E. K. POST.

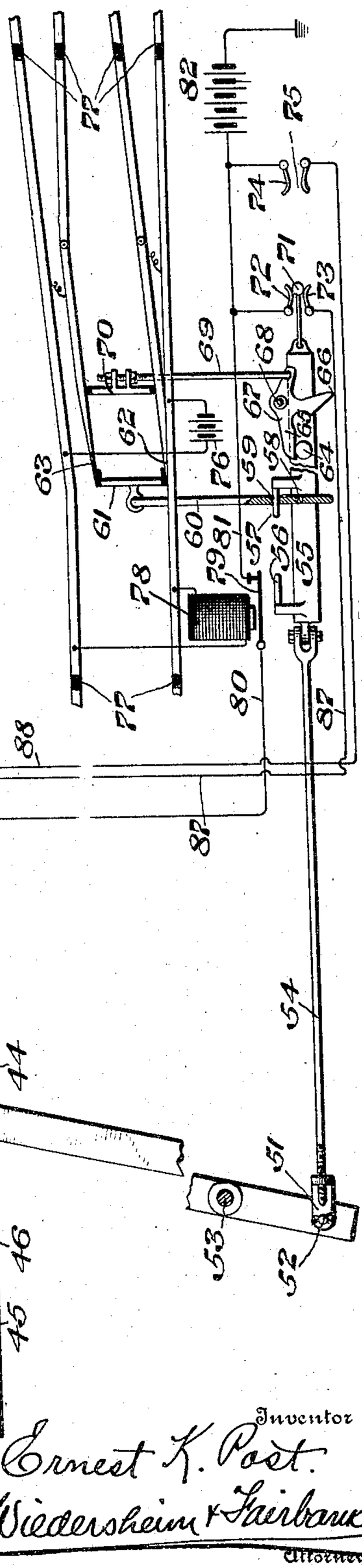
INTERLOCKING SWITCH AND SIGNAL SYSTEM.

APPLICATION FILED JULY 29, 1908.

923,702.

Patented June 1, 1909.

6 SHEETS—SHEET 1.



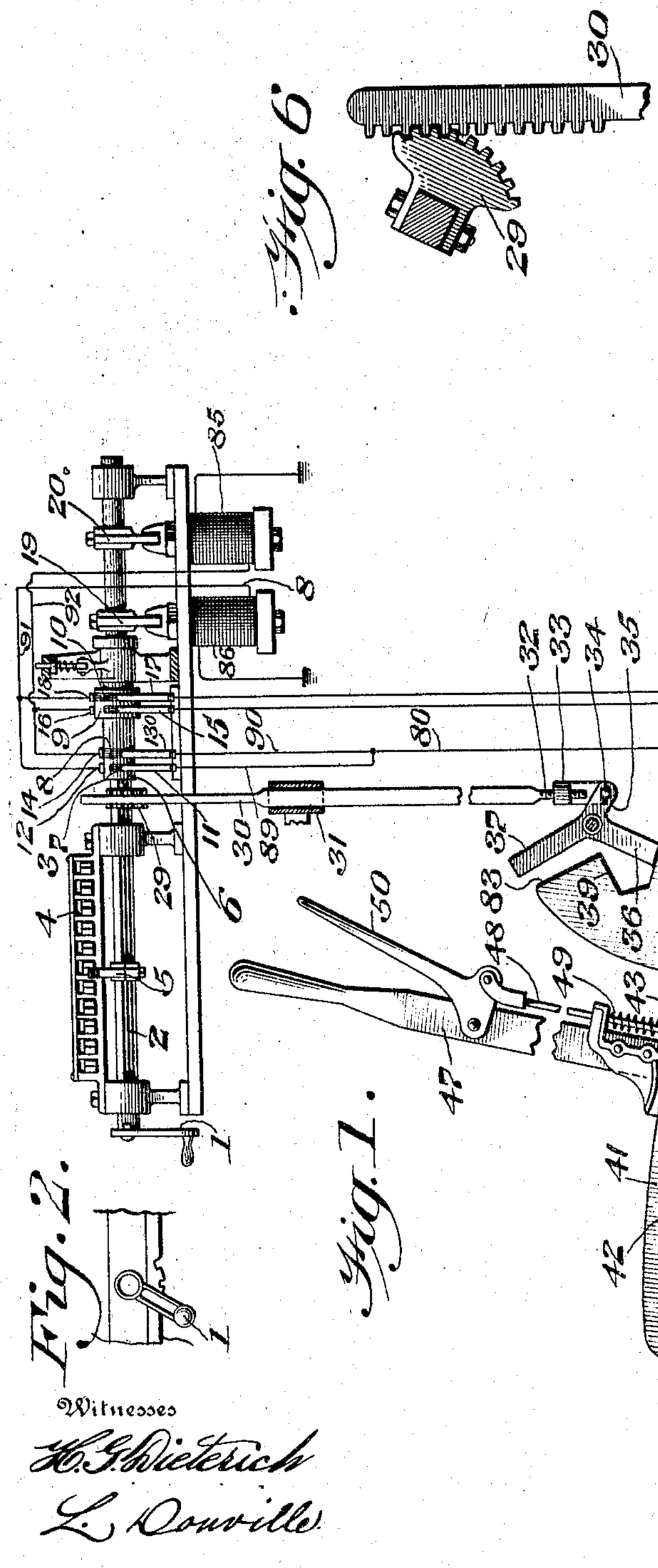


Fig. 1.

Fig. 2.

Witnesses

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6 SHEETS—SHEET 2.

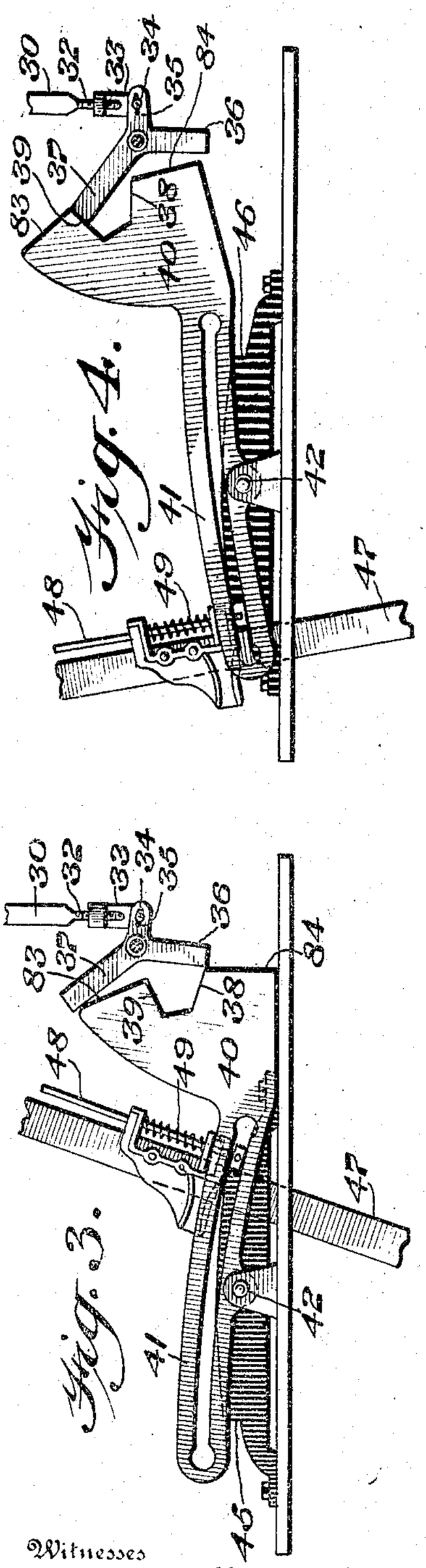

Fig. 4.

Fig. 3.

