March 9, 1954 R. F. SYMONDS 2,671,880

ELECTRIC MOTOR CONTROLLED WINCH

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Fig. 6

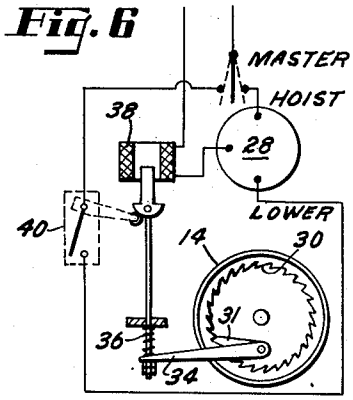

Fig. 1

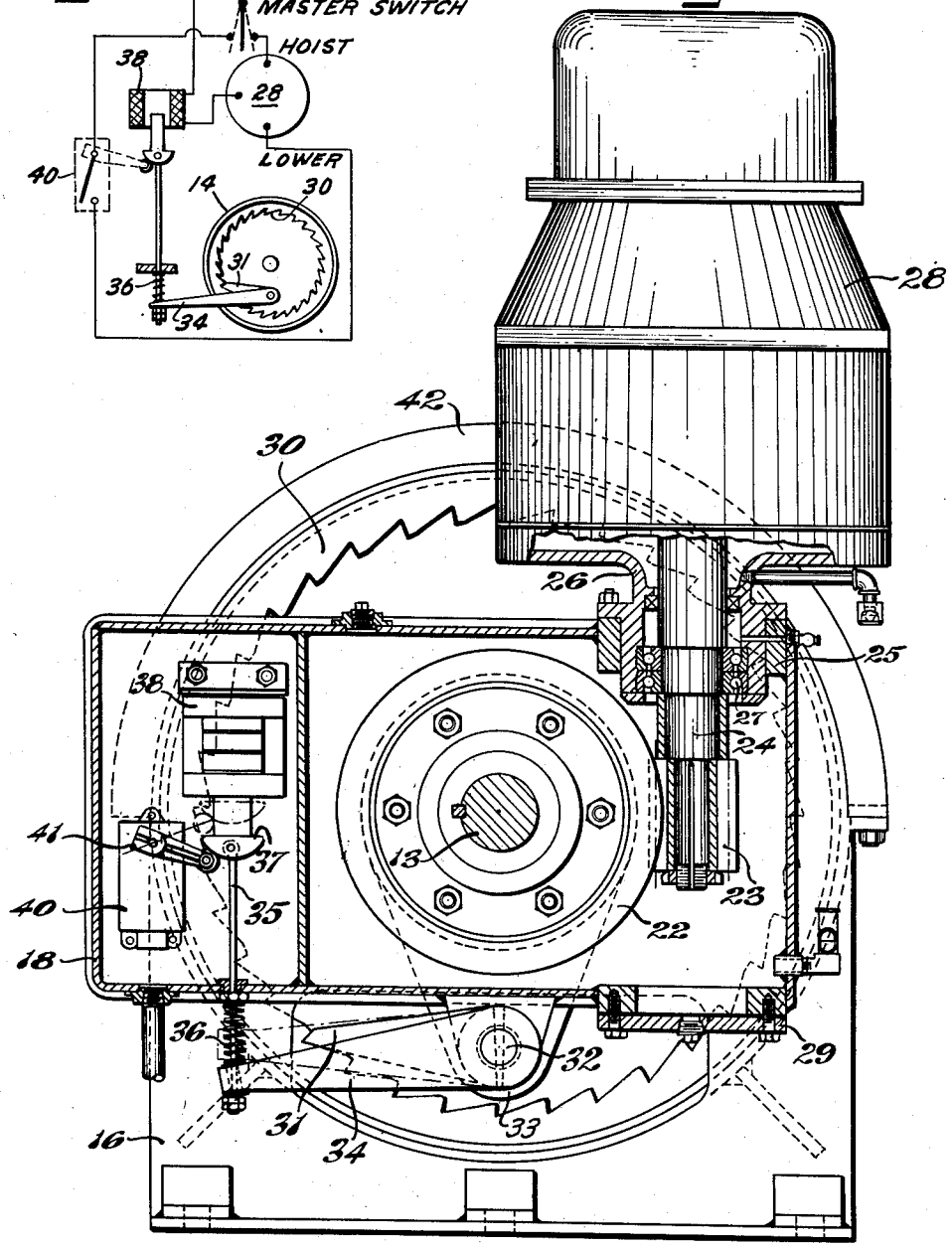

