Dec. 19, 1950 G. E. MOORE 2,534,726

POWER-OPERATED TWO-SPEED HOIST

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Fig. 1

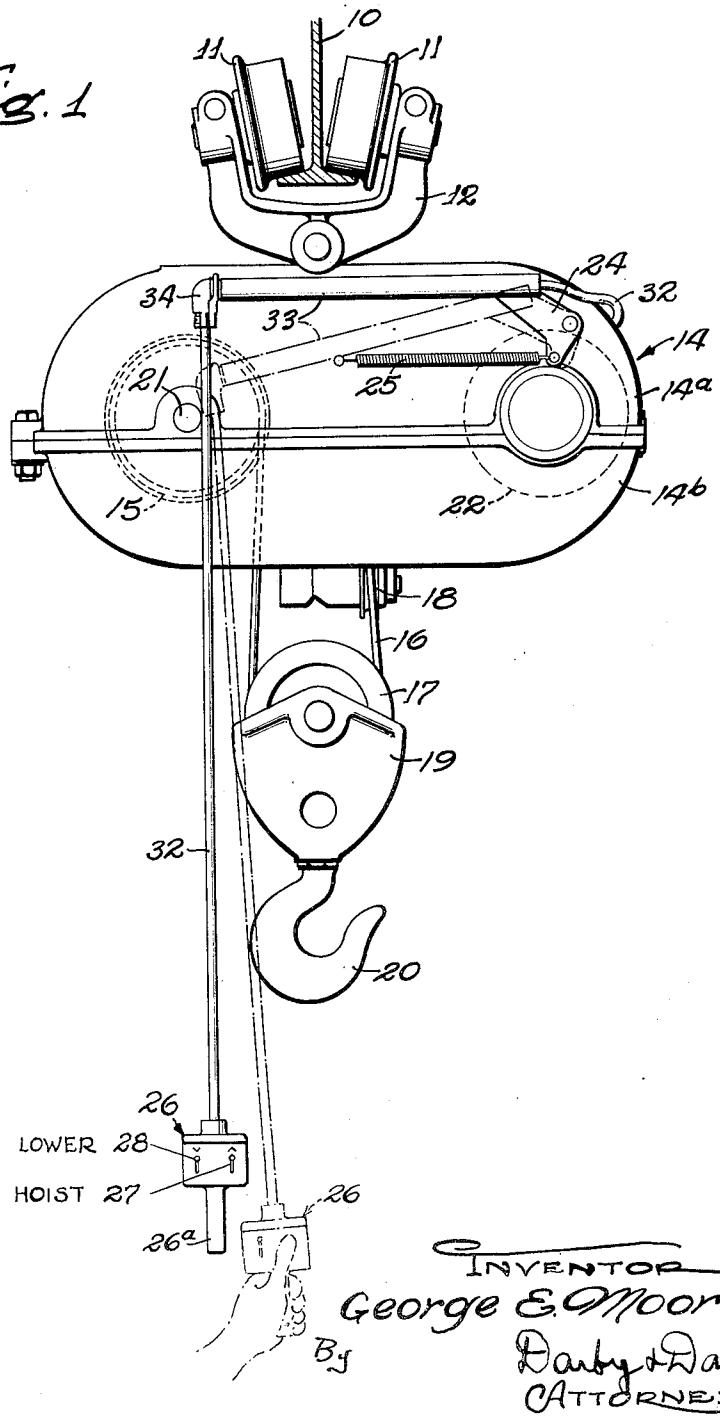


