No. 743,889. PATENTED NOV. 10, 1903.

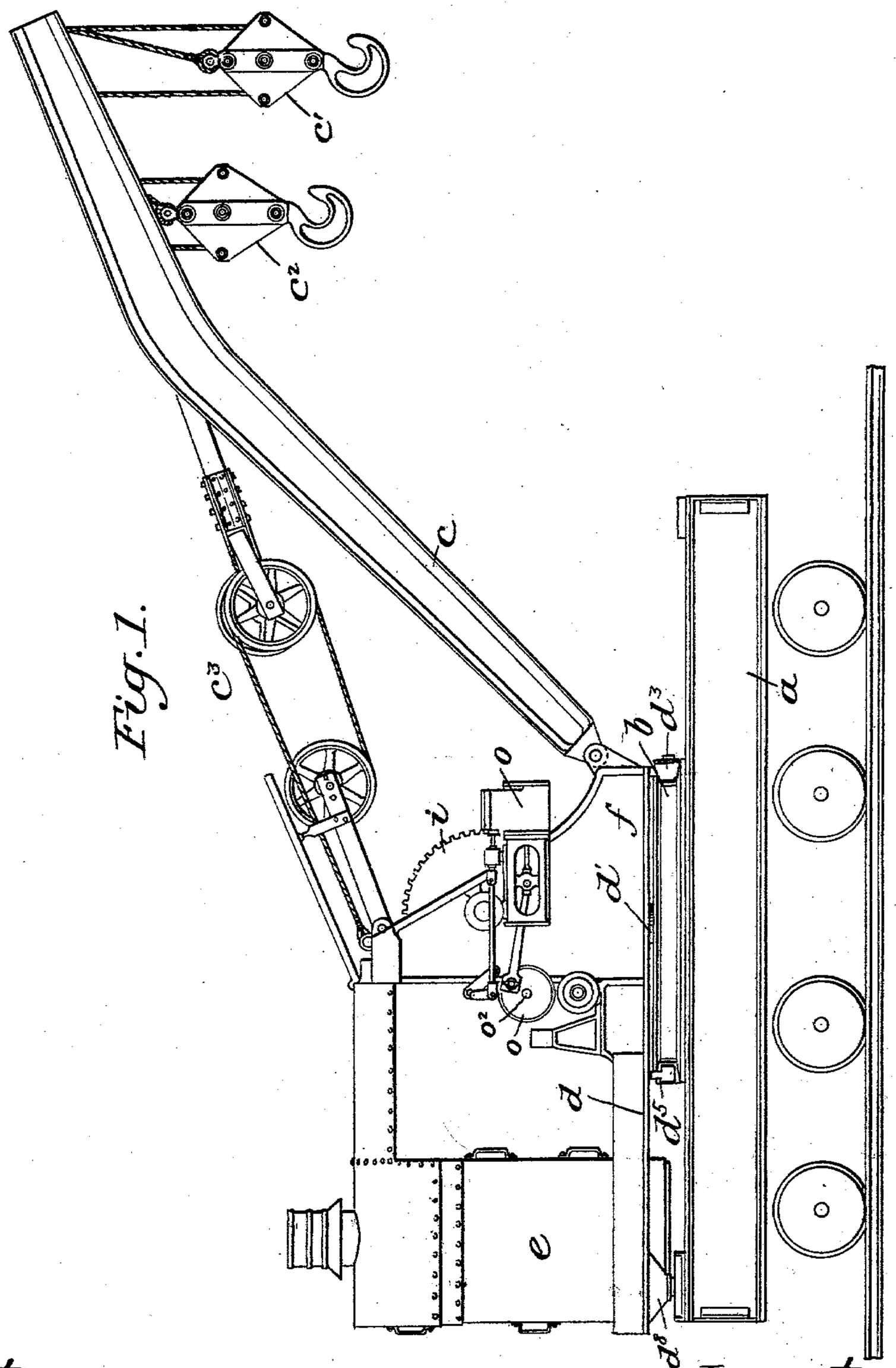
S. L. G. KNOX & W. FERRIS.

HOISTING APPARATUS.

APPLICATION FILED MAR. 12, 1903.

NO MODEL. 7 SHEETS—SHEET 1.

Fig. 1.



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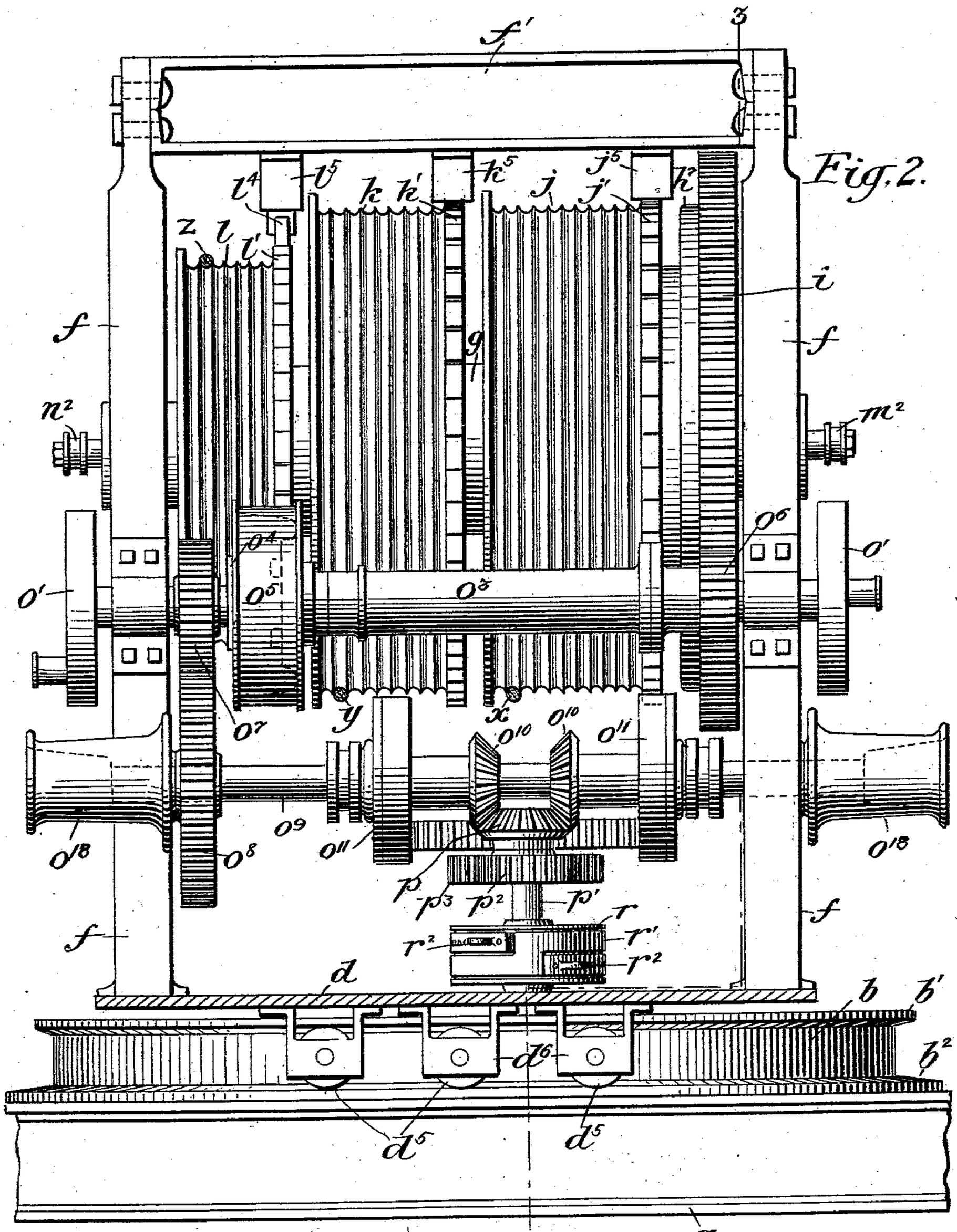

Fig. 2.

