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V. R. & E. H. BROWNING.

HOISTING APPARATUS.

APPLICATION FILED MAY 10, 1904.

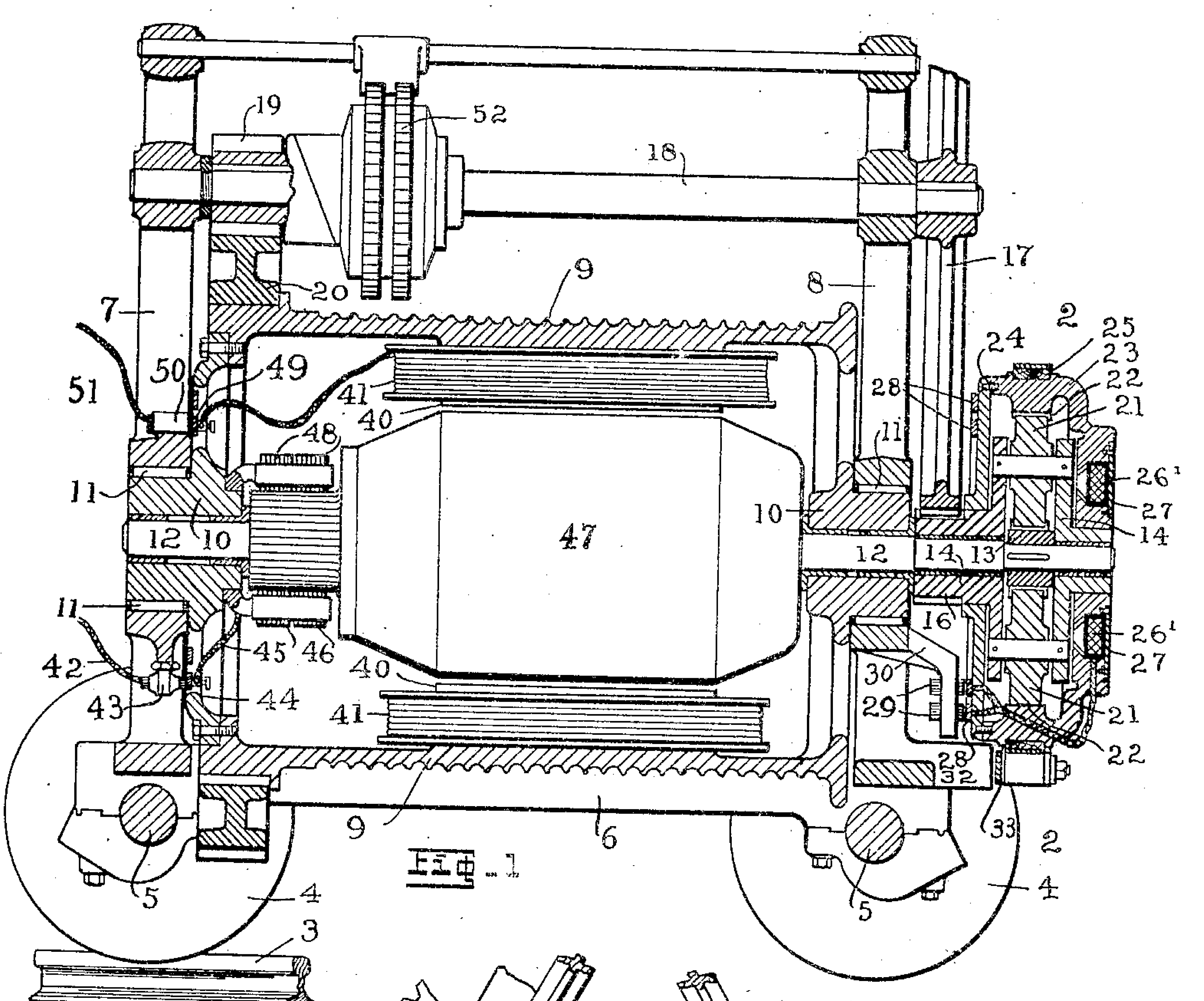

Fig. 1

