No. 869,555. PATENTED OCT. 29, 1907.

W. DAVES.

BLOCK SIGNAL SYSTEM.

APPLICATION FILED APR. 22, 1907.

5 SHEETS—SHEET 1.

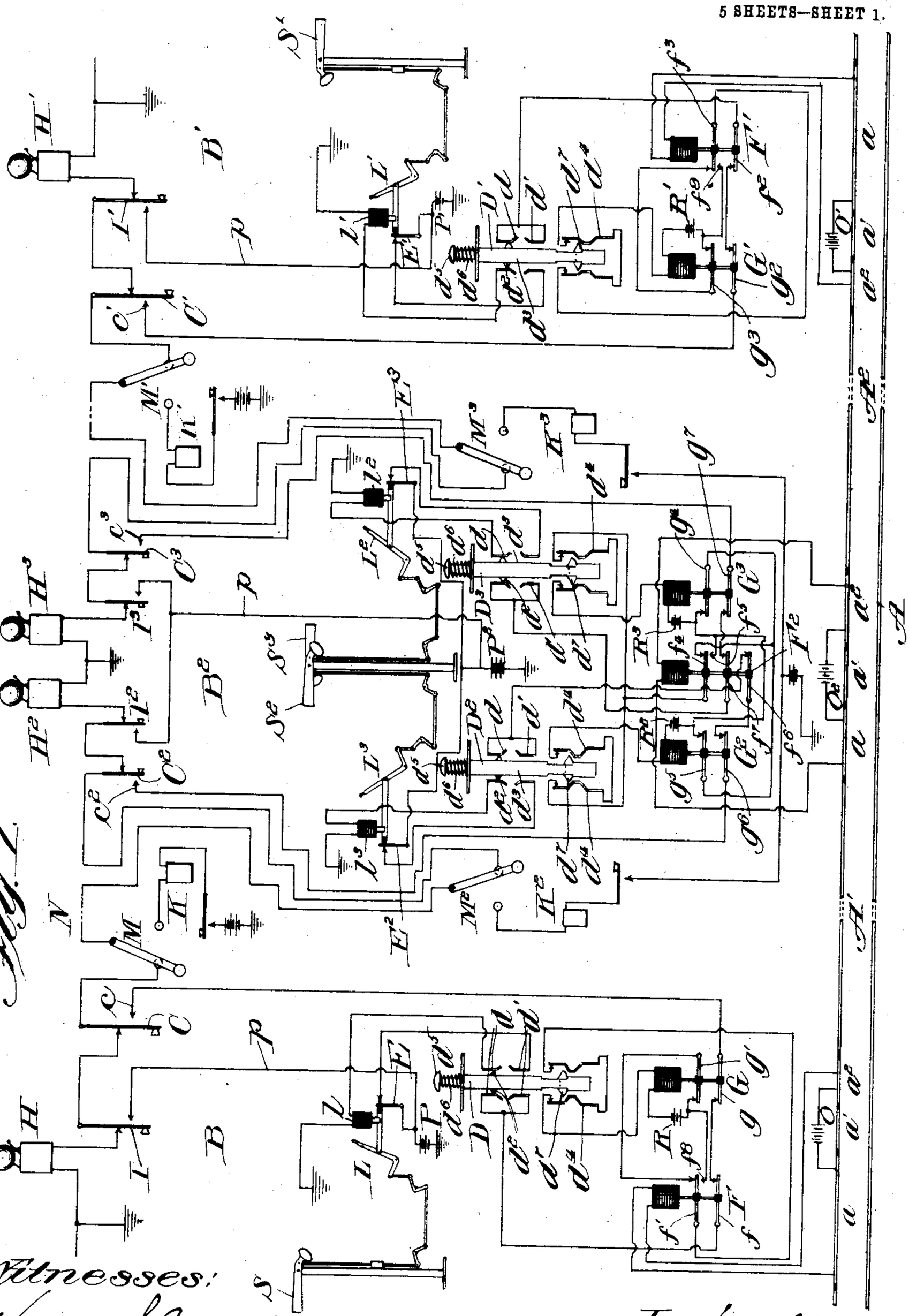

Fig. 1.

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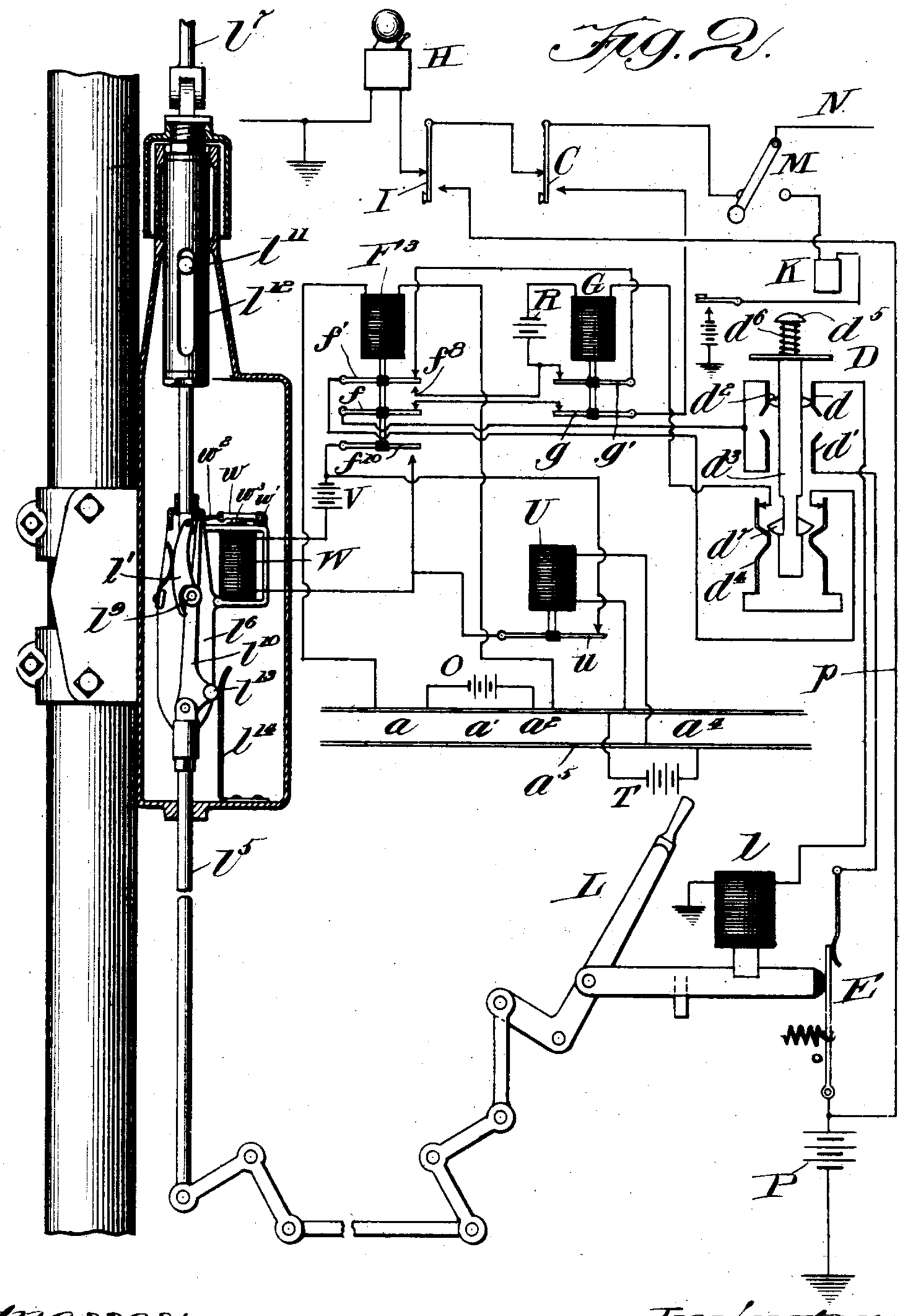
5 SHEETS—SHEET 2.

Fig. 2.



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5 SHEETS—SHEET 3.

Fig. 6.

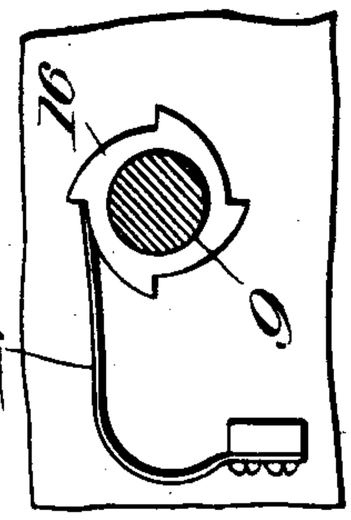

Fig. 7.

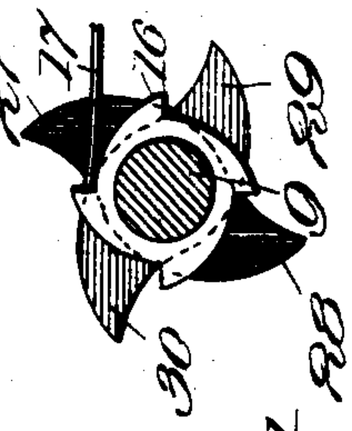

Fig. 8.