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NO MODEL. 7 SHEETS—SHEET 3.

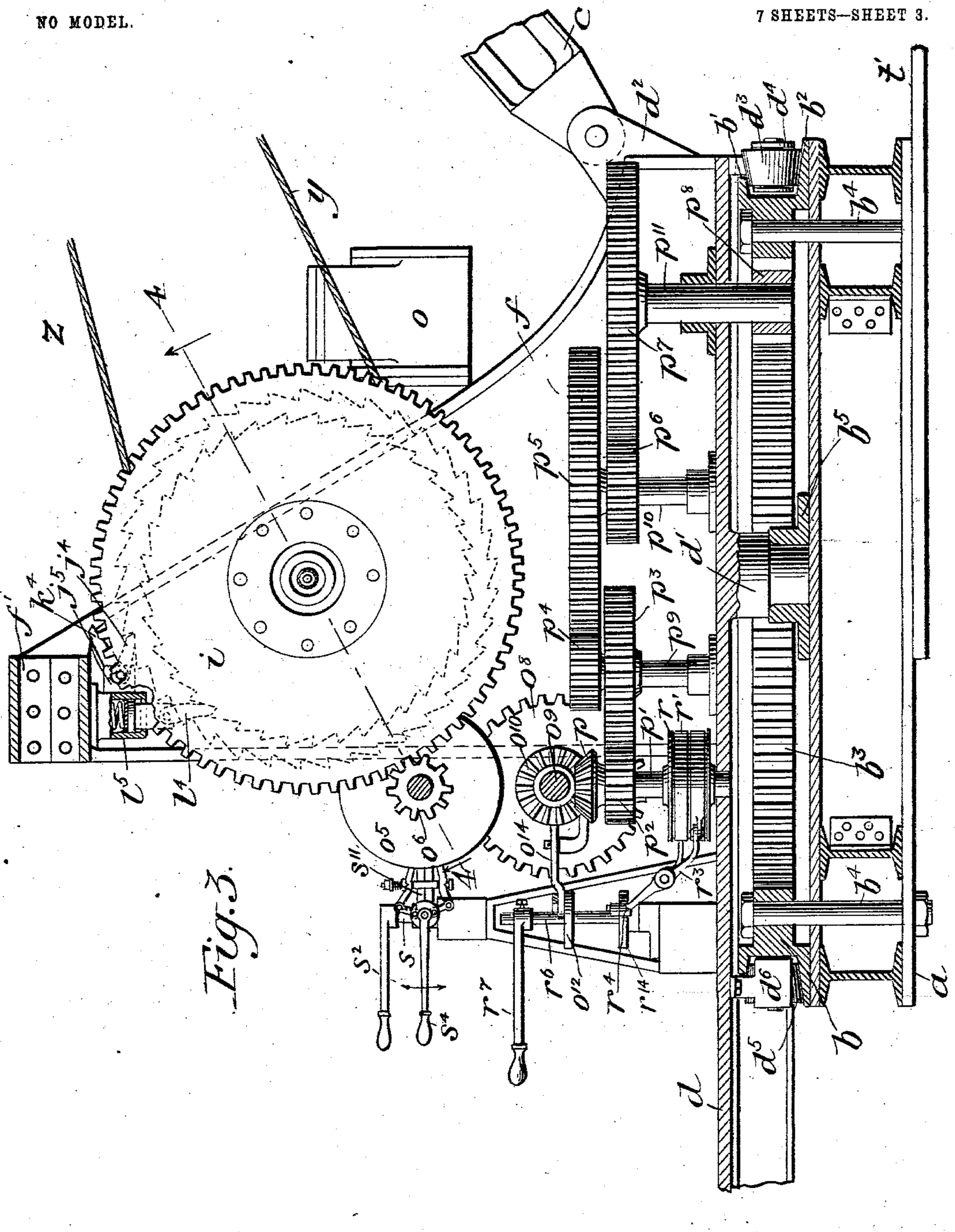

Fig. 3.

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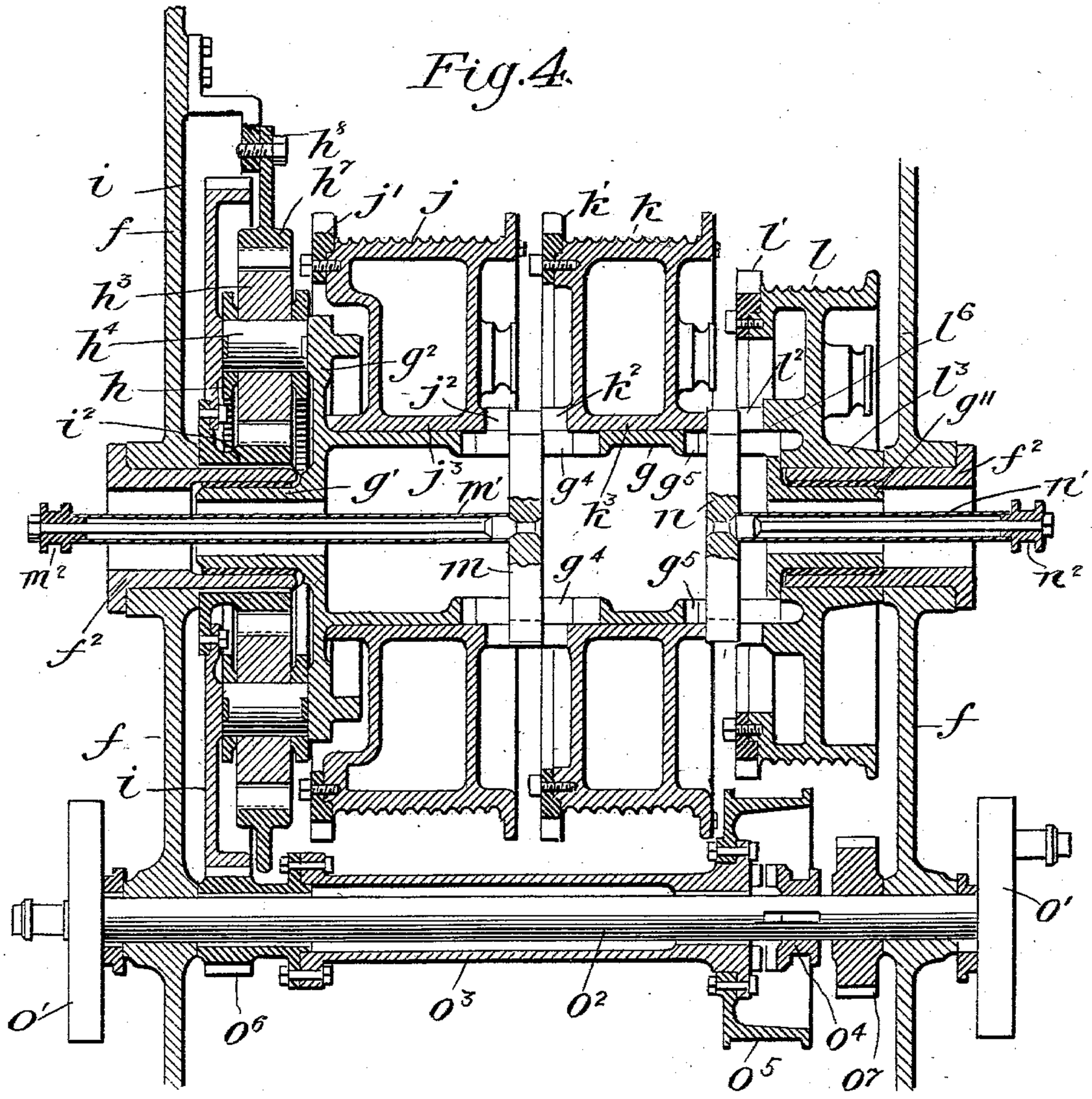
NO MODEL. 7 SHEETS—SHEET 4.