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Fig. 2

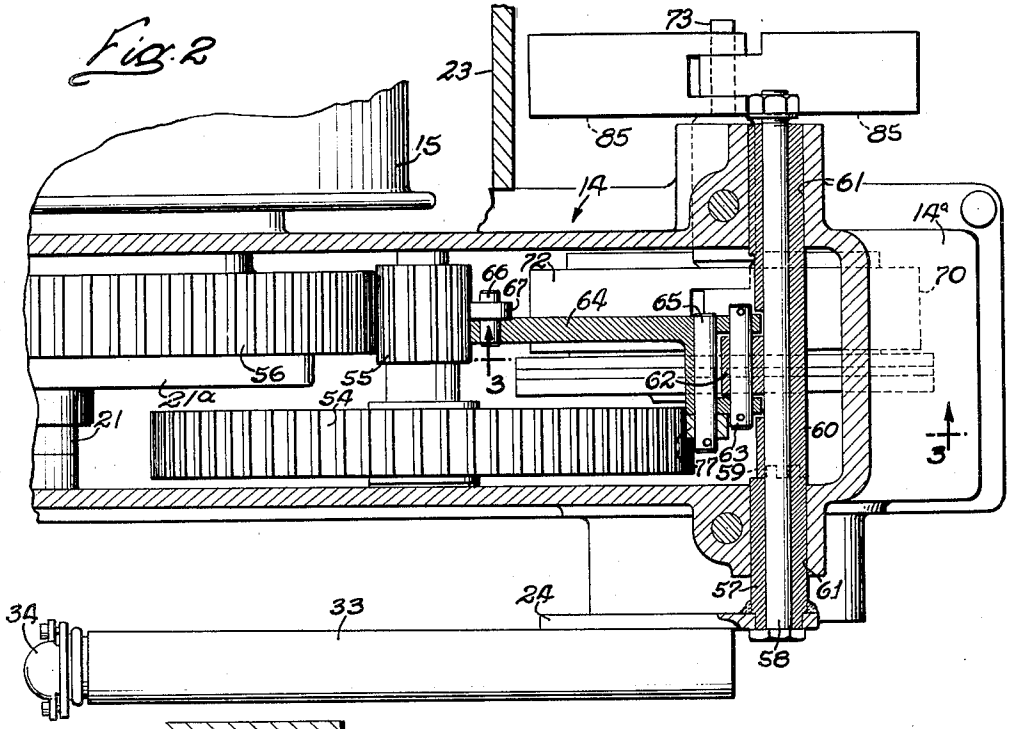


Fig. 3

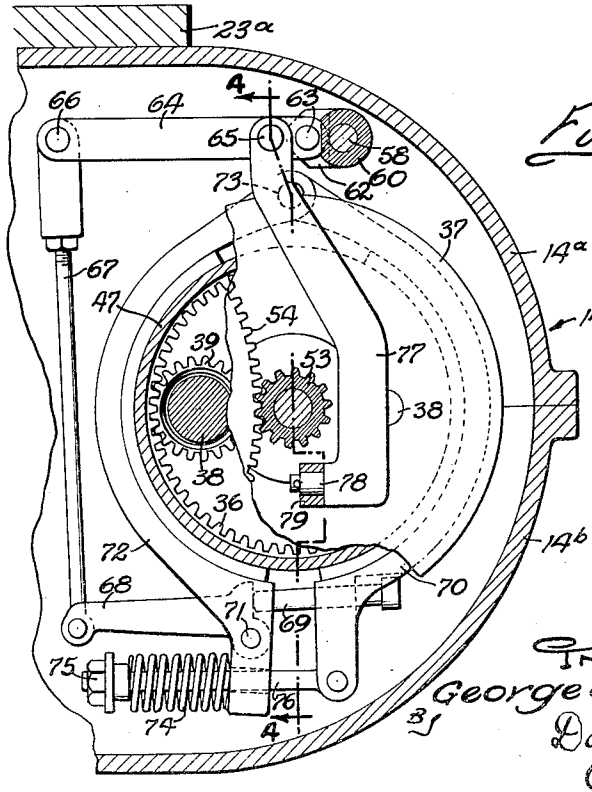


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Fig. 4

