No. 786,368. PATENTED APR. 4, 1905.

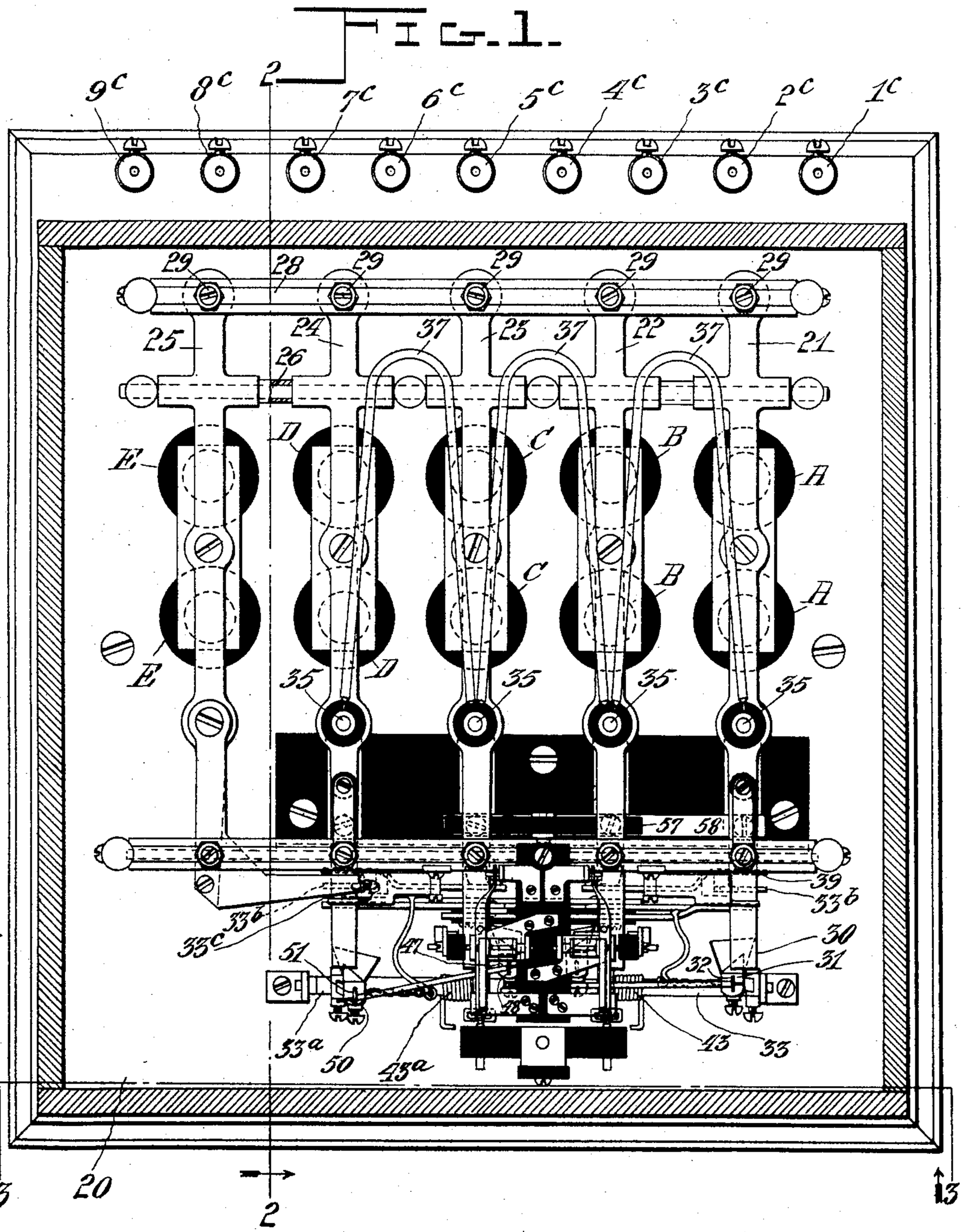
J. LEMIRE.

RAILWAY SIGNALING SYSTEM.

APPLICATION FILED OCT. 3, 1904.

7 SHEETS—SHEET 1.

Fig. 1.



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7 SHEETS—SHEET 2.

FIG. 2.

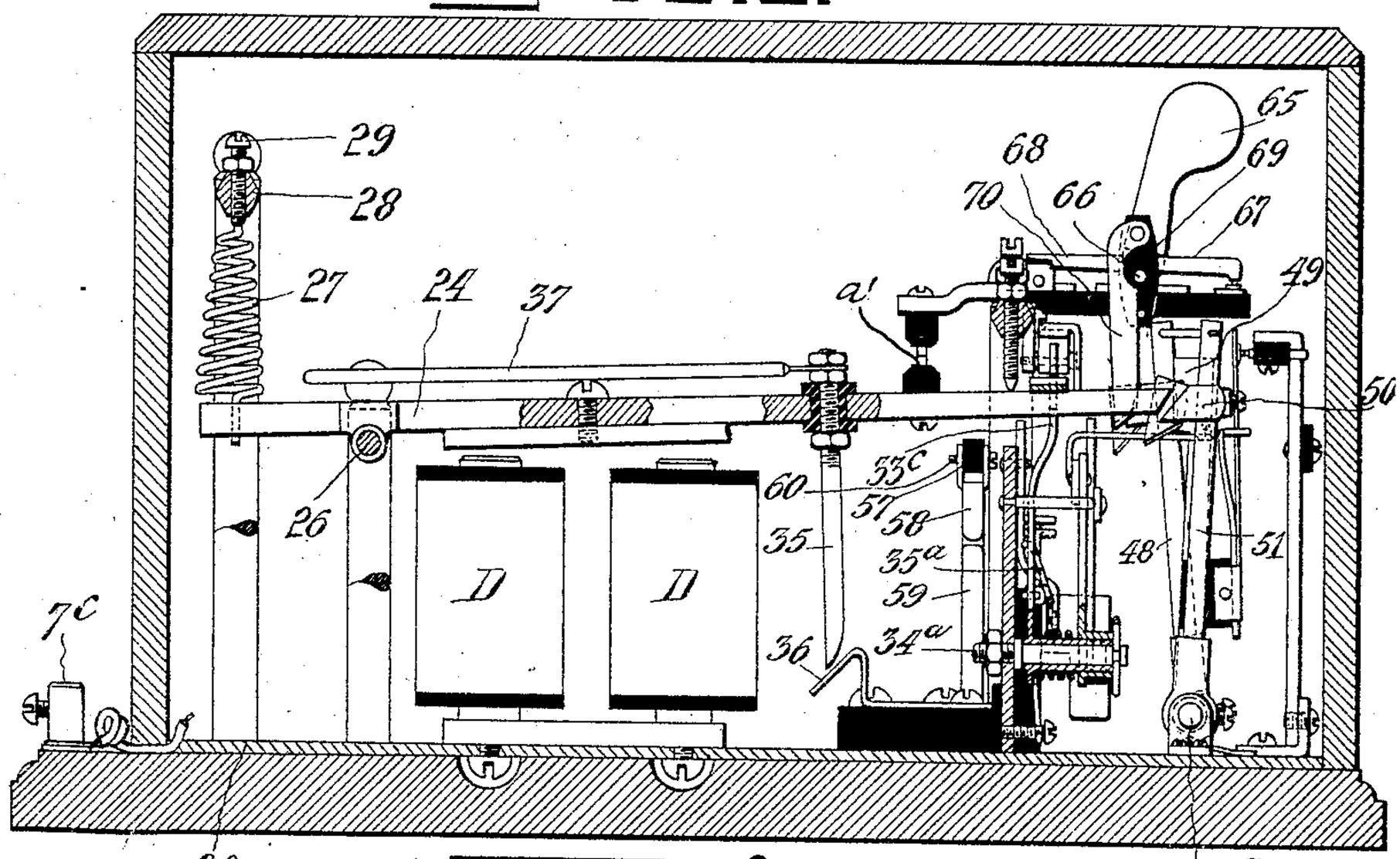

FIG. 3.

