J. F. SCHNABEL.

PLATE HANDLING APPARATUS.

APPLICATION FILED OCT. 13, 1908.

**916,374.**

Patented Mar. 23, 1909.

7 SHEETS—SHEET 1.

FIG. 1.

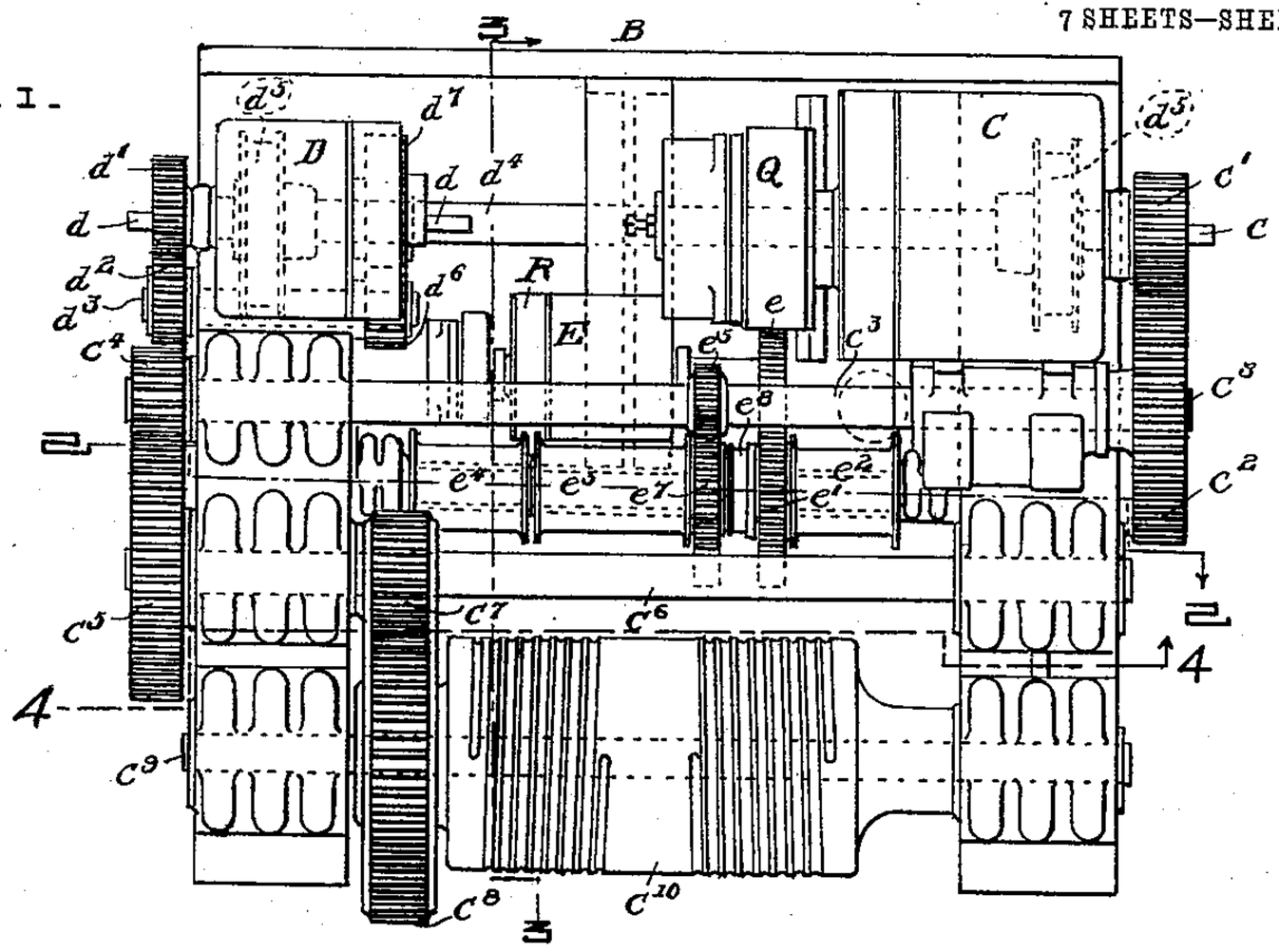



FIG. 4.

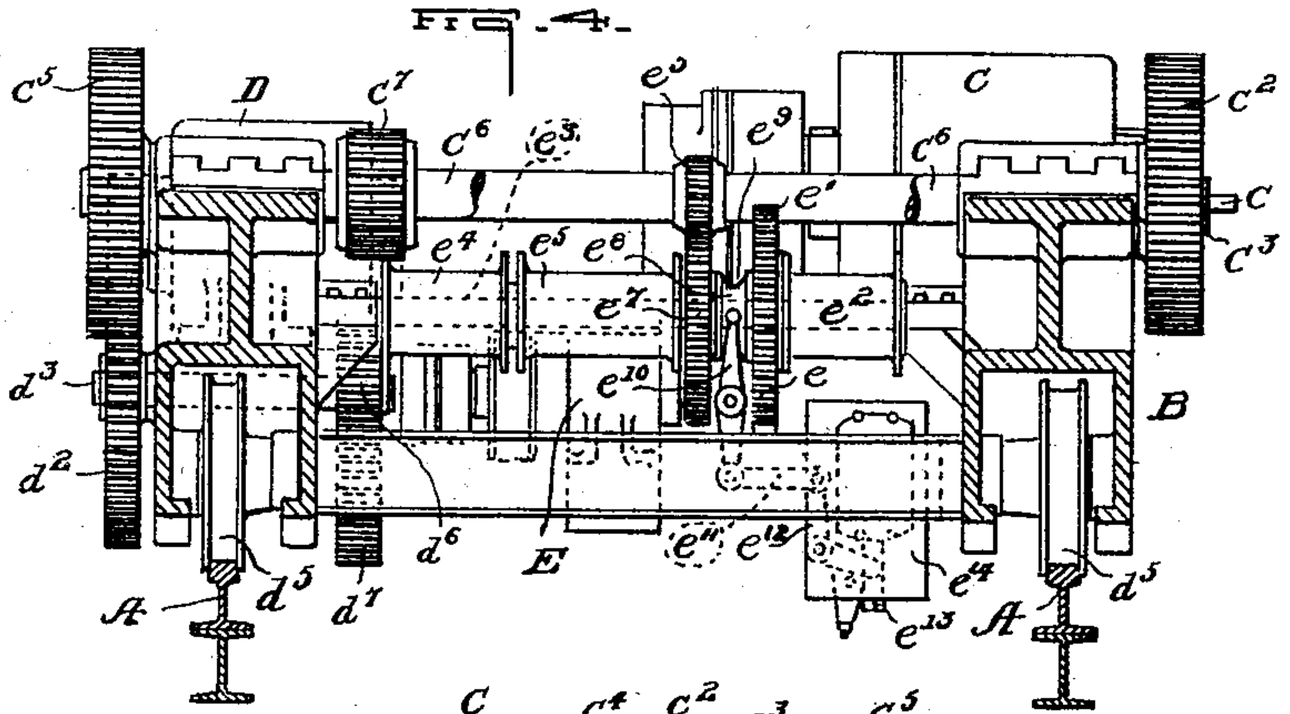
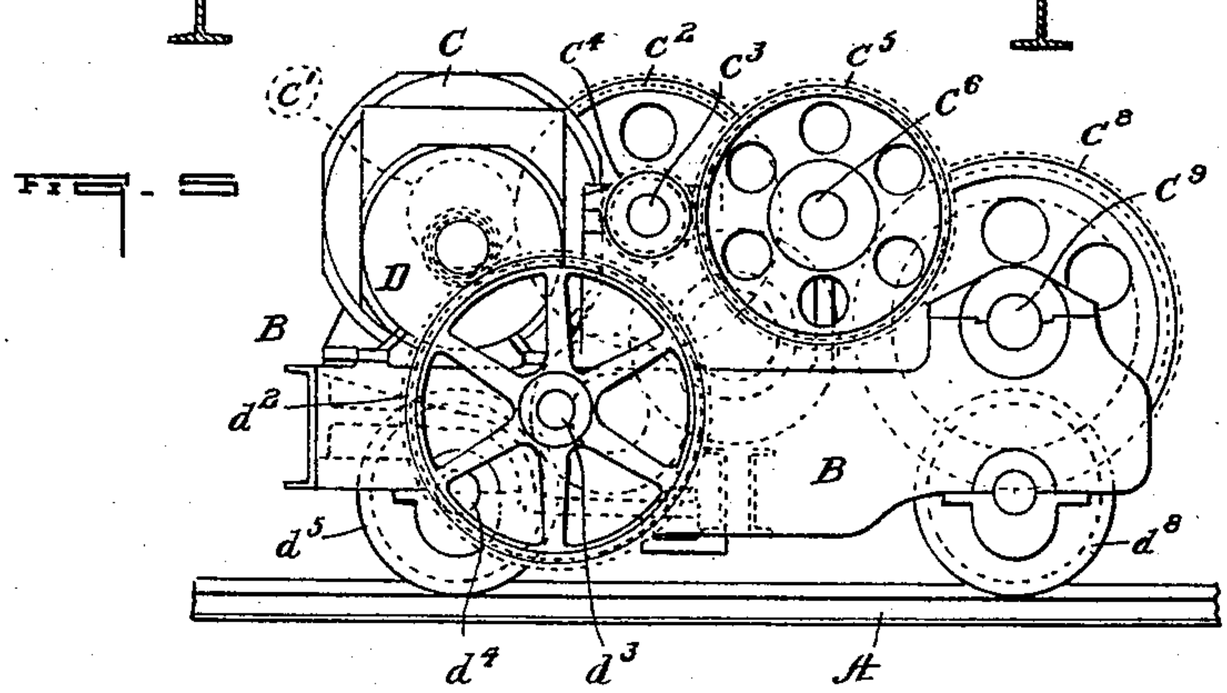



FIG. 3.