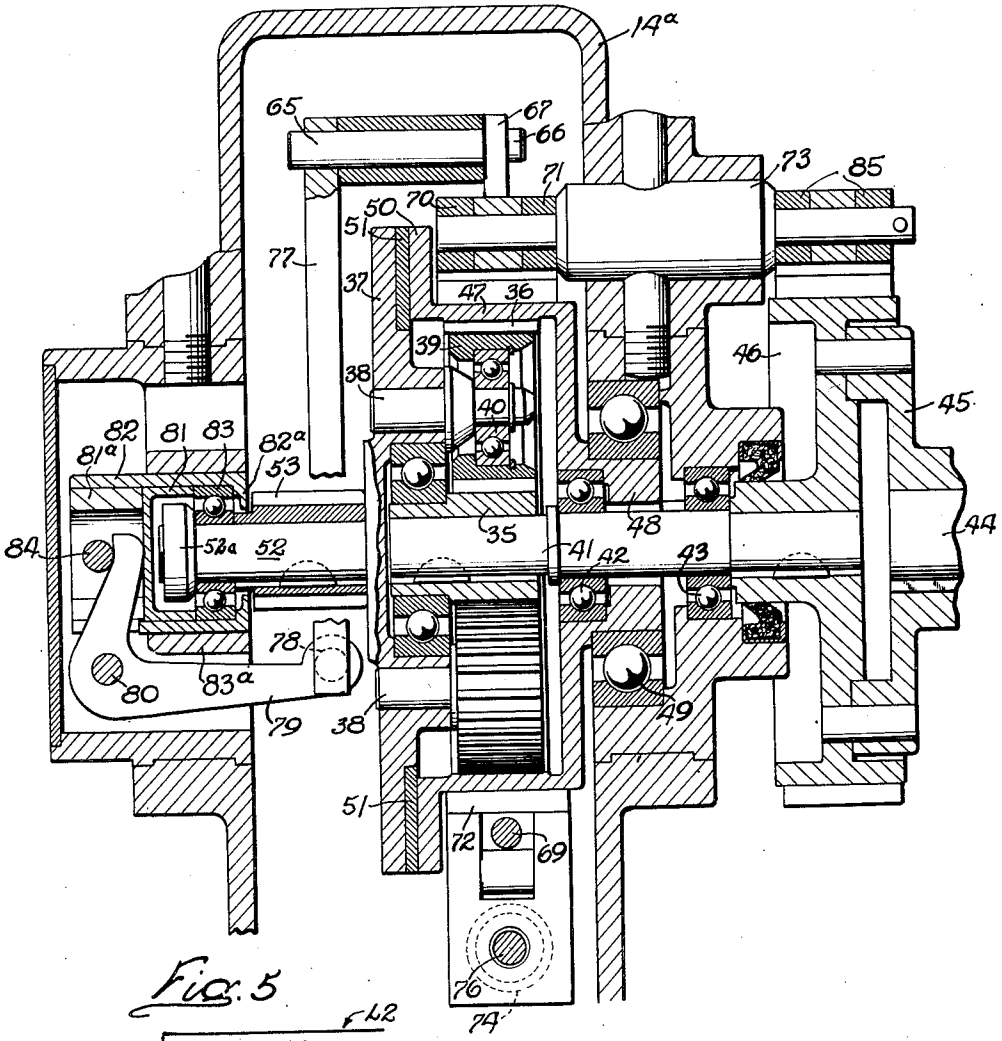
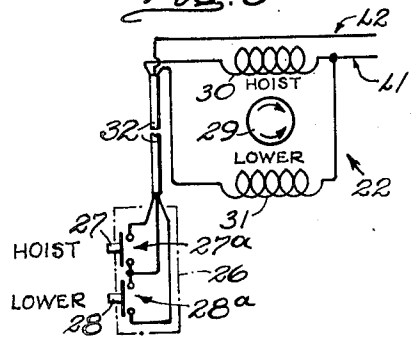



Fig. 5

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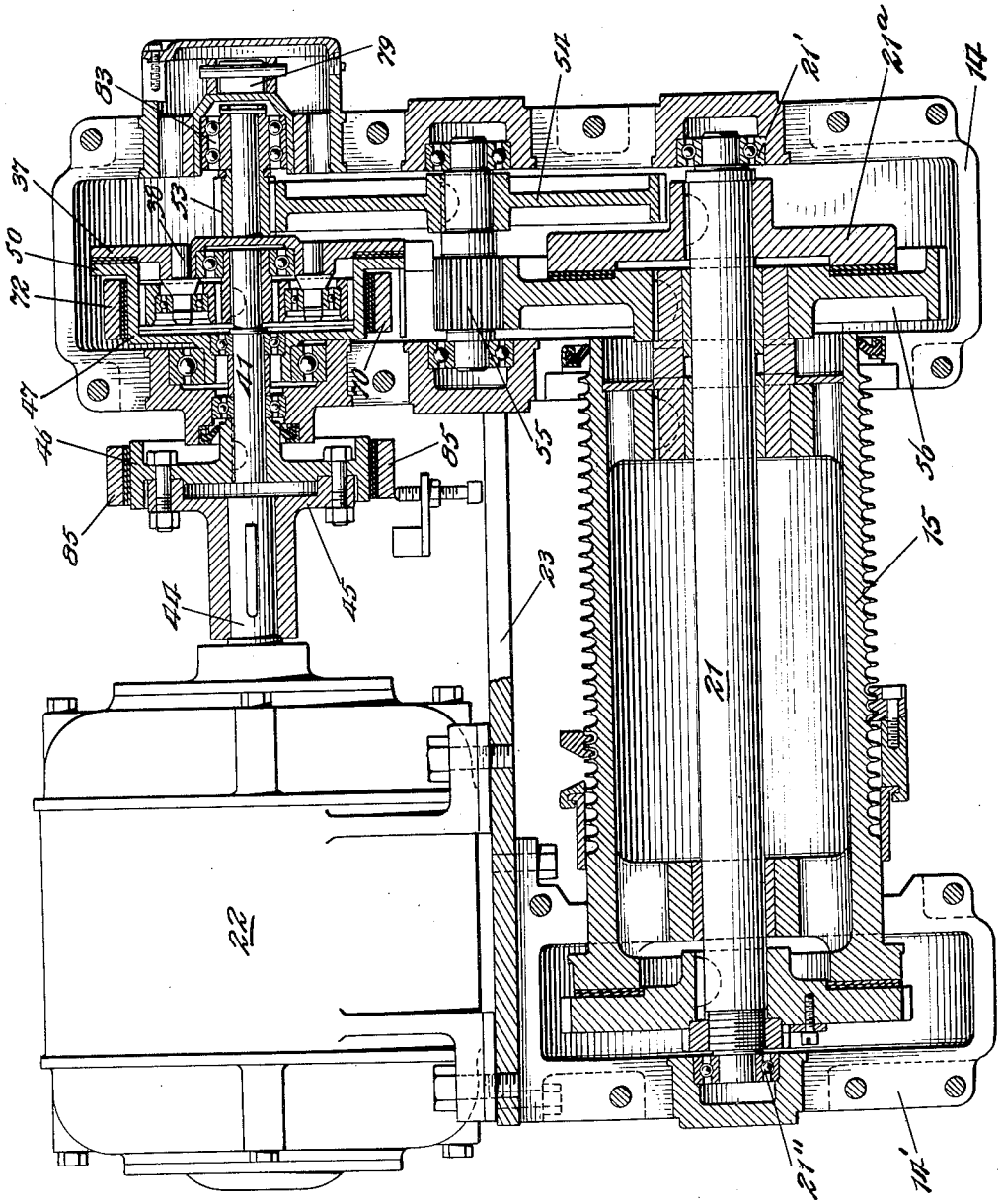