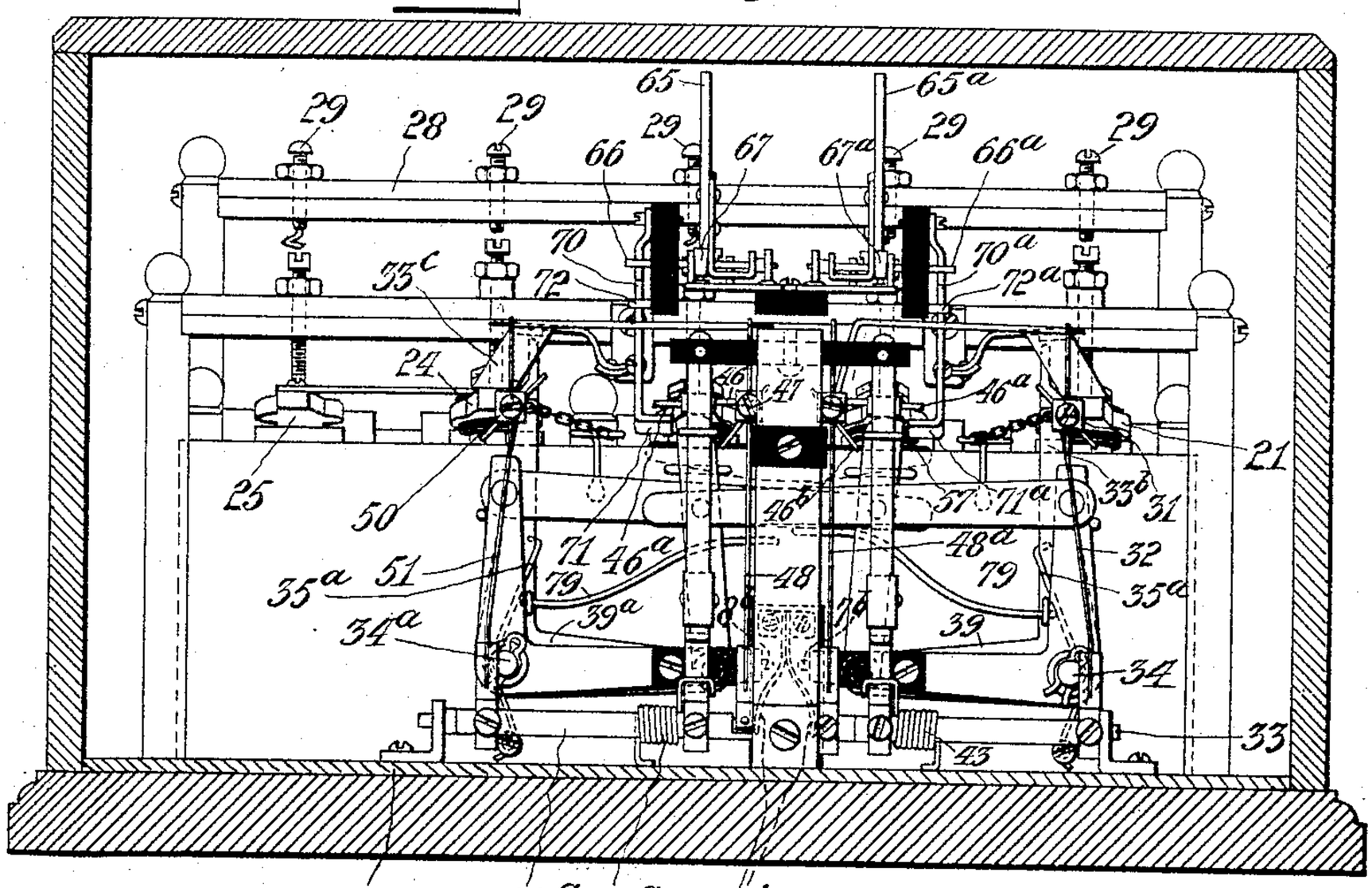

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PHOTO-LITHOGRAPHED BY SACHETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

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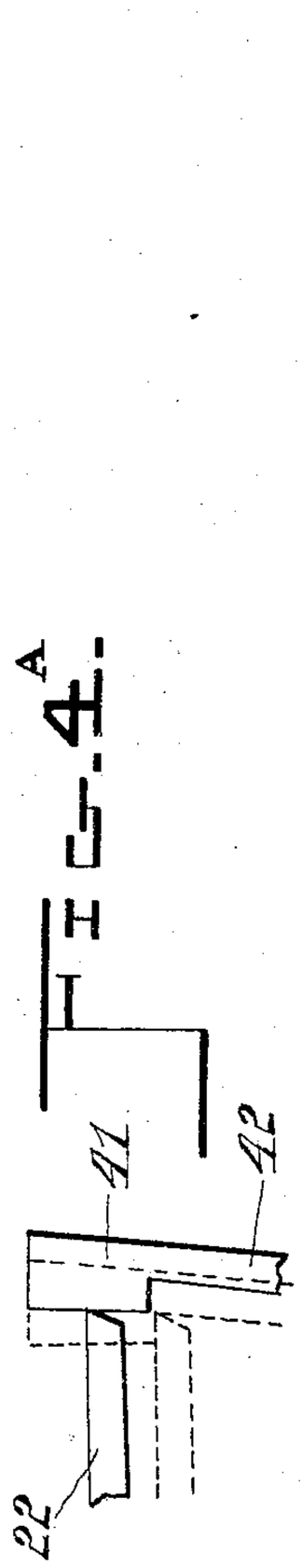
7 SHEETS—SHEET 3.



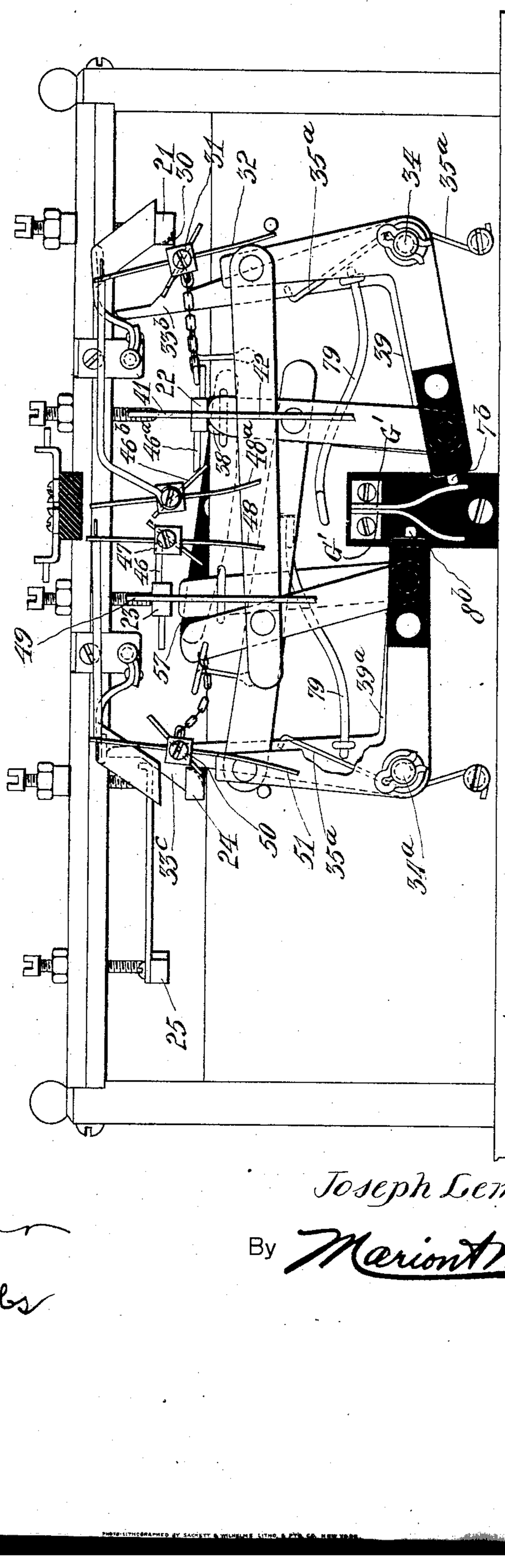


FIG. 4.