Fig. 4.



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NO MODEL. 7 SHEETS—SHEET 5.

Fig. 5.

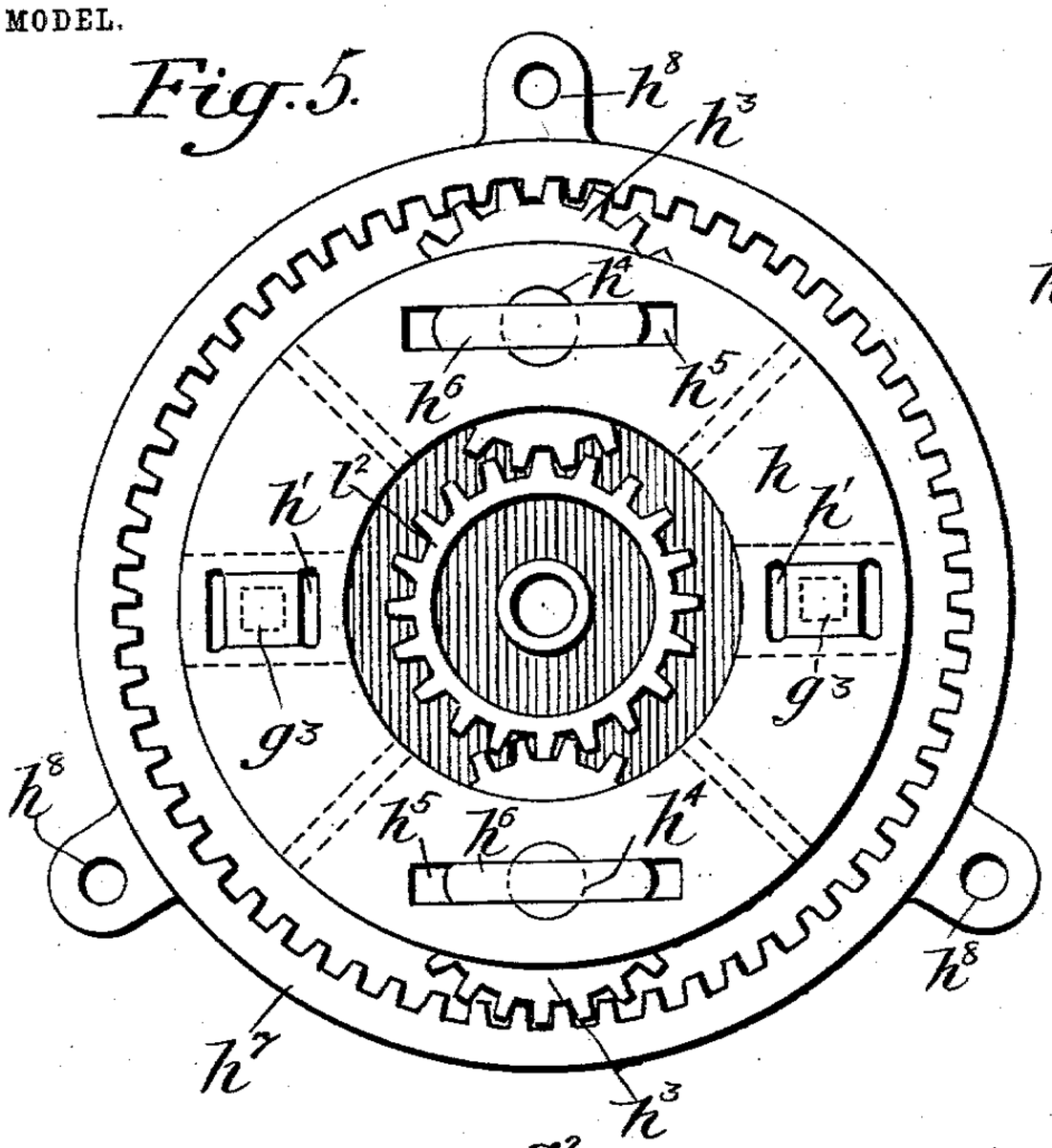


Fig. 6.

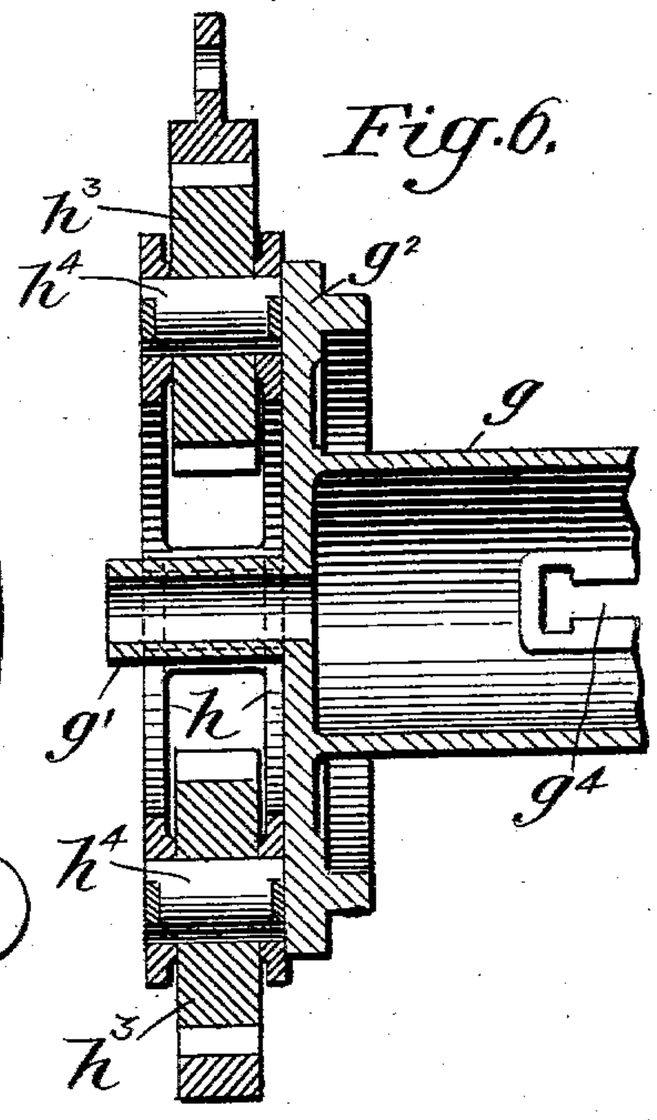


Fig. 7.