Fig. 6.

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2,534,726

## POWER-OPERATED TWO-SPEED HOIST

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Application December 28, 1944, Serial No. 570,046

9 Claims. (Cl. 254—168)

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The present invention pertains to two-speed power operated hoists, having particular utility in electric motor driven types.

One general object of the invention is to provide a power operated hoist, which the operator can control by one hand to alter speed as well as to stop, start or reverse the same.

More specifically, it is an object to provide an electric motor driven hoist in which a speed control cable or the like, suspending a switch control box for the hoist motor, serves to change the hoist speed from normal slow speed to a higher speed.

It is an object to provide a novel and improved multi-speed hoist of this type employing planetary speed change gearing.

Further objects and advantages of the invention will become apparent as the following description proceeds.

This invention resides substantially in the combination, construction, arrangement and relative location of parts as will be described in detail below.

In the accompanying drawings—

Figure 1 is a front elevation of a hoist embodying the present invention, and showing the same suspended from a rail, indicated in section;

Figure 2 is an enlarged fragmentary plan view of the hoist with the gear casing shown in transverse section, to expose the interiorly located parts;

Figure 3 is a vertical sectional view taken substantially along the line 3—3 in Figure 2;

Figure 4 is an enlarged sectional view taken substantially along the line 4—4 in Figure 3;

Figure 5 is an elementary wiring diagram for the motor circuits of the hoist; and

Figure 6 is a horizontal, central, cross-section of the entire hoist, showing the motor in elevation.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but rather to cover all modifications and alternative constructions falling within the spirit and scope of the invention, as expressed in the appended claims.

Referring to the drawings, the hoist there shown (see Figure 1) is more or less portable in character. In use it may be mounted in some overhead position by any suitable means, such, for example, as on a rail 10 by trolley wheels 11

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journalled in a bracket 12 (Figure 1) pivotally attached to the central portion of a horizontal plate 23a fixed to the top of the hoist's gear casing 14 (Figure 3).

Incorporated in the hoist are a revoluble hoisting member and a multi-speed drive mechanism therefor, which may take a variety of forms. As illustrated the hoisting member comprises a rotatable cable drum 15 having a hoist line or cable 16 wrapped about it with one end of the cable fixed to the drum. This cable is led over a sheave 17, and its opposite end anchored to the lower portion of the hoist at 18. Turning of the drum thus serves to reel the cable 16 in or out. A sheave housing 19, in the upper portion of which the sheave 17 is journalled, has swiveled on its lower end the usual load hook 20.

Extending downwardly at right angles to the top plate 23a, and welded thereto, is a supporting plate 23 (see Figures 2 and 6) lying substantially in the central vertical plane of the hoist.

The hoisting drum 15 is rotatably and axially movable on shaft 21 which extends from front to rear through the gear casing 14, the drum being located on the exterior of the casing at its rear side (see Figure 6). Shaft 21 is journalled at one end in the bearing 21' in gear housing 14 and at the other end in bearing 21'', which is mounted in the housing 14'. The housing 14' is attached to the plate 23 (see Figure 6). The hoisting drum is thus located at one side of the vertical center lines of the hoist structure (see Figure 6) and is driven by a reversible electric motor 22 attached to plate 23b and hence on the opposite side of such center line, with its axis paralleling that of the drum. The motor 22 is detachably fixed to vertical plate 23, which is in turn fixed to, and depends beneath, horizontal top plate 23a. The latter plate is fixed to the top of the gear casing 14. This casing is divided transversely into complemental upper and lower shells 14a, 14b (Figure 1) suitably bolted together.