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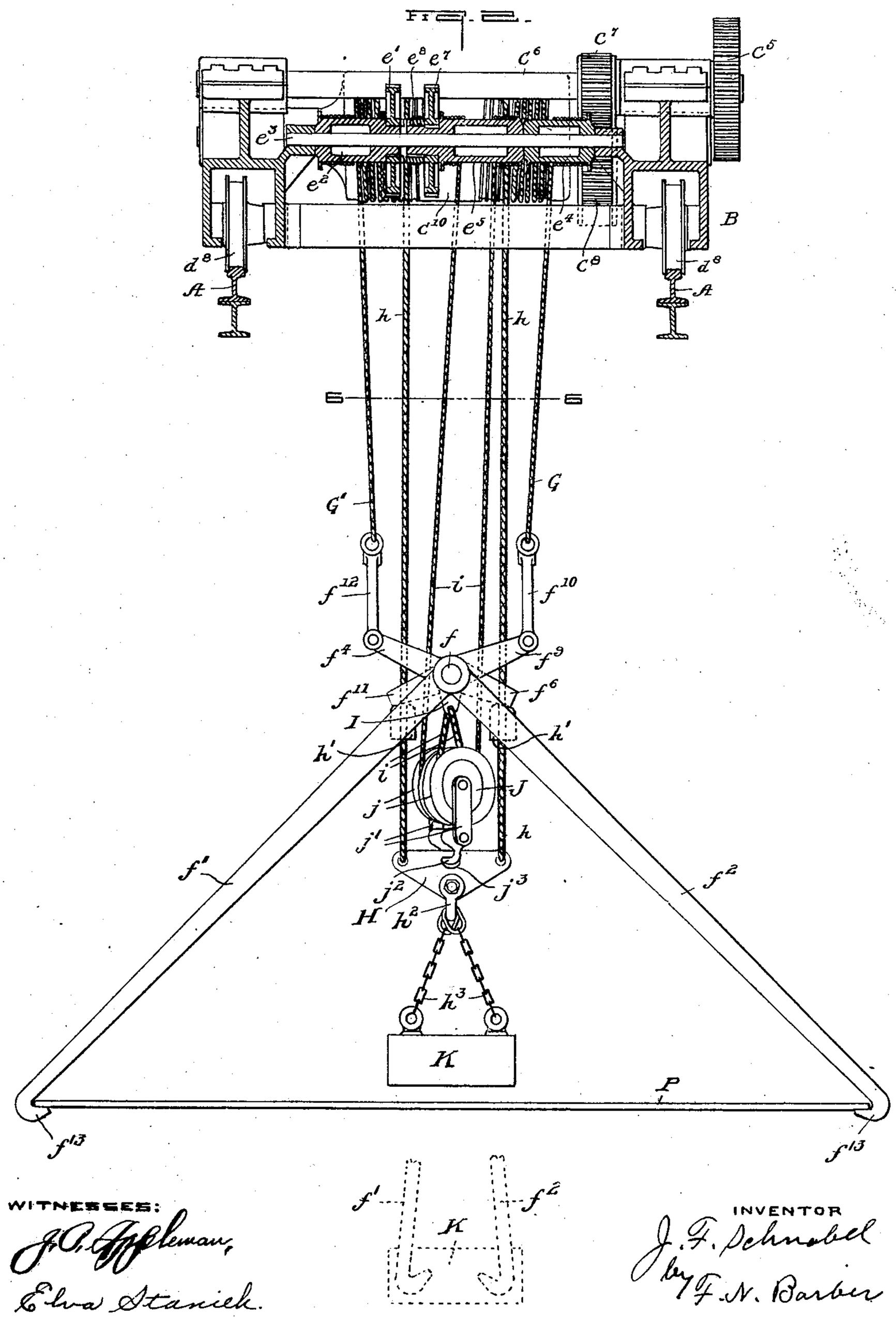


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7 SHEETS—SHEET 3.

FIG. 5.

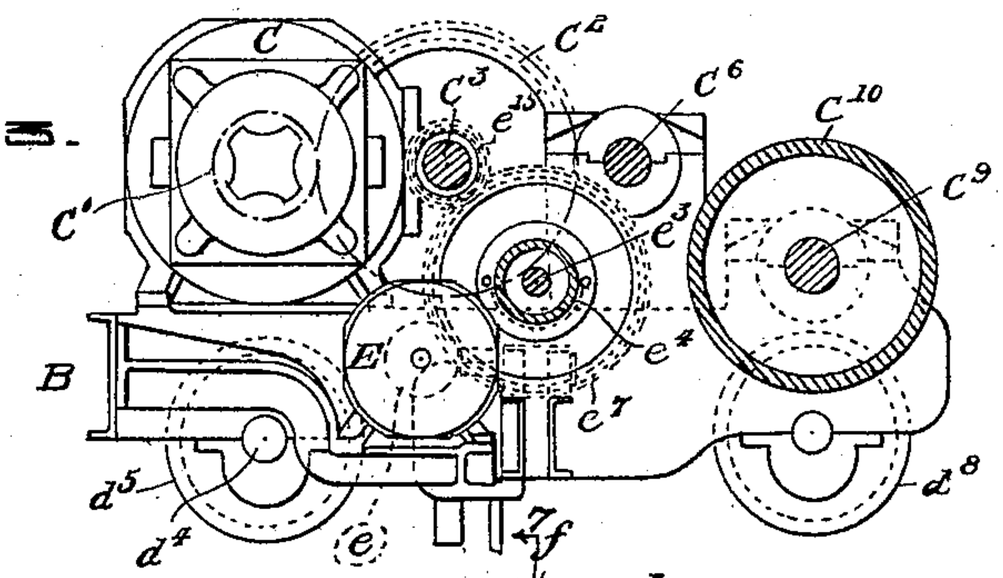



FIG. 6.