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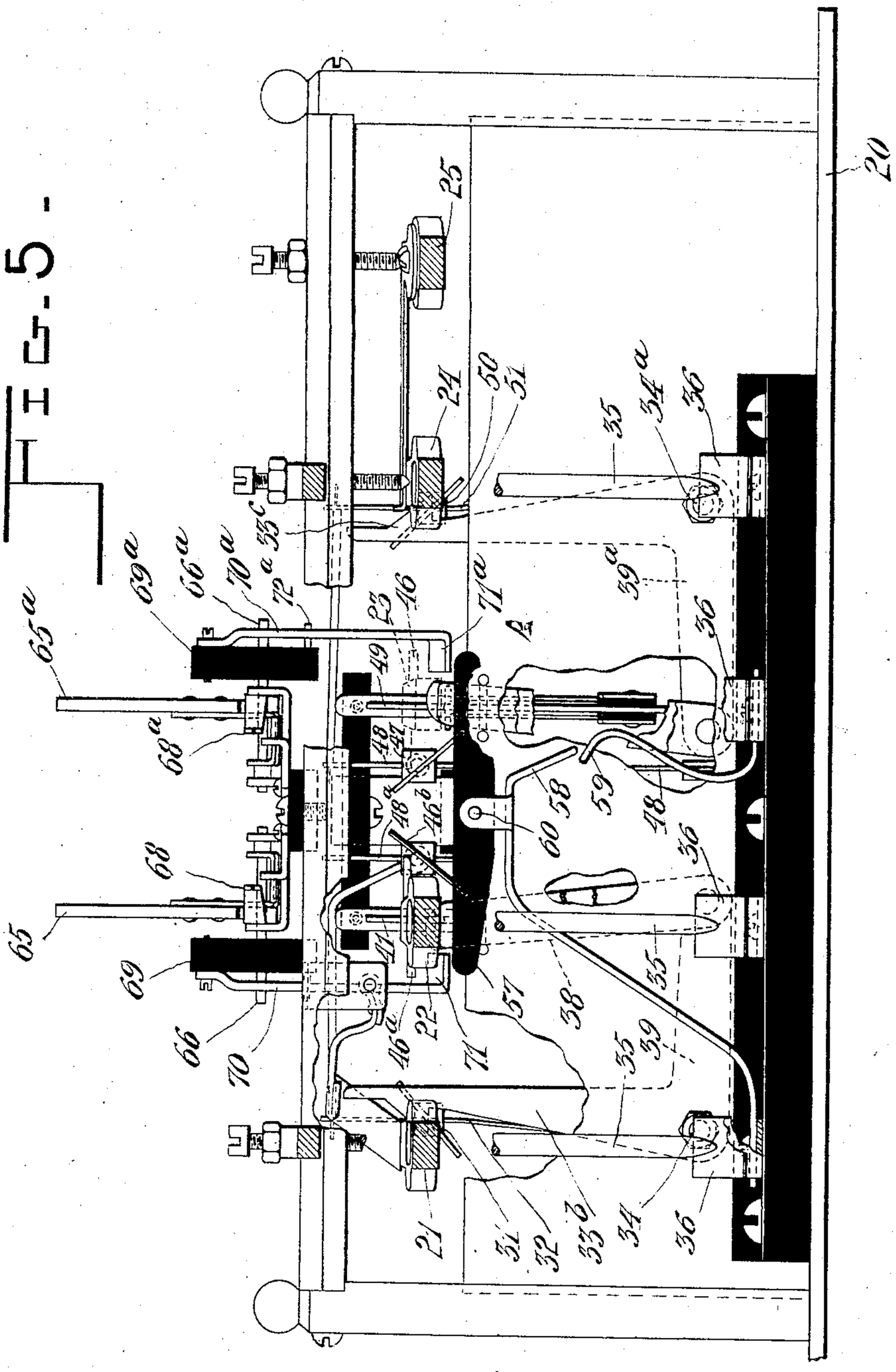
7 SHEETS—SHEET 4.

FIG. 5.



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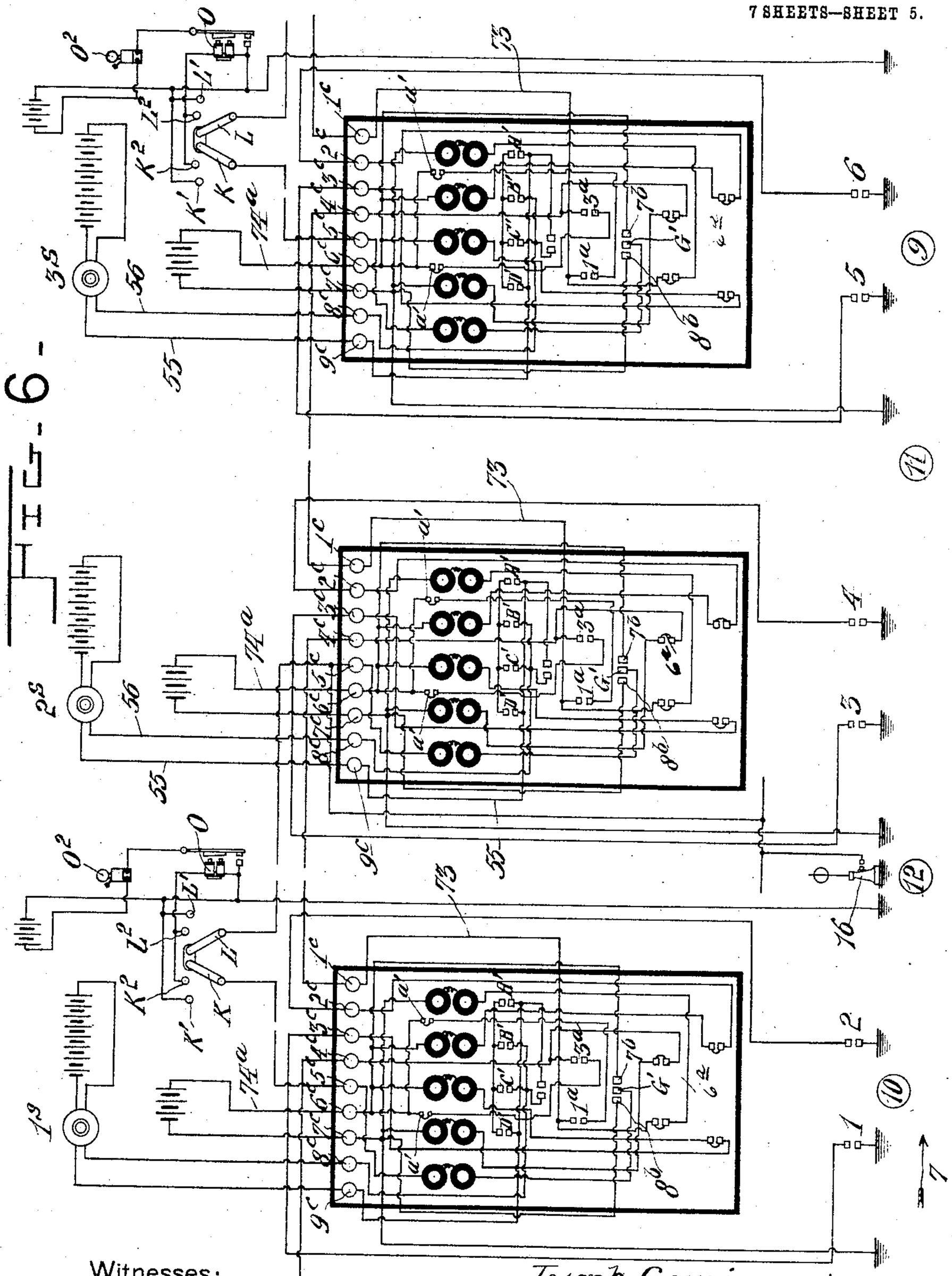
7 SHEETS—SHEET 5.