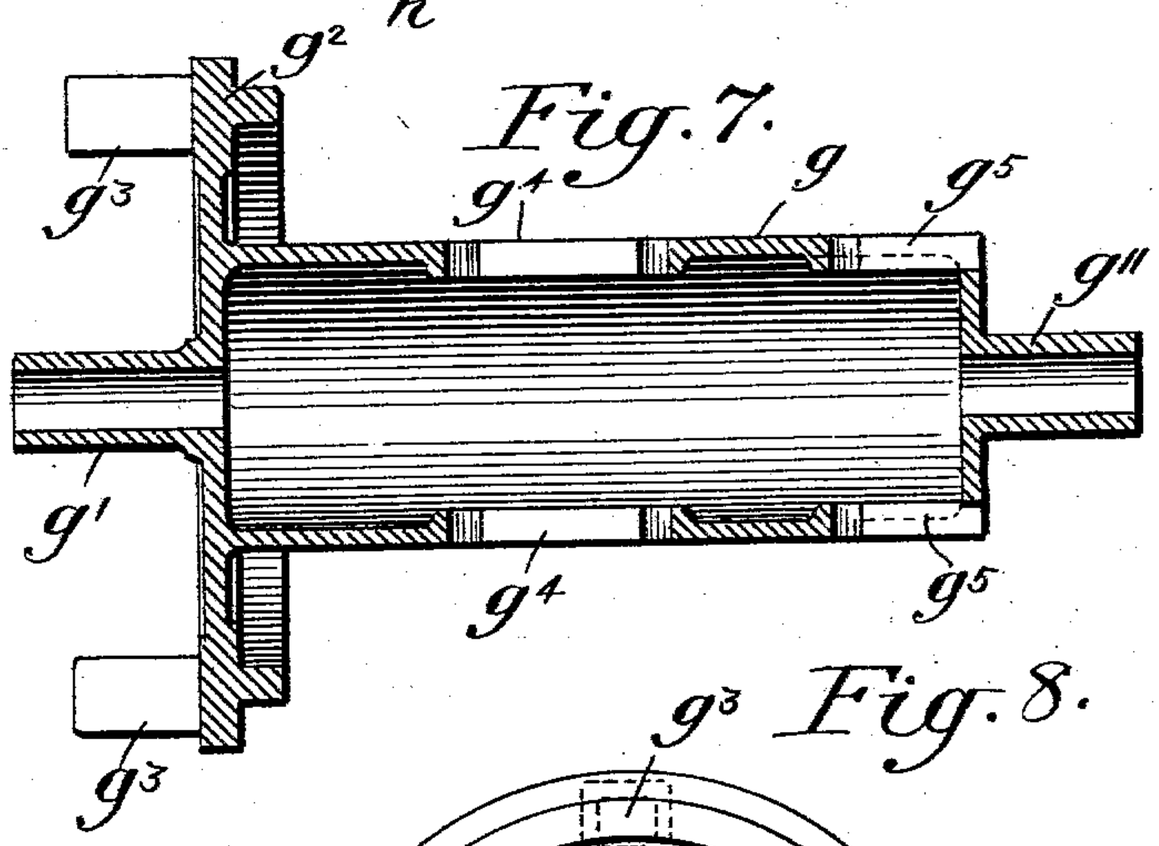
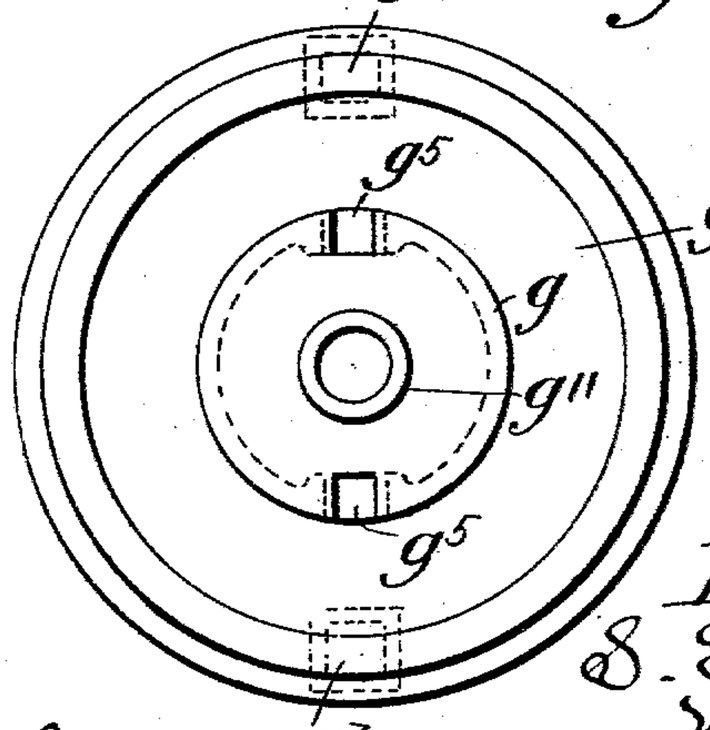


Fig. 8.



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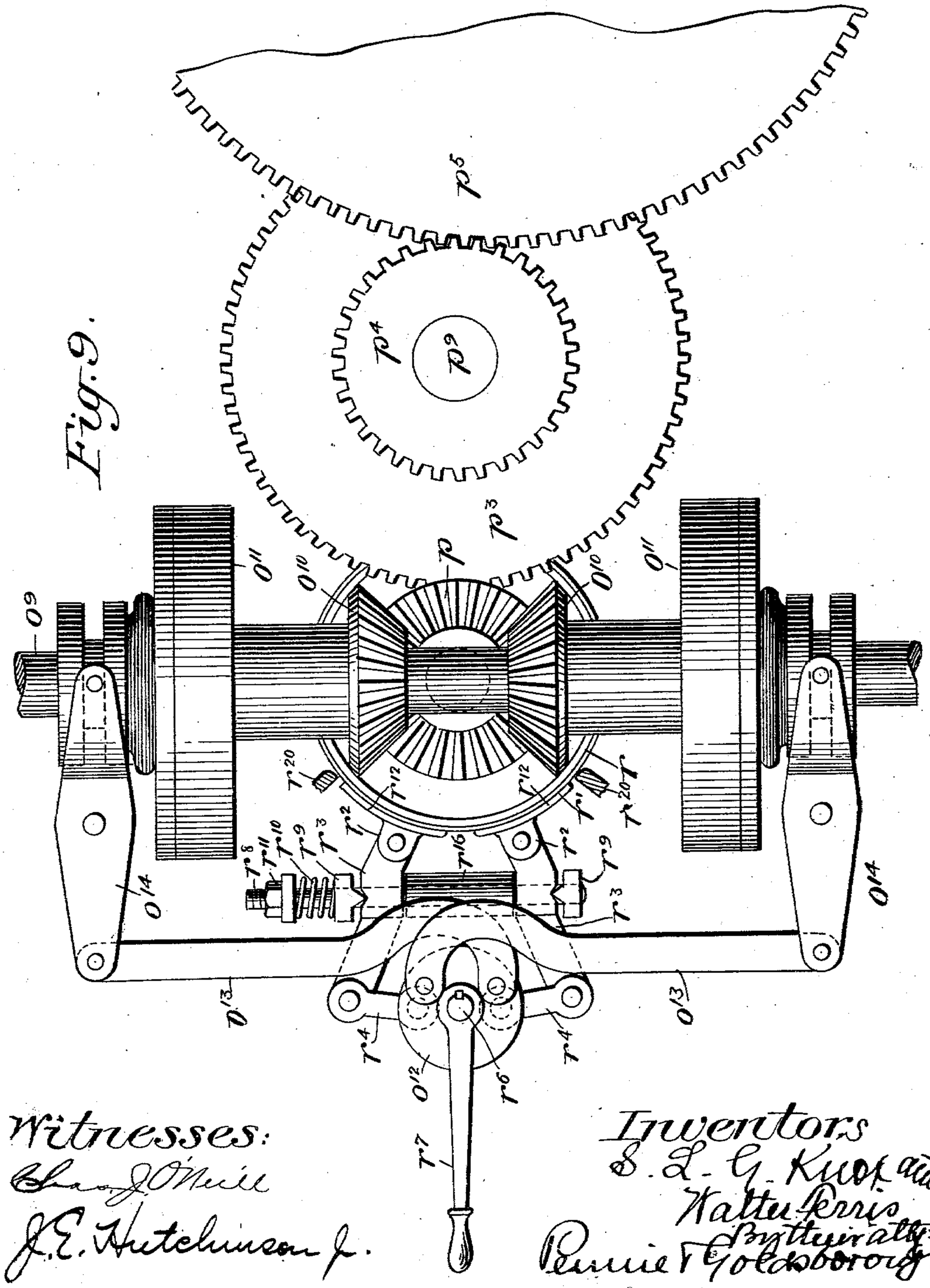
NO MODEL. 7 SHEETS—SHEET 6.