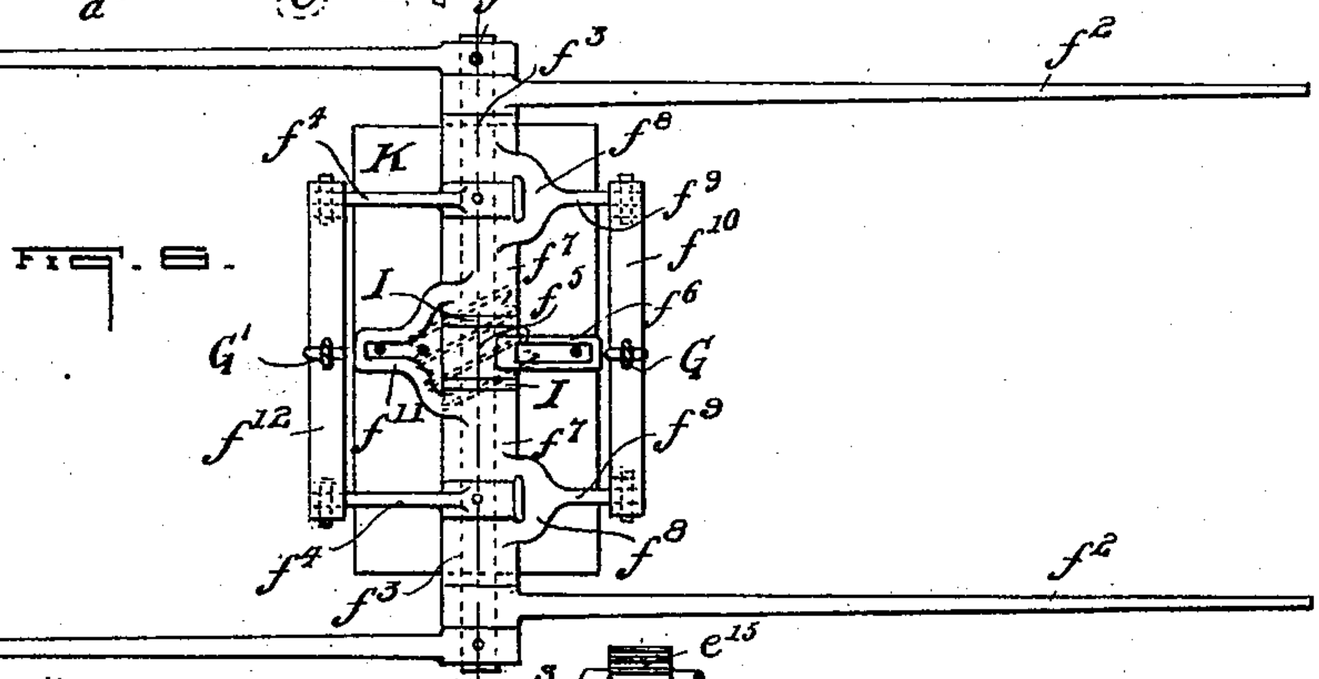
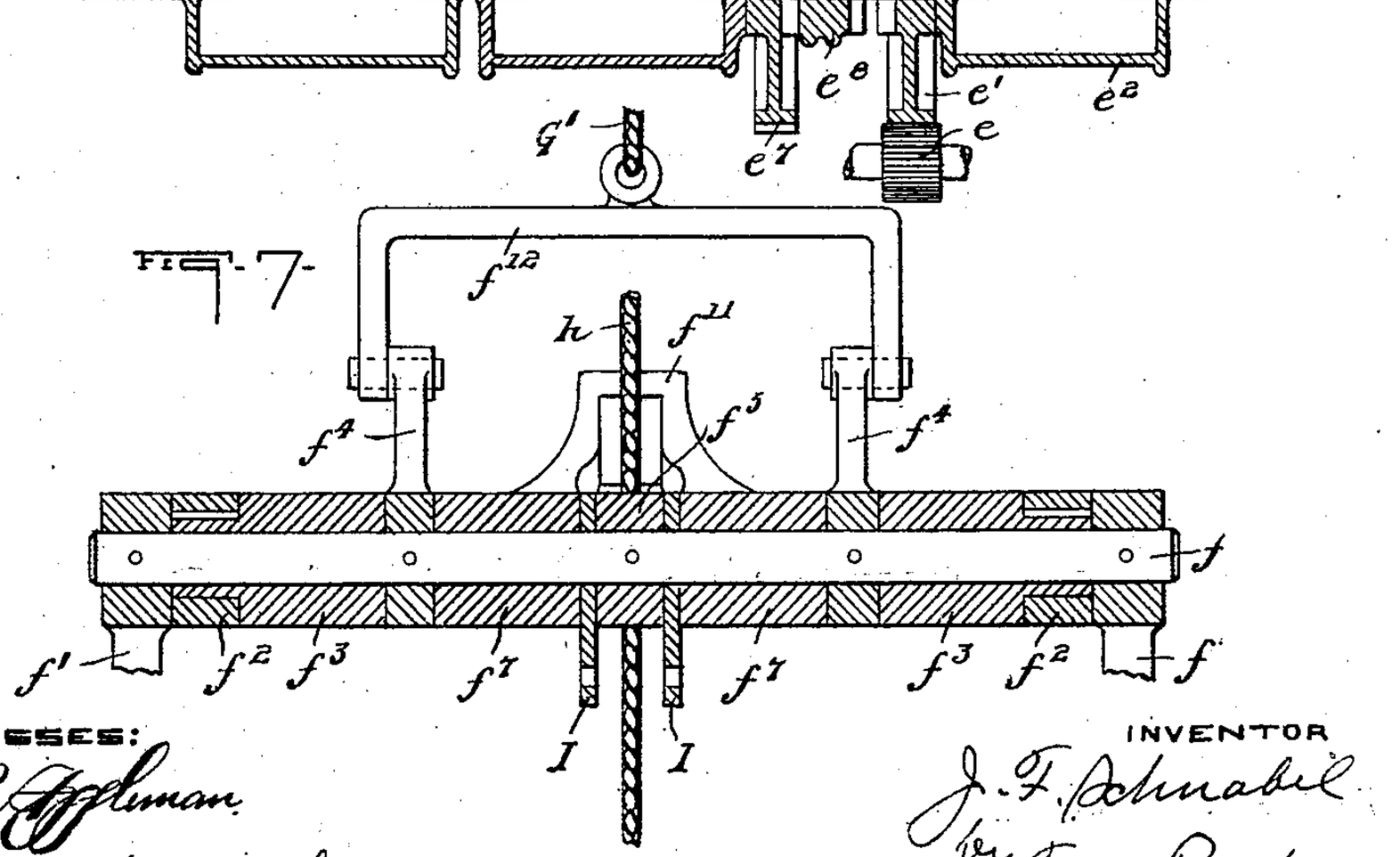



FIG. 7.

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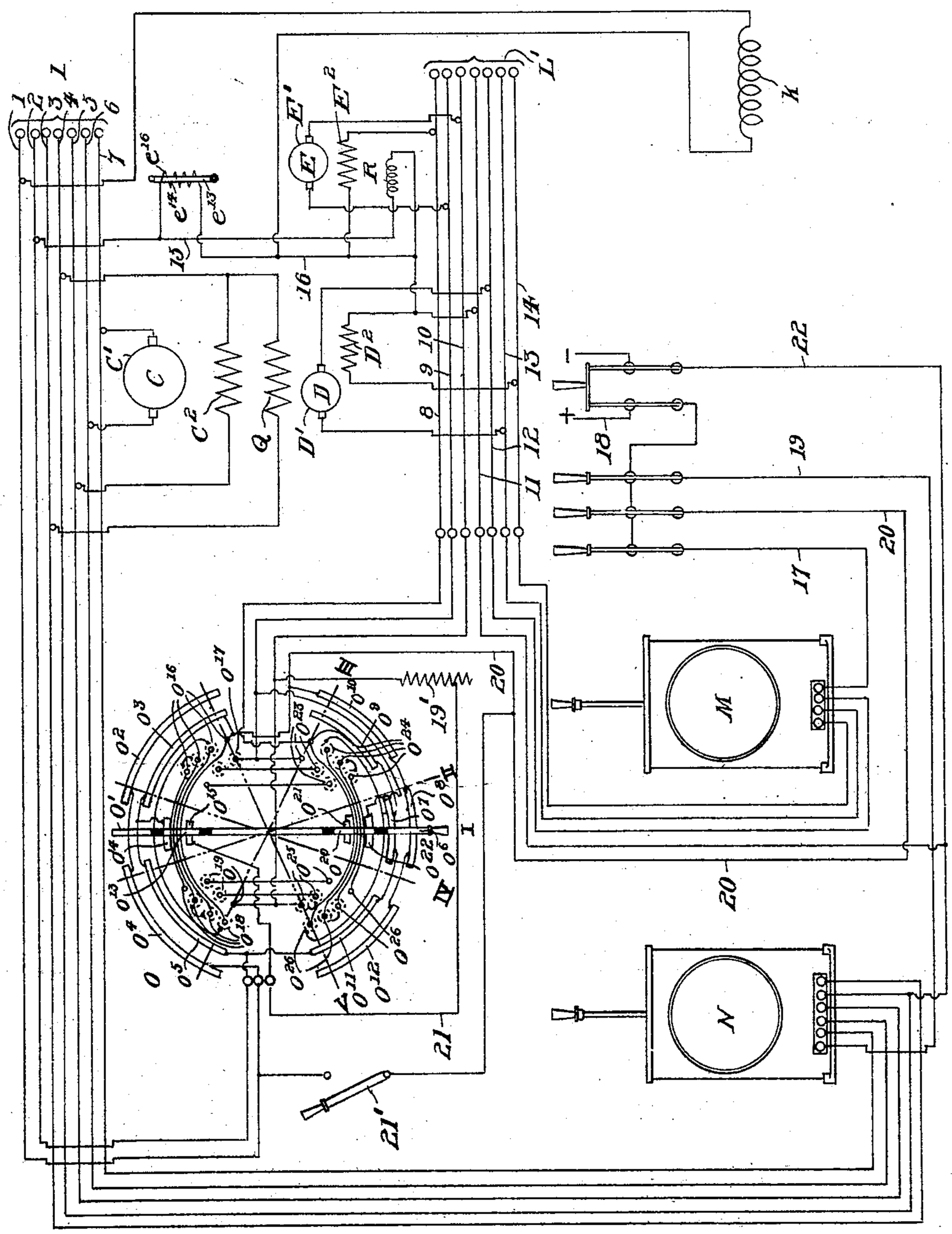
7 SHEETS—SHEET 4.

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7 SHEETS—SHEET 5.

FIG. 10.