Witnesses

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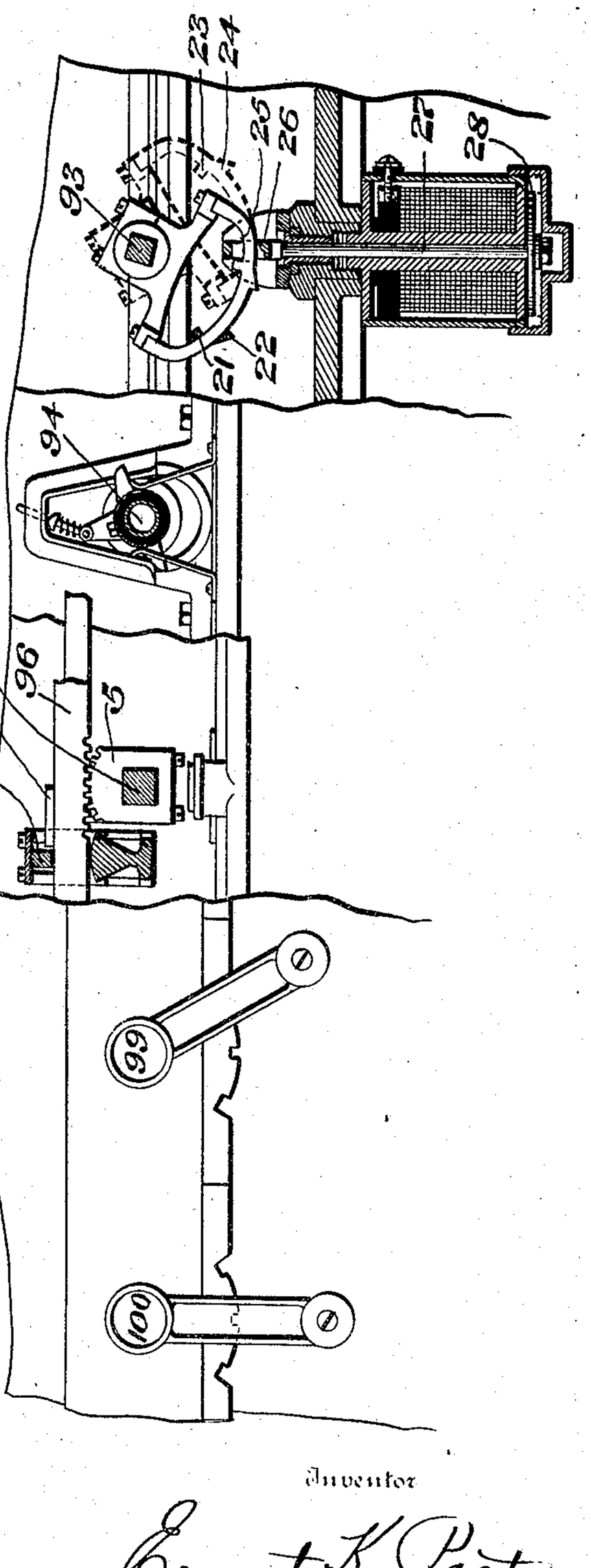

Fig. 5.

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6 SHEETS—SHEET 3.

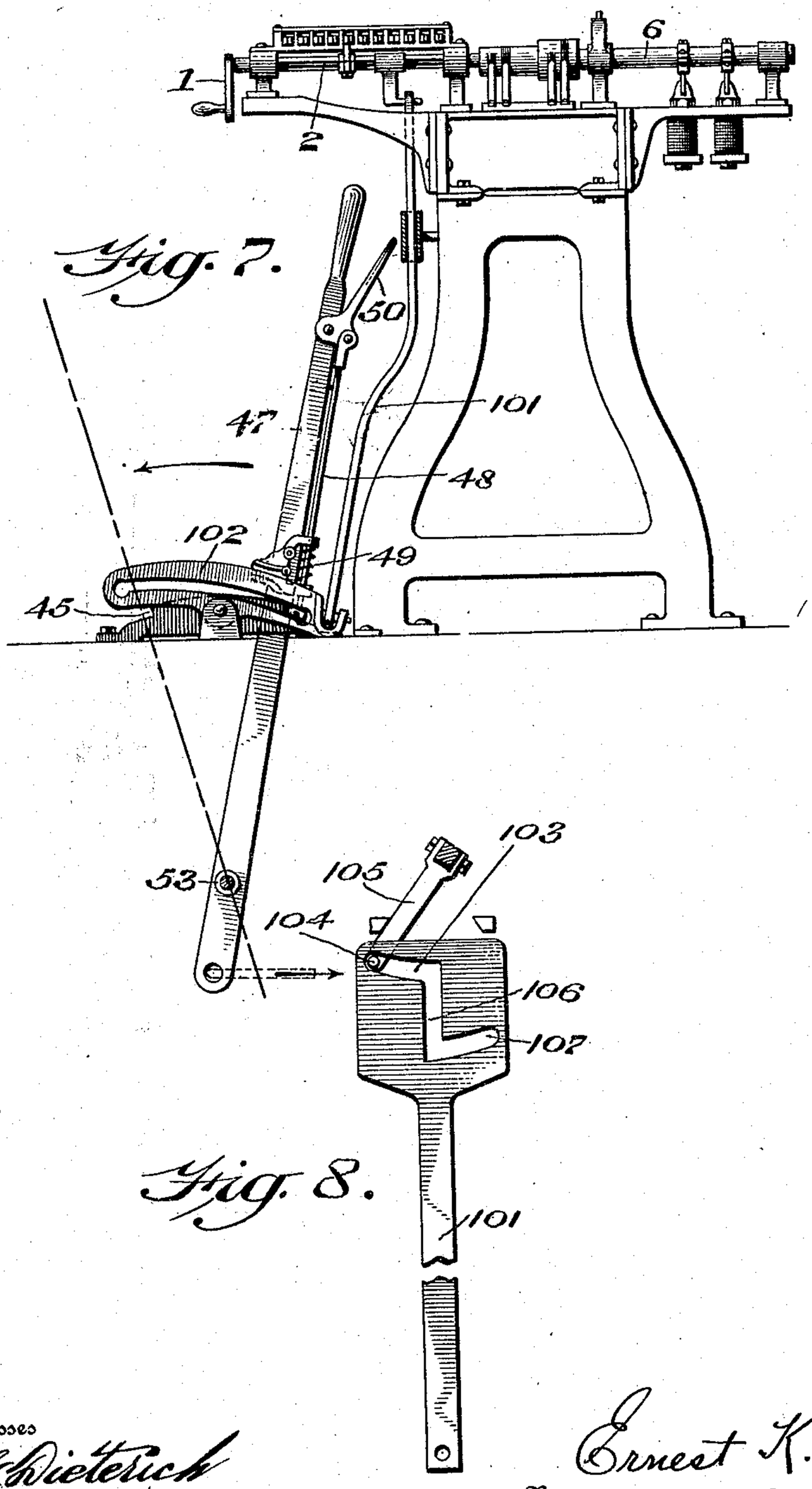

Fig. 7.

Fig. 8.

Witnesses

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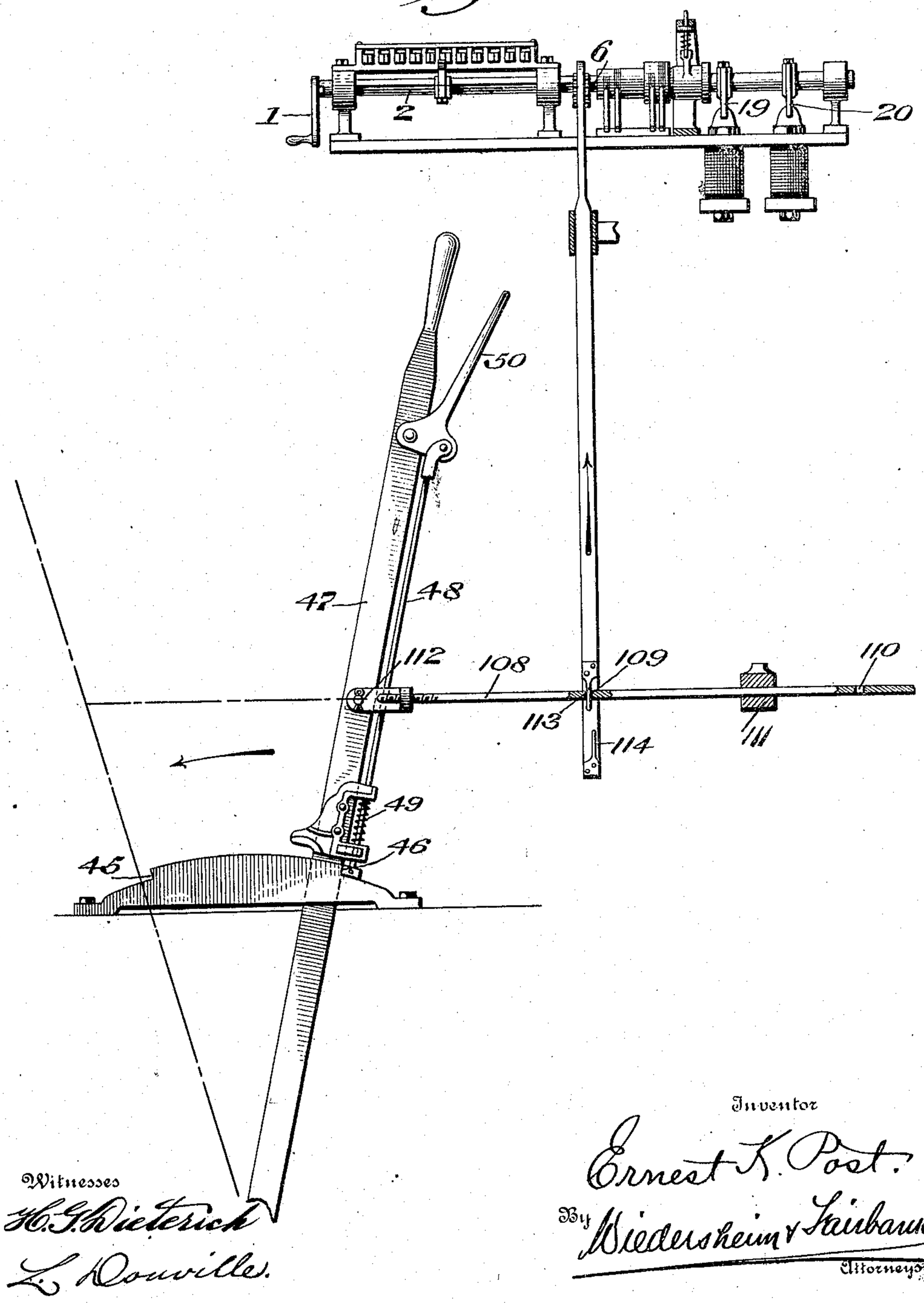
6 SHEETS—SHEET 4.