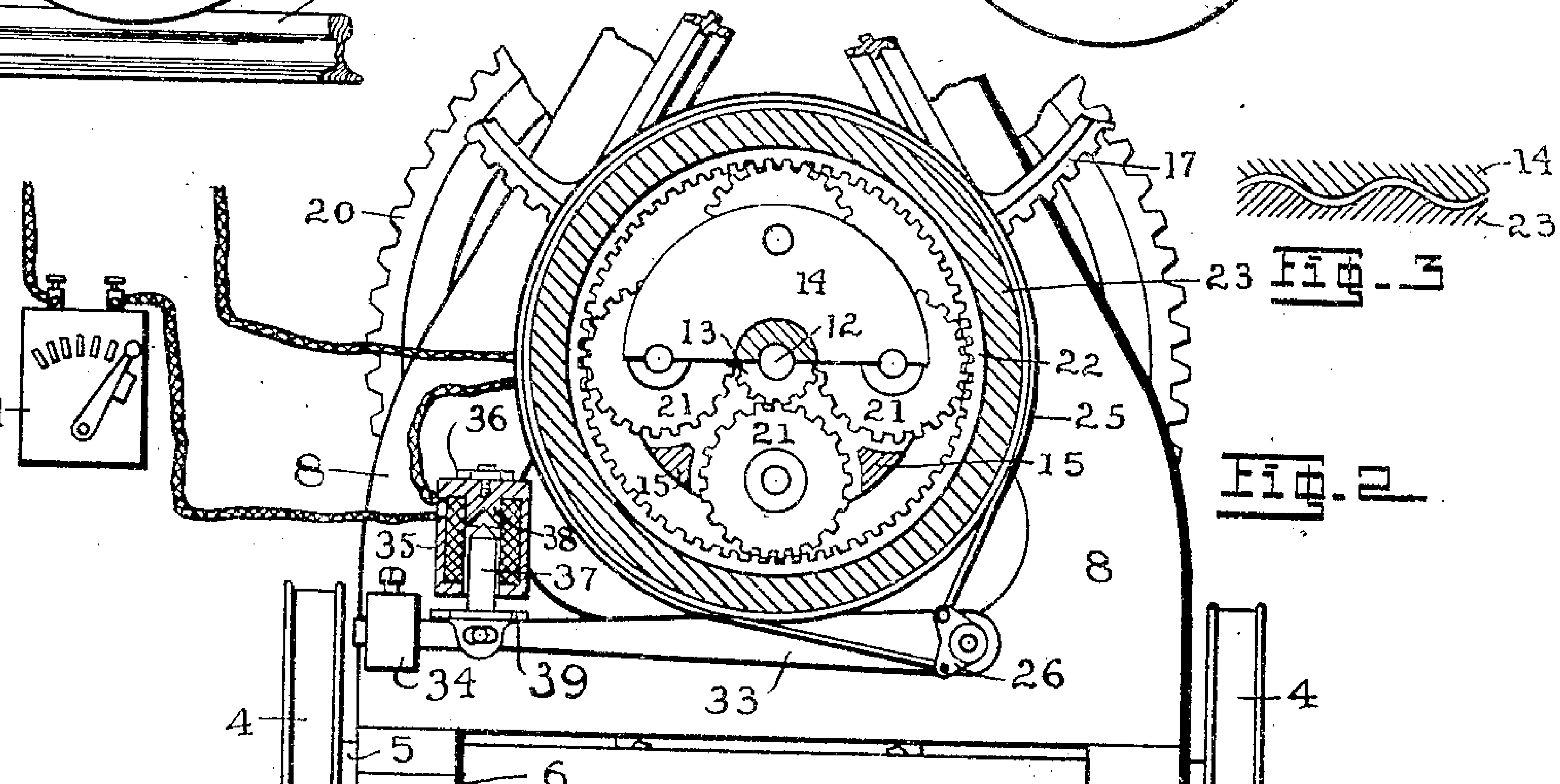

Fig. 2

Fig. 3

WITNESSES:

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UNITED STATES PATENT OFFICE.

VICTOR R. BROWNING AND EARL H. BROWNING, OF NOTTINGHAM, OHIO.