FIG. 6.



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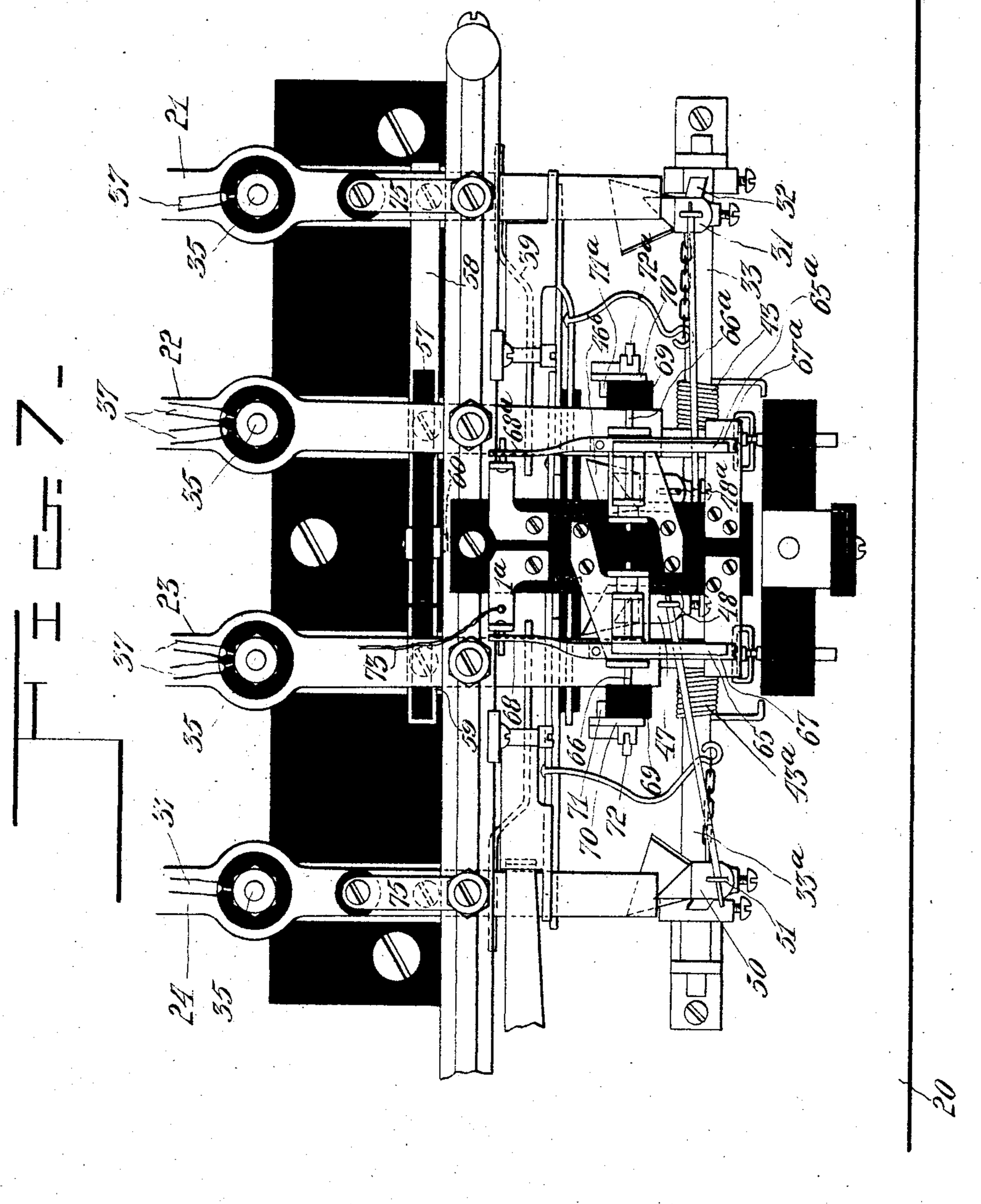
7 SHEETS—SHEET 6.

FIG. 7.



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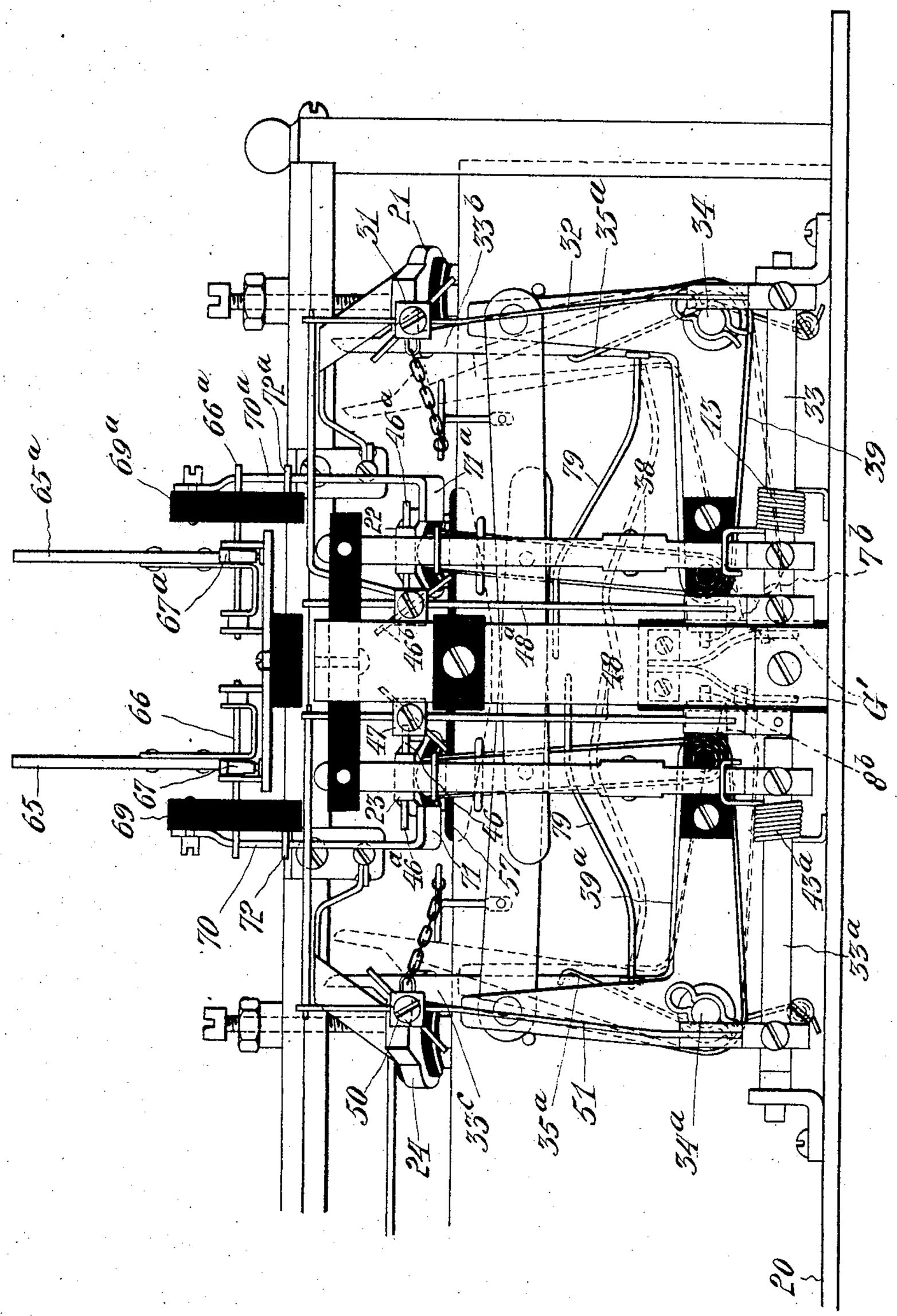
7 SHEETS—SHEET 7.

FIG. 8.



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No. 786,368. Patented April 4, 1905.

UNITED STATES PATENT OFFICE.

JOSEPH LEMIRE, OF DRUMMONDVILLE, CANADA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE AUTOMATIC RAILWAY SIGNAL COMPANY, LIMITED.

