No. 834,901. PATENTED NOV. 6, 1906.

C. E. GLESSNER.

HOIST.

APPLICATION FILED DEC. 30, 1905.

5 SHEETS—SHEET 1.

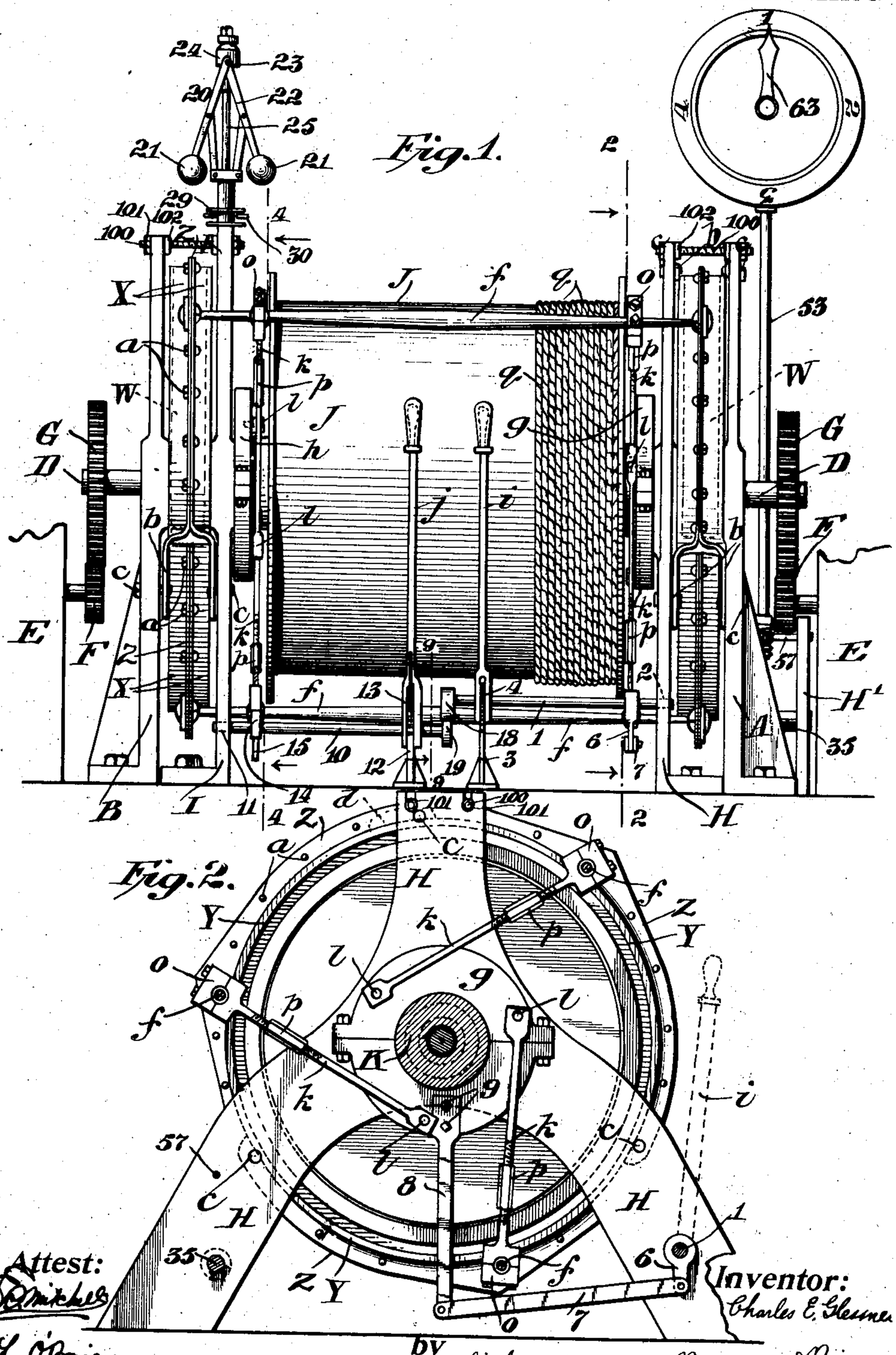

Fig. 1.

Fig. 2.

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Attys

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5 SHEETS—SHEET 2.

Fig. 3.

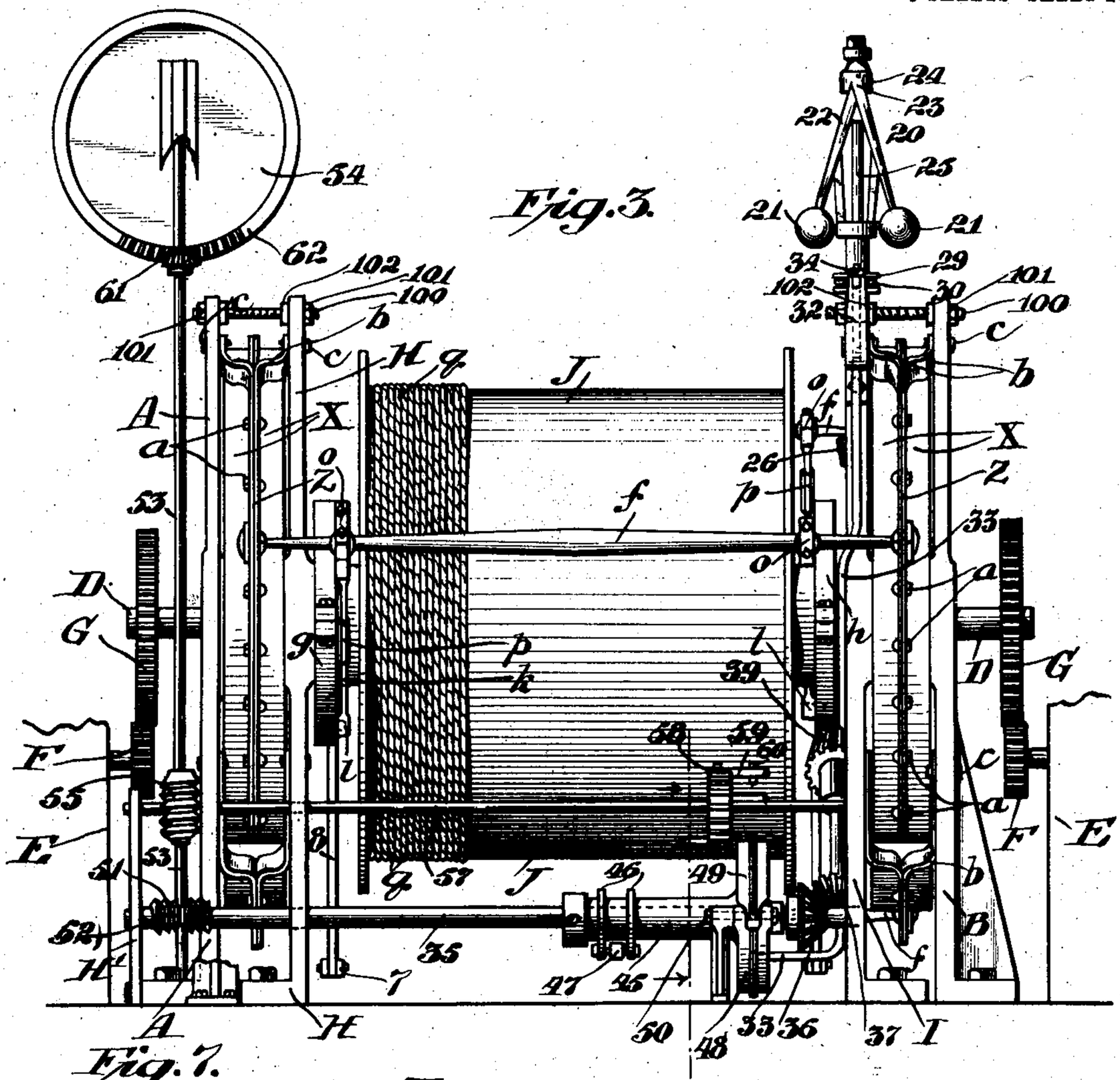


Fig. 7.