The drive mechanism including the electric motor 22 may be constructed in various ways to effect variable speed rotation of the hoisting drum 15. In the present instance, a mechanical change-speed gearing housed in the casing 14 is used for the purpose, so that the motor itself may run at substantially constant speed without electrical controls for varying its speed. The particular gearing illustrated is hereinafter detailed, but preliminarily it may be noted that rocking bell crank lever 24 (Figure 1) serves to condition the gearing alternatively for high and low speed operation. When the bell crank 24 is in the full-

line position shown in Figure 1, and to which position it is biased normally by a contractile spring 25, the gearing is conditioned for low speed rotation of the drum 15, whereas when the bell crank is rocked counterclockwise from that position the gearing is conditioned for high speed rotation of the drum. It is preferable to bias the speed control bell crank lever 24 to its low speed position as shown since less power is required for low speed starting and it is, therefore, desirable that the hoist be normally conditioned for such low speed starting. Moreover, low speed starting reduces shock to the hoist components, and for many uses slow movement of the load is desired at the beginning and end of its travel.

In accordance with one aspect of the present invention, provision is made for rocking the speed control lever 24 by simply pulling down on a hand operated switch unit 26 for the hoist (Figure 1). Projecting from the front face of the unit is a pair of switch actuating levers 27, 28 which are yieldably biased upward into "off" position. The operator grasps the handle 26*a* and pulling down one or the other of these levers 27, 28 closes a corresponding switch 27*a*, 28*a* (Figure 5) to energize the motor 22 in the usual manner for rotation in corresponding opposite directions, to hoist and lower the load. Motors with a variety of circuits controllable from such a pair of finger operated switches are available on the market, and the wiring diagram in Figure 5 is intended to indicate merely the general operation. As there shown, the motor 22 may include a rotor 29 and alternatively available field windings 30, 31 having one end of each connected to a supply line L1. A second supply line L2 is connected to the remaining end terminal of one or the other of the field windings, through the companion one of the switches 27*a*, 28*a*. When both of the switches are open, the motor is open-circuited and thus stopped. A flexible cable 32 depending from the hoist (Figure 1) houses the conductors connected to the switches in the box 26.

To arrange the cable 32 so that a downward pull on it will rock the speed control lever 24, a length of rigid conduit 33 (Figures 1 and 2) is fixed to the upper arm of the lever, and projects generally horizontally therefrom. The cable 32 is led through this conduit, and thence, down through a connector 34 threaded on the conduit's outer end, and clamped to the cable. Consequently, a downward pull on the cable will swing the conduit 33 downward, to the dot-dash line position shown in Figure 1, thus rocking the speed control lever 24 counterclockwise into its high speed position.

The described arrangement makes possible "one hand control" of the hoist with a high degree of versatility of operation. Thus the operator can grasp the control unit handle 26*a* in one hand, as indicated in Figure 1, and depress one or the other of the switch levers 27, 28 with the thumb of that same hand to run the hoist motor in a corresponding direction for either raising or lowering of the load hook 20 as desired. The switch levers 27, 28 are, as shown, located within easy reach of the operator's thumb for that purpose. To stop the hoist, it is necessary merely to release the lever, which has been depressed; and to reverse the hoist the operator has only to pull down the other lever. Finally, and of particular importance here, the operator has only to pull down on the control unit, which he is holding, in order to shift from low to high speed operation, and as soon as he quits tugging on the unit, the spring 25 restores the speed control lever 24 to its low speed position, thereby slowing down the hoist again.

Turning now to the matter of the particular speed change gearing illustrated, it will be seen, upon reference to Figure 4, that it is of the planetary type, and comprises, as its two terminal elements, a sun gear 35 and a ring gear 36. The intermediate element of the planetary gearing comprises a revoluble disk shaped carrier or spider 37 from which project one or more pins 38 having planetary gears 39, journalled thereon by antifriction bearings 40, and meshed with the ring and sun gears. The sun gear 35 is fixed to an intermediate shaft 41 journalled in antifriction bearings 42, 43 and axially aligned with the motor shaft 44. Such shafts 41 and 44 are rigidly coupled so that the sun gear 35 is turned directly by the motor 22, the coupling including a disk 45 keyed to the motor shaft and pinned to a brake drum 46 which is in turn keyed to the shaft 41.