HOISTING APPARATUS.

No. 843,558. Specification of Letters Patent. Patented Feb. 5, 1907.

Original application filed October 4, 1901, Serial No. 77,612. Divided and this application filed May 10, 1904. Serial No. 207,342.

To all whom it may concern:

Be it known that we, VICTOR R. BROWNING and EARL H. BROWNING, citizens of the United States, residing at Nottingham, in the county of Cuyahoga and State of Ohio, have invented a new and useful Improvement in Hoisting Apparatus, of which the following is a specification.

This invention relates in general to hoisting apparatus, and has more particular reference to the means employed for dispensing with the auxiliary hoist in devices of this kind, said means consisting of a differential mechanism which is connected with the motor in such a way that by throwing in the low speed additional lifting force may be secured or by throwing in the high-speed mechanism a more rapid lifting movement with consequent loss of lifting force may be secured.

Our invention has for its objects, therefore, the production of a device whereby the speed of lifting can be conveniently controlled without impairing the efficiency of the motor.

This application is a division of our former application filed October 4, 1901, Serial No. 77,612.

In the drawings forming part of this application, Figure 1 shows a longitudinal section through our improved hoisting apparatus, taken in a vertical plane through the center. Fig. 2 shows a view looking toward the right-hand end of Fig. 1, a portion of the differential gearing mechanism being shown in section, said section being taken on the line 2 2 of Fig. 1. This figure also shows in diagram the electric controller or switch for regulating the strength of current in the electric brake and the magnetic clutch for the differential gear mechanism, and Fig. 3 shows a modified form of the contacting surfaces for the magnetic clutch.

Similar reference characters designate corresponding parts throughout the several views of the drawings

Heretofore, as far as we are aware, it has been necessary, especially in overhead traveling cranes, to provide two independent hoisting devices to operate on light and heavy loads. To operate these cranes economically, it is desirable that the speed of hoisting should be proportioned to the weight of the load; otherwise a light load would require as long a time for handling as would a much heavier one. It has not been practicable to change the rate of hoisting to a sufficient degree with one hoisting device to satisfy the requirements for light and heavy loads, however, without greatly sacrificing the efficiency of the motors employed, it being understood that in order to get the greatest efficiency out of a motor it should be run at the speed for which it is designed. In order to avoid the expense and the necessity of employing both a main and an auxiliary hoist, we have devised a differential gear mechanism which is connected to the shaft of our motor, by means of which we can at will convert the single hoisting device from a main hoist for heavy loads to an auxiliary hoist for light loads. Furthermore, we have rendered the device very light and compact by using the hoisting-drum as the field-magnet for the hoisting-motor. With these features of construction we also combine certain safety appliances, so that our hoisting mechanism is rendered entirely safe and reliable.

In the drawings, 3, Fig. 1, shows a portion of the runway upon which the trolley containing our invention travels. It will be understood, however, that our differential mechanism is applicable to any sort of hoisting device where different speeds of hoist are required. The track-wheels 4 of the trolley are secured to shafts 5, which are journaled to the lower side of the frame, the longitudinal members of which are shown at 6. Rising above these longitudinal members, preferably over the axles 5, are the end frames 7 and 8, these frames being broad at their bases and converging toward their tops.

In order to economize weight and space an expense, we cause the hoisting-drum, which is shown at 9, to serve not only as a drum for hoisting, but as the field-magnets for our motor. As it is necessary for the drum to turn and also for the armature to rotate within the same, it is necessary to form the journals of the armature-shaft within the journals of the hoisting-drum. This, as will readily be seen, will require large trunnions or journals for the hoisting-drum, which journals are placed in the end frame-pieces 7 and 8, as shown at 10 in Fig. 1. In order to overcome the friction in these journals as far as possible, we provide the bearings with nests of rollers, which are shown at 11.