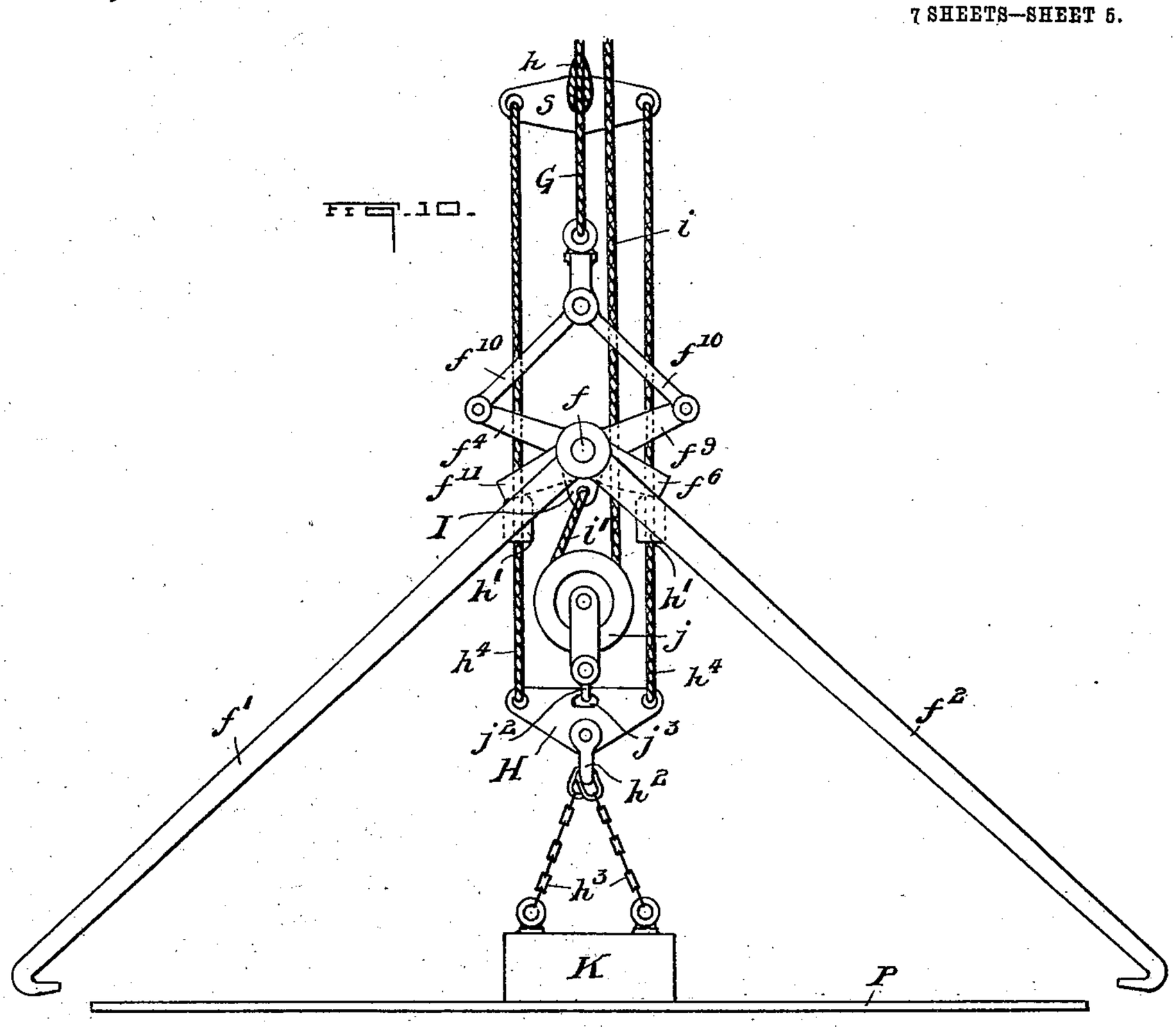
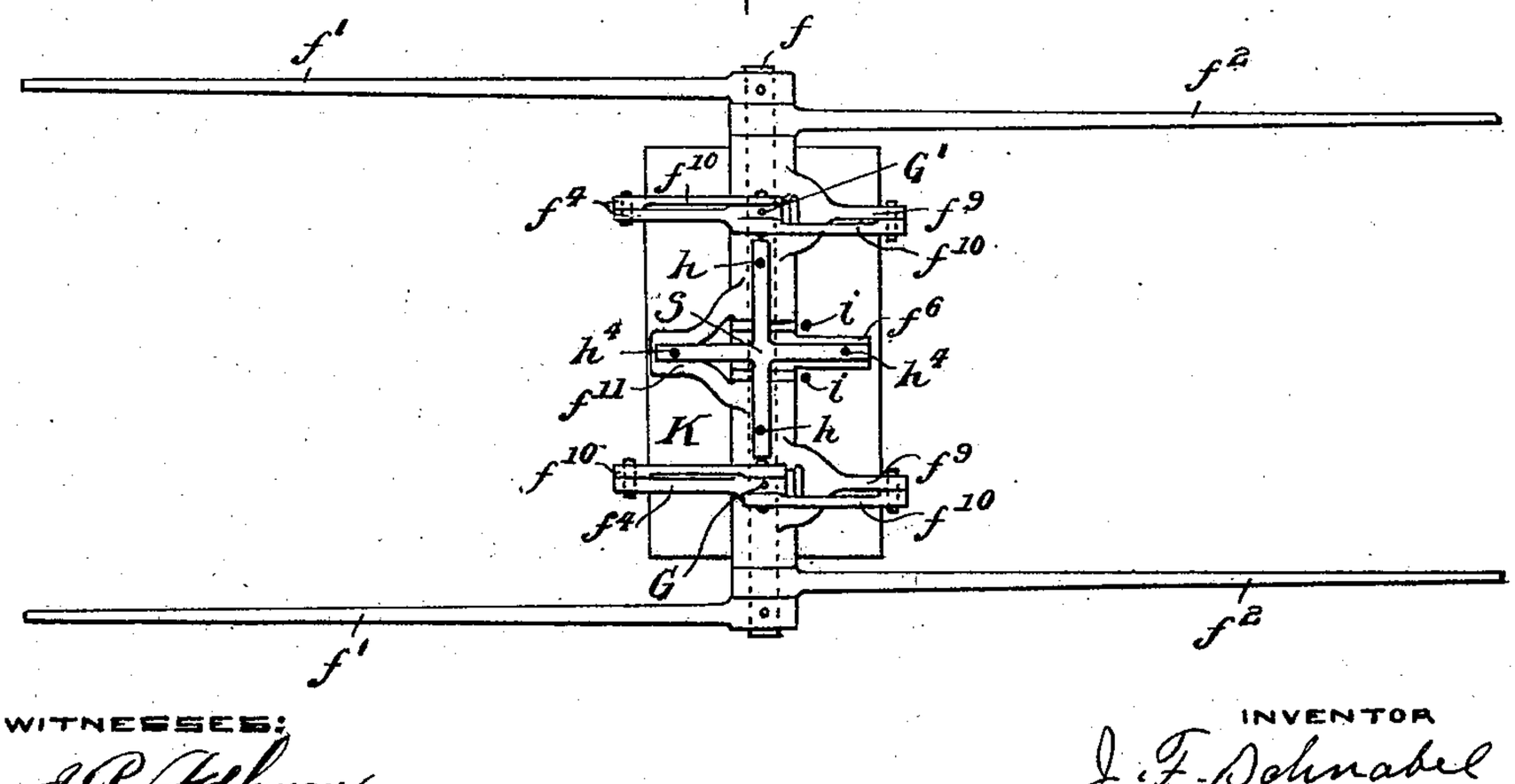



FIG. 11.

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7 SHEETS—SHEET 6.

Fig. 12.

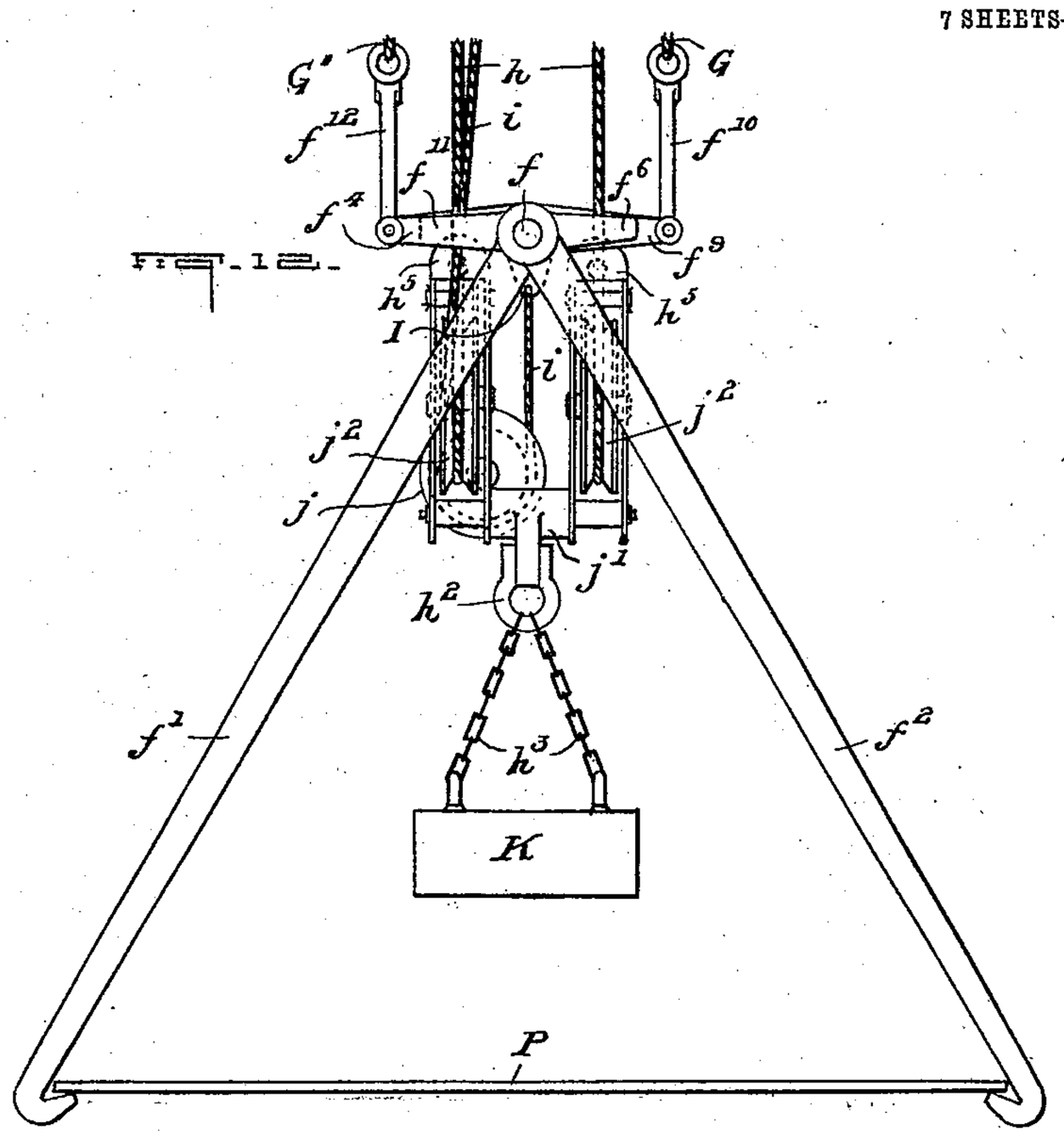



Fig. 13.