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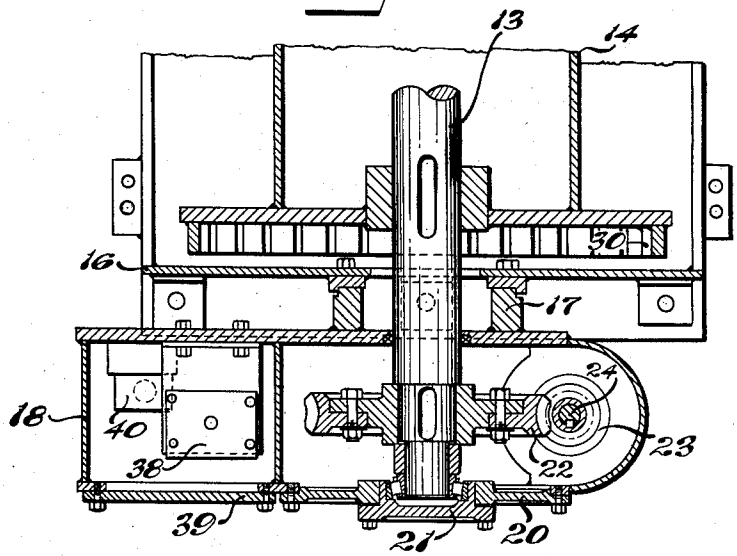
Fig. 2



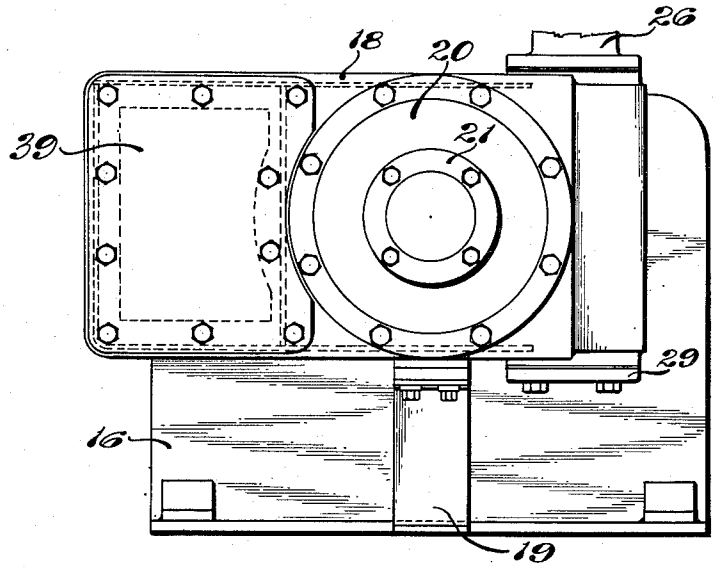


Fig. 3

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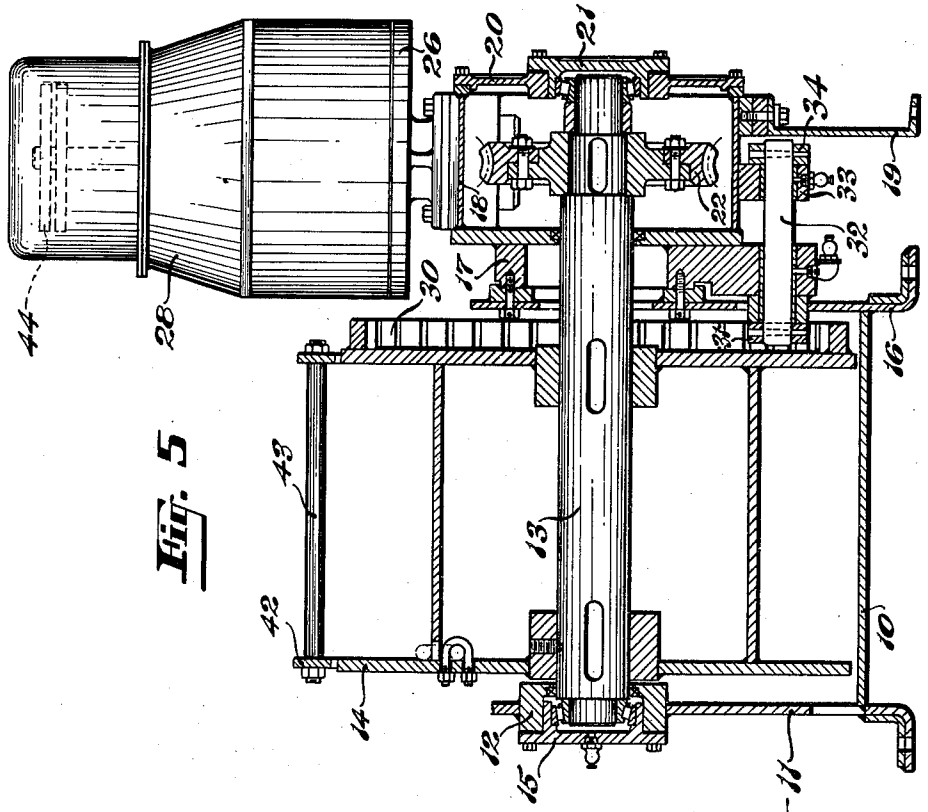