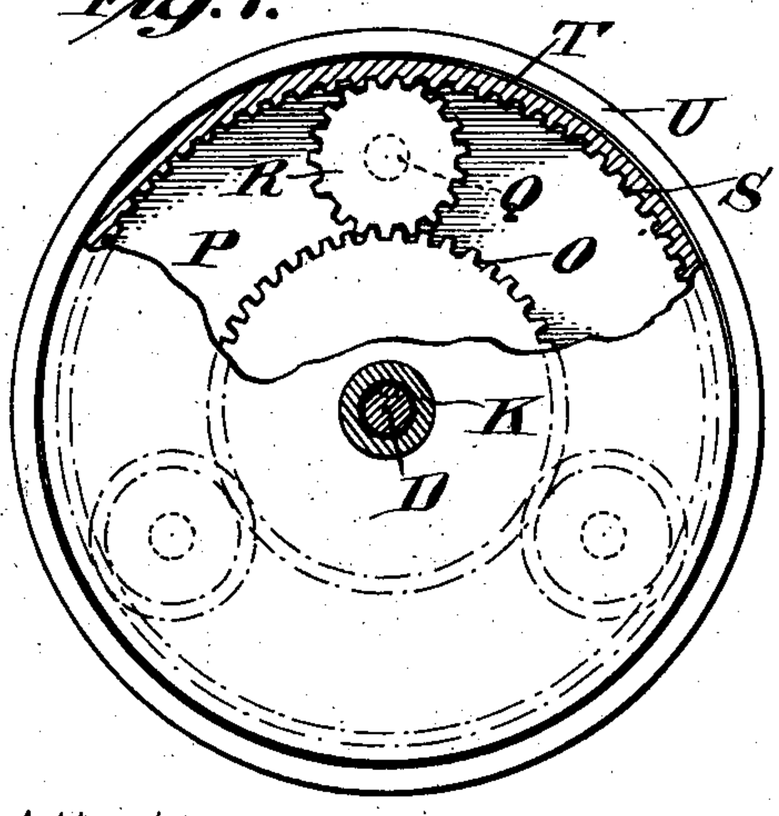
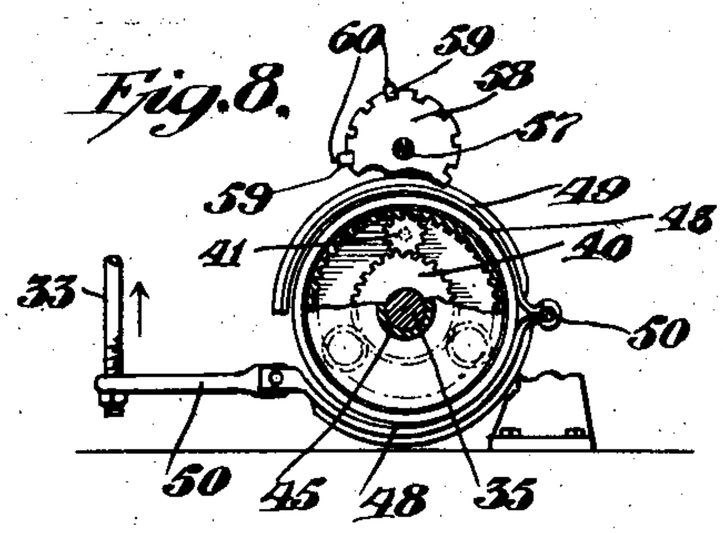


Fig. 8.



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6 SHEETS—SHEET 3.

Fig. 4.

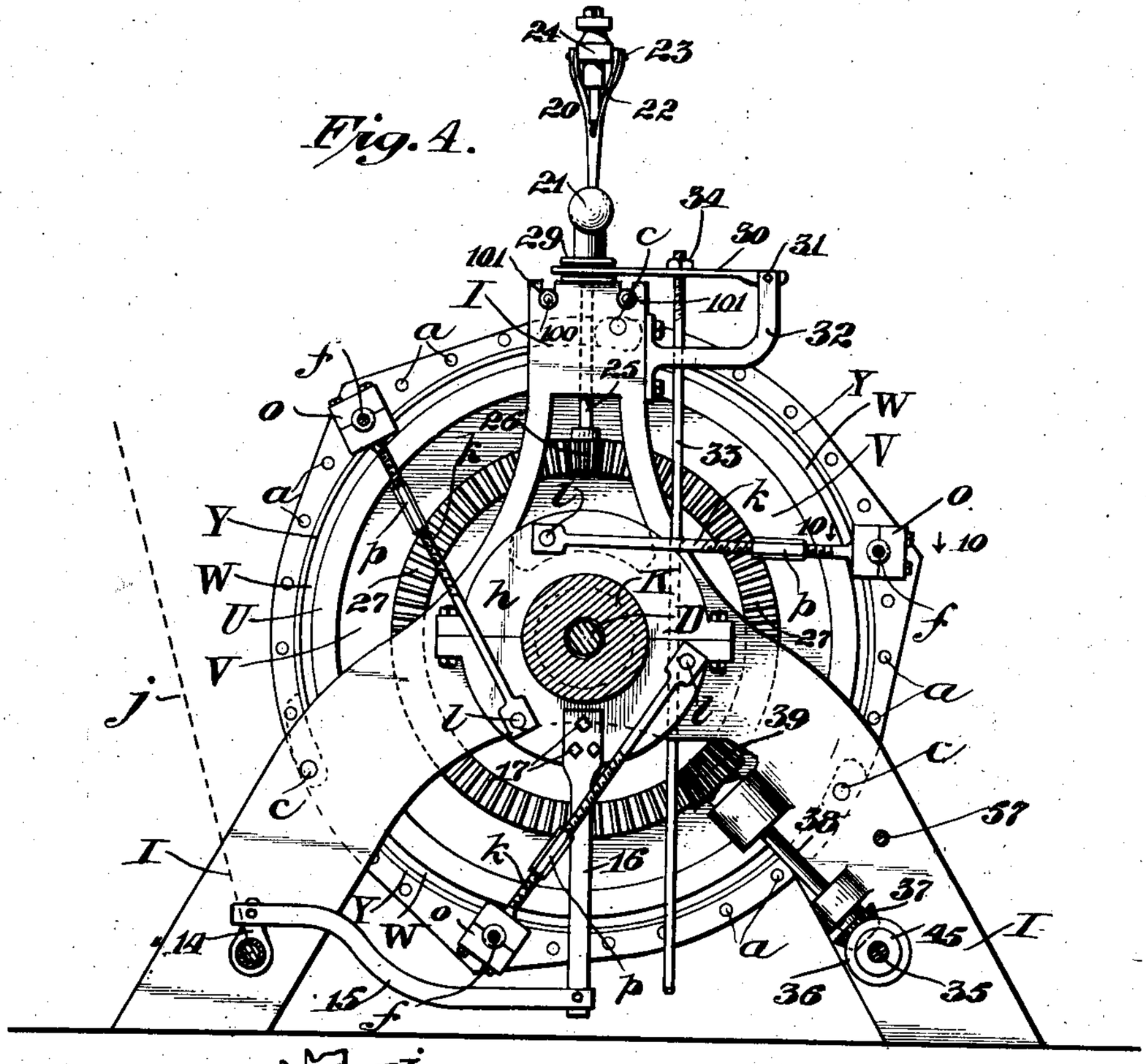


Fig. 9

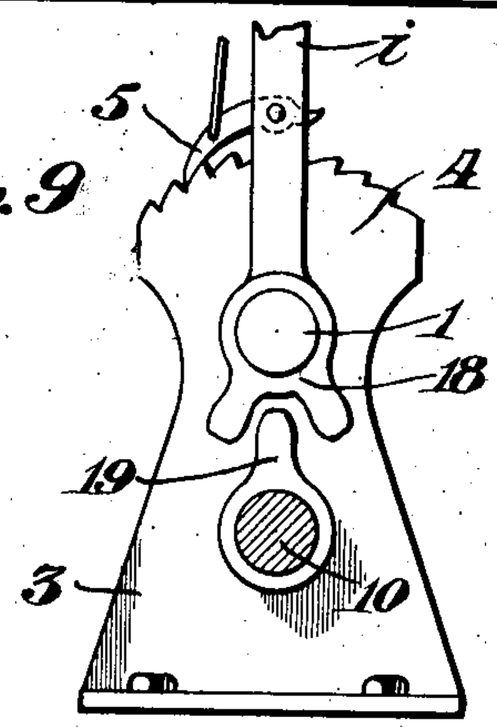


Fig. 10.

