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WINCH

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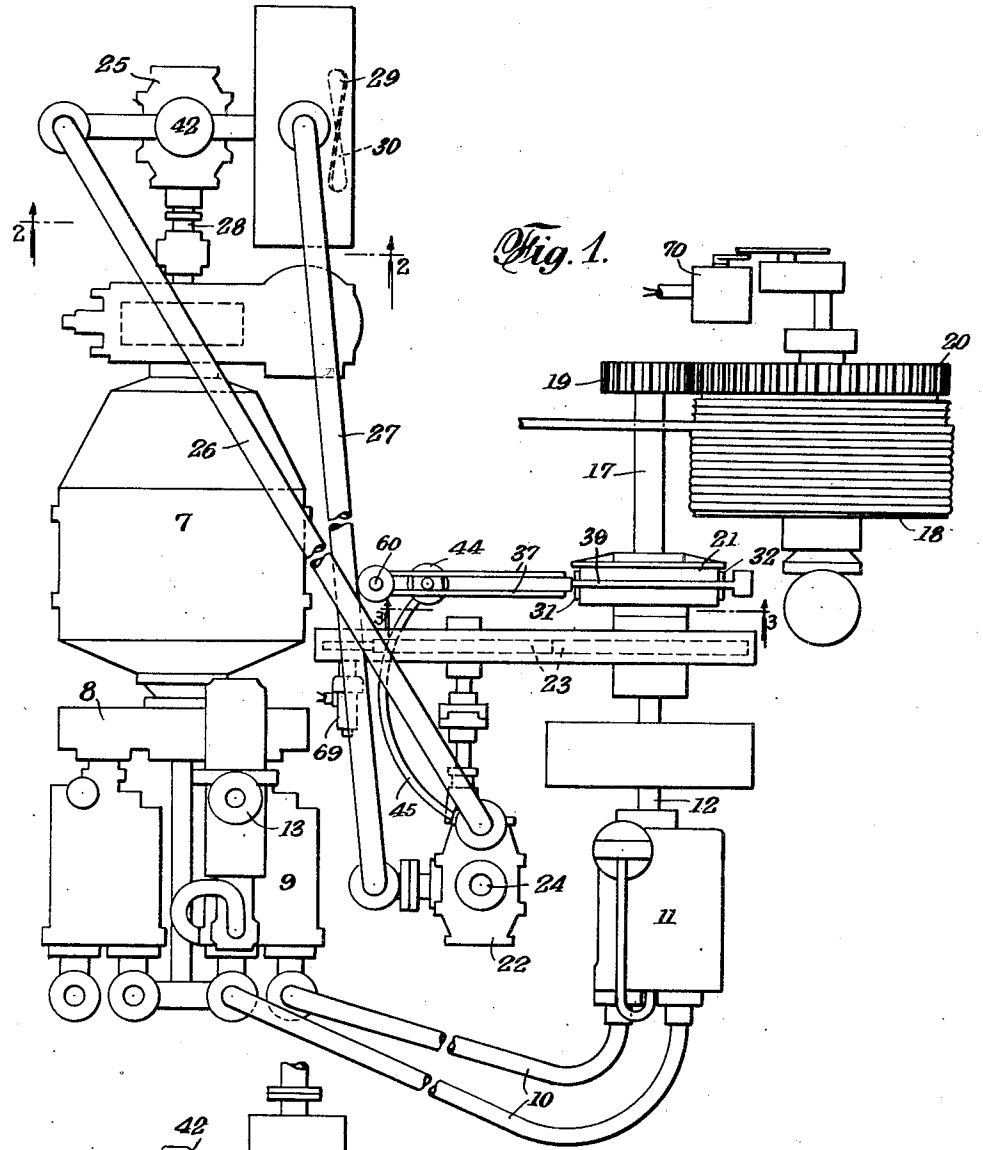


Fig. 1.

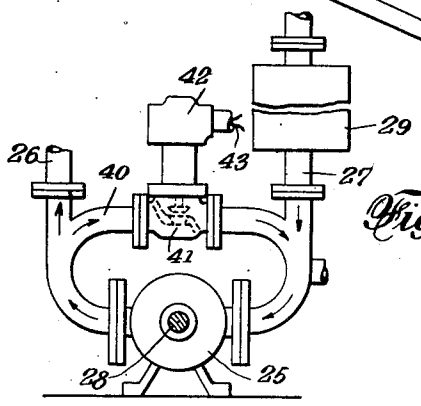


Fig. 2.