Fig. 5

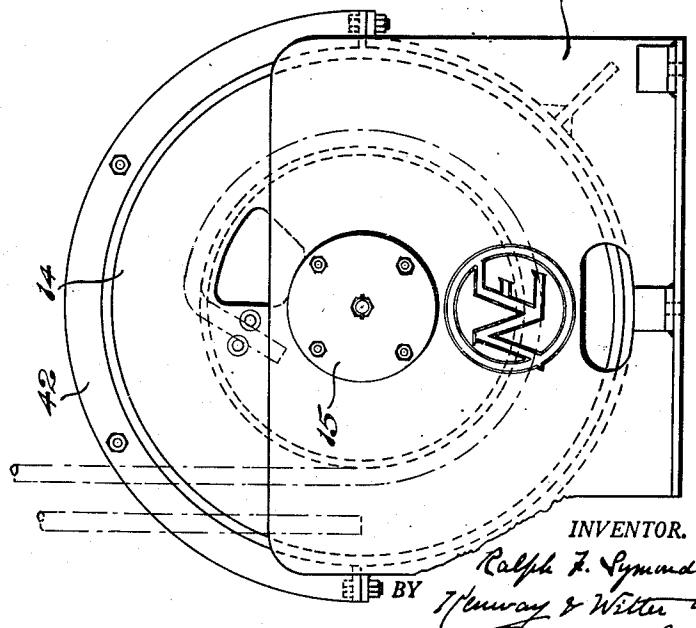

Fig. 4

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ELECTRIC MOTOR CONTROLLED WINCH

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Application September 23, 1950, Serial No. 186,333

5 Claims. (Cl. 318—261)

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This invention comprises a new and improved winch designed particularly for topping cargo booms but capable of more general application to other hoists, and useful for example wherever a winch is used to hold a load in elevated position while it is transferred from one position to another. This application is a continuation in part of my application Serial No. 702,911, filed October 12, 1946, and now abandoned in favor of the present application.

In one aspect the winch of my invention comprises a motor-driven drum, pawl and ratchet mechanism associated with the drum for locking the drum under load, and a solenoid controlling the position of the pawl. The solenoid is preferably under remote control so that the ratchet and its associated drum may be locked and unlocked after the drum has rotated the desired number of turns in either direction for the work in hand. This novel arrangement permits the operator to hoist a load to an elevated position, lock the drum and swing the boom with the load to lowering position, then start the motor for hoisting just sufficiently to release the pressure of the load on the pawl and move the pawl to its disengaged position, and then finally to reverse the motor for lowering the load while the pawl is still maintained disengaged by the delayed release of the solenoid.

Preferably and as herein shown, the solenoid is associated with a switch controlling the operation of the motor, the solenoid thus having the double function of controlling both the switch and the pawl. In one aspect the invention comprises a pawl release mechanism and a switch controlling the motor circuit for reversing or lowering, so combined with a solenoid that certain results are insured, namely (1) the release of the pawl prior to reversal of the motor and lowering of the boom; and (2) the prevention of engagement of the pawl so long as the motor circuit is closed for lowering the boom.

These and other features of the invention will be best understood and appreciated from the following description of a preferred embodiment, selected for purposes of illustration and shown in the accompanying drawings in which:

Fig. 1 is a view of the complete winch, partly in elevation and partly in vertical section,

Fig. 2 is a view in horizontal section of the gear housing and associated parts,

Fig. 3 is a corresponding view in end elevation,

Fig. 4 is a view in elevation from the end opposite that shown in Fig. 3,

Fig. 5 is a view of the winch in elevation and

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partly in section at right angles to the section shown in Fig. 1, and

Fig. 6 is a wiring diagram showing the circuit.

The winch which comprises the illustrated embodiment of my invention has a welded steel frame including a base plate 10 formed with attaching flanges by which the winch may be fastened to the deck or in other desired location, and a side plate 11. A bearing collar 12 is inserted in the side plate 11 and securely welded in place. The collar contains roller bearings for the outer end of a horizontal drum shaft 13 to which is rigidly connected the hoisting drum 14. The outer end of the bearing collar 12 is closed by a circular cover plate 15 bolted in place and provided with a fitting for pressure gun lubrication.