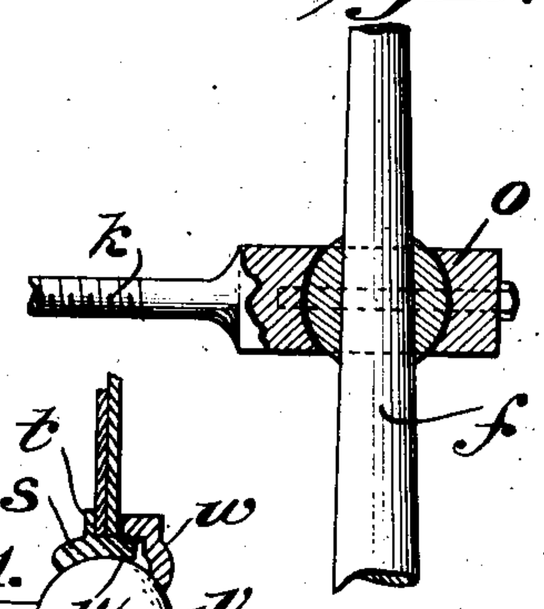
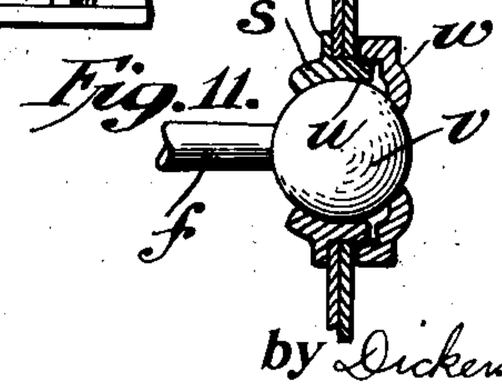


Fig. 11.



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6 SHEETS—SHEET 4

Fig. 12.

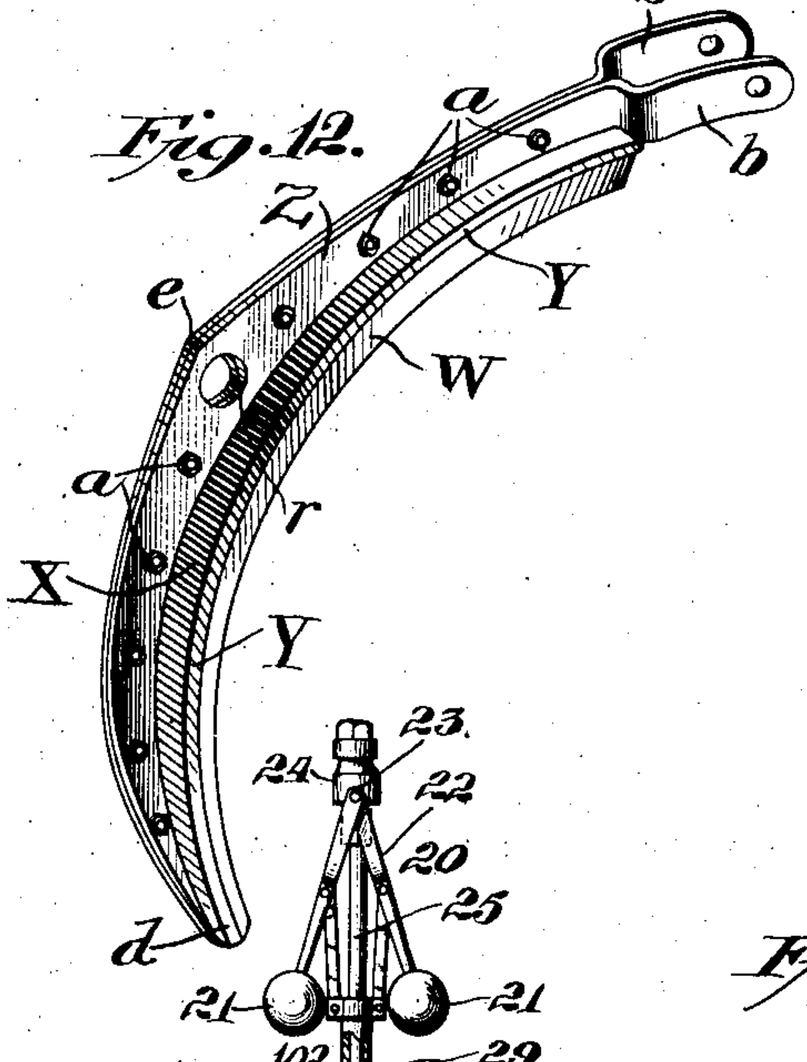


Fig. 13.

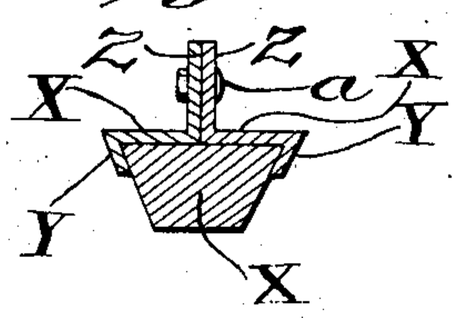
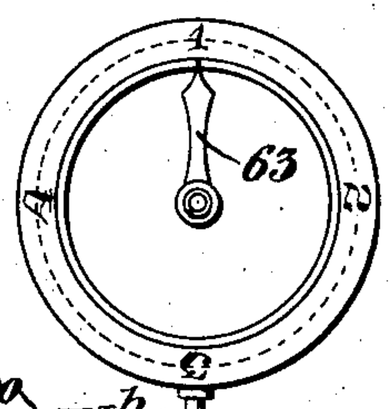


Fig. 5.



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6 SHEETS—SHEET 6.

Fig. 6.