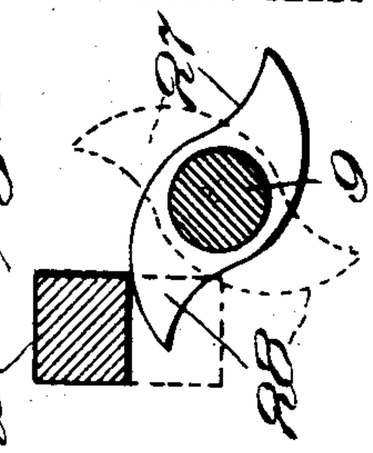

Fig. 4.

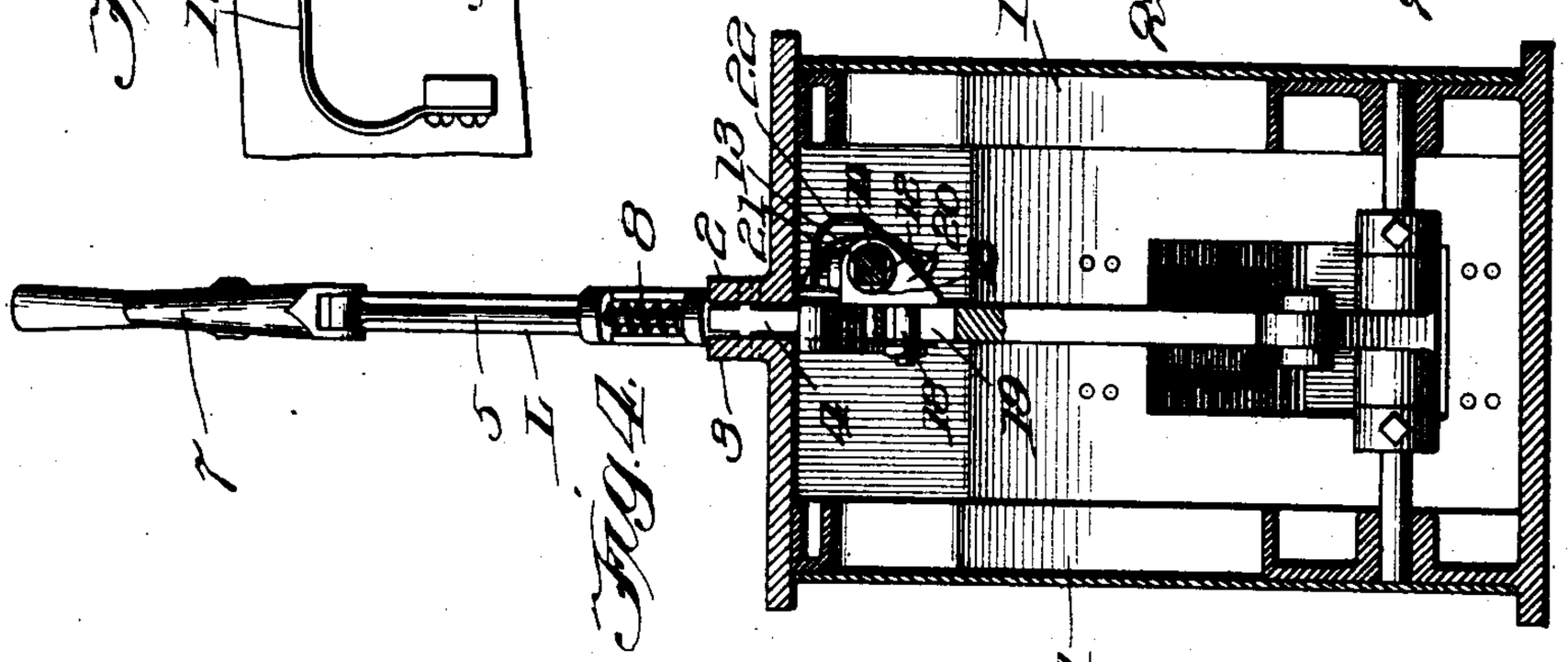

Fig. 5.

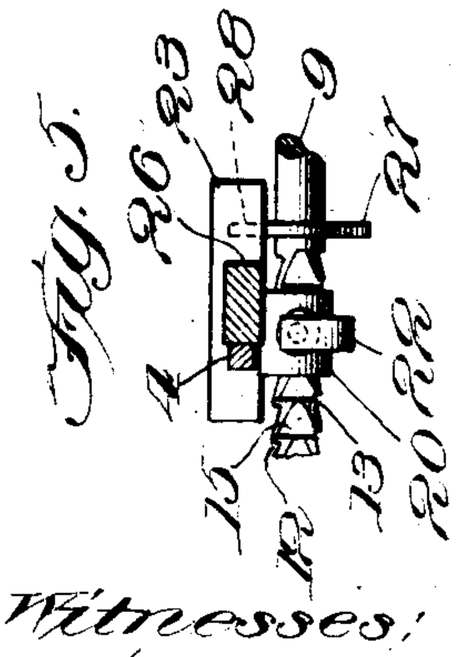

Fig. 3.

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5 SHEETS—SHEET 4.

Fig. 10.

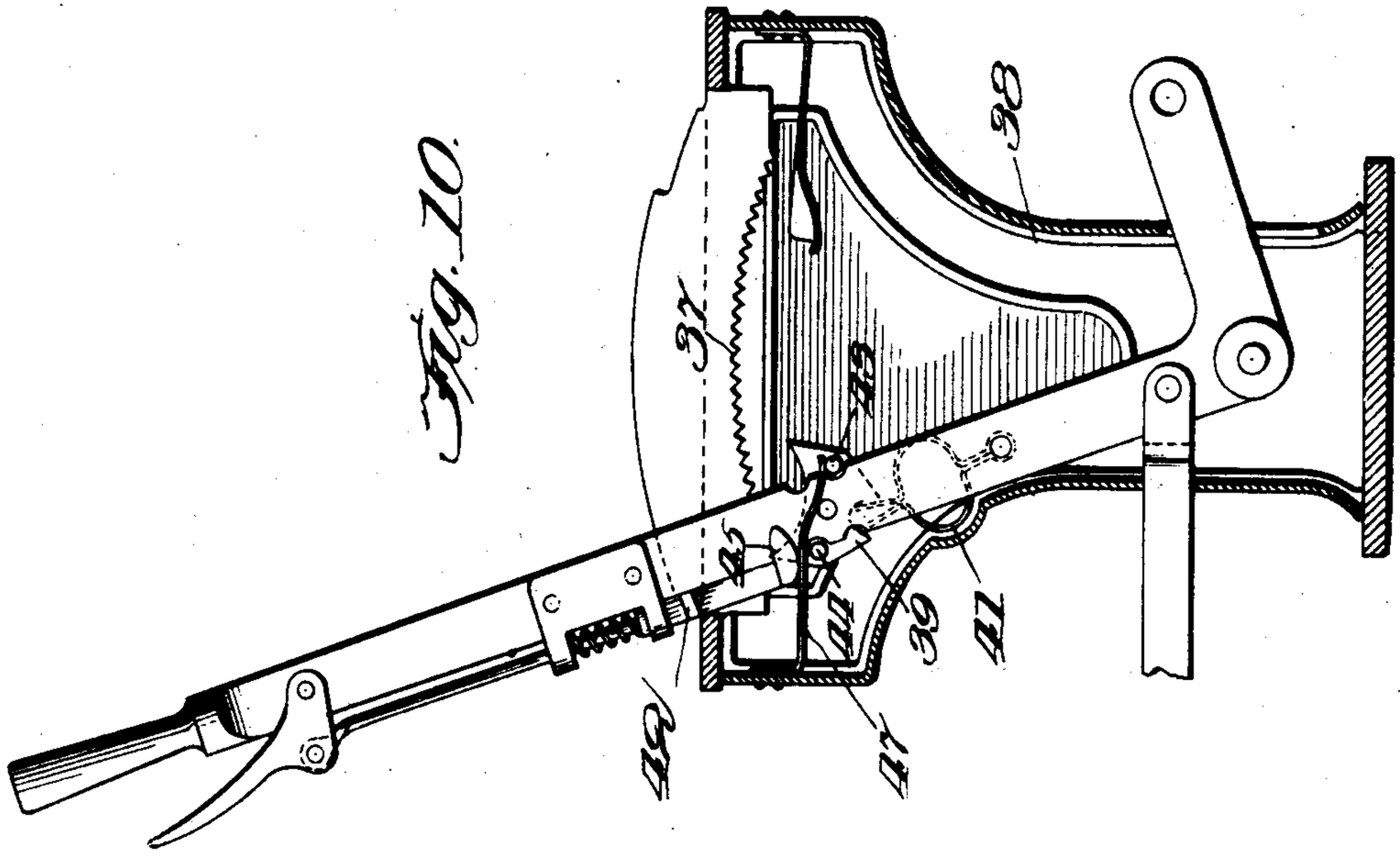
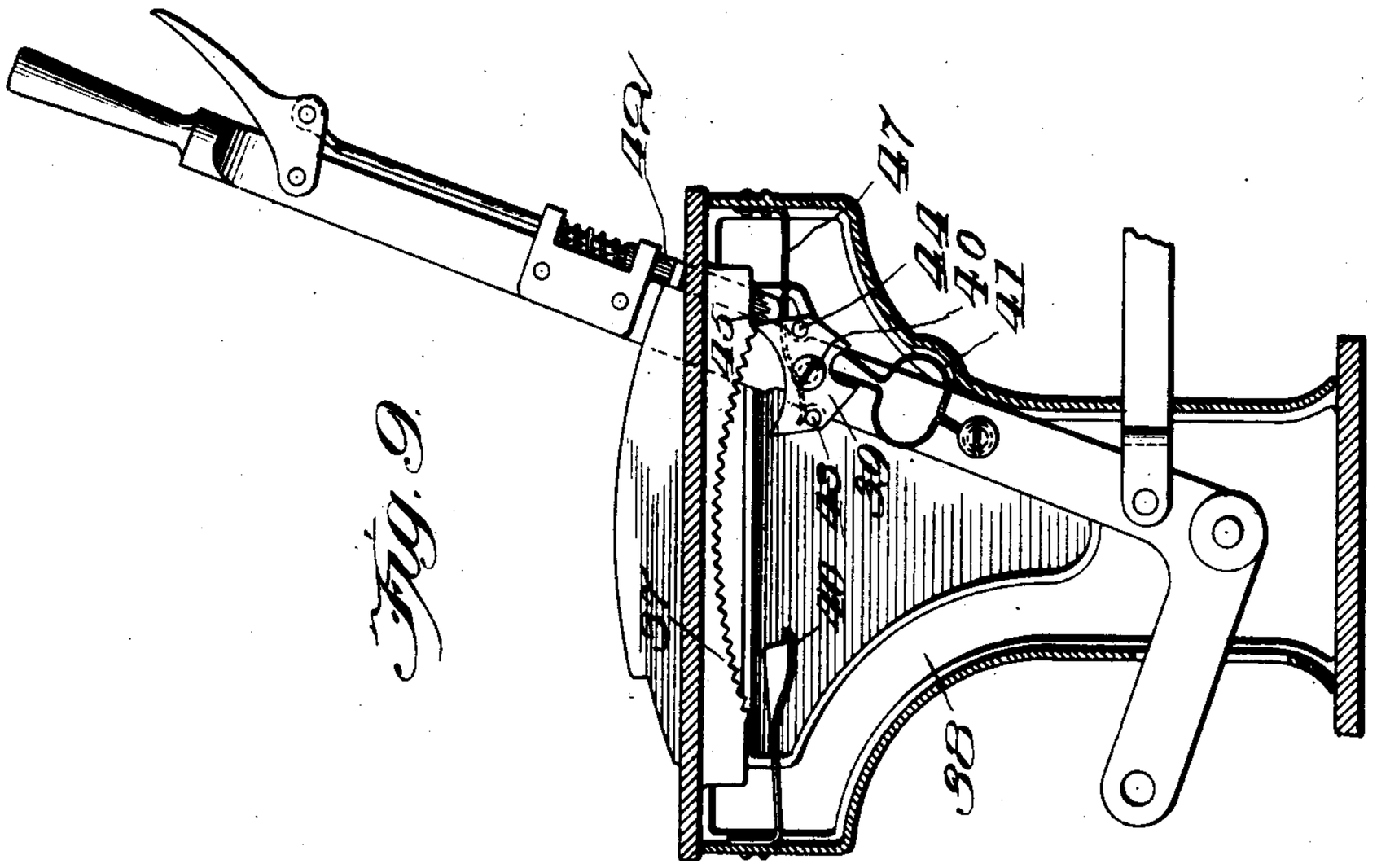