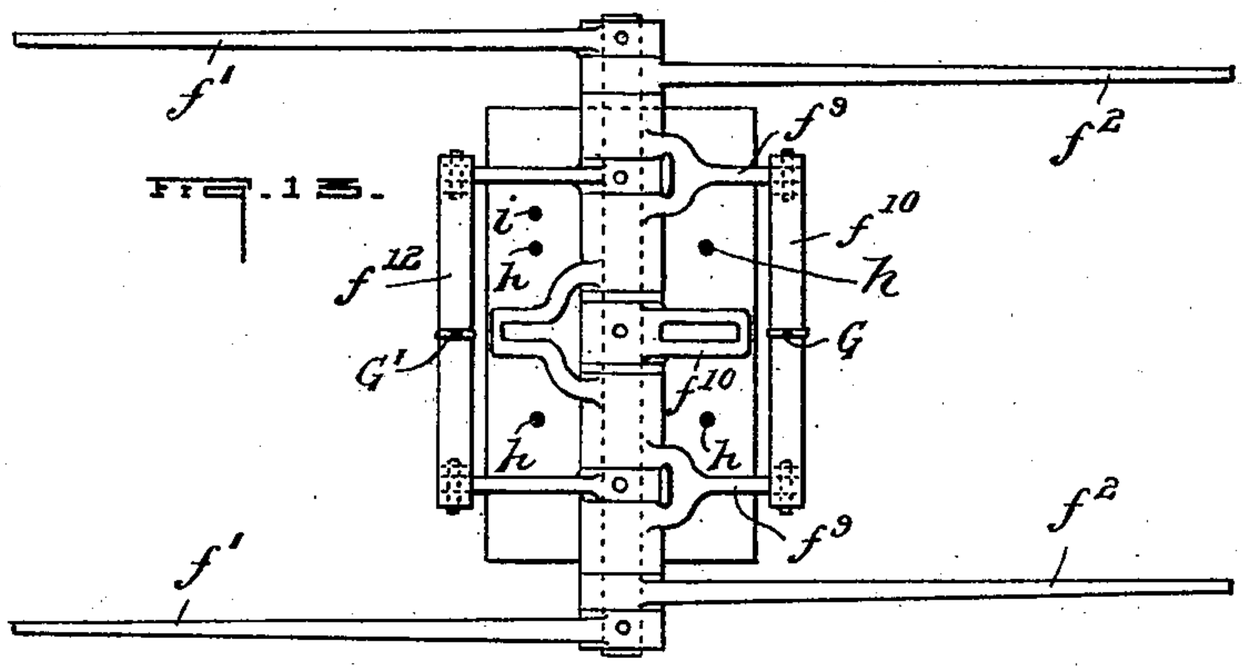
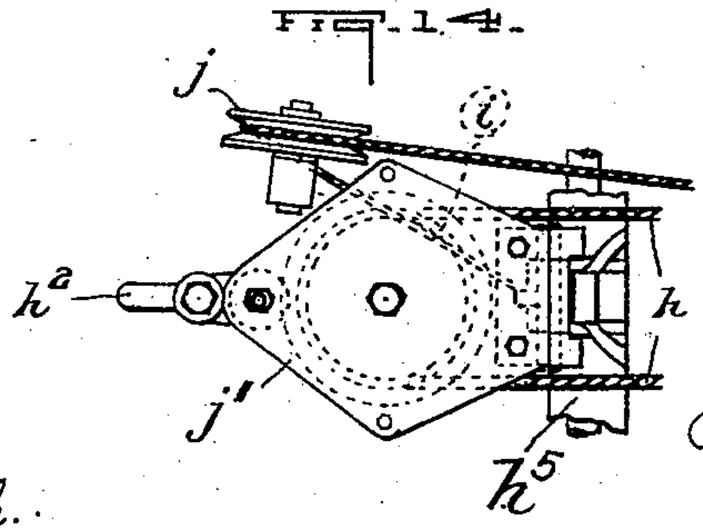



Fig. 14.

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7 SHEETS—SHEET 7.

Fig. 15.

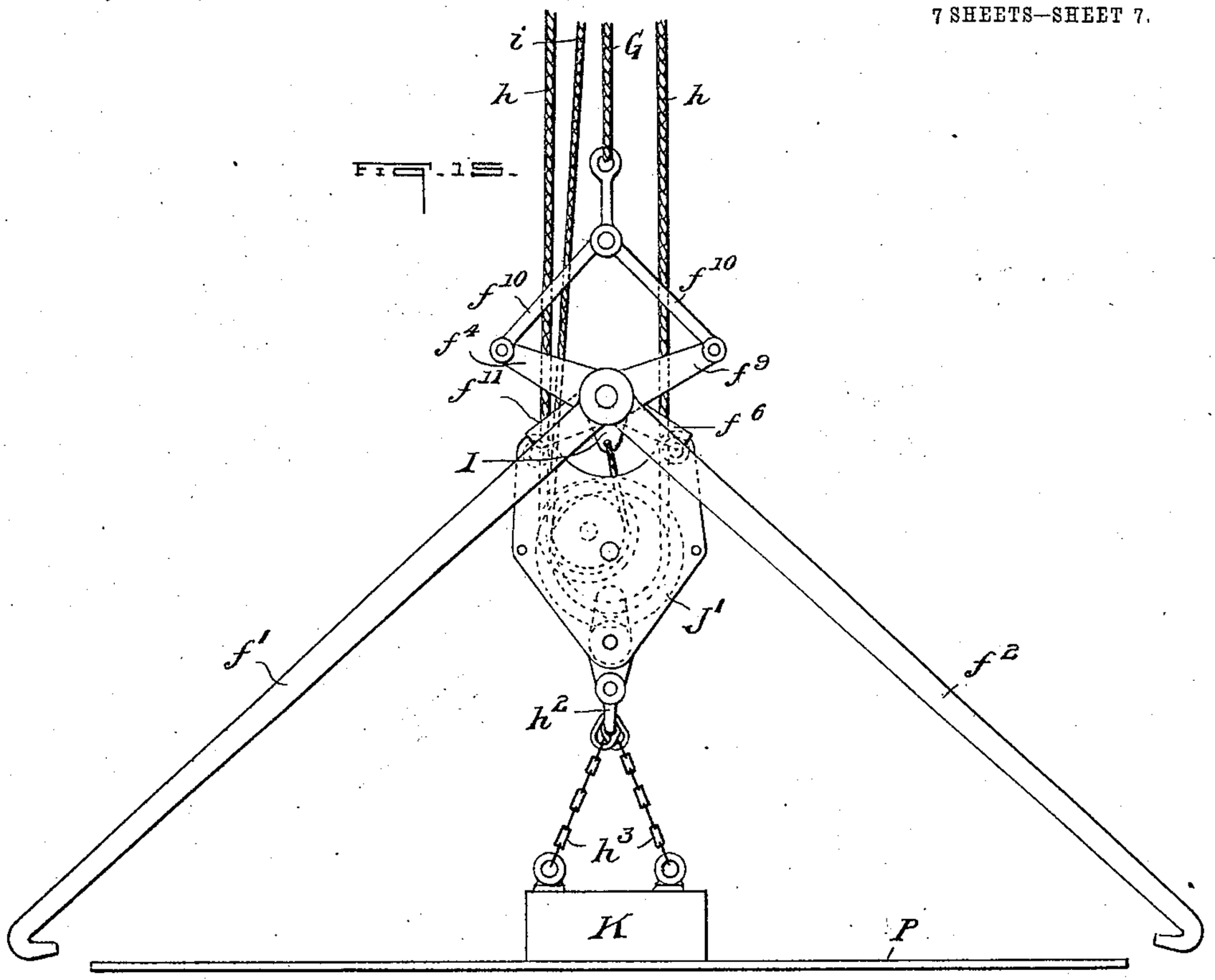


Fig. 16.