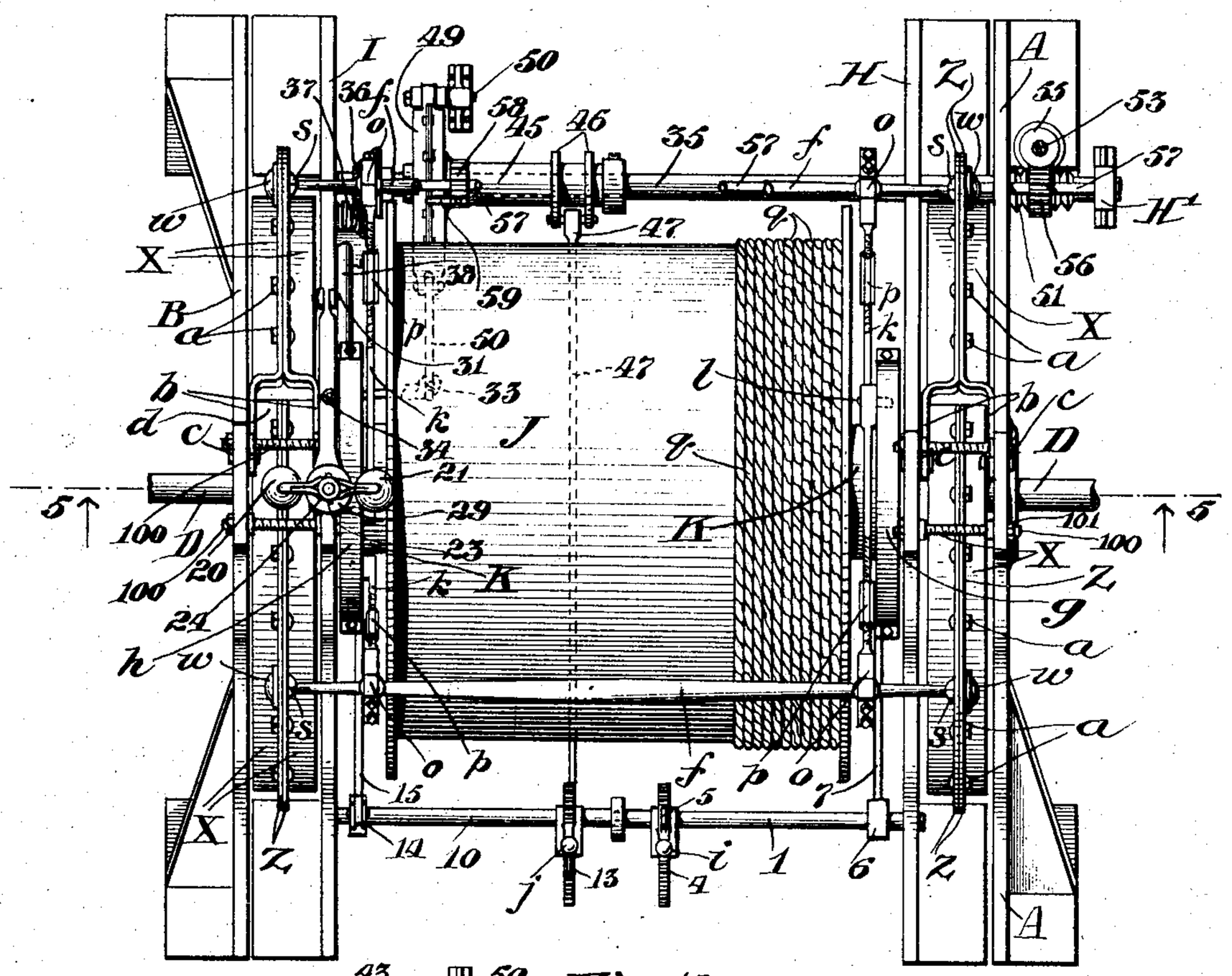


Fig. 14.

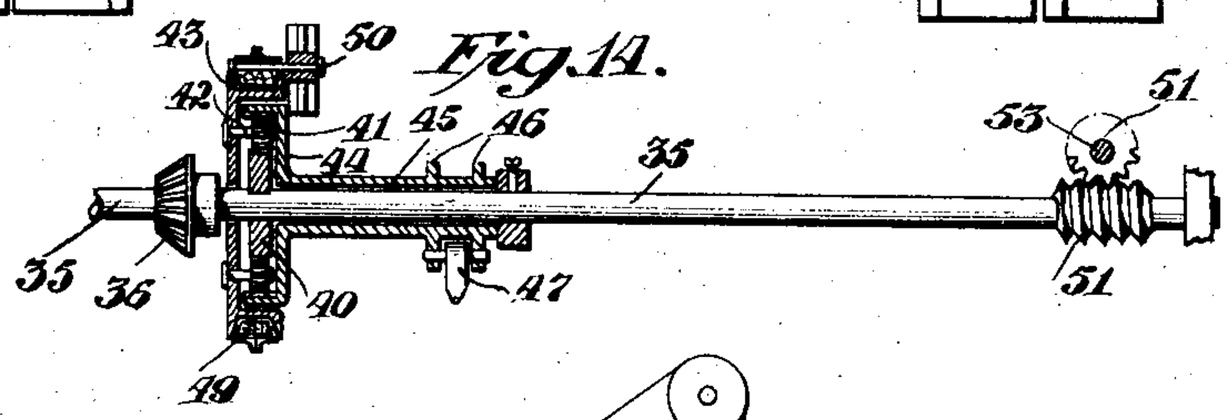
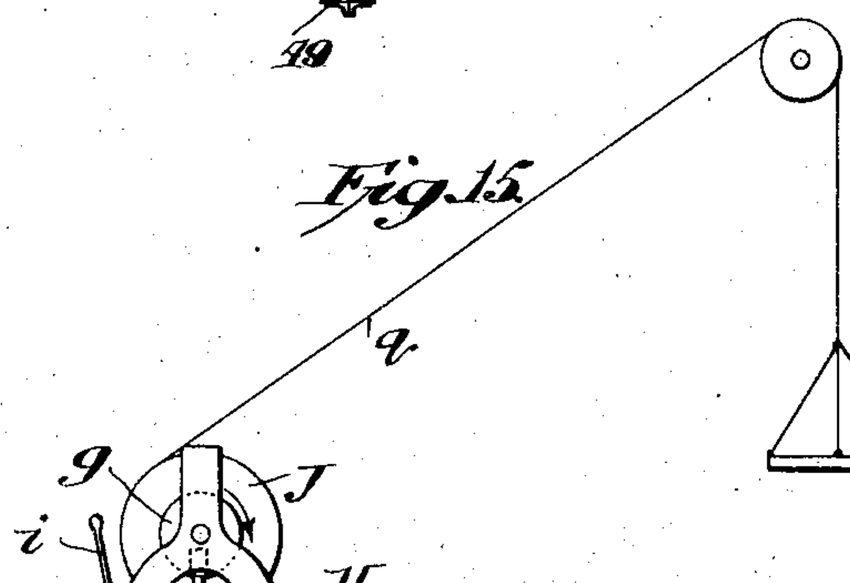


Fig. 15.



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UNITED STATES PATENT OFFICE.

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HOIST.

No. 834,901. Specification of Letters Patent. Patented Nov. 6, 1906.

Application filed December 30, 1905. Serial No. 293,922.

To all whom it may concern:

Be it known that I, CHARLES E. GLESSNER, a citizen of the United States, and a resident of Ouray, county of Ouray, State of Colorado, have invented certain new and useful Improvements in Hoists, of which the following is a specification accompanied by drawings.

This invention relates to hoists, more particularly to hoists driven by a substantially constant-speed motor, although it may be used in any connection in which it is found applicable.

The objects of the invention are to improve upon the construction and operation of hoists, render them more efficient and safe, thus preventing accidents and breakdowns and simplify the construction of the parts.

Another and very important object of the invention is to enable the starting and stopping of the apparatus under variable loads to be perfectly controlled in such manner that power is saved, and the full load need not be thrown upon the motor on starting, but may be applied gradually, thereby permitting constant-speed motors to be used in situations to which they have not heretofore been found applicable. The apparatus may be used with any suitable form of motor—as, for instance, an electric motor of the asynchronous induction type, a steam-engine, a gas-engine, or any other desired prime mover. The source of power in some instances may be a line-shaft, from which a number of hoists or power-driven devices may be driven.

The principles of the invention are applicable not only to hoists, but to many other classes of apparatus—as, for instance, to elevators, transmission-gearing for shafting, to automobiles, electric traction, and, in fact, in almost any connection in which it is desired to transmit power from a driving-shaft to a driven shaft under the complete control of the operator under varying loads and at varying speeds.

Further objects of the invention will hereinafter appear; and to these ends the invention consists of apparatus for carrying out the above objects embodying the features of construction, combinations of elements, and arrangement of parts having the general mode of operation substantially as hereinafter fully described and claimed in this specification and shown in the accompanying drawings, in which—

Figure 1 is a front elevation of a hoist embodying the invention. Fig. 2 is a transverse sectional view on the line 2 2 of Fig. 1 looking in the direction of the arrows. Fig. 3 is a rear elevation of the machine. Fig. 4 is a transverse sectional view on the line 4 4 of Fig. 1 looking in the direction of the arrows. Fig. 5 is a longitudinal sectional view of the machine on the line 5 5 of Fig. 6. Fig. 6 is a top plan view, partly in section, of the machine. Fig. 7 is a face view in section and partly broken away of the main transmission-gearing of the machine. Fig. 8 is a view similar to Fig. 7 of the automatic braking apparatus and its gearing. Fig. 9 is an enlarged detail transverse sectional view on the line 9 9 of Fig. 1 looking in the direction of the arrows, showing the means for tying the two controlling-levers together. Fig. 10 is an enlarged detail horizontal sectional view of one of the ball-and-socket joints. Fig. 11 is an enlarged detail horizontal sectional view taken through one of the ball-and-socket joints which connect the brake-shoes to their shafts. Fig. 12 is an enlarged detail perspective view of one of the brake-shoes. Fig. 13 is a transverse enlarged sectional detail view of one of the brake-shoes. Fig. 14 is a longitudinal sectional view through the small transmission-gearing for the automatic speed-controlling device. Fig. 15 is a diagrammatic view illustrating the relative positions of the hoist and load.