Fig. 9.



Witnesses

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6 SHEETS—SHEET 5.

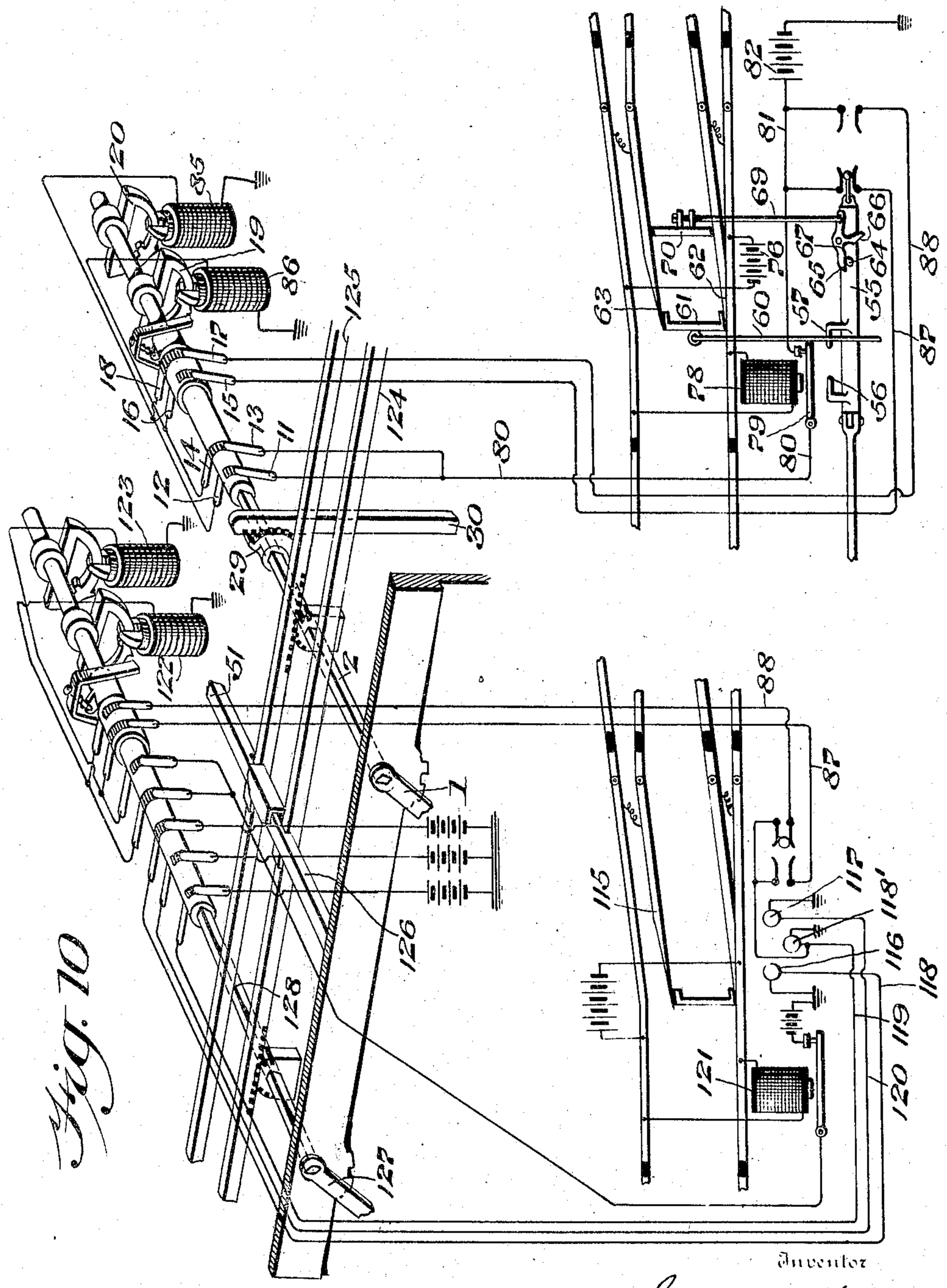

Fig. 10

Witnesses

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INTERLOCKING SWITCH AND SIGNAL SYSTEM.

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6 SHEETS—SHEET 6.

Fig. 12

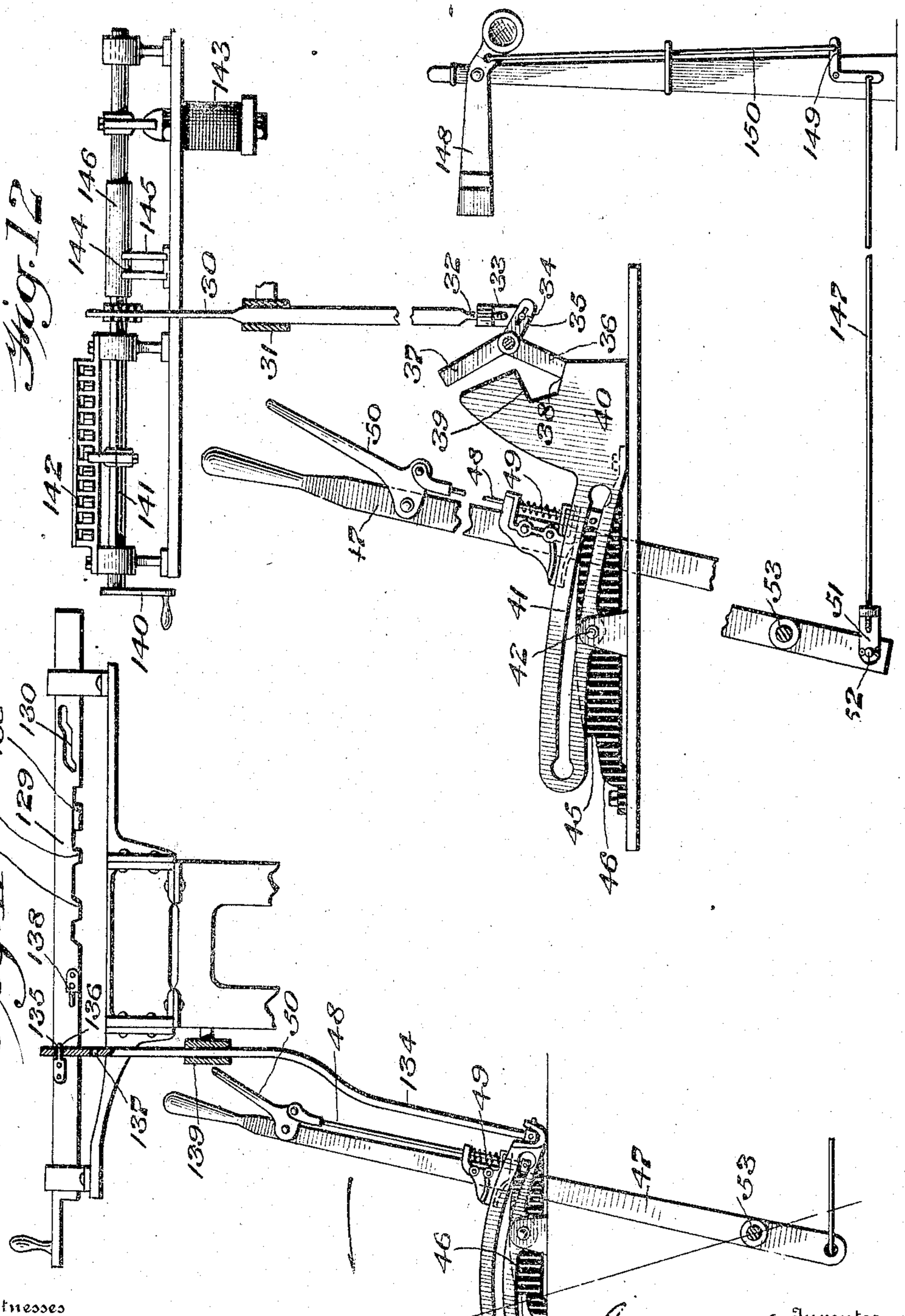

Fig. 11

Witnesses

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UNITED STATES PATENT OFFICE.

ERNEST K. POST, OF HARRISBURG, PENNSYLVANIA.

INTERLOCKING SWITCH AND SIGNAL SYSTEM.

No. 923,702. Specification of Letters Patent. Patented June 1, 1909.

Application filed July 29, 1908. Serial No. 445,957.

To all whom it may concern:

Be it known that I, ERNEST K. POST, a citizen of the United States, residing in the city of Harrisburg, county of Dauphin, State of Pennsylvania, have invented a new and useful Interlocking Switch and Signal System, of which the following is a specification.

The purpose of my invention is to provide a mechanical system of interlocking switches and signals by which distinctive advantages of the power operated systems are obtained with greater simplicity and ease of manipulation than in the present mechanical systems.