Fig. 9.



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NO MODEL. 7 SHEETS—SHEET 7.

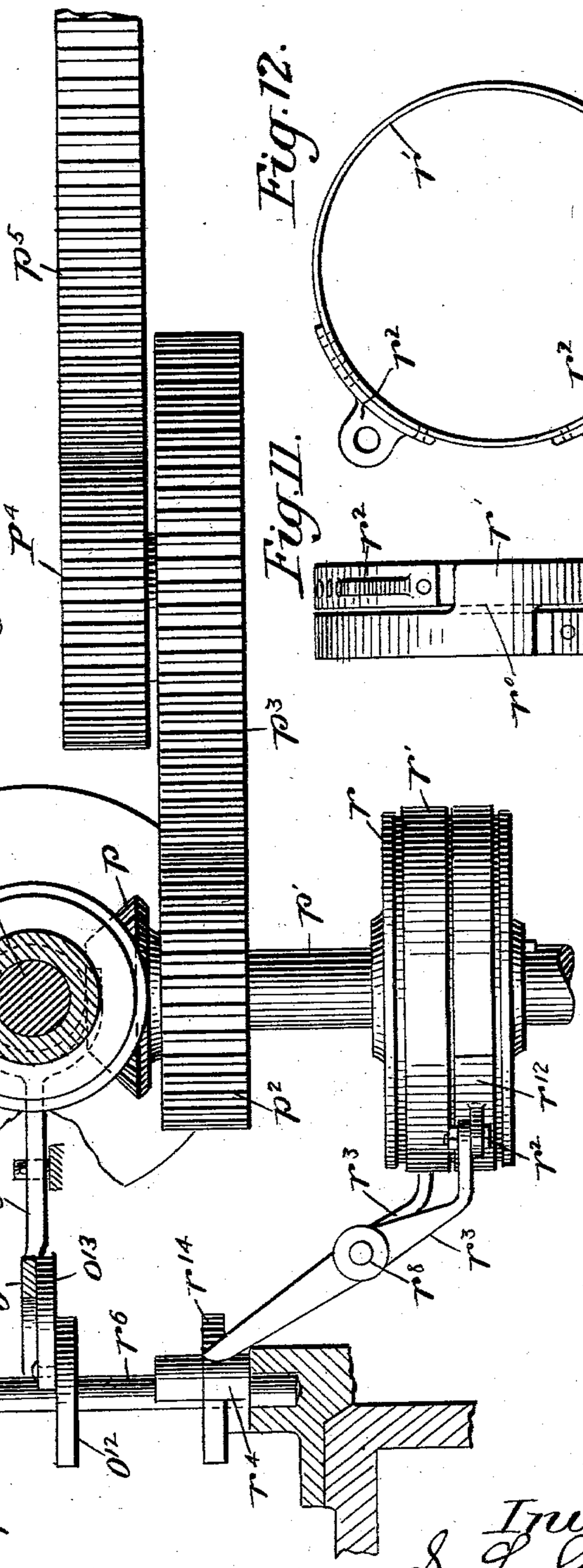

Fig. 10.

Fig. 12.

Fig. 11.

Fig. 13.

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No. 743,889. Patented November 10, 1903.

UNITED STATES PATENT OFFICE.

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HOISTING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 743,889, dated November 10, 1903.

Application filed March 12, 1903. Serial No. 147,457. (No model.)

To all whom it may concern:

Be it known that we, SAMUEL LIPPINCOTT GRISWOLD KNOX, residing at Milwaukee, and WALTER FERRIS, residing at South Milwaukee, county of Milwaukee, State of Wisconsin, both citizens of the United States, have invented certain new and useful Improvements in Hoisting Apparatus; and we do hereby declare the following to be 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.

Our invention relates to hoisting apparatus, and more particularly to wrecking-cranes, and has for its object to provide a machine to meet the exigencies of heavy railroad-work with a maximum mechanical efficiency, marked simplicity of construction, and inherent structural durability, said machine comprising a support, preferably a truck, having a rotary superstructure thereon which carries a vertically-adjustable jib supporting the load-hoisting cables, a series of hoisting-drums mounted upon and driven from a single barrel or cylinder, which drums are adapted to operate the cables in a manner to prevent either the load or the jib "running away," a circular track supporting the superstructure provided with means to prevent the latter tilting under an abnormal load on the jib, and actuating mechanism for rotating the superstructure while the crane is loaded or unloaded.

Our invention has for its further object to improve the various structural details of such machines, to which end it comprises the various novel features of construction and operation hereinafter described in this specification and particularly set forth in the claims hereunto annexed.

Our invention is illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of the apparatus. Fig. 2 is a rear elevation of the operating mechanism for the various hoisting-drums and the rotary superstructure. Fig. 3 is a vertical section on line 3 3 of Fig. 2. Fig. 4 is a transverse section on line 4 4 of Fig. 3 looking in the direction of the arrows. Fig. 5 is an end view of the equalizing-gearing operating the drum cylinder or barrel. Fig. 6 is a sectional view showing the relation of the equalizing-gearing and the drum-cylinder. Figs. 7 and 8 are respectively a longitudinal section and an end elevation of the cylinder or barrel which carries the hoisting-drums. Fig. 9 is an enlarged detail plan view of the clutch-and-brake mechanism controlling the gearing for rotating the superstructure. Fig. 10 is an elevation of the same; and Figs. 11, 12, and 13 are details of the brake-band.