Referring to the drawings, A and B represent frames provided with bearings C for the shaft D, which is connected to be driven from the source of power, in this instance represented by two constant-speed induction-motors E, suitably geared to the shaft D by means of pinions F and gears G. Any suitable motors may be provided for operating the hoist and any suitable gearing may be utilized for connecting the motors to the shaft D. Preferably two motors are used, as shown, one at each side of the hoist, as is customary in practice.

Arranged inside of the frames A and B are the frames H and I, which may be termed the "main frames," for supporting the hoisting-drum J, in this instance shown hollow and provided with hollow trunnions K in the form of sleeves loose upon the shaft D and independent thereof and turning loosely in bearings L in the frames H and I.

The hoisting-drum J is connected to be driven from the shaft D by means of suitable transmission-gearing, by means of which the speed of the drum may be controlled without changing the speed of the motors and the load may be gradually applied in starting. In this instance I prefer to use a planetary system of gearing for connecting the hoisting-drum to the shaft D and, as shown, there is a gear O suitably connected to the shaft D, as by means of a key, and loose on the shaft D is a disk P, to the periphery of which is adapted to be applied a brake or brakes, so that said disk may be held from rotation or permitted to rotate at full speed or permitted to slip under the brake-shoes.

Suitably pivoted to the rotatable disk P on studs Q are planetary pinions R, meshing with the gear O and also meshing with the internally-toothed gear S, having the toothed rim T, adapted to fit beneath the rim U of the brake-disk P. The internally-toothed gear S is fast upon the sleeve K of the hoisting-drum J, being connected thereto in any suitable manner, as by means of a key, and thus rotates therewith. It is obvious that according to whether or not the brake-disk P carrying the pinions R is held from rotation or permitted to rotate at varying speeds the power will be transmitted from the shaft D to the drum J, and said drum may be operated at varying speeds according to the amount of slip permitted for the disk P.

Suitable means are provided for braking the disk P of the planetary gearing, and means are also provided for applying a brake to the drum J, as by means of the brake-disk V, connected to rotate with the sleeve or hollow trunnion K of the drum J in order to stop the drum in any desired position by means of said brake, although, as will hereinafter appear, the load or cage connected to the cable may be stopped in any desired position by permitting the slip on the disk P to compensate for the power applied. From this point the speed of the drum J may be varied as desired up to full speed.

Both disks P and V are provided with grooved peripheries U, and the brake-shoes are adapted to conform to said peripheries. By means of such construction the disks P and V are centered or maintained in one plane when the brakes are applied. It is more important that the disk P should be centered and prevented from getting out of alinement, since in this instance the brake-shoe is not applied over the center of the disk, as in the case of the brake-disk V; but I preferably make the peripheries of both disks alike and construct the shoes substantially alike. The disk V, as stated, is keyed directly to the sleeve K on the drum, while the disk P, on the other hand, is loose on the shaft D, and for this reason the means for centering the disk add greatly to the efficiency of the machine. The grooved disk V, since it is part of the drum, aids in centering the disk P.

The brake-shoes may be constructed in any suitable manner; but I prefer to construct them substantially as shown in detail in Fig. 12, in which W represents a wooden shoe gripped between steel angle-irons X, having inwardly-projecting flanges Y for gripping the shoe W. The upright legs Z of the angle-irons are suitably connected together, as by means of bolts *a*, and means are provided for pivoting said angle-irons carrying the shoes W around the periphery of the brake-disks P and V, and operating means are provided for tightening and loosening said brake-shoes upon the periphery of said disks. In this instance the upright legs Z of the angle-irons X are bent outwardly at the heel of each shoe to form lugs or ears *b*, which are pivoted on the pins *c* between the frames A II and B I around the periphery of the disks P and V. According to this construction the disks are maintained in one plane and substantially the whole of the strain comes upon the frames and the operating-levers are relieved of a large part of the strain. I preferably provide three brake-shoes for each brake-disk, although any suitable number may be provided in any suitable arrangement; but I have found three brake-shoes in the arrangement described to operate satisfactorily. The angle-frames X of the brake-shoes are pivoted at suitable intervals around the disks on the frames of the machine, and the shoes are of sufficient length to substantially cover the entire periphery of the brake-disks. The toe *d* of each shoe preferably extends between the forked portion of the angle-irons between the ears *b* of the shoe immediately in front.

Preferably the webs or vertical legs Z of the shoe angle-irons are thickened at their middle portions *e* and provided with bearings for the brake-beams *f* connecting the shoes, of which there are three extending longitudinally of the hoist. Suitable means are provided for operating the brake-shoes, and in this instance disks *g* and *h* are provided adjacent each drum-head and seated in bearings on frames H and I, respectively, in such manner that said disks may be rotated slightly in their bearings. These disks are connected in this instance to be rotated by the hand-levers *i* and *j*, although any suitable means may be provided for operating the brakes, and the disks *g* and *h* are pivotally connected by levers *k* to the brake-beams *f*, which extend longitudinally across the machine and are connected to the brake-shoes.

One of the objects of this invention is to enable the power for applying the brakes to the disks P and V to be alternately compounded or not, as desired. The machine is so constructed that by properly manipulating the hand-levers *i* and *j* the thrust or

leverage may be all applied to one brake or the other, as desired, and by a system of compound leverage the brake-pressure on one disk or the other may be greatly multiplied over that which might be applied by one lever only.

The levers *k* for the brake-shoes on the periphery of the brake-disk P are pivoted at the point *l* to the disk *g* and are pivoted by means of any suitable form of ball-and-socket joints *o* to the brake-beams *f*. The levers *k* are preferably provided with turnbuckles *p* in order to make their length adjustable. The levers *k*, connected to the disk *h* at the other side of the drum, are constructed in the same manner and connected to the brake-beams by ball-and-socket joints *o*. The brake-shoes for each brake-disk P and V are pivoted on the frames of the machine at the points *c*, and the shoes extend around the peripheries of the disks from their pivotal points in the proper direction to apply the brake-pressure in the most advantageous manner, according to the direction of the rotation of the disk to which pressure is applied. The brakes for the disk P extend in the direction of rotation of said disk when power is being applied to the drum J to raise the load, and the brakes for the disk V preferably extend in the direction of rotation of the drum when the cable *q* is unwinding and lowering the load. In the drawings the brake-shoes W are shown extending in the same direction, and this is correct, because the direction of rotation of the disk P when power is applied to the drum is the same as the direction of the rotation of the disk V when the drum is reversed and the cable is unwinding.

Any suitable form of ball-and-socket joint may be provided for connecting the ends of the brake-beams *f* to the angle-irons forming the body portions of the brake-shoes. In this instance the thickened portions *e* of the webs of the angle-irons for the shoes are provided with hollowed sockets *r*, into which fit split sleeves *s*, provided with bearing-flanges *t* and having screw-threaded portions *u*. The ball-heads *v* of the brake-beams *f* are placed in the sleeves *s*, and internally-screw-threaded caps *w* are screwed over the ends *u* of the split sleeves *s*, thereby securing the balls *u* in their bearings.