A further purpose of my invention is to safeguard the use of a single mechanical lever for unlocking, throwing and locking a switch or signal, rendering this practice safe.

A further purpose of my invention is to make use of hand operated controlling levers of extremely easy throw in place of the locking and unlocking levers normally used in a mechanical interlocking system, which locking levers, largely because of the detector bars thrown thereby, are the hardest levers in the tower to throw.

A further purpose of my invention is to avoid all use of detector bars.

A further purpose of my invention is to apply to mechanical systems electric detector locking similar to that now used on power systems, in order to prevent unlocking and throwing of a switch while a train is upon it or upon its track within fouling distance.

A further purpose of my invention is to electrically lock and unlock a mechanical switch or signal controlling lever in the tower and thus to electrically control the movement of a mechanical switch or signal lever, thus electrically and reliably performing the work of the detector bar.

A further purpose of my invention is to make mechanical switch and signal throwing quicker by reducing the energy required to operate, replacing a heavy locking lever by a controlling lever and moving it but a short distance in one direction as compared with the present long throw forward and back of the mechanical locking lever.

A further purpose of my invention is to avoid the use of facing point lock levers.

A further purpose of my invention is to do away with the independent intermediate mechanical connections between the tower and the switch now normally used for separately locking and unlocking the switch or signal in mechanical interlocking switch or signal systems.

A further purpose of my invention is to transfer the machine locking of mechanical systems from the operating levers to controlling levers, reducing the strain and consequently the size and practically eliminating the lost motion by more direct connection.

A further purpose of my invention is to reduce the number of locking rods in the interlocking machine and the cross locking thereof by eliminating the separate locking levers previously requiring representation there.

A further purpose of my invention is to reduce the space in the tower required for the controlling and operating mechanism of mechanical switch and signal systems.

A further purpose of my invention is to remove the machine locking for hand operated interlocking switch systems from direct action upon the mechanical switch or signal levers and their connections, thus reducing the size of the locking rods and cross locking.

A further purpose of my invention is to permit the use of miniature machine locking between operating levers or their controlling mechanisms for mechanically operated switch and signal systems.

A further purpose of my invention is to apply the machine inter-locking system between levers, indication magnets, quick switches and other connections normally used in a tower in power interlocking systems, to the electric control of mechanical switch mechanism.

A further purpose of my invention is to make use of the miniature machine interlocking, circuit controllers, quick switches and indication magnets which have normally been used in the operation of power interlocking, to the control of mechanically operated switches and signals, both as regards electric substitution for detector bars and indication locking.

A further purpose of my invention is to apply the power type interlocking lever complete, normally used in the tower of a power interlocking switch and signal system, to the locking and releasing of a mechanical switch or signal lever either by direct connection thereto or through its link or other governing means.

A further purpose of my invention is to provide electrical connections and mechanism for a mechanical switch or signal lever indicating the final locking movement in normal and reverse positions. This is used as a lock upon the controlling lever.

A further purpose of my invention is to avoid the weakness of present mechanical interlocking switch and signal systems, the possibility of locking these systems in normal or reverse position when the indication of the switch or signal lever shows the reverse or normal position.

A further purpose of my invention is to avoid the incomplete release of the locking mechanism sometimes occurring with the facing point locks used in mechanical interlocking switch systems and to avoid also the delay and expense of obtaining and using extra thick pipe for the mechanical switch throwing connections now required to protect against buckling of the pipe in such cases.

A further purpose of my invention is to mechanically lock the link of a mechanical switch or signal lever in its positions at the extremities of throw of the lever by means, operated from a power-type interlocking lever complete which acts as a controlling lever for the mechanical lever.

For the purpose of distinguishing between switch and signal systems in which the actual throwing of the switch is done by manual labor from those in which the actual operation of the switch or signal, while directed by the movement of a lever is actually effected by electricity, compressed air or other application of power through suitable connections or valve movements formed, I have designated the former, that is, the actual manual throw, by the term mechanical or mechanically operated whether it refer to the manually operated lever alone by which the switch or signal is thrown, or to the entire system, or to other parts of the system than the manually operated lever, such as the connections of the switch or signal so thrown; and I have designated the latter system, that is the one making use of a source of power, as electricity or compressed air, as power operated, and refer thereby or by the term "power" either to the lever itself or to all or a portion of the system so included as may readily be seen by the context. In the art as it at present exists the distinction between these two is clear and this is particularly true because of the different types of lever, connections and interlocking ordinarily used. Thus the mechanical lever ordinarily used is of a long and powerful type operating over a quadrant, latched at each end of the quadrant by a latch which is spring-set and which is released by a small lever grasped within the hand that grasps the handle of the mechanical lever; the connections with the switch are formed by levers and pipes by means of which the throwing of the mechanical lever actually produces the movement of the switch or signal; the machine locking used with the mechanical lever is composed of relatively large bars capable of withstanding the strain that can be brought upon the interlocking by the full arm or body "throw" of the operator and these bars are normally connected to the link mechanism. Evidently the term interlocking in the claims is broad enough to cover both this interlocking and miniature interlocking unless one is specifically named or otherwise indicated by the context. The power lever on the other hand is a very short lever and is capable of operation by hand or wrist movement as opposed to arm or body movement. In most of its forms it acts more directly upon its interlocking than in the case of the mechanical lever, giving room for less lost motion, and it can make use of very much smaller bars in the interlocking system because they do not have to withstand anywhere nearly as much possible strain. The power lever makes connections which cause some source of power, as electricity or compressed fluid, to be applied to the actual physical movement of the switch or signal. As the lever is relieved of the duty of physically moving the switch or signal, the resistance to its movement is very much less than that present in the mechanical lever and the shorter leverage and smaller levers and miniature interlocking already referred to are permissible. Most of the manufacturers of power machines have taken advantage of the smaller and more compact construction permissible to make the connection with the interlocking more direct than is the case in the standard mechanical interlocking, thus reducing lost motion. The switches and signals themselves used in the power operation differ from the switches and signals used in the mechanical operation in the application of the power thereto, and in this way only.

In practical application to railway switch and signal work some power systems have directly connected rotatable or sliding levers, used for forming the connections for the throw of the switch or signal, with the interlocking mechanism, by means of a rack or segment secured to the rotating shaft or by a cam groove in the sliding shaft; and the detector and release locking engage directly with a segment or plate upon the shaft by means of electrically operated latches.

In what I have designated as the "power-type lever" it is permissible to make use of a lever having all or as many as may be desired of the characteristics of a power lever to which I have referred above, in so far as concerns the rotatable, rocking or sliding char-

acter of the lever, the small size of the ver, the relatively direct connection with the interlocking, the small size of interlocking because of freedom from possibility of excessive strain, the direct engagement of electrically or otherwise operated release and detector locking with the shaft of the lever through projections thereon or upon a segment or plate thereon, and quick switches, thus making possible the use of a substantial duplication of the power lever insofar as its form, operation and control are concerned, but differing from this power lever in that the actual operation of the switch or signal is not effected by power set in motion by connections upon the lever itself as in the power systems but is delegated to a manually operated lever known here as a mechanical lever. The latter is controlled by the power type lever which permits but does not cause the movement of the switch or signal. I recognize that the lever made use of in connection with this mechanical lever need not resemble the present recognized forms of power lever and that variations may be made not only in the lever itself but in the interlocking to which it is connected and in the detector and release locking thereof.

Each power-type lever is intended to be and preferably is most desirably individual to one mechanical lever and likewise each mechanical lever is preferably individual to one controlling lever. This is particularly desirable because of the advantage and in many cases necessity for direct locking of the mechanical lever (through the lever itself or its link) by the controlling lever. If there be not direct locking, each section of whatever indirect means is provided gives opportunity for lost motion and increases the cost and the space occupied.

If the controlling lever and mechanical lever be not individual each to the other, one of the main advantages of my invention is lost in that the controlling lever ceases to be capable of being itself controlled by the indication and track circuit detector conditions of the switch or signal which is to be thrown by the mechanical lever; *i. e.*, the controlling lever wholly loses its utility so far as the device to be thrown by the mechanical lever is concerned and controls instead with respect to some outside separate and distinct mechanism or condition only. Thus, for a mechanical switch lever, my controlling lever is primarily intended to control with respect to the condition of the track (detector) or position of the switch and to take care of other conditions and the position of other mechanisms, such, for example, as signals, through the interlocking connected with the controlling lever. Again, my mechanical lever where used for signal operation is intended primarily to be controlled by its controlling lever with respect to the position or condition of the signal and the position or condition of other mechanisms is taken care of through the interlocking of the controlling lever.

Notwithstanding that one of the main advantages of my invention may be so lost if the controlling lever and mechanical lever do not bear the close individual relation which I have pointed out, some advantages of my invention for special purposes may be attained with an individual controlling lever for each mechanical lever but responding to the position or condition of a signal, for example, though controlling a mechanical switch lever, or with a controlling lever, responding to the position or condition of a group of switches, for example, and governing a corresponding group of mechanical levers.