The ring gear 36 (see Figure 4) is formed internally in a cup-shaped brake drum 47 having a hub portion 48, rotatably journalled in an enlargement on the rear side of the gear casing, by an antifriction bearing 49. At its outer end, this drum 47 has an annular peripheral flange 50 opposed to the marginal portion of the carrier 37, with an annular clutch shoe 51, of friction material, interposed between the two, and fixed in a complemental annular recess in the carrier. When the carrier 37 is thrust axially toward the flange 50, the shoe 51 frictionally engages the latter and thus, in effect, connects the carrier 37 and ring gear 36 to revolve in unison.

Projecting from the outer side of the carrier 37, and rigid therewith, is a coaxial stub shaft 52 having keyed thereon a pinion 53 (Figure 4). This pinion meshes with a spur gear 54 (Figures 2 and 3) rigid with a second pinion 55 which meshes with a second spur gear 56. The latter gear is connected through the usual load brake 21*a* (forming no part of this invention) to the shaft 21 of the hoisting drum 15.

For low speed operation the ring gear 36 is held against rotation by a clasp brake (hereinafter more particularly described) engaging the exterior of the drum 47, the clutch shoe 51 being backed away from the flange 50 to permit free rotation of the carrier 37. With the gearing so conditioned, the motor-driven sun gear 35 turns the planets 39, rolling them around the stationary ring gear 36, and thus revolving the carrier 37 at a low speed of, for example, one fifth that of the motor. The carrier is connected at all times through the heretofore described spur gearing 53—56 to the hoisting drum 15, so that the latter is revolved at slow speed. To change to high speed the brake on the ring gear 36 is released and this gear clutched to the carrier 37, in consequence of which the planetary gearing turns as a solid unit, wherefore the pinion 53 is revolved at the same speed as the motor shaft 44, and the hoisting drum 15, thus, is driven at high speed.

Rocking of the speed control lever 24, heretofore noted, serves to actuate both the brake for the ring gear 36 and the clutch arrangement for connecting the latter to the carrier 37. For such purpose the lever 24 is fixed to a sleeve 57 (Figure 2) telescoped on a retaining bolt 58 and rigidly coupled by teeth 59 with a second sleeve 60, also telescoped on the bolt. These sleeves are jour-

naled in transverse bores 61 in the front and rear walls of the gear case 14 to accommodate rocking of the lever 24. Projecting laterally from the intermediate portion of the sleeve 60 is a lug 62, through which projects a transverse pin 63. This pin connects the lug 62 to the bifurcated end of a lever 64 pivoted intermediate its ends on a pin 65, and pivotally connected at its opposite or outer end by a third pin 66 to a depending pull rod 67.

Counterclockwise movement of the speed control lever 24 rocks the pin 63 downward (Figure 3), thus tending to swing the outer end of the lever 64 upward and draw the pull rod 67 upward. A spreader 68, pivoted to the lower end of the pull rod, is thus rocked clockwise (as viewed in Figure 3), and thrusts a pin 69 outward. Such pin is adjustably threaded in the lower end portion of one brake arm 70 embracing the brake drum 47, whereas the spreader 68 is pivoted at 71 to the lower end portion of a second and opposed brake arm 72 also embracing this drum 47. Consequently, thrust on the pin 69 by the spreader 68 forces the brake drum arms 70, 72 to swing outward about their upper end pivot 73 to release the drum 47 for free turning of the ring gear 36 on the latter. A helical compression spring 74 interposed between the lower end of the brake arm 72 and a nut 75 on the end of a pin 76, pivoted to the lower end of the other brake arm 70, yieldably urges the arms toward each other into drum-engaging position.

The downward movement of the lug-carried pin 62 incident to rocking of the speed control lever 24 counterclockwise also tends to draw the pin 65 downward. Pivoted on this latter pin 65 is a depending link 77 (Figure 3), having its lower end pivoted at 78 to a transversely extending bell crank 79 (see Figure 4). Movement of the latter bell crank is utilized for urging the clutch shoe 51 into engagement with the flange 50. For that purpose the bell crank 79 is pivoted at 80, and disposed with its upwardly projecting arm interposed between the outer face of a cup 81 and a transverse pin 84 extending diametrically across a ring 81*a*, such pin serving to fix the ring 81*a* in a sleeve 82. An anti-friction bearing 83 for the stub shaft 52 is interposed between the cup 81 and a flange 82*a* on the adjacent end of the sleeve 82. The inner race of the bearing 83 is fixed between the pinion 53 and a nut 52*a* on the shaft 52. Consequently, when the bell crank 79 is rocked, the assembly 81, 81*a*, 82, 83 and 84 slides in a stationary bushing 83*a*, moving the pinion 53 and shaft 52 endwise as well as the clutch shoe 51 fixed to the carrier 37 on such shaft. Thus upon movement of the shaft 52 inward, the clutch shoe 51 is pressed into firm frictional engagement with the flange 50 so that the carrier and ring gear of the planetary gearing turn in unison. Movement in the opposite direction releases the clutch. It will be appreciated that only a very limited movement of the order of a fewthousandths of an inch for the carrier 37 is required for clutching and unclutching it to the flange 50. Since the movement required for the carrier 37 is very small, that required for the pin 65 is also small. Accordingly, the latter may function properly as a floating pivot for the lever 64, it being immaterial if the clutch 50, 51 tends to engage momentarily before release of the brake 70, 71, 46 in view of the slippage permitted in the friction type clutch.