Fig. 9.



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5 SHEETS—SHEET 5.

Fig. 13.

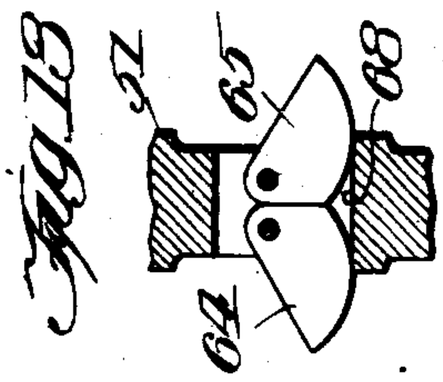


Fig. 14.

Fig. 12.

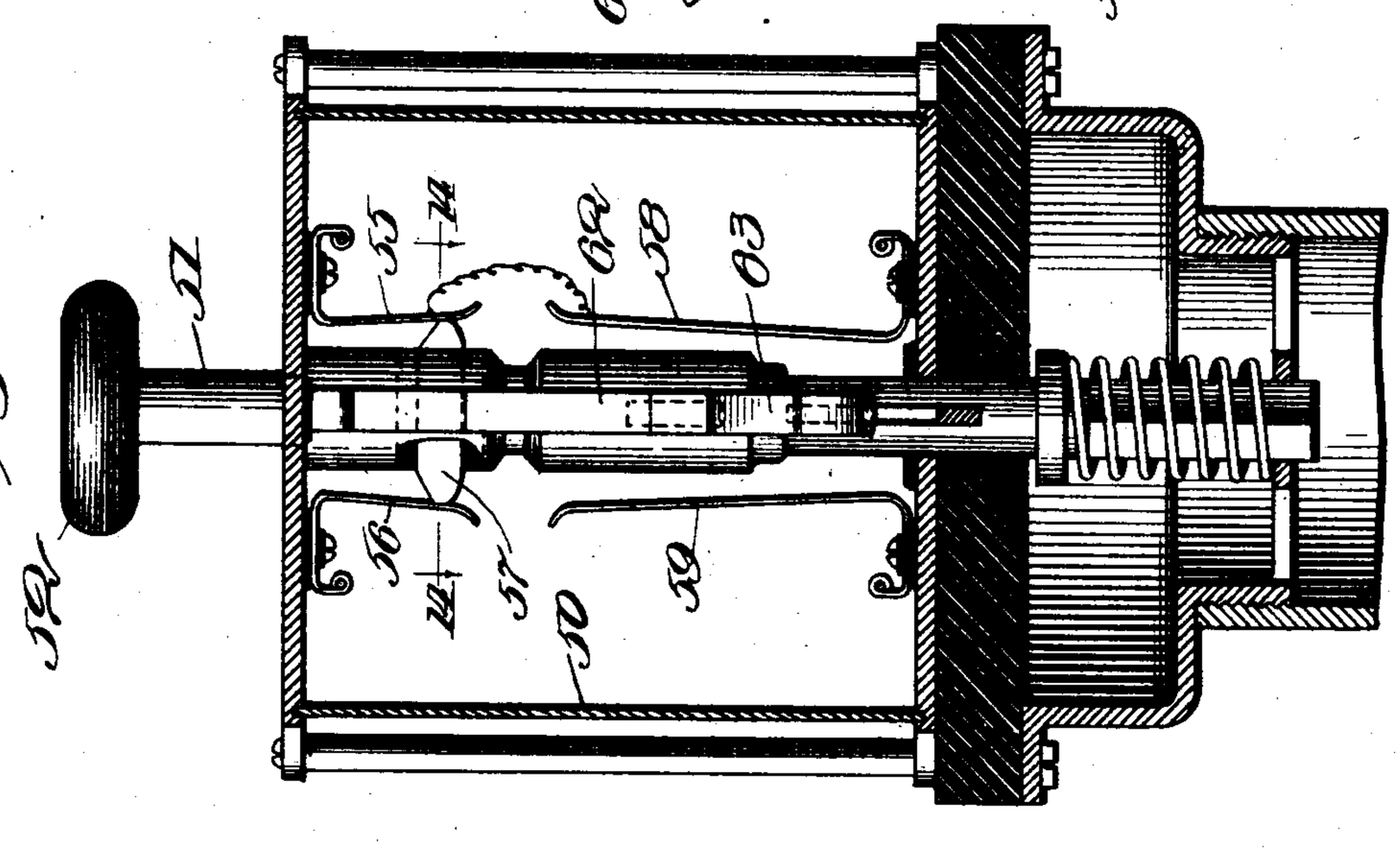
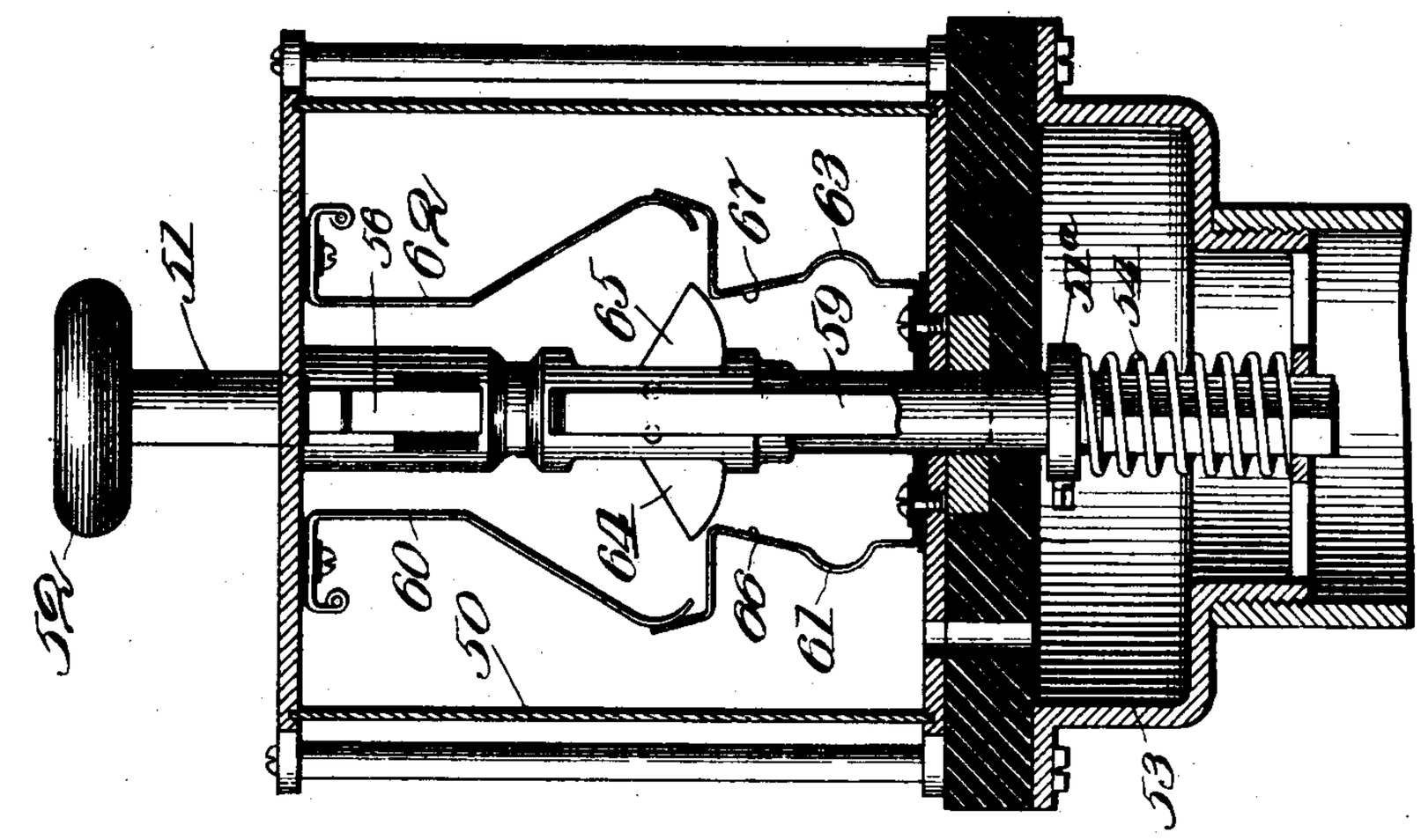