The motor-shaft, which is indicated at 12, passes through the center of the trunnions for the drum and extends for some distance beyond the end frame 8. Keyed to the shaft 12 near its right-hand end, as seen in

Fig. 1, is a pinion 13. Also mounted to turn upon this end of the shaft or upon bushings carried by the same is a trunnion-frame 14, which consists of two disk-shaped side plates, which for the purpose of giving the required strength are cast with suitable connecting portions. (Shown at 15 in Fig. 2.) That face of the disk-shaped side plate which is next to the frame-piece 8 of the trolley is provided with a pinion 16, which meshes with a large gear-wheel 17. This gear-wheel is keyed to a longitudinal shaft 18, which, journaled in the side frames 7 and 8 above the motor-shaft 12 and which carries near its end opposite the gear 17 a pinion 19. This pinion, which is driven with the shaft, meshes with a large annular gear 20, which is keyed to the end of the hoisting-drum 9. From this description it will be seen that when the trunnion-frame 14, with its pinion 16, is turned motion will be transmitted through the gears 17, 19, and 20 to the hoisting-drum 9.

Journaled within the trunnion-frame 14 are a number of planet-gears 21, all of which mesh with the pinion 13, which, as has been stated, is keyed to the shaft 12. When the shaft is turned, therefore, and these planet-gears are permitted to rotate, they will turn on their axles in a direction opposite to that of the pinion 13. The disk-like plates of the trunnion-frame 14 are each provided on their outer sides with hub-like extensions, upon which is trunnioned a frame which carries an internal gear 22, which is in line and in mesh with the planet-gears 21. This frame is composed of two main pieces 23 and 24, which are suitably secured together, so as to form a box-like covering for the various gears.

Were the internal gear 22 and its supporting frame-piece 23 permitted to do so, they would turn freely upon their trunnions if the motor-shaft 12 were rotated, and no power would be transmitted through the trains of gears extending to the hoisting-drum. When, however, this frame and its internal gear are held stationary, while the motor-shaft with its pinion 13 is rotated in either direction, the planet-gearing will be caused to travel about within the internal gear 22 in the same direction and will in this way cause the pinion 16 to be rotated at a speed which is very much slower than the speed of the pinion 13, the ratio of said speeds depending upon the ratio of the diameters of the gears 13 and 22. In order to hold the frame-piece 23 and its internal gear from rotation, we groove its outer circumference for the reception of a brake-strap 25, which passes around the same and has its opposite ends connected to the ends of a bell-crank 26. As has been stated, when the frame 23 and its internal gear are held as described the planet-gears will travel slowly about within the same, and as they are securely journaled in the trunnion-frame 14 the frame and the pinion 16 will be driven slowly, which will also, through its train of gears and shaft 18, drive the hoisting-drum 9 at a slow speed. Therefore when it is desired to lift a heavy load the brake-strap 25 should be caused to engage tightly with the surface of the frame-piece 23, which will hold the internal gear 22 from rotation. There are times, however, when it is very desirable to rotate the hoisting-drum at a much greater speed and for this reason it should be made possible to turn the pinion 16 at higher rates of speed, the highest possible rate for the mechanism shown being that at which the pinion 13 or the motor-shaft 12 is driven.