Whatever the arrangement, among the several indicated above, and whether the entire advantage of my invention be thus attained or not, it is possible to secure a control of switch or signal mechanical levers hitherto impossible, and to secure it with a single system of interlocking and that miniature, permitting association with power levers and interlocking therewith with increase of safety and reduction of expense, space and complexity.

Where I have referred to the power lever complete, I indicate such a lever as has connections for miniature interlocking, and such detector and release locking and quick switch control as may be necessary for its use, differing for switch and signal use in this, and which forms connections which apply power to switch or signal operation. Where I have referred to power type interlocking lever complete, I indicate a lever of such a general character having connections for miniature interlocking, and, if necessary, for indication and release locking and a quick switch, but lacking the connections by which the power is set in operation. In neither case do I wish to be understood as specifying that the lever, the miniature interlocking with which it is to be connected, the detector locking, the release locking or the quick switch need be of the present recognized standard types nor indeed need they be of any present known and recognized types provided they perform the same function.

I do not purpose in this application covering or attempting to cover the various methods of or apparatus now known for the control of a ground switch lever in which mechanism within the tower is made to release a check or stop at a designated switch which is then free to be thrown by hand.

In the use of interlocking switches and signals the railway companies of the country have had to choose between two systems. One of these, the power system, involves the necessity for installation of compression or other power plants as well as the distribution of the operative parts over a consider-

able area. All of these outside of the tower are necessarily somewhat exposed with the consequent opportunity for mechanical injury and destruction, all at enormous expense. The other, the mechanically operated, here called "mechanical," interlocking switch and signal system has complete separate locking and operating connections between the tower and the switch or signal, which are unreliable because of incomplete protection against failure to throw, partial unlocking and wrongful locking. From the tower standpoint these mechanical switches and signals are cumbrous, occupy a great deal of space and are extremely difficult to handle. One of the highest types of power interlocking switch and signal system as recognized generally by its use upon the most important railroads and terminals, comprises in its switch mechanism, which may be taken as typical of the mechanism useful for throwing either switches or signals, a complete tower equipment of small controlling levers connected by miniature machine interlocking and carries contact switches directly upon the lever shaft for the control of the power operating mechanism, among them quick switches, to switch the indication contacts to normal or reverse position immediately after the lever passes the center of its throw in either direction, and indication magnets preventing continuous complete throw of the lever in either direction and acting to release the lever, to permit completion of its movement in either direction, actuated by a detector track circuit and by the "indication" contacts made after the locking at the extremities of normal and reverse throw of the switch. The quick switch is effective to direct the current to the proper indication magnet.

In close proximity to the track switch a motor is used, in the particular form under description, a cylinder controlled by a slide valve. Electrical connections controlled by the lever in the tower throw the current upon a "normal", "reverse" or locking electromagnet according as it is desired to move the slide valve so as to move the switch to normal or reverse position, and to lock or unlock the same.

The piston rod, moved by the piston in the cylinder, has some play in either direction without effecting movement of the switch, this play being made use of to lock and unlock the switch and, at the extremities of its movement in each direction, to make contacts for the indication magnets. The intermediate portion of the movement of the piston rod throws the switch.

The present tendency toward placing the towers closer together and particularly so in proximity to terminals is bringing a larger and larger percentage of the switches and signals to be controlled within the physical reach (800 feet) of mechanical switches should they be made reliable in operation.

In the best mechanical system in use at present, the switch is thrown by a large hand lever, link locked at each end of its movement, and by a system of intermediate levers and pipe connections. A second separate lever in the tower and a second set of lever and pipe connections act upon one arm of a three-arm bell crank beside the track whose other two arms are connected respectively to the detector bar which is operated by means of links or slides and to the locking and unlocking mechanism by which the switch is locked and held in normal or reverse position. Should the switch fail to throw with movement of the switch operating lever, as might occur through breakage or buckling of the pipe, the locking mechanism would engage with the same opening from which it had just been disengaged and the switch would be locked in the original position while the lever in the tower would indicate the opposite position. No practical means has yet been applied to mechanical interlocking switch or signal systems which reliably guards against the failure of all movement of the switch in such instances. Furthermore, in view of the lost motion, separate connections from the mechanical locking and unlocking levers, this lever has sometimes been thrown without locking the switch.

The use of the detector bar is quite unsatisfactory and is growing more so. The rail heads are getting wider and wider while the wheel faces are remaining the same. The detector bar is necessarily on the outside of the rail. The rails may be worn and where the train hugs the other rail at the time the wheel faces may fail to reach the detector bar. Sliding of the rails laterally under strain has a similar effect. The detector bars, now required to be of fifty feet length, make the locking and unlocking levers extremely hard to throw. The length of the cars is constantly increasing.

Among signal engineers the fact that switches are frequently thrown under trains by reason of the failure of the detector bar is notorious. Railroads have sought to protect against this by the use of an electric lock which is, however, so unsatisfactory that they have been unable to omit the detector bars and have had to rely upon both of these means for mechanical interlocking switches, notwithstanding that neither one is sure.

It further consists of other novel features of construction, all as will be hereinafter fully set forth.

Figure 1 represents a view, part in elevation, part plan and part diagrammatic, showing a construction embodying one form of my invention. Fig. 2 represents a por-

tion of Fig. 1 in fragmentary end elevation. Figs. 3 and 4 represent a portion of the structure set out in Fig. 1 in different positions. Fig. 5 represents an end elevation, partly in section, showing various positions and portions of controlling mechanisms embodying my invention. Fig. 6 represents in detail section, a portion of the controlling mechanism in Fig. 1. Figs. 7 and 8 represent a side elevation and a detail, respectively, of a modification of the connection between the controlling and operating mechanism of Fig. 1. Fig. 9 shows a further modification of this connecting mechanism. Fig. 10 shows a combined view, in perspective, plan and diagrammatic form, of the combination in the same board of the controlling and interlocking mechanisms used by me and the operating and controlling mechanism used on a modern power interlocking system, the levers being interpolated in the same frame. Fig. 11 shows an elevation of a power type machine interlocking lever having a different direction of movement from that shown in the other figures but suitable for use with interlocking systems. Fig. 12 shows an elevation of an interlocking controlling lever and mechanical lever applied to the operation of a signal.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings:—1 designates a lever which I have illustrated as of a character frequently used in power operated interlocking systems, using a rod 2 connected therewith, a miniature interlocking rack 3, comprising longitudinal bars 4, each operated by a segment 5 upon one of the rods 2 and transverse bars or cross interlocking not shown in Fig. 1. The parts which I have described are normally horizontal though it will be recognized that the direction of the rod has nothing to do with the invention, or indeed with the use of the power interlocking lever complete, a part of which has just been described. The portion 6, which I have shown as a continuation of the rod 2, may be in line therewith, or at any angle thereto and is quite frequently vertically disposed in relation thereto, for economy of space or other convenience. Upon it in power interlocking systems are normally located switches known as circuit controllers of which I make use of two, 7 and 8 respectively. It also carries quick switches 9 and 10, which are well known in the art and which move together, which I have, therefore, not illustrated in great detail. These are best seen in Fig. 5.

The fixed contacts coöperating with these switches are two in number for each switch and I have designated them as 11, 12, 13, 14, 15, 16, 17 and 18 respectively. Preferably upon the same shaft 6 are located quadrants 19 and 20 of the well known type, having segments or lugs 21, 22 and 23, 24 respectively for engagement with the upper and lower members 25 and 26 of indication latches mounted upon armature stems 27 of armature 28. The parts are alike for each of these indication magnets and this description will, therefore, suffice.

The operation of the power interlocking lever complete is so well known that it will not be necessary to describe it in detail further than to say that the reverse and normal indication magnets operate alternately to permit movement of the lever in the two directions initially and at the limit of movement and that the quick switch acts as a distributing switch for the circuits which are to be connected by means of the other switches. Applying this power type interlocking lever complete to my invention, while I have preferred to use a positive mechanically operated stop between this power type interlocking lever complete and my hand lever I recognize that an electrically operated stop might be made use of in a great variety of forms, for example of the type of the indication magnet, using a quadrant upon the end of the link or by an electrically operated plunger fitting into apertures in a segment end of link with or without indication to show the engagement of the electric lock. The electrical connections in such case would be made very simple by switches of the type shown at 7, 11, 12. However, I prefer to make use of the mechanically operated lock and will describe at this point one form of this lock; that illustrated in Fig. 1 in one position, and in other positions in Figs. 3 and 4. I make use of segment 29 upon the rod 2, or any extension or connection therewith, operating upon a rack or rod 30 which is shown guided at 31 and terminating at 32 in a thread. This is connected to a lug 33 having pivotal connection at 34 with a double bell crank. This has arm 35 engaging therewith and arms 36 and 37 for engagement with the faces 38 and 39 of an aperture formed in extension 40 of link 41, said link 41 being otherwise of the general type used in connection with mechanical lever and attached to rock about pivot 42 to permit the passage therein of a slide 43 dropped into the offsets 44 and 45, at the extremities of a quadrant segment 46 about which the lever 47 moves. The connections of slide 43 are attached to a rod 48 spring-pressed at 49 and controlled by hand latch 50.

In Figs. 1 and 2 the switch is shown in normal position which in these views corresponds to the righthand position of lever 1.