Referring to Fig. 1 of the drawings, *a* indicates a wheeled truck of the usual type employed in this class of apparatus, having a structural body-framing upon which is supported a circular trackway *b*, which in turn supports a rotary superstructure comprising all of the operative mechanism of the hoisting apparatus proper, hereinafter to be more particularly described. Broadly considered, the superstructure comprises a platform or turn-table *d*, arranged to revolve around the center of the trackway *b* and normally supported by a series of rollers d^3 d^5, secured to the platform and running upon the trackway, an adjustable jib or boom *c*, multiple hoisting-drums, and actuating and controlling mechanism for the drums and for the rotary platform supported upon said platform. The jib *c*, which is pivoted in bearing lugs or brackets on the machine-frame *f*, is provided at its outer end with hook-blocks c' and c^2, the former being an auxiliary block for light loads and the latter the main block for heavy loads. To the jib is attached the usual arrangement of sheaves or pulleys c^3, to which is operatively connected the rope or cable employed to adjust the jib up and down, and thereby vary the radius of the crane to meet the varying condition of operation. Heretofore it has been the general practice to operate the load and jib hoisting cables from hoisting-drums mounted upon separate shafts controlled by separate gearing, clutches, and brake mechanisms. In the present construction the several drums are mounted upon a single hollow cylinder, which is driven from a suitable source of power by a single train of spur-gears.

Referring more particularly to Figs. 2, 3,

and 4 of the drawings, $f\ f$ indicate the side frames of the hoisting apparatus between which the various actuating and controlling mechanisms are mounted. Removably secured in flanged orifices in the side frames are hollow studs or thimbles $f^2\ f^2$, which project within the space included between said frames and form bearings for the hollow end journals or trunnions $g'\ g''$ of a hollow barrel or cylinder g, which barrel, inclusive of the journals $g'\ g''$, is of a length to permit it to clear the inside of the frames $f\ f$ and allow said barrel to be removed from its bearings $f^2\ f^2$ and lifted from between the frames upon withdrawing said bearings $f^2\ f^2$ from engagement with the journals $g'\ g''$. The barrel g is preferably provided at one end with an annular flange g^2, from which project two pins or studs $g^3\ g^3$, preferably rectangular in cross-section and disposed at substantially diametrically opposite points. The body of said barrel is pierced at points in its surface with two sets of diametrically opposite elongated orifices $g^4\ g^4$ and $g^5\ g^5$, referred to with more particularity hereinafter. The barrel g is immediately rotated by means of an equalizing-frame h, which comprises two annular parallel plates united by cross-webs to form a rigid and preferably integral structure, which is pierced by two rectangular slots $h'\ h'$, fitting over the pins g^3 on barrel g and permitting a slight movement of the frame with respect to the drum in the direction of the diameter. Disposed between the slots $h'\ h'$ and preferably on a diameter at right angles to that on which the slots lie are two studs $h^4\ h^4$, rigidly secured to the frame by retaining-plates h^6, fitted in slots h^5, upon which studs are rotatably mounted the floating pinions $h^3\ h^3$. Said pinions $h^3\ h^3$ mesh on their outer sides with a stationary internally-toothed gear h^7, which is rigidly secured to the machine-frame by two or more lugs h^8, and on their inner sides with an external gear i^2, which is connected to a relatively large external gear i, which is driven from a gear o^6, actuated from engine-shaft o^2.

It is to be particularly observed that the purpose of the equalizing-frame is to secure a perfect bearing between the teeth of the several gears at all points, and therefore an equal division of the load between gear i^2, pinions $h^3\ h^3$, and the stationary gear h^7. The connections between the equalizing-frame h and the barrel g are therefore designed to permit a certain amount of movement of the frame with respect to the barrel in a direction not parallel with the diameter on which the floating pinions are mounted, thereby compensating for a thick gear-tooth or a piece of foreign matter between any of the teeth by moving the equalizing-frame bodily along the line of the connections until an equality of pressure is obtained between pinions $h^3\ h^3$ and the gears in mesh therewith. Thus by a slight sliding movement on the studs $g^3\ g^3$ the equalizing-frame maintains at all times a substantially equal division of the load between the pinions, and thereby enables the use of smaller gear-teeth and reduces the wear on each tooth.

Of course it is to be understood that there are other forms of sliding driving connections or couplings than the pin-and-slot type shown that are quite as well adapted to the particular purpose specified, and all equivalent connections—such, for instance, as the well-known pin-and-link coupler—which serve to securely unite the barrel and the equalizing-frame in driving relation and still permit a small relative movement between them are to be considered within the purview of my invention.

Mounted on the barrel g are three hoisting-drums j, k, and l, which are adapted to rotate freely thereon when unrestrained, said drums being provided with ratchet-rims j', k', and l' and clutch-teeth j^2, k^2, and l^2, respectively, mounted in the present instance upon opposite sides of said drums. The ratchet-rims are adapted to be engaged by pawls j^4, k^4, and l^4, mounted in friction-buffers j^5, k^5, and l^5, secured to the cross-beam f', spanning the frames $f\ f$. The purpose of the friction-buffers on which the pawls are mounted is to avoid sudden injurious shocks by taking up the heavy strains upon the pawls in bringing the drums to rest and converting the strains into frictional work and heat. It is to be understood, of course, that the pawls are to be provided with any desired form of operating device whereby any or all of them may be engaged with or disengaged from the respective ratchets. In order to avoid the large frictional loss which would result if a heavily-loaded drum were allowed to rest upon the moving surface of the barrel, the jib-hoisting drum l, which is always loaded and generally stationary, is journaled upon and supported entirely by the thimble f^2. An inner flange having the clutch-teeth l^2 thereon projects over the end of barrel g merely to afford a convenient engagement with the clutch-bar n and said clutch-teeth. The purpose of the relatively large barrel g is to afford a more extensive bearing-surface for the drums, to reduce the strain on the clutches which couple the drums to the barrel, and to facilitate the operation of said clutches from within the barrel.

Slidably mounted within the hollow barrel g and projecting through the slots $g^4\ g^5$, respectively, are two clutch members $m\ n$, the former of which when moved toward the drum j engages teeth j^2 thereon and locks said drum to the rotary barrel g. A corresponding movement toward the drum k locks the latter to the barrel and releases drum j, and when said clutch is moved to mid or neutral position neither of said drums j or k is connected to the barrel g. When clutch n is moved toward drum l, the latter is locked to the rotary barrel, and when the movement is reversed

the said drum l is released. The clutches m and n are moved into any desired relation with the drums by means of rods m' n', projecting through the hollow trunnions g' g'' and the thimbles or bearings f^2 f^2, said rods m' n' being provided with collars m^2 n^2, engaged by suitable operating-levers. (Not shown.)

The diameters of the drums j, k, and l should be so related in any given crane as to make the turning moments of the cables around the axis of the drums as nearly equal as may be. In the present instance drum l, which is employed to raise and lower the jib c, is made smaller in diameter than drums j and k, which are employed in operating the load-lifting cables running over blocks c' and c^2, respectively, but of course the relation might be reversed and drum l be the larger under other circumstances. In order to lessen the strain on a single drum and to prevent either the load or the jib running away, and thereby endangering the apparatus, the cables on the load-hoisting drums j and k are wound in a direction opposite to that of the cable on the jib-hoisting drum l, so that in any event the cables for lifting the load and the jib will pull against each other in their attachment to the united drums, each cable tending to pull its drum around in opposition to the other, whereby the excess of pull in either cable is never enough to overcome the frictional resistance of the machinery, and the load and jib will remain suspended and stationary, until moved by the engine to another position.