For purposes of description we will first assume that we desire to change the slow speed for heavy loads, which is secured, as above described, to the highest rate of speed—that is, to the speed which is attained when the pinion 16 is driven with the shaft. As has been stated, when the frame 23 and its internal gear are held stationary the frame 14 rotates within the same. If now the trunnion-frame and the frame 23 were locked together, so that they would be compelled to rotate as a single piece, and the brake-strap 25 were loosened, so that they could so rotate, the pinion 13, planet-gears 21, internal gear 22, and pinion 16 would all be rigidly locked and would all rotate together as one gear. Consequently when the motor-shaft was turned the frame 23 and all the gears which it contains would be driven with the same, and motion would be transmitted through the train of gears to the hoisting-drum, driving the same at a very much higher speed than when the trunnion-frame was permitted to move. Various means may be employed for locking the trunnion-frame and the frame 23 together; but we prefer to use the electric clutch mechanism which is shown in Fig. 1. The frame-piece 23, which is made of iron, has a circular recess extending about and at some little distance from the hub of the trunnion-frame, upon which it is mounted. Within this recess we place a coil of wire 26′ and secure the same in place in the recess by means of an annular soft-iron plate 27. The ends of this coil are drawn through a hole which is made in the part 23 and thence through a hole through the same frame outside the internal gear 22 to rings 28, which are carried in the outer side of the frame-piece 24. These rings, it will be understood, extend entirely about the motor-shaft, so that they may be constantly engaged by brushes 29, which are carried by a bracket 30, projecting from the main frame-piece 8. In Fig. 2 we have shown at 31 a conventional form of controller or switch-box, which is placed in the electric circuit running to the brushes 29 and by means of which the strength of current can be regulated or entirely cut off. When the current is turned through the magnet-coils 26′, the frame-piece 23 is converted into an electromagnet, the lines of force passing through that portion which is embraced by the coil, thence across the air-gap between the frame-piece 23 and the trunnion-frame 14 into the trunnion-frame, thence across the air-gap again, thence through the frame-piece 23 outside the coil, and thence through the plate 27, thus completing the circuit. As is well understood, the trunnion-frame 14 will be very strongly attracted by and will be drawn up to the frame-piece 23, to which it will adhere so closely as to prevent slippage between the contacting surfaces. In view of the previous description it will now be understood that as soon as the current is thrown into the coils 26′, as described, the trunnion-frame will be drawn into contact with the frame-piece 23, and the entire series of gears, including the pinion 16, will be driven as one piece with the motor-shaft, which will greatly increase the speed of the hoisting-drum. The pinions 13 and 16 and also the internal gear 22 are provided with elongated teeth, so as to permit the trunnion-frame, with its planet-gearing and pinion 16, to be drawn over and still remain perfectly in mesh.

In order to permit the frame-piece 23 to rotate as above described, it is necessary to loosen the brake-strap 25, which normally holds it stationary. As has been stated, this brake-strap is secured at its opposite ends to the bell-crank 26. This bell-crank is pivoted to a bracket 32, which projects from the main piece 8. Secured to this bell-crank and rigid therewith is a lever-arm 33, which projects forwardly below the frame-piece 23 and carries at its forward end a weight 34. As long as this weight is permitted to hold down the end of this lever the brake-strap will be held tightly about the circumference of the frame-piece 23, thus holding the same from rotation. Before it can be permitted to rotate, therefore, this brake-strap must be loosened, and in order to secure this result we provide an electromagnet 35, which is secured to a bracket 36, projecting from the main frame-piece 8. This magnet, which is of peculiar construction in order that it may attract its plunger 37 with as great force as possible, is composed of an outer soft-iron cylindrical shell, within which is placed the magnet-coils. Projecting from the top of the magnet at the center between the coils is a soft-iron boss or hub 38, said boss being provided with a conical countersink to fit the upper end of the plunger 37. This plunger forms a portion of the armature, the main portion 39 of which is jointedly secured to the lever 33. This structure causes the lines of force to pass upwardly through the plunger and thence across the gap between the conical end thereof and the countersink in the magnet. This gives the magnet the effect of a solenoid, so that when the lever 33 is in its lowermost position the magnet will have sufficient strength to draw in the plunger and lift the lever. The armature 39 will also be attracted by the lower portion of the shell, which will securely hold the lever in its position with the brake-strap released. As will be understood, it is necessary to release this brake-strap to free the frame-piece 23 at the same time that the current is thrown into the friction-clutch coils 26′, and for this reason the two magnet-coils are placed in series, the same current passing around both. Whenever, therefore, the current is turned into this circuit, it will result in releasing the frame-piece 23 from the brake-strap at the same time that it secures it to the trunnion-frame 14. When, therefore, it is desired to change the hoist from a slow to a high speed, all that is necessary is to turn the switch 31 and throw the current through these two magnet-coils.