Fig. 11.



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UNITED STATES PATENT OFFICE.

WILLIAM DAVES, OF BLOOMINGTON, ILLINOIS.

BLOCK-SIGNAL SYSTEM.

No. 869,555. Specification of Letters Patent. Patented Oct. 29, 1907.

Application filed April 22, 1907. Serial No. 369,454.

To all whom it may concern:

Be it known that I, WILLIAM DAVES, a citizen of the United States, residing at Bloomington, county of McLean, State of Illinois, have invented a certain new and useful Improvement in Block-Signal Systems, and declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to block signal systems and particularly to that type known as controlled manual block systems, namely: systems wherein, although the signals are actuated manually, provision is made which renders it necessary that the signalmen at both ends of a block coöperate in order that a clear signal may be displayed at either end of the block. The purpose of requiring the coöperation of the signalmen at both ends of the block, in order that either may show a clear signal, is to reduce the liability of accident through negligence or mistake on the part of a signalman by placing the responsibility for a clear signal at either end upon the signalmen at both ends of a block. In order that signal systems of the character specified may act as the safe-guards which they are intended to be, they should be so constructed and arranged as to make their operation absolutely certain and reliable; so that a careless or even a malicious signalman cannot display a clear signal except with the coöperation and consent of the signalman at the other end of the block, and under conditions which will make it entirely safe for a train to proceed.

The object of my invention is to provide a signal system of the character described which shall fully answer the requirements just enumerated.

A further object of my invention is to provide a signal system wherein any wilful or negligent action or failure to act on the part of a signalman in the manipulation of the apparatus at his station will positively result in the display and maintenance of a danger signal until the conditions are rectified.

A further object of my invention is to provide a novel arrangement whereby, after a signalman has coöperated to produce a safety signal at the opposite end of the block, it becomes impossible for him to display a safety signal at his end of the block until the train has cleared the block.

A further object of my invention is to provide a signal system of the controlled manually-operated type wherein the signalmen must always place the operating levers fully into the positions toward which they are started before they can be returned to the initial position.

A further object of my invention is to provide a novel arrangement for controlling the automatic trip mechanism for the semaphores at the ends of a block system so that the semaphores are always restored to danger when the last car leaves a station, independently of the length of the train.

A further object of my invention is to provide a novel arrangement of circuits for controlling the track relays whereby the number of insulated joints in the rails is reduced and at the same time the danger of interferences under conditions which should not affect the track relay is reduced to a minimum.

A further object of my invention is to provide a novel construction of parts and arrangement of circuits whereby but a single conductor need be used between stations in order to enable the signalmen to signal to each other, telegraph to each other, and produce the other operations which will permit the display of a clear signal at either end of a block.

A further object of my invention is to provide means whereby the operating lever for a signal, after it has been moved from one of its operative positions toward another, cannot be returned to its initial position until it has been brought completely to the other operative position.

My invention contemplates also further improvements in circuit connections and in the construction and arrangement of the various mechanical devices which go to make up a system.

The various features of novelty which characterize my invention will be hereinafter particularly pointed out in the claims, but for a full understanding of my invention and of its various objects and advantages, reference is to be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a diagram showing two blocks governed by a signal system arranged in accordance with a preferred form of my invention; Fig. 2 is a diagram showing one of the end stations of a system having applied thereto my improved arrangement for automatically returning the signal to danger after a train leaves the station; Fig. 3 is a longitudinal section through the supporting frame of a signal operating lever arranged in accordance with the preferred form of my invention; Fig. 4 is a section taken on line 4 Fig. 3 looking in the direction of the arrows; Fig. 5 is a detail view; Fig. 6 is a section taken on line 6—6 Fig. 3 looking in the direction of the arrows; Fig. 7 is a section taken on line 7—7 Fig. 3 looking in the direction of the arrows and showing only the locking bar for the lever; Fig. 8 is a detail view showing the method of operating the locking bar; Fig. 9 is a view similar to Fig. 3 showing a modified form of locking mechanism for the lever; Fig. 10 is a view similar to Fig. 9 showing, however, the opposite side of the lever; Figs. 11 and 12 are side and front elevations respectively of one of the circuit breakers illustrated in Fig. 1;

the casing being shown in section; and Figs. 13 and 14 are detail views of the circuit breaker, Fig. 14 being a view on line 14 of Fig. 12.

Referring first to Fig. 1 of the drawings, A shows a single track divided up into blocks A′ and A². There may, of course, be any desired number of blocks in any one system, but I have shown only two of such blocks since this is all that is necessary to clearly disclose the arrangement of the end stations and an intermediate station; which latter station is, of course duplicated at all of the intermediate stations which there may be. B and B′ represent respectively the stations at the end of the section divided into blocks and B² is the intermediate station. There need be only one semaphore at each of the stations, these being indicated by S and S′, respectively; while at the intermediate station there are two semaphores S² and S³. Thus there are two separate semaphores at each block, one arranged at each end thereof.

In order to make it difficult to tamper with the immediate operating mechanism for each semaphore, I prefer to connect the operating levers L, L′, L², and L³ thereto by means of rigid rod and pipe connections. It will, of course, be understood, however, that the operating mechanism between the semaphores and the levers may be varied to suit the taste of the engineer or the exigencies of the situation in which the system is employed.

The system illustrated is of the normal danger type, namely the semaphores normally occupy the positions which indicate danger. The parts in the drawing are all shown in the positions which they normally occupy when no train is upon or about to enter either block. The semaphores are illustrated as extending horizontally, this position being therefore that of danger. When the several operating levers occupy their normal positions, they are locked in place in any suitable manner, preferably by means of electromagnetic locks *l*, *l′*, *l²*, and *l³*. Circuit connections are provided so that the locks at one station are under the control of the operator or signalman at the adjacent stations: thus the signalmen at stations B and B² must coöperate to release the lock *l*. Similarly the lock *l′* requires the coöperation of the signalmen at stations B′ and B² and the locks *l²*, and *l³* require, respectively, the coöperation of the signalmen at stations B′ and B², and at B² and B, before the signalman at station B² can move the operating levers controlled thereby. Each lock is also controlled by relays located at the same station and controlled in part by the trains which run on the track and in part by switch mechanism which the signalmen are required to operate. At the station B is a double-throw switch C, a circuit-breaker D, and a single-throw switch E. The switch C and the circuit-breaker are manually operated, and the switch E, which is arranged so as to have a tendency to remain open, is controlled by the operating lever L so as to be closed thereby only when the operating lever is in the danger position. At the station B′ are switches C′, D′, and E′ corresponding to the switches C, D and E and at the station B² are two sets of switches C², D², E², and C³, D³, and E³, which also correspond to the switches C, D and E.