The operating-lever *i* is fast to the shaft 1, which is suitably rotatably supported in a bearing 2 in the main frame H and in a bracket 3. In this instance the lever *i* is forked and straddles a toothed segment 4, and the lever is provided with a spring-pressed pawl 5, adapted to coöperate with the teeth on the segment 4. As shown, the outer end of the shaft 1 is provided with a downwardly-extending arm 6 fast thereto, to which is pivotally connected one end of a link 7, the other end of said link being pivotally connected to an arm 8, in turn connected to the disk *g*, as by means of the bolts 9, so that the arm 8 turns with the disk *g*. By operating the hand-lever *i* the disk *g* may be rotated. I am not to be understood as limiting myself to the connection shown and described for operating the disk *g*, because any suitable form of mechanism may be provided. By pressing the lever *i* inward it will be seen that the disk *g* will be rotated in a direction to tighten the brake-shoes upon the periphery of the disk P and by pulling the brake-lever outward the brake-shoes on the lever P will be loosened.

Suitable mechanism is provided for operating the brake-shoes on the disk V. As shown, the hand-lever *j* is connected to a longitudinally-extending shaft 10, supported in the bearing 11 in the frame I and in the bracket 12. As shown, the lever *j* straddles the toothed segment 13, the teeth of which extend in the opposite direction to the teeth on the segment 4, and a spring-pressed pawl connected to the lever *j* coöperates with said teeth. The shaft 10 is provided with an upwardly-extending arm 14—in this instance at its outer end—having one end of a link 15 pivotally connected thereto, the other end of said link being pivotally connected to an arm 16, connected to the disk *h* by suitable means, as the bolts 17, so that the disk and arm 16 move together. By pulling the hand-lever *j* outward the disk *h* will be rotated in a direction to loosen the brakes upon the disk V, and by pushing the arm *j* inward the brakes will be tightened on said disk.

Preferably the two shafts 1 and 10 are tied together with a lost-motion connection in such manner that when the lever-arm *i* is pressed inward to tighten the brakes on the disk P the lost motion may be taken up and the connecting tie or coupling brought into action to force the arm *j* outward, thereby loosening the brakes on the other disk V. On the other hand, by forcing the lever *j* inward the brakes for the disk V are applied, and the lost-motion connection between the shafts 1 and 10 may be taken up, thereby forcing the arm I outward and loosening the brakes on the other disk P. Any suitable lost-motion connection may be provided for the shafts 1 and 10, in this instance the shaft 1 being provided with a fork 18 and the shaft 10 with a coöperating lug or ear 19, which enters the fork 18 and has a certain play therein. According to this construction rotation of one shaft will cause rotation of the other shaft in an opposite direction. I am not to be understood as limiting myself to this construction, because any suitable means may be used for accomplishing this same end.

In order to compound the leverage for the brakes and increase the pressure on one disk P or the other one V, the levers *i* and *j* must be operated in different directions. If, for

instance, the lever *i* is pressed inward to apply the brakes to the disk P, the other lever *j* may be pulled outward, thereby loosening the brakes on the disk V and at the same time forcing the ends of the brake-beams *f* at that side of the drum outwardly, with the ball-and-socket joints *o* at the opposite ends of the brake-beams as pivotal points, thus forcing the brake-shoes on the disk P more strongly against the disk. If the operation of the levers *i* and *j* is reversed, the leverage may be compounded to apply the pressure more strongly to the brake-disk V. When the lever *j* is pulled outward to apply the brakes to the disk V, if the lever *i* is forced inward at the same time the ends of the brake-beams *f* on the geared side of the drum will be forced outwardly about the ball-and-socket joints *o* at the other ends of the brake-beams as pivotal points, thus increasing the leverage on the brake-shoes for the disk V. It is important to hold the disk P very firmly, especially under heavy loads, and it is also important to hold the drum very firmly in order to stop the cage at any desired point, as in a mining-hoist, for instance.

According to the construction of this machine one brake is thrown off as the other it thrown on, although the slight lost motion between the operative parts permits the operator to apply the brake to a certain degree to the drum before the transmission-gear is entirely released, and vice versa. In this way a skilful operator may readily learn to control his hoist, because he can tell by manipulating the lever-arms *i* and *j* at just what point he is to release the transmission-gear and apply the brake to the drum. In other words, he may feel his load either in ascending or descending, and still accidents due to carelessness are prevented, because both brakes cannot be applied at the same time, and the load could not drop. According to this construction the load may be applied gradually to a motor rotating constantly at the same speed, and the load, on the other hand, may be removed gradually therefrom. If the machine is being used for a mining hoist or elevator, power will be applied to raise the load, and it will be permitted to fall of its own weight. According to this machine sudden strains on the apparatus are entirely obviated, and all the operations take place gradually. The operator at all times has the machine under complete control.

Automatic controlling means are provided for limiting the travel at the top and bottom of the shaft, and this automatic controlling means may be adjusted to stop the cage, if in a hoist, at any desired level. In case of an accident this automatic controlling means will stop the apparatus at one or the other limits of its travel or in an intermediate point, if it is adjusted for such a stop. I utilize in connection with this controlling means a transmission-gear substantially like the planetary gearing for transmitting power to the drum and a governor for controlling the operation of said transmission means. The controlling transmission-gearing is connected to operate the brakes on the disk V, connected to the drum, so that the drum is stopped automatically. Any suitable form of apparatus may be provided for carrying out this object; but I have shown in this instance a ball-governor 20, having the balls 21, carried on arms 22, pivoted at 23 to a cap 24, which is held in frictional contact with the vertical shaft 25, said shaft being provided with a bevel-pinion 26, meshing with the bevel-gear 27 on the inside of the disk V. The balls are also connected to the sleeve 28. The sleeve 28 is provided with a collar 29, which coöperates with a forked rod 30, pivoted at 31 on a bracket 32, carried by a frame I. Forked arm 30 supports a vertical rod 33, having an adjusting-nut 34 for adjusting the length of said rod. When the drum speeds up beyond a predetermined limit, the rod 33 will be raised and set in operation the mechanism for applying the brakes to the disk V on the drum. Extending longitudinally along the back of the machine is a shaft 35, supported in suitable bearings in the frame I and in the bracket H'. This shaft is provided with a bevel-gear 36, meshing with a bevel-gear 37, carried on a shaft 38, provided with another bevel-gear 39, meshing with the large bevel-gear 27 on the disk V, so that rotation from the disk V is imparted to the shaft 35. This shaft 35 also carries a small planetary transmission-gearing having the gear 40 connected to rotate with the shaft, as by means of a key, and meshing with planetary pinions 41, carried on studs 42, connected to the grooved brake-disk 43, loose on the shaft 35. Internally-toothed gear 44 also meshes with the planetary pinions 41 and is connected to a sleeve 45, loose on the shaft 35 and provided with collars 46, to which is pivoted a transversely-extending rod 47, so that the construction acts like a crank and crank-pin. The rod 47 is connected to operate the hand-lever *j* and in this instance is shown pivoted to said lever, coöperating with the brake-disk V.

On the small transmission-gearing are brake-shoes 48 and 49, in this instance pivoted to each other at 50 and substantially encircling the grooved periphery of the brake-disk 43, thus maintaining the same in one plane. As shown, the lower brake-shoe 48 is connected, by means of the link 50, to the lower end of the governor-operated rod 33, so that when said rod is raised by the operation of the governor the shoe 48 is applied to the periphery of the disk and the disk is partially prevented from rotating. The other end of the shaft 35 is provided with a worm-gear 51, meshing with pinion 52, carried on the

indicator-rod 53, which extends up to the indicator 54 for indicating the levels or points at which the load or cage is to stop. The indicator-shaft 53 is also provided with a worm 55, meshing with a pinion 56, carried by a longitudinal shaft 57, supported in suitable bearings in the frame I and bracket H'. Said shaft 57 is also provided with a small drum 58, provided with adjustable stops or fingers 59, having adjusting-screws 60, adapted to bear upon the upper brake-shoe 49 when one of said fingers comes opposite said brake-shoe in the course of rotation of the shaft 57 and drum 58, thereby forcing said brake-shoe against the periphery of the brake-disk. I have described suitable shafting and gearing for operating the parts of the automatic controlling means; but I am not to be understood as limiting myself to the construction disclosed, as any suitable means may be provided for this purpose.