Thus far we have described our device as adapted to only two speeds—viz., the slow speed for heavy hoisting and the rapid speed when the gears are firmly locked together and rotate with the shaft. There are loads, however, which are too heavy for this very high speed and too light to make it economical to use the very slow speed, the ratio of these speeds under most conditions being about four to one, although any other ratio may be employed. It is desirable, therefore, to provide a structure whereby any required intermediate speed may be secured. The structure already described, however, is adapted to this end, for the reason that the surfaces between the brake-strap and the frame-piece 23 and between this piece and the trunnion-frame are smooth and may be permitted to slip when in contact. Now the ease with which these surfaces may slide upon each other will depend upon the strength of the current passing through the magnet 35 and the friction-brake coils 26′. Thus when the lever of the switch 31 is moved to the first segment shown a weak current will pass, which will loosen the brake-strap only slightly and will also create only a small amount of friction between the trunnion-frame and the frame-pieces 23. Consequently the frame-piece 23 will move very slowly, while the movement between the trunnion-frame and the frame-piece will be but slightly diminished, so that the rate of hoisting will not be very greatly increased. When, however, the switch-lever is moved to the farthest segment and the current is thrown on in full strength, the trunnion-frame will be securely held to the frame-piece and the brake-strap entirely released, so that the maximum rate of hoisting will be secured. It will be understood that when the switch-lever is placed upon any of the intermediate segments the strength of current will be again changed, and the amount of slippage in the brake and the friction-clutch will also vary, so that the speed of hoisting will be changed. In this way any speed desired within the two fixed limits first described may be secured.

While we have never had any difficulty and believe that no difficulty will ever be experienced in using smooth contacting surfaces between the trunnion-frame and the frame-piece 23, at the same time if it should be found that a sufficient amount of friction cannot be produced between these surfaces to lift the required loads they may be corrugated, as shown in the detailed view in Fig. 3, in which 14 represents the trunnion-frame and 23 the frame-piece, as before. When constructed in this manner, it will be impossible for these surfaces to slip unless they cam themselves apart, and the pull of the electromagnet will be sufficient to prevent any such action. As will be evident, however, this construction makes only the two extreme speeds of hoist possible, and for this reason we prefer not to use the corrugated surface except under conditions when it becomes absolutely essential.

As has been stated, the drum 9 is caused to serve as the field-magnet for the electric motor. With this end in view we form in the inner surface of the drum a suitable number of inwardly-projecting pole-pieces 40, about which are placed spools of magnet-wire, as shown at 41. The current for the motor enters, say, through the wire 42 to the brush 43, and from thence to the ring 44, which is mounted upon the end of the drum 9. From this ring the current is led through the wire 45 and brush 46 to the armature 47. After passing through the armature the current is led by way of the brush 48 to the field-magnet coils 41, and thence to the ring 49 on the end of the drum, from which it then returns through the brush 50 and wire 51 to its original starting-point. It will thus be seen that the armature and field-coils are in series, although they may obviously be placed in parallel, if preferred.

In order to avoid any possibility of a fall or a too rapid descent of the load by reason of the stoppage of the current or the breakage of any of the driving parts, we place at some convenient and suitable point in the train of gearing a safety lowering device, which will permit the load to descend only as the motor is positively driven in a reverse direction. This device is represented at 52 and is shown in the drawings as applied to the shaft 18. Inasmuch as this device is not a part of the present invention, we do not think it necessary to describe the same in detail herein.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a hoisting apparatus, a drum, a shaft passing through said drum, a motor mounted within said drum for turning said shaft, a pinion secured to the shaft, a planet-gear in mesh with said pinion and mounted to revolve about the same, an internal gear surrounding the orbit of said planet-gear with which it is in mesh, a frame in which the planet-gear is trunnioned, a pinion connected with said frame, and gearing connecting said pinion with the drum.

2. In a hoisting apparatus, a drum, a shaft, a motor for driving said shaft, a pinion secured to the shaft, a planet-gear in mesh with said pinion and mounted to revolve around the same, an internal gear surrounding the orbit of said planet-gear with which it is in mesh, means for holding said internal gear from rotation, a frame in which the planet-gear is trunnioned, a pinion connected with said frame, and gearing connecting said pinion with the drum.