The relays at the several stations comprise track relays F, F′, and F² respectively, and stick relays G, and G′ at the end stations, and a pair of relays G², and G³, at the intermediate station. The track relays are normally energized and are so connected to the rails that they are deënergized by a passing train. The stick relays are controlled from the track relays and also from the circuit-breakers at the respective stations. Other adjuncts at each station are bells H and H′ at the end stations and H² and H³ at the intermediate station.

I, I′, I² and I³ are bell switches located at the several stations.

K, K′, K², and K³ are telegraph instruments whereby telegraphic messages may be sent between stations.

M, M′, and M² are double-throw switches arranged to disconnect the bell switches from the single signal and control wire N and to connect thereto, instead, the telegraph instruments.

One rail of the track is divided at each station into three insulated sections *a*, *a′*, and *a²* and the other rail may be arranged in any manner desired. The section *a′* is made of such length that it can be spanned only by a full-sized car; that is, as cars are now built, this section should be about thirty feet long. The opposite terminals of the coils of the track relays are connected to the sections *a* and *a²*, respectively, and the exciting batteries O, O′, and O² have their opposite terminals also connected to these sections. Normally, therefore, the track relays are supplied with current from the batteries. When, however, a train passes in front of a station, one pair of trucks will place the section *a* in electric connection with the other rail and another pair of trucks will similarly connect *a²* and the other rail: therefore the battery at that station will be short-circuited and the current will be diverted from the track relay, so that this relay is deënergized and causes its normally closed contacts to open. It will be seen that, by dividing the track in the manner described, only one of the rails need be thoroughly insulated and the danger of shunting the battery so as to deënergize the track relay on account of a bar or wire falling across the track, or a hand car being placed upon the track, is obviated. This feature of my invention I regard as of importance, not only for use in connection with the other novel features, but also in connection with any form of signal systems.

Assuming that a train is approaching the station B from the left and that the signalman desires to display a clear signal so as to allow the train to proceed toward the next station: he first presses the bell switch I, and current is caused to flow from a battery P through the wire *p*, through the switch I, switch C, switch M, wire N, to the switch M², to the switch C², to the switch I², through the bell H², to ground and back to the battery. The bell H² is therefore caused to ring, and the signalman at the intermediate station is apprised of the desire of the operator at the other station to actuate his signal. If the track conditions are such that it is proper for the signal at station B to be placed at clear, then the signalmen must operate the switches C and C² at their respective stations and the signalman at the intermediate station must also operate the circuit-breaker D². The magnetic lock *l* will thereupon be actuated to release the signal operating lever at the station B and the signal may be thrown to clear. The circuits are so arranged that the signalmen can not release the lock except when the track is clear and all of the parts of the apparatus are in the positions in which they properly

belong; so that even if the signalmen should, through carelessness or otherwise, attempt to give a clear signal at one station when there is a train between stations, or when the signal at the other station is not set fully at danger, it would be impossible for them to do so. Thus, the energizing circuit for the lock at the left hand station, beginning with ground at that station, passes through the actuating coil of the lock, thence through the upper contact d of the circuit breaker D, through the lower contact f of the track relay F, through the lower contact g of the stick relay G, through the switch C, switch M, wire N, switch M^2, switch C^2, lower contacts g^6 of relay G^2, at the station B^2, lower contact f^6 of the track relay F^2, through the contact d' and circuit breaker D^2, thence through switch E^2, through battery P^2 to ground. The contacts d' of the circuit breaker, are bridged by means of the movable contact member d^2 carried upon the stem d^3 of the circuit breaker when the circuit breaker is operated.

It will be seen that unless the lever L^3, at the middle station, is in the danger position so that the semaphore S^3 projects horizontally and warns a train coming from the right hand side against entering the block A', the actuating circuit for the lock at the left hand station cannot be completed; and therefore, it is necessary that the signal at the intermediate station be placed at danger before the signal at the first station can be made to indicate safety. Furthermore the signal at the end station can only be thrown to safety provided there is no train standing at the corresponding station; for if there be such a train, the track relay F will be deënergized and the lock actuating circuit will be interrupted thereby. If, however, the conditions are such that a safety signal may properly be displayed, the lock-actuating circuit will be completed in the manner described and the signal lever will be released so that the signalman can operate the signal. When the signalman at the intermediate station operated the circuit breaker he rendered his own apparatus inoperative to display a safety signal for the block A' until after the approaching train has passed his station. The arrangement whereby this is effected is as follows: The stick relay G^2 is normally energized by means of current flowing from battery R^2 through the contacts g^5 of this relay, through the contacts f^4 of the track relay F^2, through the lower contacts d^4 of the circuit breaker D^2, thence through the actuating coil of the relay back to the battery. The circuit breakers are also constructed (as will hereinafter be described in detail) so that when the buttons d^5 are depressed circuits will be broken at contacts d and completed at d' and then, upon release of the buttons, the springs d^6 force the movable members of the circuit breakers to the positions shown; but during this latter movement the cams d^7 momentarily force the movable members of the contacts d^4 away from the fixed members. Therefore, when the signalman at the intermediate station operated the circuit-breaker so as to permit the signalman at the other station to give a clear signal, he interrupted the circuit controlling the stick relay G^2 and the contacts of the relay dropped open. As long as this relay remains open the lock l^3 cannot be released, since the actuating circuit for this lock passes through the contact g^6 of the stick relay. After the stick relay has become deënergized, it cannot be again energized until the corresponding track relay has been deënergized so as to allow the movable member of the contact device f^4 to drop into engagement with the fixed contact f^5; this occurring only after the train, which has left the other station, reaches the intermediate station and short-circuits the battery O^2 by bridging the track rails at each end of the insulated section a'. When this occurs and the track relay drops, an actuating circuit for the stick relay may be traced from the lower terminal battery R^2, through the contact members f^4 and f^5 of the track relay, through the contact d^4 of the circuit breaker D^2, through the coil of the relay, back to the upper terminal of the battery. Thus the stick relay is automatically operated by the train so that, after the train has passed the station, a clear signal may be displayed in the direction of the block A'. In the same way, if the signalman at the intermediate station desires to set a clear signal so that the train may enter the block A' from the block A^2, he first signals the station B by pushing the bell switch I^2, causing the bell H at the other station to ring. If after the signalman has intimated his desire to set a clear signal, the signalman at the other station presses the switch C so as to cause the movable member to engage with the fixed contact c and also depresses the button on the circuit breaker, then upon operating the switch C^2 so as to bring a movable member in engagement with the fixed contact c^2, the circuit through the lock l^3 is completed as follows: from ground through the contacts d of the circuit breaker D^2, through the contacts f^6 of the track relay F^2, through the contacts g^6 of the stick relay G^2, through the switch C^2, through the switch M^2, through the wire N, through the switch M, through the switch C, through the contact g of the stick relay G, through the contact f of the track relay F, through the contacts d' and d^2 of the circuit-breaker D, through the switch E, through the battery P to ground. Thus, if there is no train at either station or between either station and the operating lever at the station B is in the danger position, the lock at the intermediate station is released and the signal may be set. In the same way trains may be sent between stations B and B^2 provided that in every case the proper conditions are complied with. The several stick relays are identical in every respect and it is believed to be unnecessary to trace all of the circuits leading thereto or therefrom as they are all clearly identicated on the drawing. Thus the relay G has two contact devices g and g' corresponding to the contact devices g^6 and g^5 of the relay G^2 and with the contact devices g^2 and g^3 on the relay G', and contact devices g^7, and g^4 on the relay G^3. Current for the relays G, G', and G^3, is supplied respectively by batteries R R', and R^3 similar to the battery R^2. The track relays at each station are the same except that the relay at the intermediate station has an additional contact member f^7 which is connected to the contact g^7 of the stick relay g^3 in the same manner that the contact f^6 is connected with the contact g^6 of the stick relay G^2. Thus the contacts f, f^6, f^7, and f^2, perform corresponding functions, while the contacts f', f^4, and f^3, perform corresponding functions; the contact f^4 being, however, connected in parallel to the two circuit breakers at the intermediate station and controlling both of the stick relays. Also contact devices f^5, f^8, and f^9 of the several track relays perform similar functions.

In addition to the safety devices heretofore de-

scribed, the operating lever mechanism is so constructed and arranged, as will hereinafter appear, that after a lever has once been started from the safety position to the danger position, or vice versa, the movement to the opposite position must be wholly completed before the lever can be returned to the starting point. This will prevent a signalman from throwing his lever only far enough so as to partially indicate danger or safety and then return it to the starting point. It will therefore be seen that there is small possibility of having a wrong signal displayed through carelessness, inadvertence, or mischievousness on the part of either or both operators.