The motive power is supplied by one or two engines o, mounted on the side frames f f and driving through crank-disks o' o' a main power-shaft o^2, upon which is mounted a sleeve o^3, having attached to one end thereof a spur-gear o^6, which, as hereinbefore described, drives the drum-actuating train of planetary gearing. On the other end of said sleeve is secured a brake-drum o^5, which is preferably supplied with a double-acting cumulative band-brake similar in all essentials with the brake to be described later in connection with other parts of the mechanism. A toothed clutch member o^4, keyed to shaft o^2, is adapted to engage a similar member on the sleeve o^3, and thereby couple the drum-driving train to the engine-shaft. The latter, of course, may be supplied with any preferred form of reversing mechanism. Also mounted in bearings in the side frames f f below the shaft o^2 is a second shaft o^9, provided with a spur-gear o^8, which is driven from a similar gear o^7 on shaft o^2. Shaft o^9 is provided with two normally loose bevel-pinions o^{10} o^{10}, which are adapted to be coupled alternately to said shaft by means of friction-clutches o^{11} o^{11}. The gears o^{10} o^{10} mesh with a similar bevel-gear p, secured to a vertical stub-shaft p', mounted on the platform d or on the bottom of the supporting-frames f f, which shaft is provided with a spur-gear p^2, driving a train of reducing spur-gears p^3, p^4, p^5 p^6, p^7, and p^8, mounted on appropriate stub-shafts p^9, p^{10}, and p^{11}, the last-mentioned gear meshing with an internal circular rack b^3, formed on the inside of the trackway b. Gears p and p^2, with the connected train of spur-gears, are rotated in one direction or the other to swing the superstructure on the trackway b when the respective clutches o^{11} o^{11} are operated to lock one or the other of gears o^{10} o^{10} to shaft o^9. Said clutches o^{11} o^{11} are operated by rock-levers o^{14} o^{14}, pivoted to the frame and connected by links or rods o^{13} o^{13} to a disk o^{12}, mounted upon a vertical staff r^6, which is oscillated by a handle r^7. As handle r^7 is swung approximately sixty degrees to the right or left, the clutch to the left or the right of said handle is engaged with its corresponding bevel-gear o^{10}, and the gear-train for rotating the platform is actuated to swing the latter to the right or left, as the case may be. When the handle r^7 is in mid-position, as shown in Fig. 9, the clutches are both disengaged and the shaft p' is not rotated.

Secured to the shaft p' below the gear p^2 is a brake-drum r, upon which is mounted a flexible brake-band r', comprising two peripheral sections united by a cross-web r^0 at the point of juncture of the sections, so that said band is applied to the drum in two wraps or bights, and when the ends are drawn together the braking force is applied. The free ends of this band are provided with lugs or ears r^2 r^2, secured thereto by straps r^{12} r^{12}. To each of said lugs is pivoted a link or lever r^3, which in turn is coupled by a pivot-pin to a second link r^4, each of said links r^4 being pivoted to a wrist-pin plate or cross-arm r^{14} on the staff r^6, as shown in Figs. 9 and 10. Passing through the levers r^3 r^3 and intermediate the ends thereof is a pin r^8, provided with knife-edge fulcrums r^9 r^9, one of which is held yieldingly in contact with its lever by a helical spring r^{10}, which is held in position and adjusted as to tension by set-nut r^{11} on said rod r^8 to regulate the braking force.

The circular trackway b comprises an annular metal frame secured to the top of the truck-frame by heavy bolts b^4. The outer periphery of said frame is provided with two projecting rims or flanges b' and b^2, which constitute upper and lower tracks or bearings which are engaged by the two series of antifriction-rollers d^3 and d^5, mounted in depending brackets d^4 and d^6, secured to the platform or superstructure. The inner periphery of the annular frame b is provided with a rack b^3, which, as described, is engaged by the gear p^8 of the spur-train and affords the resisting member or fulcrum to secure the rotation of the superstructure through said gear-train. A depending lug d', secured to the lower side of the platform, engages a socket b^5, mounted on the truck-body, and serves to maintain the platform in proper position with respect to the circular track.

The various operations of the apparatus as above described involve hoisting, holding, or lowering the load by either of the blocks c' or c^2, raising or lowering the jib c while unloaded or while loaded to the full capacity of the crane, swinging or rotating the superstructure on the truck through a complete circle when the crane is loaded or unloaded, and dragging the load attached to either of said blocks by moving the apparatus along the rails while the jib is swung out to the right or left of the truck even to the full extent of the radial movement of said jib. These various operations are accomplished with great facility of operation and high mechanical efficiency, and inasmuch as the several transmitting mechanisms may be adjusted to slip under an abnormal load the danger of breaking any part of the apparatus by overloading is practically avoided. To lift a load by means of block c', for instance, clutch member m is thrown into engagement with teeth j^2 on drum j by operating a suitable hand-lever (not shown) connected to rod m, thereby locking the said drum to barrel g and causing the drum and the barrel to rotate in a direction to wind the hoisting-cable of block c' upon the drum. When the load has been lifted clear of the ground, the radius of the jib c may be changed by clutching drum l to barrel g, or the superstructure may be rotated upon truck a in either direction by swinging hand-lever r^7 to the right or left to release the brake r and couple one of the bevel-pinions o^{10} to the rotating shaft o^9, and thereby actuate the train of spur-gears p^2 p^8, causing the last-named gear p^8 to react against the stationary rack b^3 and rotate the entire superstructure. It is to be observed that all of these operations may take place concurrently—viz., the load may be lifted, the radius of the jib changed, and the superstructure rotated to swing the jib to the right or left—thereby greatly economizing in the time required to perform the several necessary steps in lifting and transferring a given load. If it is desired to hold the load suspended from the block for any period, clutch o^4 is operated by lever s^2 to uncouple sleeve o^3 from shaft o^2, and hand-lever s^4 is turned to apply the brake to the brake-drum o^5, which arrests the movement of the planetary driving-gear and stops the rotation of barrel g and the drum coupled thereto. If it is desired to suspend the load without interfering with the operation of the barrel g, pawl j^4 is dropped into engagement with ratchet-rim j', and clutch member m is moved out of engagement with the teeth j^2, the rotation of drum j is immediately arrested, and said drum is held stationary against the pull of the load by pawl j^4. Clutch member m may then be engaged with teeth k^2 on drum k, which drum will then be rotated to operate the cable-controlling block c^2. Drum k, which is employed to operate the cable of block c^2 for heavy loads, is susceptible of the same operations as drum j, just described, and therefore may be allowed to rest idly on the barrel g, clutched to said barrel to lift or lower the load on block c^2 or retained in locked position against the pull of a suspended load by means of pawl k^4 engaging ratchet k'. Drum l is employed only for raising and lowering the jib c. Hence when said drum is clutched to barrel g by moving clutch member n into engagement with teeth l^2 through the agency of a suitable hand-lever connected to clutch-rod n' the cable attached to the jib is wound upon or paid off from said drum and the jib thereby raised or lowered until the radius of its lateral swing is properly adjusted. Normally the drum l is locked in position by pawl l^4, coöperating with ratchet-rim l', and the radius of the jib is maintained uniform. When it is desired to change the radius of the jib while a load is held suspended by one of the drums j k, the drum l is clutched to the barrel, and the cable controlling the jib is taken in or paid out to raise or lower the jib, as the case may be. When the radius of the jib is changed while the load is suspended, the fact that the load-hoisting cables and the jib-hoisting cables are wound in opposite directions on the respective drums prevents both the load and the jib running away.

In operating the apparatus to revolve the superstructure around the pin or gudgeon d' lever r^7 is swung to the right or left, as the case may be, clutching appropriate bevel spur-gear o^{10} to the shaft o^9 and releasing brake r', whereby the platform or turn-table is revolved to the right or left until the jib faces in the desired direction, after which the lever r^7 is returned to mid-position, unclutching the bevel-gear and applying brake r' to arrest the movement of the platform.