Fig. 4 shows the mechanical lever, link and locking thrust extension 40 in "reverse position" while in Fig. 3 the mechanical lever is shown in normal position, but with the thrust lock bell crank out of engagement with the locking extension 40. This is the

position just before the lever 1 has been sent "home" to its final position and corresponds to the position of the parts at the final release of the rod 2 by the corresponding indication magnet.

Referring to Fig. 1 and tracing the movement of the track operating parts and position of the circuits, which are shown conventionally, as are various other of the parts used in carrying out my invention, 51 designates a lug pivoted at 52 to the extension of the mechanical lever shown as pivoted at point 53. A rod 54 connects lug 51 to a slide 55 bearing the switch locking means and suitably guided so as to give a straight line movement. It will be understood that the connections which I have indicated are conventionalisms merely and that in fact there would ordinarily be various changes of direction interposed between the mechanical lever and the slide.

The slide 55 carries oppositely directed pins 56 and 57 which perform locking function at the extremities of the movement of the slide, engaging with the apertures 58 and 59, respectively, in the transversely movable locking rod 60 suitably guided and movable with the connection 61 which is attached to the movable points 62 and 63 of the switch. A stud 64, during the locking movement, at each extremity of stroke moves parallel with one of the faces 65 or 66 of an escapement crank 67 pivoted at 68. This escapement crank is, however, itself rocked by stud 64 during that portion of the movement of the slide 55 when unlocking and locking are not taking place. The stud has acted merely as a bar to movement of the escapement by touching one face as 65 thereof, then parallel to its line of movement, until the slide passes the unlocking position, when it actively engages with the escapement and throws it to the position where the other face, as 66 is parallel to the line of movement. The escapement rocks between these two limits defined by parallelism of the two faces, one at each limit with the slide, this rocking being controlled absolutely by the stud which prevents such movement except when it is causing the same. The movement of the escapement crank causes movement of the switch points by means of rod 69 and bar 70. The final movement of the slide in each direction makes contacts between 72 and 73 or 74 and 75 by means of block 71, insulated from the slide.

A difference of potential is normally maintained between the track rails by means of battery 76 and the insulation 77 of rails about the switch. This is effective to cause current to pass through the magnet 78 holding armature 79 closed as a switch to unite the parts 80 and 81 of a circuit containing battery 82. The difference of potential is reduced and the switch armature at 79 is opened when the rails are short circuited by the presence of a train upon any portion of the tracks within the section to be protected. This track relay and short circuit operation to take the place of a detector bar, is of course well known, as also are the use of a slide and locking points and contacts but they have not previously been available and serviceable for mechanical switch operation.

In the position shown in Figs. 1 and 2 the lever 1 is in normal position. In operation it is thrown to the middle position putting the double bell crank in the position shown in Fig. 3, where the arm 37 is stopped in its further movement by face 83 of extension 40, and where arm 36 will be blocked by face 84 if there be any rocking of the link, leaving the quick switch in the original position, with 15 and 16 disconnected and 17 and 18 connected. This initial movement cannot take place unless the proper indication magnet 85 or 86 is energized. In this case, as the circuits are drawn, the indication magnet 85 would have to be energized, which requires that the switch armature 79 be energized, insuring freedom of track from train occupation.

In the circuit illustrated I have shown contacts 72 and 74 connected to 81 while contacts 73 and 75 are connected by wires 87 and 88 with brushes 15 and 17. Connection 80 is branched at 89 and 90 to 11 and 13 whose complementary brushes are connected with the indication magnets 86 and 85, 12 with the former by wire 91 also connected to 18, and 14 by wire 92 also connected to 16. The other sides of the indication switches are grounded, as is one side of battery 82. After this partial movement of the lever 1, the mechanical lever is free to be operated and its movement from normal to reverse results in the unlocking, throwing and re-locking of the switch as previously indicated. The controlling lever 1, which I prefer to model after power switch levers, must now be thrown the rest of the way, that is, to its reverse position as shown at the right in Fig. 5. This final movement of the lever 1 is not possible unless the slide 55 has completed its movement to locking position as it depends upon connections made between the contacts 74 and 75 by means of block 71.

With the quick switch in the position shown and lever 1 in its middle position the completion of the circuit between contacts 74 and 75 energizes magnet 86 and permits the lever to be thrown beyond the middle position.

A further check to movement of the controlling lever beyond the middle position exists in the fact that the end 37 of the double bell crank cannot move farther than the position shown in Fig. 3 because of face 83 unless the mechanical lever is entirely over in

the reverse position and the latch has been dropped to permit the link to raise to its extreme position.

A movement of the lever 1 beyond the middle position throws the quick switch, locks the mechanical lever and releases locking in the locking frame to permit the signal to be given corresponding to the switch position. The completion of this throw of the mechanical lever places the parts in the same position, except that it is reversed, as that previously occupied in the normal position of the parts and the movement of the lever 1 and mechanical lever 47 from reverse to normal is a repetition of the movement from normal to reverse, using corresponding other connections.

In Fig. 5 I have shown lever rods 93 and 94 for switch operation, one a controlling lever for a mechanical switch lever, and the other an operating lever for a power system and have illustrated them as mounted in the same frame as a switch rod 95 which I have illustrated as seen to make clear that it can be interpolated into any combination of mechanical lever control and power operating levers and that it makes use of the same type of longitudinal interlocking 96 and cross interlocking 97 with dogs 98 as may be used for the controlling or operating levers. The levers 99, 100 may be any of the types which I have indicated, switch controlling for mechanical switches, switch operating for power switches, signal controlling for mechanical signals or signal operating for power signals.

In order to indicate very clearly that the particular form of connection between the controlling lever of Fig. 1 and the mechanical switch lever there shown is only one of many mechanical forms as well as the electrical forms which can be used, I have shown two other forms, one in Figs. 7 and 8 and the other in Fig. 9. Taking up the form in Figs. 7 and 8, I may pivot a rod, as 101, or otherwise attach it to the end of a link 102 making in its top a guide for the movement of the rod 2. Thus I may form a transverse slot 103 therein permitting travel of a pin 104 mounted upon arm 105 and secured to rotate with rod 2, until the lever 1 reaches the middle position when the lever 47 must be thrown and latched to rock the link 102 until pin 104 has traversed slot 106 and can be turned into slot 107 to complete the movement of lever 1.

In the form shown in Fig. 9 a rod 108 having openings 109 and 110 and guided at 111 is connected as at 112 to move with the lever 47. The pins 113, 114 engage with the several openings to lock the operating lever in its several positions. This form also is not subject to the possibility of relocking without throwing this lever, in this case because of the staggering of the pins.

In Fig. 10 I have illustrated the use side by side with the same machine interlocking, of a controlling lever 1 and rod 2 with connections for controlling a mechanical lever by means of a connection 30 and a power operating lever and connections which I have illustrated conventionally and in which the switch 115 is thrown by an air cylinder and piston whose valve is worked by magnets 116, 117 and locked by magnet 118′ energized by connections 118, 119, 120, the same protection being had by track circuit detector magnet 121 and indication or release locking magnets 122, 123 and their connections as has already been described. The same interlocking machine is shown in use having locking bars 124, 125 and cross locking 126 for the lever 1 with its rod 2 as for lever 127 and its rod 128.

In Fig. 11 I have shown a lever 129 of the longitudinally movable type of well known use having lock operating slot 130 and the usual lugs 131, 132, 133 or any suitable arrangement of these parts. I have illustrated here one form of connection by which the levers may be locked together and improper movement prevented. The rod 134 is moved by the link to bring aperture 135 in line with pin 136 or aperture 137 in line with pin 138, but not to permit pin 136 to engage in aperture 137 nor pin 138 to engage in aperture 135 because of the staggering of the pins. The rod 134 is guided at 139.

In Fig. 12 I have shown a lever 140 moving rod 141 having interlocking 142, indication magnet 143 and any suitable contacts 144, 145 to engage with rings upon insulation 146, the mating contacts not being here shown. I have illustrated this in order to bring out the utility of such a controlling lever for use in connection with a signal operating mechanical lever and have shown the same connection between the rod 141 and lever 47 as in Fig. 1 by segment 29, rod 30 guided at 31 and the stop for the link extension shown. I have connected lever 47 by rod 147 with a conventional means for throwing a signal 148 through bell lever 149 and rod 150.

It will be understood that my illustration of the various forms of locks shown, the several movements of levers to which my invention is here adapted, and the combinations by which I am able to make use of controlling levers for mechanical switches or signals or both, in the same interlocking combinations as power operating levers for switches and signals, and that permissibly miniature, is for the purpose of showing the independence of my broad idea of these differences as well as for the purpose of showing these meritorious forms of my invention.

Where I refer in the claims to switch or signal and kindred expressions it will be understood that I am including also structures where both occur, and a switch or signal in

the singular is intended also to cover a plurality where they move together, as in the case of the switches of a cross-over.

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

1. In an interlocking system, the combination of a power interlocking switch lever and connections, and a mechanical switch or signal lever and connections using common machine interlocking.

2. In an interlocking switch system, two switches, a power interlocking lever complete for one switch, miniature interlocking therefor, and a mechanical lever and connections for the other switch using the same miniature interlocking.