In the operation of the governor-controlled braking device the application of the lower brake-shoe 48 to the periphery of the brake-disk 43 causes rotation of the internal gear 44 and loose sleeve 45 on the shaft 35, thereby pulling the lever 47 transversely of the machine, rocking the hand-lever *j*, thus applying the brakes to the disk V on the drum with a certain amount of pressure and partially retarding the rotation of the drum and keeping it within the speed limit. The rotation of the shaft 35 also causes rotation in the shaft 57 through the gearing described, thereby rotating the drum 58 and bringing one of the stops 59 into contact with the other brake-shoe 49 and forcing said brake tightly against the periphery of the brake-disk 43, thereby strongly applying the brakes thereto and holding said disk from rotation. The rod 47, connecting the sleeve 45 with the lever *j*, is therefore drawn with maximum force against the lever *j*, thereby applying the brakes to the disk V with maximum pressure. At the same time the pawl on hand-lever *j* locks said lever in its forward position and locks the drum from rotation. This locking of the drum will occur either at the top or bottom of the travel of the load or at any intermediate point, according to which one of the stops 59 has been brought into operation. This automatic stopping means may be used as a safety limit only or adjusted for any desired position.

The indicator-rod 53 is provided with a gear 61, meshing with a gear 62 on the indicator-disk 54, and said disk is provided with a pointer 63, and the disk itself is marked off into suitable divisions to indicate the points at which the load is to be stopped. In this instance the pointer is shown stationary, and the disk revolves; but any suitable construction may be provided. Preferably the fingers or stops 59 are slidable in grooves in the periphery of the drum 58, so that they may be adjusted as desired.

In the operation of the apparatus the motor or motors E are supposed to be continuously running at substantially constant speed. Let it be assumed that the load represented—as, for instance, by a loaded cage—has been stopped at a certain level by applying the brakes to the disk V, connected to the drum, thereby preventing the drum from rotating. The brakes on the disk P of the transmission-gearing have then been removed, and rotation cannot be imparted to the drum from the shaft D. In order to lower the cage, the brake-pressure is gradually relieved on the drum-disk V by pulling the hand-lever *j* toward the operator away from the drum. In this case if the drum should speed up the governor 20 will come into operation and automatically apply the brakes in order to keep the speed within limits.

When the brake-drum is held from rotation by the brakes on the disk V, as described, if it is desired to raise the cage the hand-lever *i* is forced away from the operator in the direction of the drum, thereby beginning to apply the power, and after the power is applied the lost-motion connection between the hand-lever shafts comes into operation and begins to relieve the brake-pressure from the drum-disk V. The construction is such that the point at which power begins to be applied to the drum and the brake-leverage is removed from the drum is automatically taken care of; but because of the lost motion between the connections this point is also within the control of the operator, so that he can feel the point at which the load is applied and govern the operation of the hoist accordingly.

A skilful operator will soon learn to operate the hand-levers *i* and *j*, in accordance with this construction, back and forth, feeling the load on his drum all the time, so that it can be readily told when more power should be applied or when the drum should be more greatly retarded.

The automatic controlling means for limiting the travel of the load or cage is applicable to various forms of apparatus. I have shown one application of it in the machine disclosed; but I am not to be understood as limiting the invention to this particular class of apparatus, for it may be used in connection with the transmission of power wherever it is applicable—as, for instance, in connection with elevators, cranes, electric cars, especially on grades, cog-roads, tramways, and on many classes of mining machinery.

In order to stiffen the frame, the upper ends of the frames A H and B I are suitably tied together, as by means of the bolts 100, having the nuts 101 and collars 102 for bracing the frames. These bolts are placed in slots in the upper ends of the frames.

Obviously some features of this invention may be used without others, and the invention may be embodied in widely-varying forms. Therefore, without limiting the invention to the apparatus shown and described nor enumerating equivalents,

I claim, and desire to obtain by Letters Patent, the following:

1. In a hoist, the combination of a substantially constant speed-motor, a driving or power shaft continuously driven in one direction from said motor at substantially constant speed, a variable-speed transmission-gear for connecting the load to the source of power, comprising a spur-gear and an internally-toothed gear, one of which is connected to the power-shaft and the other being adapted to be connected to the load, a friction-disk having planetary gears meshing with both the spur-gear and the internal gear, and a brake coöperating with said friction-disk, whereby the load may be thrown gradually on the motor on starting.

2. In a hoist, the combination of a substantially constant speed-motor, a driving or power shaft continuously driven in one direction from said motor at substantially constant speed, a variable-speed transmission-gear for connecting the load to the source of power, comprising a spur-gear and an internally-toothed gear, one of which is connected to the power-shaft and the other being adapted to be connected to the load, a friction-disk having planetary gears meshing with both the spur-gear and the internal gear, and a brake coöperating with said friction-disk, whereby the load may be thrown gradually on the motor on starting, another brake for controlling the descent of the load, and operative connections for controlling both of said brakes.

3. In a hoist, the combination of a source of power, a driving or power shaft, a hoisting-drum, a variable-speed planetary transmission-gear for connecting the drum to the driving-shaft to raise the load, comprising a spur-gear and an internally-toothed gear, one of which is connected to the power-shaft and the other to the drum, a friction-disk having a grooved periphery and carrying planetary gears meshing with both the spur-gear and the internal gear, a brake having shoes adapted to coöperate with the grooved periphery of said disk, another friction-disk connected to the hoisting-drum and also having a grooved periphery, a brake having shoes coöperating with said second friction-disk, and means for controlling both of said brakes.

4. In a hoist, the combination of a source of power, a hoisting-drum, a variable-speed transmission-gear for connecting the drum to the driving-shaft, comprising a spur-gear and an internally-toothed gear, one of which is connected to the power-shaft and the other to the drum, a friction-disk having a grooved periphery and carrying planetary gears meshing with both the spur-gear and the internal gear, a brake having shoes adapted to coöperate with the grooved periphery of said disk and thereby aid in centering the disk in the operation of the apparatus, and means for operating said brake to control the transmission-gearing and throw the load of the drum upon the source of power gradually.

5. In a hoist, the combination of a source of power, a driving or power shaft, a hoisting-drum loose on said shaft, a variable-speed-transmission gear for connecting the drum to the driving-shaft comprising a spur-gear and an internally-toothed gear, one of which is connected to the power-shaft and the other to the drum, a friction-disk having planetary gears meshing with both the spur-gear and the internal gear, a brake coöperating with said friction-disk, another brake coöperating with the drum and means for operating said brakes.

6. In a hoist, the combination of a source of power, a hoisting-drum, a frictionally-controlled variable-speed-transmission gear for connecting the drum to the source of power, a brake for controlling said transmission-gear, a brake for controlling said drum, operative connections for applying the pressure of the brake to the transmission-gear, and means for compounding the brake-pressure on said gearing.

7. In a hoist, the combination of a source of power, a hoisting-drum, a frictionally-controlled variable-speed-transmission gear for connecting the drum to the source of power, a brake for controlling said transmission-gear, a brake-disk and brake for controlling the hoisting-drum when the transmission-gear is released, means for applying the pressure of the brakes to the transmission-gearing and to the drum-disk, means for preventing the application of both brakes at the same time, and means for compounding the pressure upon either brake, as desired, thereby increasing the pressure of either brake.

8. In a hoist, the combination of a source of power, a hoisting-drum, a frictionally-controlled variable-speed-transmission gear for connecting the drum to the source of power, a drum-disk, a brake coöperating therewith, a brake coöperating with the transmission-gear, brake-beams connecting said brakes, controlling-levers for said brake-beams and operative connections for compounding the pressure upon either brake as desired, said connections being so constructed that upon relieving one brake, the pressure of the other brake is augmented.