The disclosed planetary type gearing affords a rugged, compact speed-change device with smooth transition from one speed setting to another. Moreover it is especially well suited to actuation by pull on the control cable 32.

The hoist is also desirably provided with a motor brake for effecting quick stoppage of the electric drive motor whenever the latter is de-energized. In the illustrated arrangement the brake drum 46, heretofore mentioned as comprising a part of the coupling between the motor shaft 44 and intermediate shaft 41 (Figure 4), constitutes a part of the motor brake. This brake drum 46 is embraced by a pair of clasp-type brake arms 85 (Figures 2 and 4), which may be of the same general form as the arms 70, 72, and pivoted on the same pin 73, which carries the latter. The arms 85 of the motor brake are normally spring-urged into engagement with the brake drum 46 and any suitable means (not shown) may be provided for thrusting them apart into released position upon energization of the motor.

The operation of the disclosed hoist will in general be clear from the foregoing. By way of brief recapitulation, it may be assumed first of all that the hoist motor is stopped with the load hook 20 elevated as shown in Figure 1. To lower the hook the operator grasps the handle of control unit 26 and depresses the "Lower" switch lever 28, thereby energizing the hoist drive motor for rotation in a direction appropriate to lowering. Coincident with starting of the motor, the motor brake 46, 85 is released and the motor revolves the sun gear 35 at motor speed. The ring gear 36 being restrained against rotation by the encircling brake arms 70, 72, the planets 39 are rolled about the ring gear, and revolve the carrier 37 at low speed, wherefore the hoisting drum 15 is also turned in a lowering direction at low speed. If the operator wishes to speed up the lowering, he has only to tug on the switch unit 26, thereby pulling the conduit lever arm 33 downward to rock the speed control lever 24 counterclockwise (Figure 1). Such rocking of the speed control lever releases the clasp brake 70, 72 from the ring gear drum 47 and coincidentally clutches the latter to the carrier 37 so that the planetary gearing revolves as a unit with 1 to 1 ratio, and the speed of the hoisting drum is accordingly increased. Restoration of low speed operation entails merely a relief of the downward pull on the switch unit 26 so that the spring 25 may return the speed control lever 24 to its normal or low speed position. For hoisting the manipulations are substantially the same except that the operator pulls down the "Hoist" switch lever 27 rather than the "Lower" switch lever 28. When both switches are released they snap upward into "off" position so that the motor is open-circuited and the motor brake automatically engaged.

Making two speeds readily available for the hoist affords a number of advantages in operation. Since the hoist is normally conditioned for low speed starting the operator has an opportunity, in view of the low speed, to adjust load chains, slings, ropes, etc., as slack is taken up in initiating the lifting of a load. Likewise, in setting the load down, the available low speed operation makes it possible to lower the load gently onto scales, trucks or the like where impact is objectionable or where the operator may be occupied with guiding the load. Similarly, if the hoist is used in a foundry the available low speed op-

eration is desirable since it makes it possible to withdraw patterns from molds slowly and to take care of equalization of sling tension. Somewhat the same problems arise in the setting of cores and placing of pattern forms. Aside from such portions of the hoisting cycle, when low speed operation is very desirable, the hoist herein disclosed may be operated at high speed to move the load quickly, and thus minimize overall operating time.

Those skilled in the art will readily appreciate that the physical embodiment of the invention selected for illustration herein is not the only form that it may take. For example, the two-speed hoist construction herein disclosed may be operated with other sources of power than electric motors as, for example, internal combustion engines and the like. Furthermore, it is equally clear that cord or rod **32**, by means of which speed change is effected, need not include the switch structure **26**. Cable **32** and the switch **26** could be independently supported. Likewise, the speed change could be effected by a lever arrangement rather than by a cord or cable.