RAILWAY SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 786,368, dated April 4, 1905.

Application filed October 3, 1904. Serial No. 226,883.

To all whom it may concern:

Be it known that I, JOSEPH LEMIRE, a subject of the King of Great Britain, residing at Drummondville, county of Drummond, in the Province of Quebec, Canada, have invented certain new and useful Improvements in Railway Signaling Systems; and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a new and useful improvement in railway signaling system and means for carrying into operation the system of signaling hereinafter described by means of which each train in passing over a track equipped with the system will only partially close a semaphore-operating circuit through a serially-arranged bank of electromagnets whose armatures are carried by spring-actuated armature-arms adapted to coöperate with locking means which are so arranged as to be tripped or released by the next succeeding armature-carrying arms of the series; and it consists in certain features of novelty in the said system and the mechanism used for carrying the same into effect, all as hereinafter more fully described, and specifically pointed out in the claims.

The object of the invention is to produce a system of the character described in which a single train will partially close and lock in a semaphore-circuit or a series of such circuits through serially-arranged electromagnets, and such circuit or circuits will be completed by means of a second train traveling in the same zone or by means of a track-switch or by a station-switch adapted to be controlled by the operator.

In the annexed drawings, in which similar characters of reference indicate corresponding parts in all the views, Figure 1 is a plan view of the electrically-operated serially-arranged bank of magnets described. Fig. 2 is a sectional view taken on line 2 2 of Fig. 1. Fig. 3 is an end view of the parts shown in Fig. 1, with the front of the casing removed, taken substantially on line 3 3 of Fig. 1. Fig. 4 is a front end view, enlarged, with some parts broken away and some parts removed. Fig. 4ª is a detail hereinafter described. Fig. 5 is a view looking toward the rear face of the front plate shown in Fig. 4; and Fig. 6 is a diagrammatic view illustrating the electrical connection of the various circuits with the electromechanically-operated parts of the system, showing the general arrangement thereof when in position. Figs. 7 and 8 are respectively enlarged details provided for the purpose of better illustration of details shown in other figures and hereinafter more fully described.

For a better understanding of the system it will be necessary to describe certain features of the apparatus used for carrying the same into effect, which apparatus is illustrated in the drawings, wherein the magnets A, B, C, D, and E are shown in position upon the base-board 20, upon which the contact-posts 1^c, 2^c, 3^c, 4^c, 5^c, 6^c, 7^c, 8^c, and 9^c are secured, to which posts connecting-wires of the system are adapted to run, as shown in the diagram referred to. The magnets A to E, inclusive, are provided with spring-actuated armature-carrying arms 21, 22, 23, 24, and 25, which, as shown in Fig. 2, are balanced upon the shaft 26 by means of the springs 27, which springs bear at their lower ends against said armature-carrying arms and are adjustably locked in position at their upper ends beneath the cross-piece 28, through which project a series of adjusting-screws 29 for varying the tension of said springs.

As will be evident, suitable insulation is necessary for the circuit-carrying parts of the device; but as such insulation is well understood in connection with this class of devices it will not be described in detail.

In the consideration of the apparatus as shown the magnets A, B, C, and D are referred to as a "bank," and in the specification and in some of the claims hereinafter the term "bank" is employed to indicate said magnets for convenience of description; but it will be understood that any convenient means which will accomplish the same function is intended to be covered by the term "bank," and the

magnets are merely shown by way of illustrating one means of performing the necessary operation. While the magnets A to D, inclusive, are hereinafter referred to by the term "bank," it will be understood that all of said magnets are not necessary, and any three serially-coöperating magnets similarly arranged and adapted to perform the same function will be understood as included within the term "bank" if they are so connected as to successively lock and be released by the succeeding magnet during one operation and close a circuit when two magnets are locked upon another operation of the device.

By means of connections of any suitable character the magnets A B C D are arranged to operate serially when a train is passing over a track equipped with the present invention, and for better understanding of such connection reference is made to the diagrammatic view, Fig. 6. Referring, however, to the detail parts of the apparatus illustrated in Figs. 1 to 5, inclusive, and commencing with magnet A, it will be noted that the armature-carrying arm 21 thereof extends beyond its magnet and terminates at 30 in a beveled end portion which is adapted to cooperate with the correspondingly-beveled releasing member 31, carried by the arm 32, which extends upwardly from the rockable shaft 33, which shaft carries a locking-arm adapted to coöperate with the magnet-carrying arm 22 and release the same upon depression of the arm 21. Coöperating with the arm 21 is a beveled and rockable catch 33^b, which is pivoted at 34 and held normally in engaging position by means of the spring 35^a, as shown in Fig. 4. Energizing the magnet A will draw downwardly the magnet-carrying arm 21, so as to lock the same under the member 33^b, thereby carrying the beveled pin 35 into contact with the terminal 36, which by reason of the circuit connections established will partially close a semaphore-circuit, said circuit being carried by the conductor 37 common to all the magnets A to D, inclusive. (Shown connected in Fig. 1.) The arm 35 and contact 36 are duplicated in connection with each of the magnets A to D, so that when any of said magnets A to D is energized and its armature-carrying arm is depressed a contact will be established through corresponding members 35 and 36 for each of said magnets, and thereby partially close a semaphore circuit. Assuming that the arm 21 is depressed and locked by means of the member 33^b, if the arm 22 is depressed its outer end will bear upon the arm 38, which as shown in Fig. 4, extends upwardly from the bell-crank lever 39, which being pivoted at 34 terminates at its upper end in the hook 33^b for locking the arm 21, so that the arms 21 and 22, operating serially, the arm 21 will be released by the arm 22 and contact of the members 35 and 36 of arm 21 will be broken, while a corresponding contact will be established with relation to the arm 22. When the arm 22 is depressed, this armature-arm will be locked by means of the hook or angular extension 41, carried by the arm 42, which is supported upon said shaft 33. The tendency of the spring 43 is to throw the locking-shoulder 41 into engagement with the forward end of the arm 22, so that when said arm has passed below the shoulder thereof said spring will cause said member 41 to lock the arm 22 in its depressed position, again establishing contact between corresponding members 35 and 36 and partially closing the semaphore-circuit. Assuming that the arm 22 is locked, depression of the arm 23 will cause a release of the arm 22 by reason of the contact of the pin 46 on the free end of the arm 23 with a member 47, carried by the arm 48, which arm 48 is supported upon the shaft 33^a, which is an extension of the said shaft 33, before referred to, and is likewise provided with a spring 43^a, adapted to hold said member 48 normally in position to contact with said pin. Carried also by the shaft 33^a is a locking-hook 49, which is shaped exactly like the member 41 42, which serves as a locking means for the arm 22. These parts are shown in detail in full and dotted lines in Fig. 4^a, wherein the armature-arm 22 is shown in position to be engaged by the shoulder 41 of said member 42 in full lines and in engaged position in dotted lines. When the arm 23 is locked in the order described, the beveled member 50 is brought into close proximity to the beveled outer end of the armature-arm 24, approximately as shown in Fig. 2. This member 50 is carried by an arm 51 upon said shaft 33^a, and if the magnet D is energized the arm 24 is drawn downwardly, causing the beveled outer end of its arm 24 to contact with the beveled face of the member 50, thereby retracting said member 50 and rocking the shaft 33^a to carry the locking means for the armature-arm 23 away from said arm and permit its spring 27 to free it from engagement with said locking means. In this operation—that is, in the operation from A to D—the magnet D is not locked. Locking means are provided, however, for the arm 24 when the operation is reversed—that is, when said arm 24 is the first of the arms depressed. This occurs when, by reason of the contacts established, the circuits are operated in the opposite direction. When the magnet D is the first to be energized in the series, its arm 24 will contact with the beveled locking-hook 33^c and be engaged thereby, said member 33^c being carried by a bell-crank lever 39^a, which is pivoted at 34^a, as shown in Fig. 4, and said bell-crank lever is controlled by a spring 35^a, corresponding to a similar spring at the opposite side of the apparatus.