Since there is nothing to compel the signalmen at the end stations to place their signals at danger as soon as a train has passed, and since there is only a single semaphore at such stations, it is customary to provide means whereby a train automatically returns the semaphore to danger after it has passed upon a block pursuant to a clear indication. Such action usually takes place as soon as the head of the train reaches to, or just beyond the station, but it is frequently desirable, not only that the engineer shall see the signal go to safety before he comes opposite a station, but also that the conductor at the end of a train may see the signal go back to danger after the station is passed. I have therefore provided an auxiliary controlling device for the usual mechanism which trips the semaphore and causes it to return to danger, whereby the semaphore remains unaffected as long as a part of the train remains at a station. In other words, the signal is returned to danger only when the last car leaves. In Fig. 2 of the drawings I have shown one of the stations at the entrance to a block system embodying this latter feature of my invention. The arrangement shown is exactly the same as that at the station at the left hand end of Fig. 1, except that the track relay F^3 has an additional contact device f^{10}. In addition, a fourth insulated section a^4 at the end of the section a^2 is provided in the track rail and preferably also the other rail has an insulated joint as at a^5. A battery T is connected between the section a^4 and the other rail and leads to the coil of a relay U permanently connected through the section a^4 and the other rail. The relay U is commonly known as a slot relay. The contact devices u on the slot relay and the auxiliary contact device f^{10} on the track relay serve to complete independently of each other, the circuit from the battery V through the usual electro-magnet W controlling the mechanism which disconnects the semaphore S from the operating rod 15 so as to allow the semaphore to assume the danger position independently of the operating lever. This latter mechanism may take any preferred form, as for example the rod 15, may be provided with an enlarged guide 16 through the top of which the lower end of the rod 17 projects, the upper end of the rod 17 being attached to the semaphore. Pivoted to the lower end of the rod 17 is a pawl 18 which normally rests upon a friction roller 19 carried on a lever 110 pivoted to the top of the rod 15. The magnet W carries on the side of the guide 16 and has an armature w. The armature is pivoted at one end as at w' and has its other end connected to the top of the lever 110 by means of a link w^2. When free to do so, a spring w^3 forces the armature outwardly and draws the upper end of the lever 110 laterally and draws the roller 19 out of engagement with the pawl. If the operating lever is now in the position wherein the signal shows clear, the rod 17 and the weighted end of the semaphore arm are free to drop until brought to rest by means of the pin 111 which projects through a slot 112 in the rod 17. If the signal is already in danger, nothing will happen, but upon the subsequent energization of the magnet, the lever 110 will be forced laterally again so as to bring the roller beneath the pawl once more. It will be seen that after the signal has been automatically tripped the proper engagement between the rods 15 and 17 may be again effected by returning the operating lever to the danger position whereby the nose 113 on the lever 110 will engage with the spring 114, causing the lever to be forced lateraly into operative position with respect to the pawl. The spring 114 also prevents the disengagement of the operating rod from the semaphore if the signalman throws the signal to danger before the last car leaves the section a. The operation is as follows: As soon as the locomotive or the first car enters upon the section a^4, the battery T is short-circuited and the relay U deënergized. The circuit through the magnet W remains intact, however, as long as there are cars on the section a and a^2 which act to short circuit the battery O and maintain the track relay deënergized. As soon as the last car has left section a the short circuit about the battery O is removed and the track relay is energized so as to break the circuit through the magnet W. The circuit through this magnet is now broken at both relays and the signal must remain in danger position until the train passes wholly from the section a^4.

In Figs. 3 to 8 I have illustrated a preferred arrangement for compelling the operator to move the signal lever, after it has left either the clear or danger position, fully into the opposite position before it can be returned to the starting point. L indicates any usual form of lever pivotally supported in a supporting base, 1, so as to oscillate through a limited angle between segmental guides 2 and 3 arranged above the supporting base. 4 is a sliding dog carried by the lever and adapted to drop down past the ends of the segmental guides when the lever is in either operative position so as to hold the lever in that position. The dog is shown as mounted on the lower end of a rod 5 mounted in a guide plate 6 secured to the lever, said rod having its upper end attached to a grip 7. 8 is a spring about the rod 5 and acting to force the dog downward. All these parts may take any usual or preferred forms, since they of themselves do not constitute a feature of the present invention. Arranged within the base, at one side of the lever, and parallel to the plane of movement of the lever, is a locking bar 9. This bar is mounted in bearings in any suitable manner so that it may be rotated and at the same time be held against longitudinal movement. A convenient method of thus supporting the bar consists in providing bearings 10 and 11 in opposite walls of the supporting base and fitting ends of the bar revolubly in said bearings. The bar is provided with ratchet teeth on its four sides. The series of teeth, 12 and 13, on opposite sides thereof are similarly arranged, that is the square shoulders thereof face in the same direction. The two other series of teeth, 14 and 15, are also similarly arranged, but face in the opposite direction from the teeth 12 and

13. A four-pointed star wheel 16 is secured to one end of the bar and this is engaged by a spring 17 carried from a fixed position of the base. The function of the star wheel and the spring is to yieldingly hold the bar in any one of four positions. Carried by the lever and connected thereto, preferably by means of a bolt 18 passing through a slot 19 in the lever, is a collar 20 loosely surrounding the bar. The connection between the collar and the lever is a loose one so that, as the lever moves back and forth, the collar moves in a straight line along the bar and at the same time travels up or down, as the case may be, along the lever. Projecting through the top wall of the collar is a pin 21, and this pin is normally pressed inward by means of a spring 22 which is secured at one end to the collar and bears at its other end upon the outer end of the pin. The pin is of such length that it tends normally to drop behind the teeth on the bar, so that when the lever is moved in one direction the pin slides over the teeth, but when it is attempted to move the lever in the opposite direction, without turning the bar, the pin abuts against one of the teeth and locks the lever. Thus, assuming that the lever is in the position shown in Fig. 3, it is evident that it may be moved toward the left without interference on the part of the locking pin and the toothed bar; but a backward movement will be positively prevented. In order to utilize this characteristic of the locking mechanism so as to make it necessary for the operator to always move the lever fully into one of its positions after he has started it from the other position, I provide means for causing the locking bar to be rotated a quarter turn at the end of each stroke of the lever. Thus after the lever has been moved fully toward the right, the locking bar is rotated a quarter turn so as to bring the series of teeth 14 uppermost and, since these teeth are inclined in the opposite direction from the teeth 13, the lever is free to be moved into the position shown, the pin 21 during this movement sliding over the inclined faces of the teeth. It will be seen, however, that when the series of teeth 14 is uppermost, the lever, after it has been started toward the position shown, must continue its movement before it can be brought back to the extreme left hand position, since the teeth 14 lock the lever against movement toward the left. Any suitable means may be provided for controlling the locking bar so as to effect its partial rotation at the end of each stroke of the lever. This may conveniently be done by providing the locking dog 4 with a downward extension 23 which projects within the base and is adapted to coöperate with arms of some sort on the bar so as to rotate the bar the desired extent, after the lever has fully reached either operative position, by simply permitting the locking dog to assume its locking position behind the ends of the guide segments. The member 23 is preferably made elongated transversely of the lever and rounded on its under-surface at its two ends as at 24 and 25; and, in order to provide stiffness thereto it may conveniently be formed of a thickness equal to or greater than the thickness of the lever and be provided with a notch 26 in one side thereof within which the lever rests. Near each end of the locking bar, and in a position to be engaged by the member 23 are laterally projecting wings or arms. Thus, at the right hand end of the bar are the two oppositely-disposed curved arms 27 and 28. At the other end of the lever are two similar arms 29 and 30. The arms 29 and 30 are arranged at right angles to the arms 27 and 28. The parts are so proportioned that when the locking dog 4 drops fully into its locking position it engages one of the arms on the bar and forces it downward through an angle of 90 degrees, thereby rotating the bar a similar amount. In any position of the bar, therefore, there will always be one arm arranged in the path of movement of the member 23. In Fig. 5, and in Fig. 8 in full lines, the member 23 is shown in the position which it occupies just before it begins to rotate the locking bar. As the locking dog and the member 23 are depressed, the arm which in the illustration happens to be the arm 28, is depressed until it occupies the position shown in dotted lines in Fig. 8 and in full lines in Fig. 3. Insofar as the locking bar is concerned the lever is now free to be moved toward the left. It will be seen, however, that a retrograde movement is not permitted until the locking dog has dropped behind the left hand ends of the guiding segments, whereby the end 24 of the member 23 engages with the arm 30 on the shaft (this arm being now horizontal) and rotates it through an angle of 90 degrees. The series of teeth 14 is now uppermost and the lever may be again moved toward the right; but it will be seen that after movement toward the right is once begun, it must be continued to the extreme right before the lever can be brought back again. The function of the star wheel is now apparent, namely this wheel serves to yieldingly hold the bar in any position to which it is rotated in the manner described, but readily permits such rotation to take place at the proper times.

It will thus be seen that, by my improved locking mechanism, the lever may be moved back and forth freely, provided that it is always carried into its extreme positions; but its movement in either direction will be positively checked until a movement in the other direction has been entirely completed. By this arrangement it is made impossible for a signalman to move his lever part way so as to show a clear or a danger signal and still have control over the signal to return it to its other position before the proper conditions are observed.