9. In a hoist, the combination of a source of power, a hoisting-drum, a frictionally-controlled variable-speed-transmission gear for connecting the source of power of the drum to raise the load, brake-shoes for con-

trolling said transmission-gear to throw the load onto the source of power gradually and to release the transmission-gear and permit the load to descend by gravity, a brake-disk and brake-shoes for controlling the speed of the hoisting-drum when the load is descending by gravity, common brake-beams connecting both sets of brake-shoes, means for relieving one set of brakes when the other brakes are applied, and means for compounding the pressure of the brakes whereby the pressure of one set of brakes is augmented as the other set is relieved.

10. In a hoist, the combination of a source of power, a hoisting-drum, a variable-speed-transmission gear for transmitting power to the drum, means for controlling said transmission-gear and automatic means for controlling the speed of the drum.

11. In a hoist, the combination of a source of power, a driving or power shaft, a hoisting-drum, a frictionally-controlled variable-speed-transmission gear for connecting the drum to the driving-shaft, means for controlling said transmission-gear to throw the load of the drum onto the driving-shaft gradually, means for permitting the load to descend by gravity, means for manually controlling the speed of the drum when the load is descending under gravity, and automatic means for controlling the speed of the drum when the load is descending under gravity.

12. In a hoist, the combination, of a source of power, a hoisting-drum, a variable-speed frictionally-controlled transmission-gear for connecting the source of power to the drum to raise the load, manual means for controlling said transmission-gear to throw the load onto the source of power gradually and release the transmission-gear and permit the load to descend by gravity, manual means for controlling the speed of the drum when the load is descending, a lost-motion connection between said two manual controlling means, so constructed that one controlling means is thrown out of operation when the other is thrown into operation, and both may be operated together to a limited extent.

13. In a hoist, the combination of a source of power, a hoisting-drum, a variable-speed frictionally-controlled transmission-gear for connecting the source of power to the drum to raise the load, manual means for controlling said transmission-gear to throw the load onto the source of power gradually and release the transmission-gear and permit the load to descend by gravity, manual means for controlling the speed of the drum when the load is descending, a lost-motion connection between said two manual controlling means, so constructed that one controlling means is thrown out of operation when the other is thrown into operation, and both may be operated together to a limited extent, and automatic controlling means for controlling the speed of the drum when the load is descending.

14. In a hoist, the combination of a source of power, a hoisting-drum, a variable-speed frictionally-controlled transmission-gear for connecting the source of power to the drum to raise the load, manual means for controlling said transmission-gear to throw the load onto the source of power gradually and release the transmission-gear and permit the load to descend by gravity, manual means for controlling the speed of the drum when the load is descending, a lost-motion connection between said two manual controlling means, so constructed that one controlling means is thrown out of operation when the other is thrown into operation, and both may be operated together to a limited extent, automatic controlling means for controlling the speed of the drum when the load is descending, and indicating means for indicating the points at which the load is to be automatically stopped.

15. In a hoist, the combination of a source of power, a driving or power shaft, a hoisting-drum, a variable-speed-transmission gear for connecting the drum to the driving-shaft, said gear having a friction-disk for controlling the same, brake-shoes coöperating with said friction-disk, a revoluble disk provided with brake-levers connected to said shoes, manual means for rocking said revoluble disk applying and relieving the brake-shoes for the transmission-gearing, a brake-disk connected to the hoisting-drum, brake-shoes coöperating therewith, a revoluble disk having brake-levers connected to said brake-shoes, manual means for rocking said revoluble disk, and thereby relieving and applying the brakes to the drum-disk, and brake-beams connecting said sets of brake-shoes.

16. In a hoist, the combination of a source of power, a hoisting-drum, a variable-speed frictionally-controlled transmission-gear for transmitting power to the drum, said transmission-gear having a grooved frictional disk, brake-shoes coöperating with said grooved friction-disk and thereby centering said disk in the operation of the brakes, a grooved drum-disk, brake-shoes coöperating therewith, revoluble disks provided with brake levers or arms connected to said sets of brake-shoes, brake-beams connecting said sets of brake-shoes, hand-levers connected to rock said revoluble disks for controlling the respective sets of brakes and automatic means controlled by the speed of the drum for limiting the travel of the load.

17. In a hoist, the combination of a hoisting-drum, means for raising the load by the power applied, means for lowering the load under gravity, means for controlling the speed of the drum and the limit of travel of the load when the load is descending comprising a speed-governor and a frictionally-

controlled variable-speed-transmission gear having a friction-disk and brake-shoes coöperating therewith, said brake-shoes being controlled by the speed-governor and operative connections from said transmission-gear for controlling the speed of the drum and limit of travel of the load.

18. In a hoist, the combination of a source of power, a driving or power shaft, a hoisting-drum loose on said shaft, a spur-gear fast to said shaft, an internally-toothed gear fast to the drum, a friction-disk loose on the shaft and provided with pinions meshing with both the spur-gear and the internally-toothed gear, said friction-disk having a grooved periphery, brake-shoes coöperating with said grooved periphery, a revoluble disk movable independently of the drum-brake, arms pivoted to said disk and to the brake-shoes, a manually-controlled lever for operating said disk and brake-shoes, and a brake for controlling the speed of the drum when the load is descending.

19. In a hoist, the combination of a source of power, a hoisting-drum, frictionally-controlled variable-speed-transmission gear for applying power to the brake gradually to raise the load, a brake for controlling said transmission-gear, a brake for controlling the speed of the drum when the load is descending under gravity, a hand-lever for controlling the transmission-brakes, a hand-lever for controlling the drum-brake and operative lost-motion connections between said hand-levers whereby both brakes are prevented from being applied at the same time and one brake is automatically removed when the other is applied, thereby enabling the operator to feel the load at all times on the brake-levers.

20. In a hoist, the combination of a source of power, a hoisting-drum, frictionally-controlled variable-speed-transmission gearing for connecting the drum to the source of power gradually when a load is applied, a brake for controlling said transmission-gear, a hand-lever for controlling said brakes, a brake and hand-lever for controlling the speed of the drum when the load is descending, said hand-levers being adapted to be operated in opposite directions in order to control the hoist, and a lost-motion connection between said levers whereby one brake is relieved when the other is applied.

21. In a hoist, the combination of a source of power, a hoisting-drum, frictionally-controlled variable-speed-transmission gearing for connecting the drum to the source of power gradually when a load is applied, a brake for controlling said transmission-gear, a hand-lever for controlling said brakes, a brake and hand-lever for controlling the speed of the drum when the load is descending, said hand-levers being adapted to operate in opposite directions in order to control the hoist, and a lost-motion connection between said levers whereby one brake is relieved when the other is applied, brake-beams for connecting said brakes and operative connections for enabling pressure to be compounded when one brake is applied and the other is removed.

22. In a hoist, the combination of a source of power, a hoisting-drum, frictionally-controlled variable-transmission gearing for connecting the drum to the source of power gradually when a load is applied, a brake for controlling said transmission-gear, a hand-lever for controlling said brakes, a brake and hand-lever for controlling the speed of the drum when the load is descending, said hand-levers being adapted to be operated in opposite directions in order to control the hoist, a lost-motion connection between said levers whereby one brake is relieved when the other is applied, brake-beams for connecting said brakes and operative connections for enabling the pressure to be compounded when one brake is applied and the other is removed, and automatic controlling means for controlling the speed of the drum when the load is descending under gravity.

23. In a hoist, the combination of a source of power, a hoisting-drum, frictionally-controlled variable-speed-transmission gearing for connecting the drum to the source of power gradually when a load is applied, a brake for controlling said transmission-gear, a hand-lever for controlling said brakes, a brake and hand-lever for controlling the speed of the drum when the load is descending, said hand-levers being adapted to be operated in opposite directions in order to control the hoist and a lost-motion connection between said levers whereby one brake is relieved when the other is applied, brake-beams for connecting said brakes, operative connections for enabling pressure to be compounded when one brake is applied and the other is removed, automatic controlling means for controlling the speed of the drum when the load is descending under gravity, and for limiting the travel of the load at the top and bottom as desired, and for stopping the load at intermediate points.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES E. GLESSNER.

Witnesses:

HERBERT G. OGDEN, Jr.

LEO J. MATTY.