3. In an interlocking switch or signal system, a power interlocking lever complete with its connections and embodying miniature machine interlocking, in combination with a power type interlocking lever, making use of the same miniature machine interlocking, and a mechanical lever and connections controlled by the power type interlocking lever.

4. In an interlocking switch system, a power interlocking lever complete with switch connections, miniature machine interlocking, electrical track circuit detector locking, indication locking and power switch operation, in combination with a power type interlocking lever complete, having electrical track circuit detector and indication locking, making use of the said miniature machine interlocking, and a mechanical switch lever and connections.

5. In an interlocking switch system, a power interlocking lever complete and machine interlocking, electrical track circuit detector and indication locking, in combination with a power type interlocking lever complete, also having electrical track circuit detector and indication locking using the same machine interlocking, a mechanical lever, switch connections therefrom, and a lock for said mechanical lever controlled by the position of the power type interlocking lever.

6. In an interlocking switch system, a power interlocking lever and connections complete, embodying miniature interlocking, electrical track detector and indication locking and power switch operation in combination with a power type interlocking lever, using the same machine interlocking as the power interlocking lever, and electrical track circuit detector and indication locking therefor, a mechanical lever, a lock for the hand lever at each end of its throw, a slide moved by the mechanical lever to lock, unlock and throw the switch and make the indication connections, and means operated by the power type lever for setting the lock in the mechanical lever.

7. In an interlocking switch system, a pair of interlocking levers, electrical track circuit detector control for each, electrical indication locking for each, common machine interlocking for the two levers, two switches, a power switch operating mechanism operated by one of said levers, and a mechanical switch operating mechanism controlled by the other said lever.

8. In an interlocking switch system, a power type controlling lever, track circuit detector locking therefor, indication locking therefor, an interlocking machine connected therewith, and a mechanical switch lever directly controlled thereby.

9. In an interlocking switch system, a power type controlling lever, track circuit detector locking therefor, indication locking therefor, an interlocking machine connected therewith, a mechanical switch lever, a lock therefor, and a connection between the lock and the controlling lever.

10. In an interlocking switch system, a power type controlling lever, track circuit detector locking therefor, indication locking therefor, an interlocking machine connected therewith, a mechanical switch lever, a link therefor, a lock engaging the link at the extremities of its oscillation, and a connection between the lock and the controlling lever.

11. In an interlocking switch system, a controlling lever of the type of the power interlocking switch or signal lever complete having track circuit detector and indication locking, machine interlocking connected therewith, a mechanical switch lever, a lock therefor, and a mechanical connection between the controlling lever and the lock to lock the switch lever in either position and to prevent complete movement of the controlling lever unless there has been movement of the switch lever.

12. In a device of the character described, a mechanical switch or signal lever, an individual lock therefor, requiring movement of the mechanical lever for complete movement of the lock, a controlling lever individual to the mechanical lever, and a connection between the controlling lever and the lock.

13. In an interlocking switch or signal system, a controlling lever, machine interlocking therefor, a mechanical switch or signal lever controlled therefrom, electrical control for the controlling lever, a lock for the mechanical lever, requiring full movement of said lever for complete movement of the lock, an auxiliary lock therefor, to hold the first lock in set position and incapable of complete movement without movement of the mechanical lever and setting of the first lock, and a connection between the auxiliary lock and the controlling lever, whereby the controlling lever cannot be

moved fully in either direction without complete movement and locking of the mechanical lever.

14. In an interlocking system, a controlling lever, electrical locking therefor dependent upon the condition of the track, machine interlocking connected therewith, a mechanical lock, means for operating it directly with the movement of the controlling lever, a block engaging with said lock and preventing full movement of said lock until the block has itself moved, a mechanical switch or signal lever, and a connection between the mechanical switch or signal lever and the block moving the block with movement of said lever.

15. In an interlocking switch or signal system, a controlling lever, a lock connected therewith, a mechanical lever, and a block connected with said mechanical lever permitting partial movement of the lock but preventing full movement of the lock until the mechanical lever has been fully moved.

16. In a switch or signal system, a pair of levers, a block movable with one of said levers, a lock engaging with said block and capable of locking and releasing movement without movement of said block, but incapable of complete movement and relocking without movement of said block, and a connection between the lock and that lever not connected with the block.

17. In a switch or signal system, a plurality of levers, a rod operative with movement of one of said levers, a T-crank movable with said rod, a link connected with the other of said levers, a slide operating in said link oscillating it at the beginning and locking in the extremities of the throw of said lever, and an extension of said link, having faces engaging respectively with two arms of the T-crank at the extremities of the rocking of the link, and faces engaging to prevent full movement of the T-crank except at the extremities of the movement of the link.

18. In a switch system, a mechanical switch lever, a switch movable thereby, connections therebetween, a controlling lever, connections between the controlling lever and mechanical switch lever, requiring movement of the controlling lever to permit movement of the switch lever, and a track circuit detector lock for said controlling lever.

19. In a switch or signal system, a switch or signal, a mechanical lever and connections for throwing the same, a lock for said mechanical lever, a controlling lever, connections from said controlling lever to said mechanical lever, and a track circuit detector lock for said controlling lever.

20. A mechanically operated interlocking switch or signal system comprising a plurality of mechanical levers, latches and latch levers therefor, switches or signals, connections between them and the levers, a controlling lever for each mechanical lever and individual thereto, and machine interlocking governing the movement of the controlling levers.

21. A mechanically operated interlocking switch or signal system comprising a single mechanical lever for throwing and locking each switch or signal, a latch and latch lever for each mechanical lever, a controlling lever for each mechanical lever and individual thereto, and an interlocking system for the controlling levers.

22. A mechanically operated switch or signal system comprising a single mechanical lever for throwing and locking each switch or signal, latch and latch lever mechanism for each mechanical lever, the switches or signals and connections thereto, a controlling lever for each mechanical lever, and an electrical track circuit detector lock for each controlling lever.

23. A mechanical switch or signal system comprising a single mechanical lever for throwing and locking each switch or signal, a controlling lever for each mechanical lever, a connection between each controlling lever and its mechanical lever requiring partial movement of the controlling lever before permitting movement of the mechanical lever and requiring complete movement and locking of the mechanical lever before completion of movement of the controlling lever.

24. A mechanical switch or signal system comprising a single mechanical lever for throwing and locking each switch or signal, a controlling lever for each mechanical lever, a connection between each controlling lever and its mechanical lever requiring partial movement of the controlling lever before permitting movement of the mechanical lever and requiring complete movement and locking of the mechanical lever before complete movement of the controlling lever, and a track circuit detector lock for each controlling lever.

25. A mechanical switch or signal system comprising the switches or signals, a single mechanical lever for throwing and locking each switch or signal, a controlling lever for each mechanical lever, a track circuit detector lock for each controlling lever, and locking connections between each controlling lever and its mechanical lever, locking the mechanical lever at each extremity of movement of the controlling lever and preventing complete movement of the controlling lever without movement of the mechanical lever.

26. A mechanical switch system comprising the required switches, a single mechanical lever for locking and throwing each switch, connections therebetween, a controlling lever for each mechanical lever, machine interlocking between the controlling levers,

indication locking for each controlling lever, and locking connections between each controlling lever and its mechanical lever.

27. In an interlocking switch and signal system, a plurality of switches or signals, a single mechanical lever and connections for throwing and locking each switch or signal, a controlling lever for each mechanical lever, locking connections between the controlling and mechanical levers, and machine interlocking between the controlling levers.

28. In a switch or signal system, a switch or signal, a mechanical lever and connections therefor, a link rocking about the quadrant of the lever, a slide engaging with the extremities of the quadrant to lock the lever, a lock for said link, a controlling lever, connections between the controlling lever and the lock for the link, and machine interlocking connected with said controlling lever.

29. In a switch system, a switch, a mechanical lever and connections for locking, unlocking and throwing the same, a locking mechanism for said mechanical lever, a lock for said locking mechanism, and means including an indication circuit for preventing the operation of the lock until the switch has been thrown and locked.

30. In a switch or signal system, a switch or signal, a mechanical lever and connections for locking, unlocking and throwing the same, a link, a slide locking the position of the mechanical lever, a lock for said link, and means upon said link for preventing its locking until the mechanical lever has moved its entire throw in one direction and the slide has locked the lever.

31. In an interlocking switch or signal system, a switch or signal lever for locking, unlocking and throwing the switch or signal, a quadrant for said lever, a link in proximity to the quadrant, a slide moving in said link and engaging the extremities of the quadrant to latch the same, a T-crank, means for moving said T-crank, and a block connected to move at the same time as the link and carrying faces engaging with the ends of arms of the T-crank in approximate line with the pivot point thereof when the link is in its extreme positions and engaging with the sides of arms of the T-crank at intermediate positions of the link.

32. In a switch operating system, a switch, a mechanical lever and connections for locking, unlocking and throwing the same, a quadrant in proximity to said mechanical lever, a link pivoted in proximity to said quadrant, a slide in said link and upon said quadrant to lock the same at its extremities, a controlling lever, indication and track circuit locks for said lever, and a locking connection between said controlling lever and link permitting the movement of the lever to lock the link in either extremity of the latter's throw, but preventing complete movement of the controlling lever and locking of the link intermediate its throw.