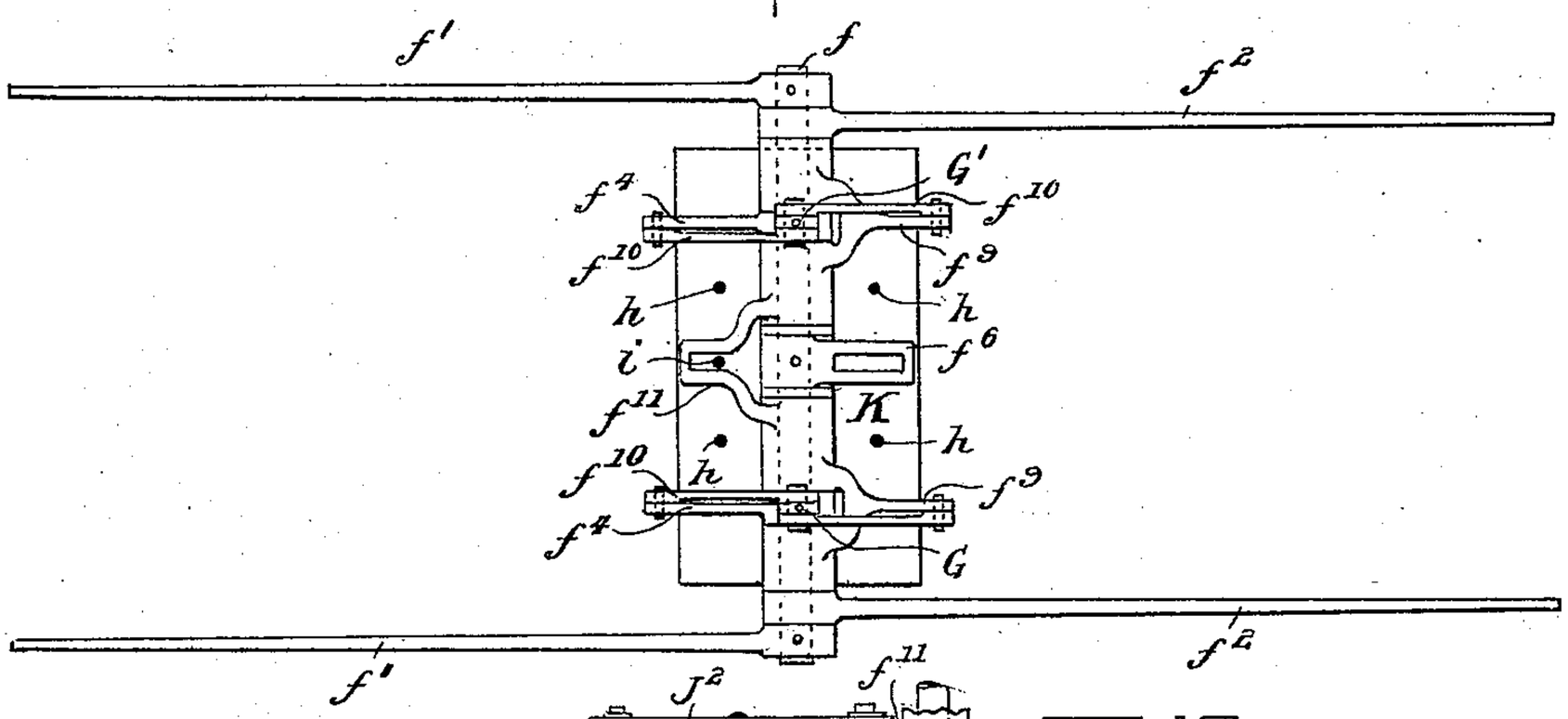


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Fig. 17.

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# UNITED STATES PATENT OFFICE.

JAMES F. SCHNABEL, OF NEW YORK, N. Y.

## PLATE-HANDLING APPARATUS.

No. 916,374. Specification of Letters Patent. Patented March 23, 1909.

Application filed October 13, 1908. Serial No. 457,453.

*To all whom it may concern:*

Be it known that I, JAMES F. SCHNABEL, a citizen of the United States, residing at New York city, in the county and State of New York, have invented or discovered new and useful Improvements in Plate-Handling Apparatus, of which the following is a specification.

My invention relates to apparatus for handling iron and steel plates by means of lifting magnets which have safety hooks associated with them, for the purposes to be explained.

In the use of lifting magnets for the handling of plates, there has always been a certain element of danger to men who are required to be near, and machinery over which plates are carried on account of the flow of current to magnet being liable to be interrupted by failure of connections and circuits. Auxiliary chains with hooks at their ends have been used in connection with lifting magnets to make plate handling safer and surer. As these chains hang from the crane, it is necessary for men to place the hooks under the plate when the latter has been raised a few inches. The magnet then releases the load which is then carried by the chains.

The object of my invention is to provide the combination of a magnet and hooks which can do the work of the chains and be controlled by the crane operator.

Referring to the accompanying drawings, Figure 1 is a plan of the trolley which I prefer to use in connection with a crane bridge (not shown); Fig. 2, a section of Fig. 1 on the line 2—2 looking toward the drum $c^{10}$, a set of plate handling devices, including a magnet and hooks, being shown in elevation; Fig. 3, a section of Fig. 1 on the line 3—3; Fig. 4, a section of Fig. 1 on the line 4—4; Fig. 5, a side elevation of the trolley; Fig. 6, a section of Fig. 2 on the line 6—6; Fig. 7, a section of Fig. 6 on the line 7—7, the sheaves and the magnet below being omitted; Fig. 8, a section through the drums and gears on the shaft $e^3$; Fig. 9, a diagrammatic view of the electric circuits which I prefer to use; Figs. 10 and 11, a side elevation and a plan of a modiform arrangement for supporting the hooks and magnet; Figs. 12 and 13, similar views, of a different modification of the same; Fig. 14, a side view of a portion of Fig. 12, showing particularly the arrangement of the sheaves and cables; and Figs. 15, 16 and 17, views similar to Figs. 14, 15 and 16, showing another modification of the same parts.

A represents the rails on which the trolley B runs, and C, the motor for driving the hoisting drum. The motor shaft $c$ has secured thereon the pinion $c'$ which drives the spur-gear $c^2$ on the shaft $c^3$ running across the trolley frame, and having the pinion $c^4$ at its end opposite that on which the wheel $c^2$ is located. The pinion $c^4$ meshes with the spur-gear $c^5$ on the shaft $c^6$ which lies across the trolley frame parallel with the shaft $c^3$ and carries the pinion $c^7$, meshing with the spur-gear $c^8$ secured to the drum $c^{10}$ which is carried by shaft $c^9$.

D is the motor for driving the trolley along the rails A. The shaft $d$ carries the pinion $d'$, which meshes with the spur-gear $d^2$ on the shaft $d^3$ parallel with the axle $d^4$ on which the wheels $d^5$ are secured, the wheels $d^5$ being on the rails A. The shaft $d^3$ and the axle $d^4$ are connected by the gears $d^6$ and $d^7$. The trolley is provided also with the wheels $d^8$ which run on the rails A, but are not motor-driven.

The trolley B carries a third motor E, which drives the pinion $e$ in mesh with the spur-gear $e'$, keyed to one end of the drum $e^2$, which is keyed to the shaft $e^3$. Said shaft has keyed thereon the drum $e^4$ and loose thereon the drum $e^5$, the latter being between the drums $e^2$ and $e^4$. The drum $e^5$ has the hub extension $e^6$, on which the spur-gear $e^7$ is freely rotatable. The extension $e^6$ has splined thereon the clutch member $e^8$ which is capable of locking the drum $e^5$ either to the gear $e'$ or the gear $e^7$ by means of teeth on the opposing faces of the said clutch member and gears. The clutch member $e^8$ has the groove $e^9$, in which the upper end of shifting lever $e^{10}$ operates to move the clutch member in opposite directions. The lower end of the lever $e^{10}$ is connected by the horizontal link $e^{11}$ to the free upper end of the bell-crank $e^{12}$, whose remaining end is connected to the lower end of the plunger $e^{13}$ of the electromagnet $e^{14}$. The gear $e^7$ meshes with the pinion $e^{15}$ on the shaft $e^3$.

Referring particularly to Figs. 2, 6, and 7, $f$ represents a shaft which forms the fulcrum for the downwardly inclined arms $f'$ and $f^2$. The arms $f'$ are secured rigidly at the ends of the shaft $f$, and the arms $f^2$ are keyed to the sleeves $f^3$ which are on the shaft $f$ between the arms $f'$ and contiguous to the latter. The arms $f^4$ are secured to the shaft $f$ and are

contiguous to the inner ends of the sleeves $f^3$. The sleeve $f^5$ is secured to the middle of the shaft $f$ and has thereon the slotted arm $f^6$, extending to the right. The sleeves $f^7$ are loose on the shaft $f$ and lie between the arms $f^4$ and the sleeve $f^5$. The sleeves $f^3$ and $f^7$ are connected in pairs by the yokes $f^8$, from which the arms $f^9$ extend to the same side of the shaft $f$ as the arm $f^6$. These arms $f^9$ are connected together by the cross-head $f^{10}$, to which is secured the cable G, secured to drum $e^4$. The sleeves $f^7$ are connected on the side of the shaft $f$ opposite the arm $f^6$ by the yoke or arm $f^{11}$. The arms $f^4$ are connected by the cross-head $f^{12}$, to which is secured the cable G′ connected to the drum $e^2$. The arms $f'$ lie on one side of the shaft $f$ and the arms $f^2$ on the other side thereof. Each arm is provided at its lower end with a hook $f^{13}$ turned toward the vertical plane including the axis of the shaft $f$. H is an equalizer or cross-head having an eye at each end to receive the cables $h$ which extend up through the slots in the arms $f^6$ and $f^{11}$, and are secured to the main hoist drum $c^{10}$. The cables $h$ carry the cable-clamps $h'$ for engagement with the under side of the arms $f^6$ and $f^{11}$. On the shaft $f$ and between the sleeves $f^5$ and $f^7$ are the hangers I, to which one end of each of the cables $i$ are secured, these cables passing down beneath the sheaves $j$ and up to the drum $e^5$, to which they are secured. The said sheaves form a part of the block J, which is connected by the links $j'$ to the clevis $j^2$ seated in the oblong hole $j^3$ in the upper part of the equalizer H. The lower edge of the equalizer H carries the clevis $h^2$ which by means of the chains $h^3$ support the lifting magnet K.