In Figs. 3 and 4 I have also shown the lock 1 and the switch E which are conventionally indicated in Fig. 1. This lock may take any desired form, as for example, a sliding rod 31 may be attached to the lever and be provided with a notch 32 which is adapted to receive the end of the plunger 33 of the electromagnetic lock when the lever is in the danger position. It will be seen that when the plunger is retracted, the lever is released and, provided that the locking dog 4 and the connecting member 23 have been moved to their lowermost positions so as to rotate the locking bar, the lever may be moved to the clear position. The switch E may conveniently consist of a fixed contact 34 and a spring arm 35 so arranged that when free to do so it moves away from the fixed contact. The member 31 has a piece of insulation 36 at its extreme end and, when the lever is in the danger position, this insulation engages the spring arm and presses it into engagement with the fixed contact. It will, of course be understood that any desired form of lock and circuit controller may be employed, the form shown being, how-

ever, such as may be used if desired without danger that the operator will be able to tamper therewith.

In Figs. 9 and 10 I have shown a further form of locking mechanism for preventing the lever from being moved in one direction before it has been brought to its extreme position in the opposite direction. Thus, instead of the toothed rotatable bar shown in the other modification, I arrange at one side of the lever, and parallel with the plane of movement thereof, a segmental rack 37 which is suitably secured to the base 38. A double-ended pawl 39 is pivoted to the lever at 40 and also mounted on the lever and engaging with the pawl is a spring device 41 which acts to hold either end of the pawl in engagement with the teeth on the segment. When the right end of the pawl is in engagement with the teeth, the lever is prevented from being moved toward the right; and when the left hand end of the pawl is in engagement with the teeth, the lever is held against movement toward the left. Means are provided for automatically shifting the pawl when the lever is brought to either extreme position so as to permit a free movement toward the other position. After such a movement has been begun, however, a backward movement will always be prevented by one of the ends of the pawl until the pawl has been tripped by bringing the lever fully into the position toward which it has been started. The pawl may conveniently be tripped in the same manner that the locking bar in the other form is rotated, namely by means of the usual locking dog 42 or an extension thereof. A convenient method of accomplishing this is to provide two laterally projecting pins 43 and 44, one at each end of the pawl. These pins project from the inner surface of the pawl across the lever and beyond the opposite side thereof, so that their free ends lie in the plane of movement of an extension 45 on the lower end of the locking dog 42. A pair of spring arms 46 and 47 are secured to the base near the opposite ends of the path of movement of the pawl and in position to engage with the ends of the pins 43 and 44. The part 45 is adapted to press down on the spring 46 or 47, as the case may be, (depending upon the position of the lever) and thereby cause the spring to oscillate the pawl in the proper direction; so that the lever may then be moved in the other direction without interference on the part of the pawl. The spring 41 may be so adjusted as to not only hold the pawl in either position, but also to complete the oscillation thereof after it has been begun through the action of the locking dog. It will be seen that the pawl is always in position to permit a free movement in one direction, but as soon as it is attempted to move the lever in the other direction without first tripping the pawl, namely without first bringing the lever to one of its extreme positions, the pawl acts as a positive lock to prevent such movement. Thus in the position shown in Fig. 9, the lever is in an extreme position and the pawl has been tripped so as to permit a movement of the lever toward the left. During such movement, the right hand end of the pawl rides over the teeth in the segment and does not interfere with the progress of the lever. If, however, it is attempted to return the lever to its initial position, the pawl will act as a positive lock, the pin 43 abutting against the edge of the lever and forming a rigid stop for the pawl. After the lever has reached the extreme left, the locking dog drops into its locking position, the extension thereon engages with the top of the resilient members 46, and the pawl is tripped by reason of the engagement of the pin 44 with the under-side of the members 46. The left hand end of the pawl now engages the segment and the lever is free to be moved toward the right. A backward movement is prevented, however, (before the other position is reached again) by reason of the engagement of the pin 44 with the edge of the lever so as to prevent the backward rotation of the pawl.

In Figs. 11 to 14 I have shown a form of circuit breaker which may be used to advantage in the system described. Referring to these figures, 50 indicates a box or casing having any suitable construction. Arranged within the casing and projecting through the top and bottom thereof is a stem 51 having a button 52 at its upper end. Surrounding the lower end of the stem and placed between a shoulder 51ª thereon and a cap 53 formed on or attached to the bottom of the casing, is a spring 54 which normally holds the stem raised. Secured to the top of and within the casing are two spring contacts 55 and 56 arranged on opposite sides of the stem. Normally these contacts are bridged by a movable contact 57 carried by but insulated from the stem. Secured to the bottom of the casing, in alinement with the contacts 55 and 56, are two other spring contacts 58 and 59 so arranged that when the button of the circuit breaker is pressed the movable contact member 57, after leaving the contacts 55 and 56, engages with their bridges the contacts 58 and 59. The contacts 58 and 59 are insulated from each other, but the contacts 55 and 58 are connected together electrically. Arranged in a plane at right angles to the plane passing through the contacts 55 to 59 are two sets of spring fingers 60, 61, 62, and 63, the fingers 60 and 62 being insulated from each other and the fingers 61 and 63 being electrically connected together. Normally the fingers 60 and 61 are in engagement with each other and the fingers 62 and 63 also engage; and when the push button is pressed inward, a pair of pivoted dogs 64 and 65, carried upon the stem, swing upwardly about their pivots so as to move downwards past the inclined portions 66 and 67 on the fingers 61 and 63, without affecting the progress. Upon the release of the button and during the upward movement of the stem, the dogs engage with a shoulder 68 on the stem and therefore act as cams which engage with the inclined portions of the fingers 61 and 63 and face them laterally so as to momentarily carry them out of engagement with the coöperating fingers. This momentary separation of the fingers effects the deënergization of the stick relay in the manner described.

While I have described in detail the best forms of my invention now known to me I do not desire to be limited to the details of construction and arrangement of parts illustrated and described, but intend to cover all forms which my invention as defined in the appended claims may take.

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

1. In a block signal system, a plurality of stations, a signal at each station, a lever for operating each of said signals, a lock for each lever, an actuating circuit for each of said locks, a switch governed by the operating lever at one station and a manually operated switch at that station arranged in the actuating circuit for the block at an adjacent station.

2. In a block signal system, a plurality of stations, a signal at each station, a lever for operating each of said signals, a lock for each lever, an actuating circuit for each of said locks, a switch governed by the operating lever at one station and a manually operated switch at that station arranged in the actuating circuit for the lock at an adjacent station, said manually controlled switch causing the actuating circuit for the lock at its own station to be interrupted when said switch is operated to complete the actuating circuit for the lock at the other station.

3. In a block signal system, a plurality of stations, a signal at each station, an operating lever for each signal, a lock for each lever, a manually controlled device at each station for governing the lock at an adjacent station, and means associated with said manually controlled devices for preventing the release of the lock at the local station when the manually controlled device is operated to cause the release of the lock at the other station, said means including a track circuit controlled by a train at the same station so as to permit the release of the local lock to be effected.

4. In a block signal system, a plurality of stations, a signal at each station, an operating lever for each signal, a lock for each lever, means associated with each lever for controlling the lock at an adjacent station, a manually operated switch at each station also controlling the lock at an adjacent station, and means associated with each of said switches for preventing the release of the lock at the same station when the switch is operated to effect the release of the lock at another station, said means including a track circuit controlled by a train at the same station so as to permit the release of the local lock to be effected.

5. In a block signal system, a plurality of stations, a signal at each station, an operating lever for each signal, a lock for each operating lever, a lock controlling circuit extending from each station to the next, a manually operated switch at each station for governing the lock controlling circuit for the next station, said switch being arranged to automatically return to normal position, a relay at each station for governing the controlling circuit for the lock at that station, means associated with each of said switches for causing the local relay to be deënergized upon the operation of the switch, and means arranged to be controlled by a train at the station for causing said relay to be energized.

6. In a block signal system, a plurality of stations, a signal at each station, an operating lever for each signal, a lock for each operating lever, a lock-controlling circuit extending from each station to the next, a manually operated switch at each station for governing the lock-controlling circuit for the next station, a relay at each station for governing the controlling circuit for the lock at that station, means associated with each of said switches for deënergizing the local relay upon the operation of the switch, and means arranged to be controlled by a train at the station for causing said relay to be energized.

7. In a block signal system, a station, a signal at said station, means controlled by a train for causing said signal to give a danger indication during the time the train remains within a predetermined distance of the station, and means also controlled by the train for preventing the aforesaid means from effecting the signal until the whole train has passed the station irrespective of the length of the train.

8. In a block signal system, a signal, a lever for operating the signal, a lock for said lever, a lock-controlling circuit, a stick relay controlling said circuit, a normally energized track relay arranged to cause the energization of the stick relay when the track relay is deënergized, a manually operated switch arranged in the controlling circuit for the lock at an adjacent station, means associated with said switch for deënergizing the stick relay when the switch is operated to cause the release of the locks at the next station, and circuits extending from the track to the track relay so arranged that the track relay is deënergized when a train is opposite the station at which the track relay is located.

9. In a block signal system, a plurality of stations, a station signal and a track signal at each station, an operating lever for each of said track signals, a lock for each of said operating levers, and means at each station for governing the track signal and operating the station signal at an adjacent station, said means including a single wire extending between the stations and including the actuating circuits for the locks at both stations.

10. In a block signal system, a plurality of stations, a signal at each station, an operating lever for each signal, a lock for locking each operating lever in the danger position, and a control circuit for each lock having therein a manually controlled switch at the local station and a plurality of manually controlled switches at an adjacent station, each of said latter switches being arranged to interrupt the circuit to the local lock when said switches are operated to complete the circuit for the lock at the other station, and means associated with one of said latter switches for maintaining the control circuit for the local lock interrupted independently of the switch until the train from the other station has cleared the block between the stations.