33. In an interlocking switch and signal system, a switch or signal, a mechanical lever for unlocking, throwing and locking the same, a lock for said lever, and a power type lever for controlling the locking of said lever in agreement with the position of the locking mechanism for the switch or signal.

34. In a switch system, a switch, a mechanical lever connected therewith, connections for unlocking, throwing and locking the same with movement of the lever, a lock for the lever, an auxiliary lock therefor, a controlling lever for the mechanical lever and a switch indication lock for the controlling lever, preventing full movement thereof until the relocking is complete.

35. In a switch or signal system, a mechanical lever, a switch or signal, connections between the lever and switch or signal for unlocking, throwing and locking the same, a lock for the lever, an auxiliary lock for the lever lock, a controlling lever operating said auxiliary lock, and an electrical track circuit detector lock for said controlling lever.

36. In a switch and signal system, a switch or signal, a mechanical lever and connections for operating the same, a controlling lever and connections for said mechanical lever and individual thereto and a machine interlocking connected with one of said levers.

37. In a switch or signal system, a switch or signal, a mechanical lever and connections for operating the same, a lock for said mechanical lever, a direct thrust lock for said lever lock, and a controlling lever for moving said direct thrust lock.

38. In a switch system, a switch, a single mechanical lever for unlocking, throwing and locking the same, a controlling lever, connections therefrom for controlling the movement of the mechanical lever and indication, and track circuit control for said controlling lever.

39. In a switch and signal system, a switch or signal, a mechanical lever and connections for unlocking, throwing and locking the same, a controlling lever for controlling the movement of the mechanical lever, and track circuit detector locking means for said controlling lever.

40. In a switch and signal system, a switch or signal, a mechanical lever and connections for operating the same, a controlling lever, connections for controlling movement of the mechanical lever, and a track detector circuit for controlling the movement of the controlling lever.

41. In a switch system, a switch, a mechanical lever and connections for unlocking, throwing and locking the same, a controlling lever and connections for controlling the movement of the mechanical lever, and indication locking mechanism for locking the

controlling lever between extremities of the switch movement until the locking of the switch is complete.

42. In a switch and signal system, a switch, a mechanical lever and connections for throwing the same, a signal, a mechanical lever for throwing the signal, a controlling lever each for the switch and signal levers, connections between the controlling levers and the mechanical levers, and common machine interlocking for the controlling levers.

43. In a switch and signal system, a switch, a mechanical lever and connections for operating the same, a signal, a mechanical lever and connections for operating it, a controlling lever for each of the mechanical levers, connections between the controlling levers and the mechanical levers controlled thereby, common machine interlocking between the controlling levers, and electric protective control for both controlling levers.

44. In a switch and signal system, a switch, a mechanical lever and connections for throwing the same, a controlling lever for said mechanical lever and individual thereto, a signal lever, a machine interlocking common to the switch controlling and signal levers.

45. A mechanically operated switch lever and connections, and a controlling lever therefor in combination with track circuit detector locking mechanism for the controlling lever.

46. A switch, a mechanical throwing and locking lever and mechanism therefor, a controlling lever itself governed by the position of the switch, and electrical means for locking the controlling lever.

47. A switch, a locking, throwing and unlocking slide therefor, indication connections made at the extremities of the movement of the slide, a mechanical lever and connections for operating the slide, a controlling lever and locking mechanism for the controlling lever controlled by the indication connections.

48. In a switch system, a switch, a mechanical lever and connections for unlocking, throwing and locking the same, a rotatable controlling lever, indication and track circuit detector locking mechanism therefor, locking mechanism for the mechanical lever, interlocking mechanism connected with said controlling lever, and a mechanically operated lock for the lever locking mechanism thrown by the controlling lever.

49. A mechanical interlocking switch or signal system comprising a plurality of mechanical levers, the switches or signals and connections to be operated by the mechanical levers, a rotatable controlling lever for each mechanical lever and individual thereto, and miniature machine interlocking governing the movement of the controlling levers.

50. A mechanical interlocking switch or signal system comprising a single mechanical lever for throwing and locking each switch or signal, a controlling lever for each mechanical lever and individual thereto, and an interlocking system for the controlling levers.

51. A mechanically operated switch or signal system comprising a single mechanically operated lever for operating each switch or signal, the switches or signals and connections thereto, a controlling lever for each mechanical lever, and electrical indication locking for each controlling lever controlled by the position of the switch or signal so mechanically operated.

52. A mechanical switch or signal system comprising a single mechanical lever for operating each switch or signal, a controlling lever for each mechanical lever, moving in one direction only for complete movement of the mechanical lever in one direction, and a connection between each controlling lever and its mechanical lever requiring partial movement of the controlling lever before permitting movement of the mechanical lever and requiring complete movement and locking of the mechanical lever before complete movement in a single direction of the controlling lever.

53. A mechanical switch or signal system comprising a single mechanical lever for operating each switch or signal, a controlling lever for each mechanical lever, moving in one direction for movement in one direction of the mechanical lever, and in the opposite direction for the reverse movement of the mechanical lever, a connection between each controlling lever and its mechanical lever requiring partial movement of the controlling lever before permitting movement of the mechanical lever in either direction and requiring complete movement and locking of the mechanical lever before complete movement of the controlling lever, and an electrical track circuit detector lock for each switch controlling lever.

54. A switch or signal, a mechanical lever for operating the same, a link and latch controlling the movement of said lever, a direct thrust lock for said link, a controlling lever, and means operated by the controlling lever for engaging the direct thrust lock with the link.

55. A mechanical interlocking switch or signal system comprising a single mechanical lever for operating each switch or signal, an individual controlling lever for each mechanical lever, and a miniature interlocking system for the controlling levers.

56. A mechanical interlocking switch or signal system comprising a single mechanical lever for operating each switch or signal, an individual power type controlling lever for each mechanical lever, and an interlocking system for the controlling levers.

57. In a mechanical switch or signal system, a switch, a mechanical lever for operating the same, a link and latch mechanism controlling the movement of the lever, a direct thrust lock for said link, means for operating the lock for the link, and machine interlocking for the link lock operating means.

58. In a mechanical switch or signal system, a switch or signal, a mechanical lever for operating the same, a link and latch mechanism controlling the movement of the lever, a direct thrust lock for said link, means for operating the lock for the link, and machine interlocking for the link lock operating means.

59. In an interlocking switch or signal system, a power lever complete, a switch or signal, operating mechanism and connections for moving the same, track detector and indication locking, a power type lever complete of the same form as the power lever complete, a mechanical switch or signal lever, and means for controlling the mechanical lever according to the position of the power type lever.

60. In an interlocking switch or signal system, a power lever complete with connections, and the switch or signal, in combination with a power type lever, a mechanical lever, a switch or signal and connections mechanically controlled by the power type lever and interlocking between the power and power type levers.

61. In an interlocking switch or signal system, a power type controlling lever, an interlocking machine connected therewith, and a mechanical lever individual thereto and controlled thereby to effect the movement of the switch or signal respectively.

62. In an interlocking switch system, a power type controlling lever, machine interlocking connected therewith, a mechanical switch lever, a lock therefor, connections between the lock and the controlling lever, and track circuit detector and indication locking directly controlling the movement of the power type lever.

63. In an interlocking switch or signal system, a controlling lever, machine interlocking connected therewith, a mechanical switch or signal lever individual to the controlling lever, a lock for the mechanical lever, and a connection between the lock and the controlling lever.

64. A mechanical interlocking switch or signal system comprising a single mechanical lever for throwing and locking each switch or signal, a latch and latch lever for each mechanical lever, an individual controlling lever for each mechanical lever, locking mechanism between each controlling lever and the corresponding mechanical lever, and an interlocking system for the controlling levers.

65. In an interlocking switch or signal system, two switches or signals, a mechanical lever and connections for operating each switch or signal, an individual controlling lever for each mechanical lever, and interlocking between the controlling levers.

66. In an interlocking switch and signal, a switch, a signal therefor, a mechanical lever for the switch, an individual controlling lever for the mechanical lever, a signal lever and interlocking between the controlling lever and signal lever.

67. In an interlocking switch and signal, a switch, a signal, a mechanical lever for each, a controlling lever and mechanical lock for each mechanical lever and interlocking between the controlling levers.

68. In switch operating mechanism, a mechanical switch throwing lever, a controlling lever of power type therefor, and mechanical locking between the two levers.

69. In an interlocking switch and signal system, a switch, a mechanical lever and connections for operating the switch, a controlling lever for the mechanical lever, track circuit detector locking and indication locking for the controlling lever, a signal, a power lever and connections for operating the signal, electric locking for the power lever and interlocking between the power lever and controlling lever.

70. In an interlocking switch and signal system, a mechanical switch lever, a controlling lever for said switch lever, a signal lever, track detector and indication locking for said controlling lever, electrical locking for the signal lever and interlocking between the two levers.

71. In an interlocking signal system, two signals, a power interlocking lever complete for one signal, miniature interlocking therefor, and a mechanical lever and connections for the other signal using the same miniature interlocking.

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