A side plate 16 is secured to the side of the base plate opposite the side plate 11. This plate is perforated to clear the drum shaft 13 and to it is bolted a heavy collar 17 which also clears the shaft 13. To the outer face of the collar 17 is welded a gear housing 18 and into this projects the right hand end of the drum shaft 13, as shown in Fig. 5. The gear housing is further supported by a flanged end plate 19 which is bolted in place beneath the housing.

The outer wall of the gear housing comprises, in part, a large circular cover plate 20 which is flanged to receive a smaller bearing plate 21 having an inwardly directed annular flange arranged to support roller bearings for the right hand end of the drum shaft 13. The bearing plate 21 is bolted in place and may be removed whenever it is desired to inspect the bearings or reach that end of the shaft.

The drum shaft 13 is shouldered within the gear housing and provided with a worm wheel 22. The latter is made in two parts, a hub section and a circumferential section in which the worm teeth are formed. These two sections, as shown in the drawings, are bolted together by a series of six bolts. A worm 23, carried by a vertical shaft 24, is arranged to mesh with the worm wheel 22. The shaft 24 projects downwardly from a vertical motor 28 mounted in the top of the gear housing. To this end a heavy bearing collar 25 is welded into the top of the housing in position to support and receive a downwardly extending sleeve which is formed integral with the lower head 26 of the motor. The sleeve is arranged to contain ball bearings 27 for the motor shaft. A clean-out plate 29 is secured in position in the bottom of the gear housing beneath the lower end of the motor shaft 24.

An annular ratchet ring 30 is secured to the

right hand end of the drum 13 as shown in Fig. 5, and with this cooperates a pawl or dog 31 pinned to a horizontal shaft 32 journalled partly in the collar 17 and partly in a bracket 33 welded to the bottom of the gear housing. The pawl 31, as shown in Figs. 1 and 5, is shaped to engage the teeth of the ratchet ring 30 and is arranged to swing into and out of engagement with the teeth in the annular space provided by the ring. An operating arm 34 is pinned to the outer end of the shaft 32 and extends substantially horizontally beneath the gear housing 18. To the outer end of the arm 34 is connected a vertical rod 35 and this is encircled by a compression spring 36 which bears at its upper end against the bottom of the gear housing and tends at all times to rock the shaft 32 in a counter-clockwise direction and to cause the pawl to engage a tooth of the ratchet wheel 30. At its upper end the rod 35 is connected to the cam-shaped head of a plunger working in a solenoid 38. The solenoid is contained in a separate compartment formed within the gear housing and closed by a rectangular cover plate 39. Also located within the housing compartment is a switch 40 having an inwardly directed roller-carrying arm 41 arranged to be swung downwardly by the downward movement of the solenoid plunger cam 37 and to return to its uppermost or closed circuit position by spring action. The spring 36 is also powerful enough, acting through the cam 37, to swing the switch arm 41 down to open position when the solenoid is deenergized. The frame of the winch carries a pair of semi-circular guards 42 which extend above and about the flanges of the drum and are connected by spacers 43. Preferably and as herein shown, the drum, frame and housing are of welded steel construction. The housing is oiltight so that thorough lubrication of the gears may be provided by an oil bath. When designed for operating 5–10 ton booms, a 5 horsepower motor operating at approximately 850 R. P. M., reversible, compound wound and self-ventilating, has been found satisfactory for actuating the winch. The worm is mounted directly on the driving end of the motor shaft and a brake is provided on the commutator end. The brake is preferably of the solenoid-operated disk type designed for a duty of approximately 30 lb. ft. but dependent on the load being carried.