Assuming that the magnets are to be ener-

gized in the inverse order to that previously described—that is, commencing with D and ending with A—the magnet D is locked by the hook 33^c and contact is established through an arm 35 and terminal 36, when the magnet D is energized. When the magnet C is energized following D, its arm 23 will contact with the upper end of the arm 38^a, which is pivotally carried by said bell-crank lever 39^a, and continued depression of the arm 23 will rock said bell-crank lever upon its pivot, thereby releasing the hook 33^c from the arm 24, whereupon said arm 23 will be locked by the arm 49 before referred to. When the magnet B is next energized, its arm 22 will be depressed, and a pin 46^a, carried by said arm 22, will contact with an inclined plate 46^b, thereby rocking an arm 48^a upon the shaft 33 and releasing the arm 23 from its engagement with the arm 49. In this operation said arm 22 will contact with the arm 38 referred to and rock the bell-crank lever 39, so as to carry the hook 33^b out of alinement with the armature-arm 21, as shown in full lines in Fig. 4. When the magnet A is next energized, its arm 21 will be depressed, carrying its beveled end 30 referred to into contact with the member 31, thereby rocking the arm 32 upon said shaft 33 to carry the locking member 41 out of engagement with the arm 22; but as the hook 33^b has been held in an abnormal position by reason of the depression of the arm 38 the armature-arm 21 will not be locked in its depressed position.

As will be evident from the diagrammatic view and the description of circuits following, the semaphore-circuit will be closed upon energizing any two magnets of the series A to C, inclusive. This is accomplished as follows: The terminals 36 of magnets A and D are electrically connected by a line leading from the semaphore-circuit at 55 to post 9^c, thence to terminal 36 of magnet D and to terminal 36 of magnet A, passing the terminals 36 of magnets B C, as shown in the diagram, wherein the members 35 and 36 of the bank of magnets are lettered A′, B′, C′, and D′, corresponding to their respective magnets A to D, inclusive. If either magnet A or D is energized and either of the magnets B C is likewise energized, circuit will be established through line 55 by reason of the contact of the members 35 and 36 of B C through contacts B′ C′ of the diagram, thence back through line 56, leading to the semaphores. Contacts B′ C′ are both on the same line 56. If either magnet B or C is energized and the other of said magnets is also energized, as may happen when two trains are approaching in the same zone, the arms 21 and 22 will both bear upon the insulated rocking arm 57, which is supported normally by the spring-arm 58, which arm is in circuit with the contact A′ and bears against the other spring-arm, 59, which is in circuit with the contacts C′. When only one magnet B or C is energized, its armature-arm will contact with the insulation rocking arm 57, said arm will rock on its pivot 60, and the contacts 58 and 59 will not be brought together; but if both arms 22 and 23 are held in a depressing position the pressure on opposite sides of the pivot 60 will depress the arm 57 and carry the members 58 and 59 into contact, thereby closing circuit from contacts A′ to contacts C′ through members 58 and 59, closing circuit through lines 55 and 56, whereupon the semaphore is thrown to indicate "danger." When the magnet A is energized and locked and C is next energized and locked, the circuits 55 and 56 will be closed to semaphore 1^s. This is true if magnet C is locked and A is next locked. If magnet B is energized and locked and D is next energized and locked, the same relative circuit will be established, and said circuit will be closed if this order is reversed to lock D and then B.

Corresponding to the contacts 1^a of the diagram is the balanced arm 65, carried on the shaft 66. Said arm 65 is provided with extensions 67 and 68, which form terminals. On the arm 65 is a block of insulation 69, to which is pivoted the hanger 70, having the beveled offset 71, which is struck by the pin 46^a on depressing armature-arm 23. A pin 72 projects laterally from the insulation-block 69 in the path of movement of the hanger 70 below its pintle 66, and when the arm 23 is depressed the hanger 70 is rocked, carrying it into contact with pin 72 and rocking the terminal 68 into momentary contact with a terminal at 1^a, the circuit being as follows: Beginning with ground at station 1^s, to post 7^c, through battery and line 74^a, post 6^c, right hand a', 1^a, line 73, and 1^c to the next station, thence through 4^c, normally closed coil 6^a to magnet D, thence to ground at station 2^s. When the pin 46^a passes the beveled offset 71, the balanced arm 65 rocks back to its normal position to break contact at 1^a. Contacts 3^a are controlled by similar means, including the balanced arm 65^a on shaft 66^a, with arms 67^a and 68^a, insulation-block 69^a, hanger 70^a, having beveled offset 71^a, actuated by pin 46^a on the armature-arm 22.

Battery-circuit 74^a leads from battery to post 6^c, thence to contacts a', (shown in the diagram,) which contacts are normally closed; but as these contacts are represented mechanically in the apparatus by the bridges 75 on armature-arms 21 and 24 it will be evident that such contacts will be broken when said arms are down—that is, when their magnets A and D, respectively, are energized—and the semaphore 1^s, 2^s, or 3^s will not be actuated when both magnets are energized in a single bank.

When magnets B and C are successively energized, it will be evident that the arms 79 are overlapped and locked to hold the locking-hooks 33^b and 33^c in abnormal position,

so that the magnets D may be energized from the next adjacent semaphore-circuit without locking the arm 24 under the hook 33^c, or the magnet A may be energized without causing its arm 21 to become locked.

A train traveling in the direction of the arrow 7 closes the contacts 1, thereby establishing a circuit through magnet C in semaphore 1^s, which circuit actuates the armature-plate of said magnet, momentarily closing the contacts 1^a and establishing a circuit through magnet D of semaphore 2^s. When the train reaches the point 2, it closes the contacts thereat, and thereby establishes a circuit through the magnet B of semaphore 1^s, actuating the armature of said magnet to momentarily bring together the contacts 3^a of semaphore 1^s, which establishes a circuit through magnet A of the preceding semaphore, thereby releasing B, which has been previously locked in the order hereinafter described as to semaphore 1^s. When A releases B, then A does not lock. When the train reaches the contacts 3, it brings the said contacts together and establishes a circuit through the magnet C of semaphore 2^s, thereby actuating the armature of said magnet, which action momentarily brings together the contacts 1^a of the semaphore 2^s, which establishes a circuit through the magnet D of the semaphore 3^s. When the train reaches the contacts 4, it closes the circuit at that point, which energizes the magnet B of semaphore 2^s, thus actuating the armature of said magnet to momentarily close the contacts 3^a, thereby establishing a circuit through magnet A of semaphore 1^s. When the train reaches the contacts 5, it brings same together and establishes a circuit through the magnet C of semaphore 3^s, actuating the armature of said magnet and momentarily closing the contacts 1^a of semaphore 3^s and establishing a circuit through the magnet D of the next succeeding semaphore. (Not shown on the drawings.) When the train reaches the contacts 6, it closes a circuit at that point, which energizes the magnet B of semaphore 3^s, thereby actuating the armature of said magnet and momentarily closing the contacts 3^a and establishing a circuit through the magnet A of semaphore 2^s. The succeeding contact, (not shown,) which will be operated by the train, operates the armature of the magnet C of the next succeeding semaphore, (not shown,) which momentarily closes the circuit that operates upon the magnet D of the second succeeding semaphore, and so on. Each contact operated upon by the train in passing serves to energize the respective magnets to which they are connected successively in the manner described.