Referring now to Fig. 9 L and L′ are two sets of trolley wires for each side of the crane, the wires 1 to 7 constituting one set, and the wires 8 to 14, the other set. M is the controller for the motor D; N the controller for the motor C; and O, the controller for the motor E, and for controlling the magnet and hooks. The armature $C^1$ of the motor C is bridged on the wires 6 and 7 and the field $C^2$, on the wires 4 and 5, the brake Q being bridged on the wire 3 and the negative side of the field $C^2$. The armature D′ of the motor D is bridged on the wires 12 and 13; and the field $D^2$, on the wires 11 and 14, the brake R for the motor E being connected by the wire 15 to the wire 2, and also at a point between the field $D^2$ and the wire 11, which is the negative side of the line. The armature E′ of the motor E is bridged on the wires 9 and 10; and the field $E^2$ is connected to the wire 8, and to the wire 16, which is bridged on the wire 15 at the opposite sides of the brake R, and includes the winding $e^{16}$ of the magnet $e^{14}$. The controller M has connected thereto the trolley wires 12, 13 and 14, and the wire 17 connected to positive supply wire 18. The controller N has connected thereto the trolley wires 3 to 7, and the wire 19 leading to the positive supply wire 18. The wires 4 and 11 are connected to the negative wire 22. The controllers M and N may be of the usual type, having points for controlling the motors and brakes in a manner well known. The controller O has the brush O′ to bridge the segments $O^2$ and $O^3$ on the right, and the segments $O^4$ and $O^5$ on the left; the brush $O^6$ to bridge the segments $O^7$ and $O^8$, when the brush is in the off-position, and to bridge the segments $O^9$ and $O^{10}$ on the right and the segments $O^{11}$ and $O^{12}$ on the left; the brush $O^{13}$ to bridge the segments $O^{14}$ and $O^{15}$ at the off-position, and the resistance contacts $O^{16}$ and $O^{17}$ on the right; and the resistance contacts $O^{18}$ and $O^{19}$ on the left; and the brush $O^{20}$ to bridge the segments $O^{21}$ and $O^{22}$ at the off-position and the resistance contacts $O^{23}$ and $O^{24}$ on the right and the resistance contacts $O^{25}$ and $O^{26}$ on the left. The wire 1 is connected to the segment $O^4$, which is joined to the segment $O^2$. The wire 2 is connected to the segments $O^{11}$, $O^7$ and $O^9$ in series. The wire 8 is connected to the last contact $O^{24}$. The wire 10 is connected to the last contacts $O^{19}$ and $O^{25}$, the adjustable resistance 19′ being in series with the wire 10 and the segment $O^{15}$. The wire 9 is connected to the last contacts $O^{17}$ and $O^{23}$. The positive wire 20 is connected to the segments $O^{10}$, $O^8$, and $O^{12}$, and to the last contacts $O^{16}$ and $O^{18}$ and the segments $O^3$, $O^5$ and $O^{14}$. An emergency switch 21 is bridged on the wires 1 and 20 for controlling the current in the magnet independently of the controller O. The magnet winding $k$ is bridged on the wires 1 and 16.

The operation is as follows, assuming the hooks to be closed and the magnet in its highest position. The crane is moved into proper position and the controller M is actuated so as to cause the motor D to bring the hooks and magnet directly over the plate P. The operator then lowers the hooks and magnet to within a few feet of the plate P by actuating the controller N which governs the motor C. The arm of the controller O is shown at the position I, which is the position for this movement. Current passes from the positive wire 18 through the wire 20, the segments $O^{10}$, $O^8$, $O^7$ and $O^{11}$, the wire 2, the windings $e^{16}$ of the clutch $e^{14}$, and the winding of the brake R in parallel, and the wire 11 to the negative wire 22. The action of the winding $e^{16}$ draws the core $e^{13}$ up, causing the clutch $e^8$ to lock the drums $e^2$ and $e^4$ to the drum $e^5$. The energizing of the winding R releases the brake of the motor E in the well known manner. The weight of the hooks is carried by the cables $h$, because the cable clamps $h'$ support the arms $f^6$ and $f^{11}$. This manner of supporting the hooks causes the arms $f'$ and $f^2$ to move toward each other

so as to lie as shown in dotted lines on Fig. 2. Current is supplied to the motor E as follows: from the positive wire 18 through the wire 20, the segments $O^3$, $O^{14}$, $O^{15}$, the wire 21, the resistance 19′, the wire 10, the armature E′, the wire 9, the segments $O^{22}$ and $O^{21}$, the wire 8, the field winding $E^2$, the wire 16, and the wire 11 to the negative wire 22. The motor E exerts a certain torque on the drums $e^2$, $e^4$, $e^5$ through the resistance 19′, which is adjusted so that the torque of the motor is just sufficient to keep the cables G, G′ and *i* taut. As the magnet and hooks descend, their weight overhauls the motor E. Next, the hooks are opened far enough to allow them to pass at the opposite sides or ends of the plate P. To do this, the arm of the controller O is moved to the position V. In this position the resistance 19′ is cut out of the circuit of the motor E, because the brushes $O^{13}$ and $O^{20}$ have left their segments $O^{14}$, $O^{15}$, $O^{21}$, and $O^{22}$. These brushes, however, coöperate with the resistance contacts $O^{16}$, $O^{17}$, $O^{25}$, and $O^{26}$ to accelerate the motor E in a manner well understood. The drums are rotated to wind up the cables G, $G^1$, and *i*, but as the cables *i* pass around the bottom of the sheaves *j*, the pull of these cables is applied in opposite directions, thereby causing the hooks to open. The magnet K is now lowered enough to bring it a little below the lower ends of the hooks. To do this, the arm of the controller O is brought to position IV. In the position the current is cut off from the motor E, the clutch winding $e^{16}$, and the brake R. The deënergizing of the winding $e^{16}$ causes the core $e^{13}$ to drop and the clutch member $e^8$ to engage and interlock with the gear $e^7$. The deënergizing of the brake R permits it to set and lock the motor E and drums $e^2$ and $e^4$. Consequently, when the main motor C is actuated to lower the magnet, the cables G and G′ support the weight of the hooks and the cable clamps *h*′ move downwardly away from the arms $f^6$ and $f^{11}$. If it were not for the retaining cables, the weight of the hooks would cause them to close, but these cables are, by the proportional sizes of the gears $e^7$ and $e^{15}$, caused to be paid out at such a rate as to keep the shaft *f* stationary. Consequently, the hooks may be held in any desired position regardless of the position or movement of the magnet with respect to them. Next, the hooks and magnet are lowered until the magnet rests on the plate P, the arm of the controller O being brought to position I while the lowering is being accomplished by the main motor C and the drum $c^{10}$, the currents being as heretofore explained in connection with the lowering of the magnet and hooks. Now, the arm of the controller O may be moved to either the position IV or the position II. Considering position IV the circuit is from the positive wire 18, through the wire 20, segments $O^3$, $O^2$, and $O^4$, the wire 1, the winding *k*, the wire 16, and the wire 11 to the negative wire 22. At the same time, current flows through the winding $e^{16}$ and that of the brake R, causing the motor E to be connected to the drums $e^2$, $e^4$ and $e^5$, and the brake for the said motor to be released. The main motor C is then actuated to cause the drum $c^{10}$ to lift the magnet K and the plate P a few inches or until the plate is above the lower ends of the hooks.

To move the hooks into contact with the edges of the plate, the arm of the controller O is moved toward the position I until the segments $O^7$ and $O^8$ are bridged by the brush $O^6$, but with the segments $O^2$ and $O^3$ still bridged by the brush O′. In this position, the magnet winding *k* is still supplied with current; the brake R is free; and the drum $e^5$ is locked to the drums $e^2$ and $e^4$. In this position the brush $O^{13}$ has not yet reached the segments $O^{14}$ and $O^{15}$, so that there is no current in the motor E to cause a downward pull on the shaft *f*. Consequently, the weight of the hooks causes them to swing inward against the plate P, as shown on Fig. 2. By closing the emergency switch 21′, the arm of the controller O may be moved to position III, which will cause the drums $e^2$, $e^4$, and $e^5$ to rotate to pay out cable, if the force of gravity is insufficient to close the hooks. The switch 21′ connects the wires 20 and 1 to keep the current in the magnet, while the arm of the controller is off the segments $O^2$ and $O^3$. The circuits through the motor E are the same as hereinbefore described except the flow through the armature is reversed. By moving the arm of the controller O to the position II, instead of to the position IV, the main motor C will be actuated to cause the magnet to lift the plate as before described. Then to move the hooks into the contact with the plate, the arm of the controller O is moved to the position III which will cause the drums $e^2$, $e^4$, and $e^5$, to rotate to pay out cable, which closes the hooks positively. This precludes any necessity of using emergency switch 21′ in closing the hooks. The controller arm is brought to position I (the switch 21′ being open) whereupon the magnet circuit is deprived of current. The plate settles down on the hooks, and the cables G, G′ until it rests on the pile of plates beneath it, with the ends of the hooks under the edges of the plate. The transfer of the support of the plate from the magnet to the hooks should be made with the plate a few inches from the pile of plates or other support, as the cable drums supporting the hooks are preferably not designed to carry anything but the dead load of hooks. With the controller arm still at the position I, the main hoist drum $c^{10}$ is rotated by the motor C to raise first the mag-

net and then the hooks and plate when the cable clamps engage the arms $f^6$ and $f^{11}$. After the plate has been raised by the drum $c^{10}$, the crane and trolley may be operated in the usual manner to carry the plate in safety to any desired point. To release the plate P, the entire load is lowered with the arm of the controller O in position I until the plate or the hooks rest on the floor or pile. The magnet is then lowered and energized, this latter being accomplished by moving the controller arm to the position IV, or to the position II which gives the same circuit connections as IV. Then the main drum $c^{10}$ is rotated to lift the plate and magnet enough to clear the plate from the hooks. The controller arm is then moved to the position V, and the motor E is operated to swing the hooks open enough to allow the plate to pass between their ends. The controller arm is then brought to position I, whereby the current is cut off from the magnet, the plate falling to a pile or other support below. The hooks and magnet may now be raised by the main hoist drum $c^{10}$, the magnet first moving to its high position with respect to the hooks and then picking up the hooks themselves. The crane is then ready to repeat the operation described.