11. In a block signal system, a pair of stations at opposite ends of a block, signals at each station, operating levers for the signals, locks for locking each of said levers in the danger position, and controlling means for each of said locks including switches and relays at both stations so arranged that after the switches at one station have been operated to release the lock at another station the operating lever at the first station is prevented from being moved out of the danger position until the operating lever at the other station has been returned to the danger position and the train has cleared the block.

12. In a block signal system, a pair of stations at opposite ends of a block, signals at each station, operating levers for the signals, locks for each of said levers, controlling means for each of said locks including switches and relays at both stations, track relays at said stations for controlling the aforesaid relays, a source of current supply having its opposite terminals connected to one of said track relays and also to one of the track rails, said rail having an insulated section between the points at which the battery is connected, said insulated section being at least as long as the distance between the trucks at opposite ends of a full sized car.

13. In a block signal system, a plurality of stations, a signal at each station, an operating lever for each signal, a lock for each operating lever, a lock controlling circuit extending from each station to the next, a manually operated switch at each station, means for automatically returning said switch to its normal position after it has been operated, normally closed contacts on said switch arranged in the controlling circuit for the local lock, normally opened contacts on said switch arranged in the controlling circuit for the lock at the next station, a relay in the controlling circuit for the local lock, means associated with the switch for deënergizing said relay when the switch is operated, and means controlled by a train at the local station for again energizing the relay.

14. In a block signal system, a station at the end of the system, a signal at said station, an electro magnet for tripping the signal from the safety position to the danger position, a relay for interrupting the circuit of said magnet, circuits from the track to the relay for causing the relay to operate to open the circuit of the magnet when a train is on the first block and within a predetermined distance of the station, a track relay and circuits to the track whereby the track relay is deënergized when a train is at said station, and means connected with said track relay for completing the circuit of the electro magnet independently of the other relay when the track relay is deënergized.

15. In a block signal system, a plurality of stations, a signal at each station, an operating lever for each signal, a lock for locking each of said levers in the danger position, means at each station for controlling the lock at the next station, said means including devices for preventing the release of the lock at the local station until the block has been cleared by the train from the other station, and means

associated with each of said levers for preventing a movement of the lever toward either the safe or danger position until it has been fully brought into the other position.

16. In combination, a lever having two operative positions, a ratchet bar arranged at one side thereof, a pawl carried by said lever, and arranged to slide over the teeth on the ratchet bar when the lever is moved in one direction but to engage with the teeth and prevent the movement of the lever in the other direction, and means controlled by said lever for moving the ratchet bar carrying the teeth thereon out of operative relation with the pawl when the lever is brought fully to the operative position toward which it is free to move.

17. In combination, a lever having two operative positions, a ratchet bar having two series of reversely arranged teeth on adjacent sides, a pawl carried by the lever and adapted to coöperate with said teeth to prevent the movement of the lever in one direction or the other depending upon which series of teeth is engaged by the pawl, and means for partially rotating said bar at each end of the movement of the lever so as to cause the pawl to alternately engage with a series of teeth which are inclined in opposite directions with respect to each other.

18. In combination a lever member, a supporting member, a ratchet bar carried by one of said members and having reversely arranged ratchet teeth on two adjacent sides, a pawl carried by the other member, and engaging with one of said series of teeth to prevent the movement of the lever member in one direction, while permitting its movement in the other direction, and means for producing relatively movement between the pawl and the ratchet bar when the lever reaches a predetermined point in its movement so as to bring the pawl into engagement with the second series of teeth.

19. In combination, a lever, a bar revolubly supported adjacent and parallel to the plane of movement of the lever, said bar having a series of ratchet teeth arranged on each of its four sides, the teeth on each side being inclined in opposite directions with respect to the teeth on the adjacent sides, a pawl on the lever arranged to engage with said teeth, a pair of radially extending arms at each end of the bar, the arms at one end being arranged at right angles to the arms at the other ends, and a member carried by said lever and arranged to engage with the adjacent arm on the bar and rotate the bar through an angle of 90 degrees whenever the lever is brought into one of its operative positions, so as to cause the pawl to cooperate with one series of teeth after another.

20. In a block signal system, a plurality of stations, a signal at each station, an operating lever for each signal, a lock for locking each operating lever in the danger position, a control circuit for each lock having therein a manually operated switch at the local station and a plurality of independent manually operated switches at an adjacent station, each of said latter switches being arranged to interrupt the circuit for the local lock when said switches are operated to complete the circuit for the lock at the other station, and a switch associated with each of said operating levers and arranged in a control circuit for the lock at an adjacent station.

21. In a block signal system, a pair of stations at opposite ends of a block, a signal at each station controlling the entrance to the block from that station, a lock for each signal, lock controlling circuits, a manually operated switch at each station for governing the controlling circuit for the lock at the other station, each of said switches being arranged to return automatically to its normal position upon operation thereof, means associated with each switch for rendering the controlling circuit for the local lock inoperative upon the operation of the switch and for maintaining it inoperative upon the return of the switch to its normal position, and means arranged to be controlled by a train at the same station for again rendering the latter circuit operative.

22. In a block signal system, a pair of stations at opposite ends of a block, a signal at each station controlling the entrance to the block from that station, an operating lever for each signal, a lock associated with each of said levers, lock controlling circuits, a manually operated switch at each station for governing the controlling circuit for the lock at the other station, each of said switches being arranged to return automatically to its normal position upon operation thereof, means associated with each switch for rendering the controlling circuit for the local lock inoperative upon the operation of the switch and for maintaining it inoperative upon the return of the switch to its normal position, and means arranged to be controlled by a train at the same station for again rendering the latter circuit operative.

23. In a block signal system, a pair of stations at opposite ends of a block, a signal at each station controlling the entrance to the block from that station, a lock for each signal, an actuating circuit for each lock extending between said stations, a manually operated switch at each station for governing the actuating circuit for the lock at the other station, each of said switches being arranged to return automatically to its normal position upon operation thereof, means associated with each switch for rendering the actuating circuit for the local lock inoperative upon the operation of the switch and for maintaining it inoperative upon the return of the switch to its normal position, and means arranged to be controlled by a train at the same station for again rendering the latter circuit operative.

24. In a block signal system, a pair of stations at opposite ends of a block, a signal at each station for controlling the entrance to the block from that station, a lock for each signal, lock-controlling circuits, a manually operated switch at each station arranged in the controlling circuit for the lock at the other station, a stick relay at each station having contacts arranged in the control circuit for the local lock, contacts on each of said switches arranged in the circuit for controlling the local stick relay, and a track relay having contacts which coöperate with the contacts on said switch to complete actuating and maintaining circuits for said stick relay in different positions of the track relay.

25. In a block signal system, a pair of stations at opposite ends of a block, a signal at each station for controlling the entrance to the block from that station, a lever for operating each of said signals, a lock for each of said levers, lock controlling circuits, a manually operated switch at each station arranged in the controlling circuit for the lock at the other station, a stick relay at each station having contacts arranged in the control circuit for the local lock, contacts on each of said switches arranged in the circuit for controlling the local stick relay, and a track relay having contacts which coöperate with the contacts on said switch to complete actuating and maintaining circuits for said stick relay in different positions of the track relay.

26. In a block signal system, a pair of stations at opposite ends of a block, a signal at each station controlling the entrance to the block from that station, a lock for each signal, actuating circuits for said locks extending between said stations, a manually operated switch at each station arranged in the actuating circuit of the lock at the next station, said switches being arranged to return automatically to their normal positions after being operated, means associated with each switch for rendering the actuating circuit of the local lock inoperative upon actuation of the switch and for maintaining it inoperative after the return of the switch to its normal position, and means arranged to be controlled by a train at the same station for rendering the latter circuit inoperative.

27. In a block signal system, a pair of stations at opposite ends of a block, a signal at each station controlling the entrance to the block from that station, an operating lever for each signal, a lock for each operating lever, actuating circuits for said locks extending between said stations, a manually operated switch at each station arranged in the actuating circuit of the lock at the next station, said switches being arranged to return automatically to their normal positions after being operated, means associated with each switch for rendering the actuating circuit of the local lock inoperative upon actuation of the switch and for maintaining it inoperative after the return of the switch to its normal position, and means arranged to be controlled by a train at the same station for rendering the latter circuit operative.

28. In a block signal system, a pair of stations at opposite ends of a block, a signal at each station controlling the entrance to the block from that station, a lock for each signal, actuating circuits for said locks extending between said stations, a manually operated switch at each station arranged in the actuating circuit of the lock at the next station, said switches being arranged to return automatically to their normal positions after being operated, a stick relay, and a track relay at each station arranged in the actuating circuits of both locks, contacts on each of said switches for controlling the circuit for the local stick relay, and contacts on each of the track relays together with circuits arranged to permit the track relay in its several positions to coöperate with the contacts on the local switch to complete actuating and maintaining circuits respectively for the local stick relay.

In testimony whereof, I sign this specification in the presence of two witnesses.

WILLIAM DAVES.

Witnesses:
WM. F. FREUDENREICH,
HARRY S. GAITHER.