What is claimed is:

1. The combination with a multi-speed type electric motor driven hoist embodying a change-speed device shiftable into selectively available speed setting positions, of a reversing control switch for the motor mounted in a casing, an elongated depending member suspending said casing from the hoist, and means operable in response to a downward tug on said member for shifting said speed control device from one position therefor to another, operation of said switch and member providing several speeds in both hoisting and lowering direction.

2. The combination with a power operated hoist equipped with a speed-change mechanism operable by a control member shiftable between selectively available speed setting positions, of a manually operable stop-start control device, an elongated depending member suspending said device from the hoist in position for manipulation by an operator stationed below the hoist, and means for shifting said control member in response to stress applied to said depending member longitudinally of the latter, said device being operable by a finger of the hand used to manipulate said member.

3. The combination of a multi-speed type electric motor driven hoist embodying a change-speed device shiftable into selectively available speed setting positions, an operating member for said device pivoted on the hoist and having an arm projecting laterally for rocking of said member by swinging of said arm, a cable suspended from the outer end of said arm, and means including a control switch for said hoist connected to the lower end of said cable and electrically connected through the latter to the hoist drive motor, a downward pull on said cable serving to swing said arm and thereby rock said operating member.

4. The combination with a multi-speed type electric motor driven hoist embodying a change-speed device shiftable between alternatively available high and low speed positions, spring means yieldably biasing said device to its low speed position, a start-stop and reversing switch for the hoist motor mounted in a casing, an elongated member suspending said casing from the hoist, and means operable in response to a downward pull exerted on said member for shifting said



speed control device from low to high speed position against the bias of said spring means.

5. The combination with a multi-speed type portable hoist embodying a speed change device selectively shiftable between alternatively available high and low speed positions as well as a reversible electric drive motor, of a control unit having a handle adapted to be grasped in an operator's hand and bearing a pair of digitally operable switch actuating levers located for movement by the thumb of an operator's hand grasping said handle, means including a cable suspending said unit from the hoist, means including a pair of normally open switches within said box adapted to be closed by movement of respective ones of said switch levers for establishing circuits through said cable for effecting rotation of said motor in directions appropriate respectively to hoisting and lowering operation by the hoist, means yieldably urging said device to its low speed position, and means operable in response to a downward pull on said cable exerted by the operator in pulling down on said unit while grasping said handle for shifting said device to its high speed position, whereby full control of both the direction and speed of the hoist can be accomplished with simply one hand manipulation of said unit.

6. In an electric hoist, the combination of an electric drive motor, a revoluble hoisting member, means including a planetary gearing including a pair of terminal elements and an intermediate element for drivingly connecting said motor to said hoisting member, means including a clutch for connecting said gear elements for rotation as a unit to effect high speed drive of said member, means including a brake for restraining one of said terminal elements against rotation to effect low speed drive of said member, means normally urging said brake to engaged position and said clutch to disengaged position, an elongated depending member carrying a control switch for said motor, and means responsive to a downward tug on said depending member for engaging said clutch and releasing said brake.

7. In an electric hoist, the combination of an electric drive motor, a revoluble hoisting member, a planetary gearing including a pair of terminal elements and an intermediate element, one of said terminal elements being driven by said motor and said intermediate element being drivingly connected to said hoisting member, a normally engaged brake for holding the other terminal element against rotation to effect low speed drive of said hoisting member by said motor through said gearing, an elongated depending member carrying a switch for controlling said motor, and means operable in response to a downward tug on said depending member for releasing said brake and connecting said gearing elements to revolve as a unit for high speed operation of said hoisting member by said motor.

8. In an electric hoist, the combination of a reversible electric drive motor, a revoluble hoisting member, means including a planetary gearing including a pair of terminal elements and an intermediate element for drivingly connecting said motor to said hoisting member, means including a clutch for connecting said gear elements for rotation as a unit to effect high speed drive of said member, means including a brake for restraining one of said terminal elements against rotation to effect low speed drive of said member, means normally urging said brake to engaged

position and said clutch to disengaged position, an elongated depending member, means responsive to a downward tug on said depending member for engaging said clutch and releasing said brake and control devices mounted on said depending member for effecting reverse energization of said motor.

9. In a power transmission unit, the combination comprising a power driven shaft, a driven member, a combined planetary gear housing, clutch member and brake drum, a second clutch member, a planetary gear train in said housing for interconnecting said driving shaft with said driven member, means cooperating with said housing to form a brake, spring means predetermining the force of application of said brake, and an interconnected linkage system for moving one of said clutch elements into engagement with the other to engage the clutch and for subsequently releasing said brake, said linkage system including a single actuating lever having two pivot points, movement of said lever on one pivot point disengaging said brake and movement of said lever on the other of said pivot points engaging said clutch.

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