3. In a hoisting apparatus, a drum, a shaft, a motor for driving said shaft, a pinion secured to the shaft, a planet-gear in mesh with said pinion and mounted to revolve about the same, an internal gear surrounding the orbit of said planet-gear with which it is in mesh, a friction-brake for normally holding said internal gear from rotation, a frame in which the planet-gear is trunnioned, a pinion connected with said frame, means for loosening the friction-brake, means for securing the internal gear to the trunnion-frame, and gearing connecting said pinion with the drum.

4. In a hoisting apparatus, a drum, a shaft, a motor for driving said shaft, a pinion secured to the shaft, planet-gears in mesh with said pinion and mounted to revolve about the same, an internal gear surrounding the orbit of said planet-gears with which it is in mesh, a friction-brake for normally holding said internal gear from rotation, a frame in which the planet-gears are trunnioned, a pinion connected with said frame, means for loosening the friction-brake, means for simultaneously securing the internal gears to the trunnion-frame, and gearing connecting said pinion with the drum.

5. In a hoisting apparatus, a drum, a shaft passing through said drum, a motor for driving said shaft, a pinion secured to the shaft, planet-gears in mesh with said pinion and mounted to revolve about the same, an internal gear surrounding the orbit of said planet-gears with which it is in mesh, a friction-brake for normally holding said internal gear from rotation, a frame in which the planet-gears are trunnioned, a pinion connected with said frame, an electromagnet for loosening the friction-brake, a magnetic clutch for securing the internal gear to the trunnion-frame, and gearing connecting said pinion with the drum.

6. In a hoisting apparatus, a drum, a shaft

passing through said drum, a motor mounted within said drum for turning said shaft, a pinion secured to the shaft, planet-gears in mesh with said pinion and mounted to revolve about the same, an internal gear surrounding the orbit of said planet-gears with which it is in mesh, a friction-brake for normally holding said internal gear from rotation, a frame in which the planet-gears are trunnioned, a pinion connected with said frame, an electromagnet for loosening the friction-brake, a magnetic clutch for securing the internal gear to the trunnion-frame at the same time that the friction-brake is loosened, and gearing connecting said pinion with the drum.

7. In a hoisting apparatus, a drum, a driven member, mechanism connecting said driven member with the drum to drive the same at a low speed, other mechanism connecting the driven member with the drum to drive the same at a high speed, frictional devices in each of said mechanisms to render them operative and means for controlling the friction and the slip in said devices so as to secure intermediate speeds for the drum.

8. In a hoisting apparatus, a drum, a shaft, a motor for driving said shaft, mechanism for connecting said shaft with the drum to drive the same at a slow speed, other mechanism connecting the shaft with the drum to drive the same at a high speed, frictional devices in each of said mechanisms, and means for regulating the friction and the slip in said devices to secure any intermediate speed of the drum desired.

9. In a hoisting apparatus, a drum, a shaft passing through said drum, a motor mounted in said drum for driving said shaft, a train of low-speed gearing connecting said shaft and drum, another train of high-speed gearing also connecting said shaft and drum, frictional devices in each of said mechanisms, and means for regulating the friction and the slip in said devices to secure any intermediate speed of the drum desired.

10. In a hoisting apparatus, a drum, a shaft passing through said drum, a motor mounted in the drum for driving the shaft, a train of low-speed gearing connecting the drum and shaft, a friction-brake coöperating with said gearing to secure the low speed, another train of high-speed gearing also connecting the drum and shaft, a friction-clutch coöperating with the latter train to secure the high speed, and means for simultaneously regulating the friction and the slip in the said brake and clutch in order to secure any intermediate speed desired.

11. In a hoisting apparatus, a drum, a shaft passing through said drum, a motor mounted in the drum for driving the shaft, a train of low-speed gearing connecting the drum and shaft, a magnetically-controlled friction-brake coöperating with said gearing to secure the low speed, another train of high-speed gearing also connecting the drum and shaft, a magnetic friction-clutch coöperating with the latter train to secure the high speed, and means for simultaneously regulating the friction and the slip in the said brake and clutch in order to secure any intermediate speed desired.

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

VICTOR R. BROWNING.
EARL H. BROWNING.

Witnesses:
JAY W. LEEPER,
E. DEEGAN.