Assuming that the track is clear and there is no train upon any section of it, all of the magnets in the various semaphores are deenergized, and the parts are all normally released excepting those contacts which remain normally closed and which will be hereinafter described, and for purposes of better illustration those contacts which are normally closed are marked by a bracket (]) on the diagram. As the train passes over the track in the direction of the arrow 7 the first magnet energized by means of its connected contact and battery is the magnet C of each semaphore, and this magnet in turn serves as a means for energizing the magnet D of the next semaphore approximately simultaneously with it. It will thus be observed that the first track-contact of each series of magnets serves to energize two magnets in successive semaphores. This is also true of a train coming in the opposite direction, in which case the other track-contact of the respective semaphores becomes the first contact, and the operation is in reverse order, as will be hereinafter explained. When the train reaches the second contact 2, it energizes the magnet B of the respective semaphore, as has been hereinbefore explained, and releases the armature of magnet C of the same semaphore, it being understood that the armature of said magnet had been temporarily locked in closed position when first acted upon, and the movement of the armature of the magnet B, as has been explained, serves to energize the magnet A of the preceding semaphore approximately simultaneously with it, and the movement of the armature of the magnet A in the preceding semaphore serves to release the armature of the magnet B of that semaphore which has up to this time been locked in position—that is, after having been closed by the passage of the train over the said preceding contact. The magnet A, however, is not locked in position by the impulse given at this time. In a similar manner the various armatures of the magnets are successively released by the action of a passing armature through the passage of a train over the connected track-contacts. It is understood that the various armatures, with the exceptions hereinafter mentioned, are temporarily locked in position whenever actuated by the corresponding magnet and are held in said locked position until released, as stated and as will be hereinafter more fully described.

The operation as explained is precisely the same, but in a reverse order when the train is traveling in an opposite direction to that described. The magnet E operates in conjunction with a track-switch and station-switch which have not yet been explained and which will be described more fully hereinafter.

The successive operation of the various armatures of the magnets has thus far been described, assuming that one train only is passing over the tracks. We will now, however, assume that a train is at a standstill at any point on the line, and a second train is following, for example. The train at a standstill is positioned on the section of track between

the contacts 5 and 6, as at 9, and has been traveling in the direction indicated by the arrow 7. The contacts at 5 having been brought together, the circuit energizing the magnet C of semaphore 3^s has been closed and the contacts 1^a have been momentarily brought together, thus establishing the circuit which energizes the magnet D of the next succeeding semaphore, (not shown), thus actuating the armature of said magnet D and bringing together the contacts corresponding to D′. This partially closes the circuit, which circuit will operate the said semaphore, and the movement of magnet C in semaphore 3^s brings together the contacts C′ of the said semaphore to partially close the circuit operating the same. The said armature D of the succeeding semaphore and the armature C of semaphore 3^s remain in the locked position as long as the train is on the section of the track between the contacts 5 and 6. It is understood that the train in passing the contact 4 has closed the circuit which operates the armature of magnet B of semaphore 2^s to partially close the circuit at B′, which circuit operates the semaphore 2^s. This armature remains in its locked position until released by the action of the armature of magnet A in semaphore 2^s, which is energized to release armature B after contact at 6 is closed, as has hereinafter been explained when the contacts 4 are closed by the train. A train traveling in the same direction as has been indicated approaches the contact 1, which, it will be observed, is the second section preceding the section upon which the train is stalled. The said contacts 1 are closed by the approaching train and establish a circuit which energizes the magnet C of semaphore 1^s, thereby closing the circuit which energizes the magnet D of 2^s. This magnet actuates its armature which is locked in position and which closes the contact D′ of 2^s. Now it will be observed that an electrical circuit has been established which will operate the semaphore 2^s through the contacts B′ and D′, which lead to the posts 8^c and 9^c, respectively, and thence to the batteries or source of electrical supply and the semaphore, the projections of the armature-plates of the magnets B and D forming two ends of a bridge which contact with the terminals of the said semaphore operating circuit at the points indicated. The operator of the second train is thus notified that the track is not clear and may take the proper precautions. As soon as the train which has been at a standstill at 9 passes on and operates the contacts 6 it establishes a circuit which will energize the magnet A of the semaphore 2^s, and this will release the armature of the magnet B, thereby breaking the circuit adapted to operate the semaphore and allow said semaphore to return to its normal position, which indicates no danger ahead. The train which has been signaled is thus notified that the track is clear. In the same manner a train following the second train may complete the circuits, which will set the semaphore preceding it. Of course it will be readily understood that these sections may be any number, according to the length of the line; but it is also understood that the semaphore and its set of contacts and circuits must be provided for each section.

We will now assume that a train is approaching the stalled train from the opposite direction, and for the matter of better illustration we will place the train between the contacts 1 and 2, as at 10. A train passing over the contact 1, as has been heretofore stated, closes the circuit which operates the armature of magnet C of semaphore 1^s and the circuit which operates the magnet D of 2^s, thereby partially closing the circuit of the semaphore 2^s at D′. A train traveling in the direction opposite to that indicated by the arrow 7 will when it reaches the contact 4 establish a circuit at that point which will operate the armature of the magnet B of 2^s. This completes the circuit at B′ of the semaphore 2^s, which has been partially closed at D′, thereby operating the said semaphore to indicate to the operator of the train that the track is not clear ahead. Assuming now that the stalled train is located between the contacts 4 and 5, as at 11, and a train is following in the direction indicated by the arrow 7, the stalled train in passing over the contact 4 has closed a circuit which operated the armature of magnet B of the semaphore 2^s and partially closed the circuit of that semaphore at B. The following train as it reaches the contact 3 closes the circuits which will operate the magnet C of semaphore 2^s, thus completely closing at 58 and 59 the circuit which operates the semaphore 2^s, thereby properly setting the semaphore-signal to indicate "danger." To further illustrate the operation of the signal when a train is coming in the opposite direction to that indicated by the arrow 7 and another train which had traveled in the direction of said arrow is stalled between the contacts 2 and 3, as at 12. This section corresponds in every respect, except probably in length, to the section between 4 and 5 and every alternate section preceding and succeeding thereto. The armature of the magnet D in semaphore 2^s is locked in position to partially close the circuit of the said semaphore at D′, having been thus positioned by the contact of the train, which is now considered as stalled, with the contacts at 1, at which time circuit is broken at contacts a', so that magnet A of preceding bank cannot be energized to release arm 22 of said preceding bank and release the semaphore, which is set behind the train at 10. The train coming in the direction opposite to that indicated by the arrow will when it reaches the contact 4 close the circuit which operates the armature of the magnet B, there-

by closing at B′ the circuit which operates the semaphore 2^s, the zone of which it is essential at the sections between the various contacts should be of sufficient length to permit the stopping of the train within an absolutely safe distance of the obstruction on the track. It will be readily observed from the description already given that as soon as the stalled train begins to move ahead it automatically breaks the circuit, (which has been established by a train following, as described,) and thus allows the semaphore to assume its normal or "safe" position, which indicates a clear track ahead.

Thus far the operation of the semaphore has been described in conjunction with trains only; but it is obvious that many switches as to sidings, &c., are provided along a line which may be opened at any time and which must be properly set before a train can pass with safety. To provide against any accident from an open switch, there is provided a series of electrical connections between the semaphore and switch mechanism which may be operated to partially close by grounding the semaphore-circuits when a switch is open. One or more switches may be located in each semaphore-section of track; but in the diagram of connections but one switch is shown in conjunction with two adjacent semaphores. The said switch 16 in the diagram is located between semaphores 1^s and 2^s, the operation being as follows: Contact at 16 being closed, if 2 is closed B′ of 1^s will be operated, and then the circuit will be from ground at 16 to post 5^c at 2^s, then line to switches L and K at 1^s, thence to post 5^c at 1^s, through E, G, and 7^b to battery and ground, the semaphore 1^s being operated by means of closed contacts D′ and B′. The same result occurs at 2^s upon the closing of the contact 4. The line continues from 7^b to the binding-post 6^c in each semaphore, through the battery to the ground, and forms a complete circuit in either semaphore when the common terminal G′ contacts with the terminal 7^b. This energizes the magnet E in the corresponding semaphore, thereby moving the armature of said magnet, which in turn operates to move the armature of the magnet D. The contact 7^b in the semaphore 1^s is brought into contact with the said common terminal when a train operates upon the contact 2 to actuate the armature of the magnet B in semaphore 1^s. The movement of the armature of the magnet B serves, in conjunction with the levers and connections heretofore explained in the operating mechanism, to bring the said common terminal and the contact 7^b into engagement with one another, thereby completing the circuit which actuates the armature of the magnet E. The movement of the armature of the magnet B partially closes the semaphore-circuit at B′, and the movement of the armature of the magnet D through the medium of the armature of magnet E serves to completely close the semaphore-circuit at D′, thus operating the semaphore to indicate "danger." The semaphore will remain in this position until the switch has been turned to its normal position and the circuit at that point broken, thus breaking the semaphore ground-circuit at the point D′. A train traveling in the direction opposite to the arrows will operate in conjunction with the contact 4 to energize the magnet B of semaphore 2^s to close the circuit which operates the armature of the magnet E and D of the same semaphore in a manner similar to that just described for semaphore 1^s. The semaphore-circuit of 2^s is closed and the semaphore is set to indicate "danger," and remains thus set until, as hereinbefore stated, the switch is returned to its normal position and the contact at that point broken. It is obvious that all switches must operate in conjunction with the semaphores at each end of the section in which they are located.