The motor 28 is operated by a master switch (see Fig. 6) which is provided with a neutral or off terminal, a right hand or hoisting terminal, and a left hand or lowering terminal. The master switch is connected to the motor by two separate lines, one leading from the right hand terminal of the switch to the hoisting terminal of the motor and the other leading from the left hand terminal of the switch to the reversing or lowering terminal of the motor. The motor 28 employs a common return line for both hoisting and lowering, and solenoid 38 is in series in said return line. Switch 40 is in series between the master switch and the motor in the line connecting the left hand switch terminal and the reversing or lowering terminal of the motor. Thus, it will be seen that when the master switch is in the neutral position neither the motor or solenoid 38 will receive current, pawl 31 will be engaged with ratchet 30 and switch 40 will be open. If the master switch is then turned to the left hand or lowering terminal, it will be seen that no circuit to the motor can be made because the switch 40 will be open. However, if the master switch is turned to the right hand or hoisting terminal, a circuit will be made through the master switch, the hoisting terminal of the motor, solenoid 38, and source of power. This will cause the motor to commence hoisting, and by energizing solenoid 38, rod 35 will be raised, disengaging pawl 31 from the ratchet ring 30 and also closing switch 40. The motor may then be reversed by flipping the master switch across neutral to the lowering terminal, and while solenoid 38 may actually de-energize momentarily, when the switch is turned promptly, there is not sufficient time for the mechanical action of rod 35 to take place, before the master switch makes contact on the lowering terminal, re-energizing solenoid 38 and thereby both retaining rod 35 in the up position and keeping switch 40 closed. On the other hand, when the master switch is left in the neutral position for a substantial period of time, solenoid 38 will be de-energized sufficiently long for the rod 35 to lower, the pawl to engage and switch 40 to open.

If the cargo boom is held by the engaged pawl in elevated position while a load is being transferred, for example, from the hold of a vessel to the dock and it is then desired to lower the boom, the master switch will be first thrown to hoisting position and then immediately to lowering position. In this way the pawl will be first disengaged and then, as above explained, maintained in disengaged position while the motor is operated in reverse to lower the boom.

Alternative control circuits for the winch are the subject-matter of my prior Letters Patent No. 2,489,832, November 29, 1949, and Letters Patent No. 2,493,005, January 3, 1950, Mahnke et al.

While the frame herein shown is constructed of steel plates welded together, it may be advantageous in some cases to employ a frame of cast metal in whole or in part, and, of course, any conventional type of anti-friction bearings may be employed in place of the roller bearings which are employed in the preferred embodiment of the invention.

Having thus disclosed my invention and described in detail an illustrative embodiment thereof, I claim as new and desire to receive by Letters Patent:

1. A topping winch comprising a vertical side plate, a main shaft journaled at one end therein and having a worm gear at its other end, an oil-tight casing enclosing said gear and supporting that end of the shaft, a vertical motor mounted on the casing and having driving connections with the shaft through its said worm gear, a drum mounted on the shaft outside said casing, an annular ratchet wheel fast to the drum, a solenoid-controlled shaft journaled beneath said casing, and a locking pawl carried thereby and movable to and from engagement with the annular ratchet wheel in the space included within the teeth of the wheel, together with a reversing switch in circuit with the motor and solenoid and a second switch in the motor circuit controlled by the solenoid whereby the pawl may be disengaged when the motor is started in hoisting direction and held disengaged while the motor is reversed for lowering.

2. A topping winch comprising a main shaft, a casing enclosing one end of the shaft and containing bearings therefor, a drum fast to the shaft outside the casing, a ratchet wheel interposed between the drum and casing, a motor

attached to the casing and having geared connections with the shaft, a separate enclosed compartment within the casing, a solenoid mounted therein, and a locking pawl movably mounted on the casing and having operative connection with the solenoid whereby the pawl may be caused to engage or disengage the said ratchet wheel, together with a reversing switch in circuit with the motor and solenoid and a second switch in circuit with the motor and having operating connections with the solenoid whereby the pawl may be disengaged when the motor is started in hoisting direction and held disengaged when the motor is reversed for lowering.

3. A topping winch comprising a gear housing carrying a motor, a drum having a shaft extending into the housing, geared connections in the housing between the motor and the drum shaft, a ratchet wheel movable with the drum, a cooperating pawl movable to lock and unlock the ratchet wheel and drum, a master switch for reversibly controlling current to the motor, a second switch in the motor circuit, and a solenoid in circuit with the master switch having connections with the pawl and also with the second switch for simultaneously disengaging the pawl and causing the motor switch to close, whereby the motor may be started in hoisting direction simultaneously with the disengagement of the pawl and then reversed while the pawl is maintained disengaged and the motor operates in lowering direction.

4. A topping winch comprising a casing in which are assembled in cooperative relation a

motor, a hoisting drum geared to the motor, and pawl and ratchet mechanism for locking and unlocking the drum, together with a reversing switch in the motor circuit, a solenoid in circuit with the reversing switch and having connection with said pawl, and a second switch also in the motor circuit and having connection with the solenoid, whereby the pawl may be disengaged when the motor is started in hoisting direction and held disengaged when the motor is reversed for lowering.

5. A topping winch as described in claim 4 in which the solenoid has a train of mechanism connecting it to the pawl for retracting the same, and a cam head for controlling the said second switch in the motor circuit whereby the pawl may be disengaged by action of the master switch while the winch is operated both for hoisting and lowering.

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