventing the return of the pinion to its original position so long as the magnet remains energized and to maintain it in the position to which it has been carried.

43. In a signal, a driving-gear, a driving-pinion engaging with a rack of the signal-rod, a slot mounted on the driving-pinion comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member forming a double locking means from the armature to the escapement-lock when the magnet is energized, means carried by the driving-gear for engaging with the primary locking device to cause the armature to contact with the magnet and the escapement-lock to be locked and for subsequently engaging with the escapement-lock thereby turning the pinion a certain distance moving the signal from "danger" to "caution," the arrangement being such that the means carried by the driving-gear releases itself from the escapement-lock when the signal has attained this position, retaining means for preventing the return of the signal to "danger" so long as the magnet remains energized and to maintain it in the position to which it has been carried, a second means carried by the driving-gear to engage with the escapement-lock of the slot whereby the subsequent rotation of the gear will turn the pinion another distance thereby moving the signal to "clear," the arrangement being such that the second means carried by the driving-gear releases itself from the escapement-lock when the signal has attained this position, and retaining means for preventing the return of the signal to "danger" so long as the magnet remains energized and to maintain it in the position to which it has been carried.

44. In a signal, a driving-gear, a driving-pinion placed eccentric of same and engaging with a rack of the signal-rod, a slot mounted on the pinion comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member forming a

double locking means for the armature to the escapement-lock when the magnet is energized, and a retaining-lock, a pin carried by the driving-gear to engage with the primary locking device to cause the armature to contact with the magnet and the escapement-lock to be locked, and for subsequently engaging with the escapement-lock thereby turning the pinion a certain distance, the pin escaping past the retaining-lock owing to the eccentricity of the pinion with relation to the gear when the said pinion has traveled the proper distance with the gear, and a notched standard to engage with the retaining-lock of the slot to prevent the return of the pinion to its original position so long as the slot-magnet remains energized and to maintain it in the position to which it has been carried.

45. In a signal, a driving-gear, a driving-pinion placed eccentric of same and engaging with a rack of the signal-rod, a slot mounted on the pinion comprising a magnet, an armature, an escapement-lock, a primary locking device, an intermediate member forming a double locking means from the armature to the escapement-lock when the magnet is energized, and a retaining-lock, a pin carried by the driving-gear to engage with the primary locking device to cause the armature to contact with the magnet and the escapement-lock to be locked, and for subsequently engaging with the escapement-lock thereby turning the pinion a distance equal to a quarter of a revolution thereby moving the signal from "danger" to "caution" the pin escaping past the retaining-lock owing to the eccentricity of the pinion with relation to the gear when the signal has attained this position, a notched standard to engage with the retaining-lock to prevent the return of the signal to "danger" so long as the magnet is energized and for maintaining it in the position to which it has been carried, a second pin carried by the driving-gear nearer its center than the first one adapted upon the subsequent rotation of the gear to engage with the escapement-lock to turn the pinion another quarter of a revolution bringing the signal to "clear," the said second pin escaping past the escapement-lock when the signal has attained this position owing to the eccentricity of the gear with relation to the pinion, a second notched standard adapted to engage with the retaining-lock to prevent the return of the signal to "danger" so long as the slot-magnet is energized and to maintain it in the position to which it has been carried.

46. In a signal, the combination of a driving-gear, a driving-pinion, a slot and magnet carried by the pinion, and means adapted to cause the pinion to follow the rotation of the gear when the magnet is energized.

47. In a signal, the combination of a driving-gear, a driving-pinion, a slot and magnet carried by the pinion adapted to cause the pinion to follow the rotation of the gear when the magnet is energized, the driving-gear being released from the slot after it has turned the pinion a certain distance, the said pinion being prevented from returning to its original position so long as the slot-magnet is energized.

48. In a signal, the combination of a driving-gear, a driving-pinion, a slot and magnet carried by the pinion adapted to cause the pinion to follow the rotation of the gear when the magnet is energized, the driving-gear being released from the slot after it has turned the pinion a certain distance, the said pinion being prevented from returning to its original position so long as the slot-magnet is energized, and means whereby the further rotation of the gear will carry the pinion another distance and whereby the gear will be released from the slot after it has arrived at the proper position and will be prevented from assuming its original position so long as the slot-magnet is energized.

49. In a signal, the combination with a driving-gear and a pinion, of a slot mounted on the said pinion, comprising: a magnet, a pivoted lever carrying an armature, an escapement-lock, coöperative means between the driving-gear and the slot for moving the armature toward the magnet and for holding the escapement-lock rigidly, the magnet when energized controlling the escapement-lock through the armature.

50. In a signal, the combination with a pinion, of a slot carried by the same, comprising in part: a magnet, a pivoted lever carrying an armature and escapement-lock, a stud connected to the pivoted lever carrying the armature and the escapement-lock, a driving-gear, coöperative means formed between the driving-gear and the stud for moving the armature toward the magnet, and for holding the escapement-lock rigidly whereby the retention of the armature against the magnet when the latter is energized controls the escapement-lock through the instrumentality of the connections between the stud, armature, and escapement-lock.

Signed at New York this 11th day of October, 1902.

JOHN MILLAR.

Witnesses:
JOHN D. KOATT,
AXEL V. BEEKEN.