At stations along the road means are provided whereby the adjacent semaphore in either direction may be set for an approaching train from the station. In the diagram there is shown two stations, one between the semaphores 1^s and 2^s and the other between the semaphore 3^s and the next succeeding semaphore considered from a direction indicated by the arrow 7. If the operator at the station located between the semaphores 1^s and 2^s desires to signal a train approaching in the direction indicated by the arrow Y, he throws the switch-arm K to the contact K′, thereby grounding the line and bringing the line leading to the magnet E of the semaphore 1^s into the same condition as it would be if the switch 16 were open, which condition has just been described, and when the train engages the contacts 2 it energizes the magnet B and brings about the same condition as has heretofore been explained and operates the semaphore 1^s, and the semaphore remains in the position indicating "danger" until the arm K has again been thrown back by the operator. If the operator desires to signal a train coming from the opposite direction to that indicated, he throws the arm L to engage the contact L′ and grounds the line leading from the binding-post 5^c of semaphore 2^s and brings about the same conditions as have just been described as existing in the semaphore 1^s when the arm K has been thrown over to ground the line. While the arm L is in the position just described—that is, in contact with the terminal L′—a train when engaging the contacts 4 establishes a circuit which actuates the armature of the magnet B of semaphore 2^s and closes the circuit which operates the semaphore. When both arms K and L are thrown over, the lines from both semaphores are grounded, and the semaphores will be operated upon the approach of a train from either direction when said train contacts with

the proper contacts on the track. It is obvious that these stations may be located at any predetermined points along the line and at any distances apart and that any number of semaphores may be arranged or set between adjacent stations, or stations may be arranged as near together as between each semaphore-section.

If the operator at a station desires to be notified of the approach of a train to the semaphore from either direction, he may set the arm K to contact with the terminal K^2, in which case he grounds the line from the semaphore 1^s, which will bring about a condition admitting of the operation of the semaphore when a train engages the contact 2; but the position of the arm as described will establish a circuit through the magnet O, and this magnet serves to draw its armature toward it to close a bell-circuit at O^2, thereby ringing a bell or similar alarm in the station. By throwing the arm L into contact with the terminal L^2 he may be notified of the approach of a train from the other direction. It will be observed, however, that the position of the arms L and K to ground the lines at K^2 or L^2 will also bring about a condition which will set the semaphores to stop the train as well as sound the alarm.

While I have shown in the accompanying drawings the preferred form of my invention, it will be understood that I do not limit myself to the precise form shown, for many of the details may be changed in form or position without affecting the operativeness or utility of my invention, and I therefore reserve the right to make all such modifications as are included within the scope of the following claims or of mechanical equivalents to the structures set forth.

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

1. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a semaphore, duplicate banks of electromagnets, and means for successively locking the individual armatures of said magnets when a single train is passing on the track.

2. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a semaphore, duplicate banks of electromagnets, and means for successively locking and for releasing the individual armatures of said magnets when a single train is passing on the track.

3. In a semaphore signaling system of the class described, a line of railway-track, a plurality of semaphores, a plurality of track-contacts, and a pair of semaphore-operating series of magnets adapted to coöperate with each other to partially close established circuits when a single train is passing on a track.

4. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a plurality of semaphores, semaphore-circuits, duplicate banks of electromagnets, circuit connection between contiguous banks, and connections between successive track-contacts and successive magnets of each bank.

5. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a plurality of semaphores, semaphore-circuits, duplicate banks of electromagnets, circuit connection between contiguous banks, and means for successively locking some of the individual armatures of a single bank of said magnets.

6. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a plurality of semaphores, semaphore-circuits, duplicate banks of electromagnets, circuit connection between contiguous banks, and means for successively locking some of the individual armatures of a single bank of said magnets and one armature of an adjacent bank of magnets ahead of a train passing on said track.

7. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a plurality of semaphores, semaphore-circuits, duplicate banks of electromagnets, circuit connection between contiguous banks, and means for successively locking some of the individual armatures of a single bank of said magnets and one armature of an adjacent bank of magnets behind a train passing on said track.

8. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a plurality of semaphores, semaphore-circuits, duplicate banks of electromagnets, circuit connection between contiguous banks, and means for causing successive locking and releasing of armatures in each bank.

9. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a plurality of semaphores, semaphore-circuits, duplicate banks of electromagnets, circuit connection between contiguous banks, connections between successive track-contacts and successive magnets of each bank adapted to partially close a semaphore-circuit, and a station-switch adapted to coöperate therewith to complete said circuit.

10. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a plurality of semaphores, semaphore-circuits, duplicate banks of electromagnets, circuit connection between contiguous banks, a switch in said circuit connection, a supplemental switch-circuit, an alarm in said switch-circuit, and connections between successive track-contacts and successive magnets of each bank.

11. In a semaphore railway signaling sys-

tem adapted for connection with a railway-track, a plurality of track-contacts, a semaphore, a semaphore-circuit, a bank of electromagnets in circuit with said track-contacts, and means coöperating therewith for releasing the armatures of some of said magnets when other armatures are actuated.

12. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a semaphore, a semaphore-circuit, a bank of electromagnets in circuit with said track-contacts, locking means for the armatures of some of said magnets, and trips actuated by other magnets of said bank.

13. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a semaphore, a semaphore-circuit, a bank of electromagnets in circuit with said track-contacts, means for locking the armatures of some of the magnets in said bank, spring-actuated armature-carrying arms, locking means coöperating therewith, and rockable trips adapted to release said locking means.

14. In a semaphore railway signaling system, adapted for connection with a railway-track, a plurality of track-contacts, a semaphore, a semaphore-circuit, a bank of electromagnets in circuit with said track-contacts, means for locking the armatures of some of the magnets in said bank, spring-actuated armature-carrying arms, rockable, spring-actuated, locking means coöperating therewith, and rockable trips adapted to release said locking means.

15. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a semaphore, a semaphore-circuit, a bank of serially-coöperating electromagnets adapted to be successively placed in circuit with said track-contacts, locking means coöperating with the armature of each magnet of said bank, and means whereby each succeeding magnet may release the armature of the next preceding magnet of the bank.

16. In a semaphore railway signaling system adapted for connection with a railway-track, a plurality of track-contacts, a semaphore, a semaphore-circuit, a bank of serially-coacting electromagnets adapted to be successively placed in circuit with said track-contacts, locking means coöperating with the armatures of some of the magnets of said bank.

17. In an apparatus for the purpose specified, a bank of electromagnets, armature-carrying arms, a rockable shaft, and means carried by said shaft adapted to lock some of said arms, a magnet-carrying arm, and a rockable catch coöperating with the magnet-carrying arm.

18. In an apparatus for the purpose specified, a bank of electromagnets, armature-carrying arms, a rockable shaft, and means carried by said shaft adapted to lock some of said arms, a magnet-carrying arm, and a rockable catch coöperating with the said magnet-carrying arm, in combination with circuit-closing means adapted to be actuated by some of said arms.

19. In an apparatus for the purpose specified, a bank of electromagnets, armature-carrying arms, a rockable shaft, and means carried by said shaft adapted to lock some of said arms, in combination with locking means embodying a rockable catch and a magnet-carrying arm with which said catch coöperates.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

JOSEPH LEMIRE.

Witnesses:
T. MYNARD,
M. MCALEER.