In practice the crane operators frequently swing the jib into a position nearly at right-angles with the line of the track, attach the block to some heavy object, perhaps thirty feet from the center of the crane, and then pull the entire crane along with a locomotive. If the resistance of the load is greater than the parts will stand, the crane would break if no provision is made to permit the load to reverse the gearing revolving the platform. In order to avoid this contingency, the brake r' is adjusted to slip on the drum r and permit the gearing operating between shaft p' and rack b^3 to turn backward when the strain on the superstructure exceeds a predetermined amount. This is accomplished as follows: When the hand-lever r^7 is moved to mid or neutral position, wrist-pin plate r^{14}, acting through links r^4 r^4, forces the ends of floating levers r^3 r^3, attached to said links, apart and brings the opposite ends of said levers, connected to the brake-band, together until the brake-band r' engages the drum r and in addition to the compression of spring r^{10} produces a practically constant converging pull, tending to apply the brake. As the

brake-band engages the drum r it is carried around with the drum until one of the projecting straps r^{12} strikes one of the stationary lugs r^{20} on the machine-frame and the corresponding end of the brake-band is arrested, while the other end continues to move under the pull of drum r, and the pressure of the spring r^{10} thereby applies the band with a constantly-augmented force until the drum is brought to rest. This braking force is maintained to prevent the jib swinging under a moderate pull; but when the strain on the jib exceeds a given amount the band slips on the drum, and consequently permits the loaded jib to drive the spur-gearing p^2 p^8 in a reverse direction and rotate the platform and jib in the direction to relieve the strain. The release of the brake is effected by means of the separator-block r^{16} on the tension-bolt r^8. When the hand-lever r^7 is moved either to the right or left, the ends of levers r^3 r^3, connected to the wrist-pin plate o^{12}, are drawn closer together by links r^4 r^4. The spring r^{10} foilows this up by pushing the fulcrum-points of levers r^3 r^3 closer together until they close upon the separator-block r^{16}, which acts as a fulcrum for both levers and pulls the ends of the brake-band r' apart, thereby releasing the wraps of said band from contact with drum r.

In the construction of crane heretofore in use when the jib is heavily loaded it tends to tilt the platform or superstructure on the front rollers adjacent the heel of the jib, thereby imposing excessive strains on the framing, one or two of the rollers, and the truck-body and necessitating a massive pivot-pin for the superstructure passing down through the center of the truck-body. By means of the improved trackway b, hereinbefore described, these various difficulties are obviated, the weight of the structure is decreased, and the strains are disposed most advantageously throughout the connections between the superstructure and the truck. The two sets of rollers d^3 and d^5 engage the trackway b between the flanges b' and b^2, which constitute a circular roller-path. The front rollers d^3 under the heel of jib c and the rear rollers d^5 rest upon the lower flange b^2 when the crane is not carrying a heavy load, and there is no tendency to tilt or upset the superstructure; but when the load on the jib is sufficient to tilt the platform d about the front rollers d^3 as a fulcrum the rear rollers d^5 come into contact with the upper flange b', and the strain is divided between the two sets of rollers and distributed throughout the trackway-casting b and thence to and throughout the truck-body. The reduction of the strains by the improved trackway is due to the doubling of the lever-arm by which the superstructure lifts the load. The load pulls down on the front rollers in both the old and new structures. In the old structure this pull is resisted by a counter pull on the center pin, which is usually about four feet from the rollers, while in the new construction the counter pull is imposed on the rear rollers, which are twice as far from the front rollers as the center pin would be. Hence the pull is only half as large in the latter case, and all of the strains, including the pressure on the front rollers, are materially reduced.

What we claim as our invention is—

1. A hoisting apparatus, comprising multiple hoisting-drums, a rotary barrel or cylinder upon which said drums are loosely mounted, and clutch mechanism mounted in said barrel for locking the respective drums to the barrel.

2. A hoisting apparatus, comprising multiple hoisting-drums provided with peripheral ratchet-teeth, a rotary cylinder or barrel upon which said drums are loosely mounted, clutches carried by said barrel for locking the respective drums to the barrel, and pawls cooperating with the ratchet-teeth of the respective drums; whereby the load on any drum may be sustained by the corresponding ratchet and pawl and the cylinder may at the same time be employed to hoist or sustain a load upon another drum.

3. A hoisting apparatus, comprising multiple hoisting-drums provided with peripheral ratchet-teeth, a rotary cylinder or barrel upon which said drums are loosely mounted, clutches carried by said barrel for locking the respective drums to the barrel, pawls coöperating with the ratchet-teeth of the respective drums, and yielding buffers interposed between said pawls and the rigid framework of the crane.

4. A hoisting apparatus, comprising multiple hoisting-drums, a rotary cylinder or barrel upon which said drums are mounted, standards between which said barrel is mounted, and removable pintles supported in said standards and forming bearings for the end journals of said barrel, whereby the barrel and drums may be removed from the standards upon disengaging the pintles from the barrel.

5. A hoisting apparatus, comprising multiple hoisting-drums, a rotary cylinder or barrel upon which said drums are mounted, journals or bearings on the ends of said barrel, standards adjacent to the ends of the journals, and hollow removable pintles supported in said standards and forming bearings or journals to support the said barrel, whereby said barrel may be removed from the standards upon disengaging the pintles from the barrel.

6. A hoisting apparatus, comprising multiple hoisting-drums, a rotary cylinder or barrel upon which said drums are mounted, an equalizing-frame connected to said barrel, floating pinions mounted in said frame, a fixed gear meshing with said floating pinions, and a driving-gear concentric with said barrel and engaging said pinions.

7. A hoisting apparatus, comprising a rotary cylinder or barrel, an equalizing-frame

adjacent to said barrel, floating pinions mounted in said frame, a fixed gear meshing with said pinions, a driving-gear concentric with said barrel and engaging said pinions, and driving connections between the equalizing-frame and the barrel, whereby the frame is permitted a limited movement with respect to the barrel to maintain the floating pinions properly in mesh with the fixed and the driving gears at all times.

8. A hoisting apparatus, comprising a rotary cylinder or barrel, an equalizing-frame, driving connections between said frame and said barrel to permit a small transverse movement of the equalizing-frame with respect to the barrel, pinions mounted in said frame between the respective connections, a fixed gear, and a driving-gear each meshing with said pinions, whereby the force applied to the barrel is divided between the several sets of gears, and the members of each set are maintained properly in mesh.

9. A hoisting apparatus, comprising a rotary superstructure, a circular track upon which said superstructure revolves, rollers secured to the superstructure and engaging said track, and a flange above said track and overlying said rollers to engage one or more of the rollers as the superstructure tends to tilt under load.

10. A hoisting apparatus, comprising an adjustable jib-crane, a circular track having upper and lower flanges upon which the crane revolves and rollers secured to the crane and engaging the track between the flanges thereof, whereby tilting of the crane under load is prevented and undue strain on the parts connecting the crane and the truck is prevented.

11. A hoisting apparatus comprising an adjustable jib-crane, a hoisting-drum for the load, and a hoisting-drum for the jib, the cables of the respective drums being wound in opposite directions thereon, whereby the respective cables pull against each other.

In testimony whereof we affix our signatures in presence of two witnesses.

SAMUEL LIPPINCOTT GRISWOLD KNOX.
WALTER FERRIS.

Witnesses:
W. E. WHITE,
G. S. ROBBINS.