In Fig. 10 and 11, the hooks and magnet are like the preceding figure, applicable to single whip cranes, but differ from them in being constructed to bring the plate P at right angles to the crane girders or the rails A (Figs. 4 and 5) instead of parallel therewith, as shown in Fig. 2. A four-armed spider S is provided to two of whose opposite arms the cables $h^4$ are secured, the cables $h$ being secured to the remaining arms of the spider. The cables $i$ pass up the same side of the shaft $f$. The pair of arms $f^4$, $f^9$ have their outer ends connected to the links $f^{10}$, which have their upper ends joined and connected to the cables G and G′. It is seen that the parts on Figs. 10 and 11 are at right angles to those shown on Fig. 2, the plane including the cables $h$, $h$, being considered the same in both.

Figs. 12, 13 and 14 are like the lower portion of Fig. 2 and Fig. 6, except that they are provided with a pair of sheaves $j^2$ for the cable $h$ to pass beneath, the ends thereof, which in Fig. 2 are fastened to the equalizer H, being continued up to the trolley, where they are dead-ended in a well known manner. The equalizer H is omitted and the clevis $h^2$ attached to the block $j'$. The cables $h$ pass under the sheaves $j^2$, which carry the rollers $h^5$ on their ends for engagement with the arms $f^6$, $f^{11}$, for the same purposes that the cable clamps $h'$ engage the arms $f^6$, $f^{11}$ in Fig. 2. The sheave $j$ is off-set from the block $j'$ as shown in Fig. 14. There is but one cable $i$ but its function is the same as where two are used. The plate is carried in the same position with respect to the rails A as in Fig. 2.

In Figs. 15, 16, and 17, the hooks are connected as in Figs. 10 and 11, but being, for a double whip, crane like Figs. 12, 13, and 14, the block J′ is employed with the sheave $j$ placed between the sheaves $J^2$. The apparatus of these figures carry the plates in the same position relative to the rails A as on Fig. 10. It is now seen that the crane operator can open and close the hooks to accommodate any size of plate within their range, and can raise or lower the magnet with respect to the hooks, no matter in what position they are; that the entire combination of hooks and magnet can be raised and lowered at will, the cable drums automatically winding up or paying out cable as needed; that the above named operations are secured by the several positions of an arm on a small controller in addition to the controller for the bridge, trolley and hoist drum used for standard crane service; that the current in the lifting magnet is also controlled by the said small controller and the arrangement is such that when the controller is set for carrying the plate on the safety hooks, the current is cut off from the magnet; that when the controller is in any position for opening or closing the hooks or lowering the magnet with respect to the hooks, the current is allowed to flow through the magnet; that the main hoist cables carry the load, the hook cables not carrying more than the weight of the hooks or the pull required to open them, and that the action of the hoisting devices is such as to maintain the hooks in engagement with the plates and precludes any danger of the plate slipping from the hooks.

The apparatus shown and described is not to be understood as embodying all the forms which my invention may assume either in its combinations or its elements.

I claim—

1. The combination of a lifting magnet and safety hooks, means for suspending the same, means for causing the magnet to lift a plate, and means actuated independently of the magnet lifting means for causing the hooks to engage the plate.

2. The combination of a lifting magnet and safety hooks, means actuated independently of the condition of the hooks for suspending the same, means for causing the magnet to lift and release a plate, and means for causing the hooks to carry the plate after the magnet has released the plate.

3. The combination of oppositely arranged hooks, means actuated independently of the load-lifting means and for lifting a load between the hooks, and means carried by the lifting means for moving the opposite hooks toward each other.

4. The combination of oppositely arranged hooks, means for simultaneously applying to the hooks forces tending to move opposite hooks in opposite directions, and means for changing one of the said forces to permit the other to act, whereby the opposite hooks may either approach or recede from each other.

5. The combination of a main hoisting device, a lifting magnet connected thereto, oppositely arranged hooks connected to move toward and from the lifting magnet, a second hoisting device connected to said magnet and to said hooks, and means supported by the main hoisting device for carrying a load engaged by the hooks.

6. The combination of a main hoisting device, a lifting magnet connected thereto, oppositely arranged hooks connected to move toward and from the lifting magnet, a second hoisting device connected to said magnet and to said hooks, and a connection between the main hoisting device and the hooks whereby the magnet may be lowered and raised through a limited distance independently of the hooks.

7. The combination of a main hoisting device, a lifting magnet connected thereto, oppositely arranged hooks connected to move toward and from the lifting magnet, a second hoisting device connected to said magnet and to said hooks, and means whereby the main device may lift the hooks and the load carried thereby, and the magnet may be raised or lowered independently of the hooks.

8. The combination of a main hoist drum, a lifting magnet connected thereto, oppositely arranged lifting hooks at opposite sides of the magnet, a second hoist drum connected to the said hooks so that their weight tends to close them, a third hoist drum connected to the said hooks so as to oppose the action of the second hoist drum, means whereby the second and third drums may be simultaneously rotated to open the said hooks, and means whereby the third drum may remove its resistance to the action of the second drum.

9. The combination of a main hoist drum, a lifting magnet connected thereto, oppositely arranged lifting hooks at opposite sides of the magnet, a second hoist drum connected to the said hooks so that their weight tends to close them, a third hoist drum connected to the said hooks so as to oppose the action of the second hoist drum, means whereby the second and third drums may be simultaneously rotated to open the said hooks, means whereby the third drum may remove its resistance to the action of the second drum, and means for causing the third drum to pay out cable as the second drum rotates to close the hooks.

10. The combination of a main hoist drum, a lifting magnet supported thereby, pivotally connected oppositely arranged lifting hooks at opposite sides of the magnet, a sheave block connected to the magnet lifting means below the pivoted connection of the hooks, a second hoist drum connected to said hooks so as to tend to open them, a third hoist-drum having a cable passing around the bottom of the sheave or sheaves in said sheave-block and connected to exert a downward pull on the pivot of said hooks, a loose connection between the main hoist mechanism and the hooks, and means for operating the main drum independently of the second and third drums, whereby the magnet may be raised and lowered and the load on the hooks be moved up and down by the main hoist drum.

11. The combination of a main hoist drum, a lifting magnet supported thereby, pivotally connected oppositely arranged lifting hooks at opposite sides of the magnet, a sheave block connected to the magnet lifting means below the pivoted connection of the hooks, a second hoist drum connected to said hooks so as to tend to open them, a third hoist-drum having a cable passing around the bottom of the sheave or sheaves in said sheave-block and connected to exert a downward pull on the pivot of said hooks, a loose connection between the main hoist mechanism and the hooks, means for operating the main drum independently of the second and third drums, whereby the magnet may be raised and lowered and the load on the hooks be moved up and down by the main hoist drum, and means for causing the second and third drums to maintain their hoist cables taut during the said operations of the main hoist drum.

12. The combination of a lifting magnet, a main drum for raising and lowering a lifting magnet, lifting hooks connected to said magnet, drums for controlling the hooks, and means for causing the latter drums to keep their cables taut during the operation of the main drum.

13. The combination of a main electric motor, a main drum operated thereby, a lifting magnet connected to said drum, a second motor, a drum operated thereby, oppositely arranged lifting hooks, means connecting the hooks to the second drum, a third drum, means connecting the second and third drums to said hooks so that the hoisting action of both drums tends to open the hooks, means for connecting the third drum at will to the main drum or to the second drum, and a connection between the magnet and the hooks.

14. The combination of a lifting magnet, a main hoist drum for the same, lifting hooks, a connection between the magnet and the hooks, supporting cables for the hooks, and means for preventing the supporting cables

from being paid out when the magnet is lowered.

15. The combination of a lifting magnet, a main hoist drum for the same, lifting hooks movable toward and from each other, a connection between the magnet and the hooks, supporting cables for the hooks, a retaining cable for the hooks, connections between the supporting and retaining cables and the hooks, and means for causing the retaining cable to act with the supporting cable to open the hooks.

16. The combination of a lifting magnet, lifting hooks arranged at opposite sides of the magnet, means for opening and closing the hooks, means for raising and lowering the magnet, and a controller having a single lever and suitable contacts for causing said hook and magnet operating means to be actuated and said magnet to be energized.

Signed at New York city, New York, this 8th day of October, A. D. 1908.

JAMES F. SCHNABEL.

Witnesses:

J. H. HALL,

H. M. MITCHELL.