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Fig. 3.

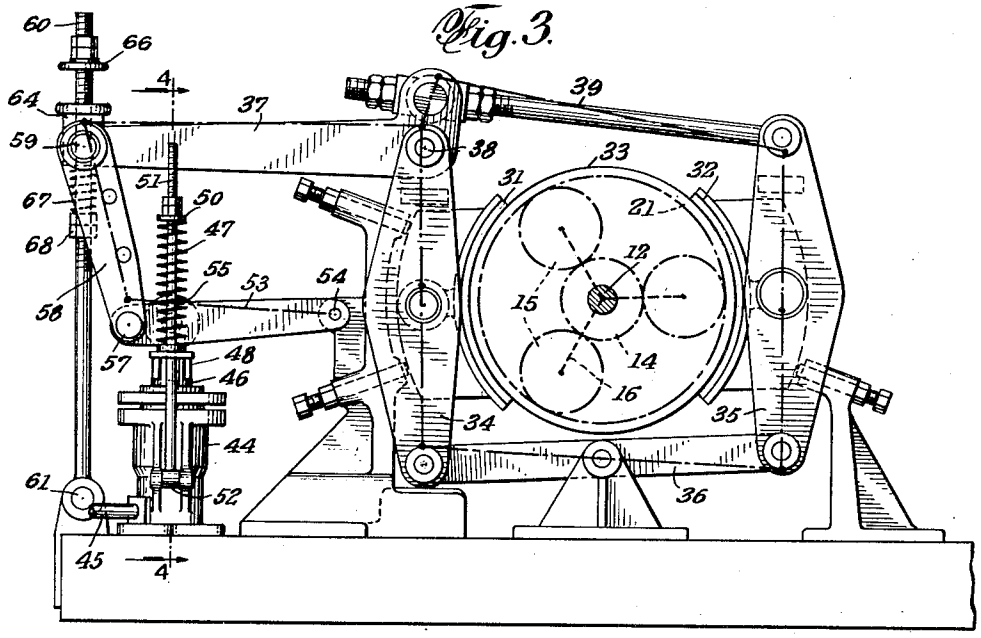


Fig. 4.

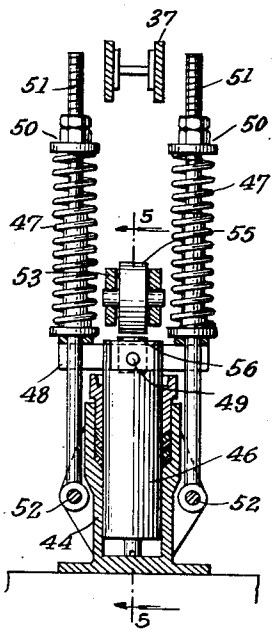


Fig. 5.

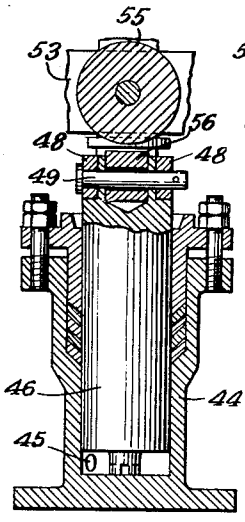
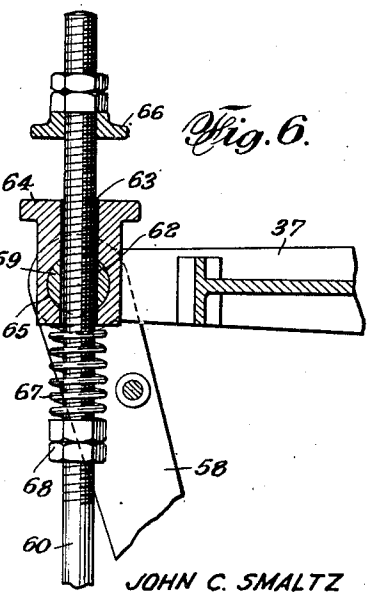


Fig. 6.



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Fig. 7

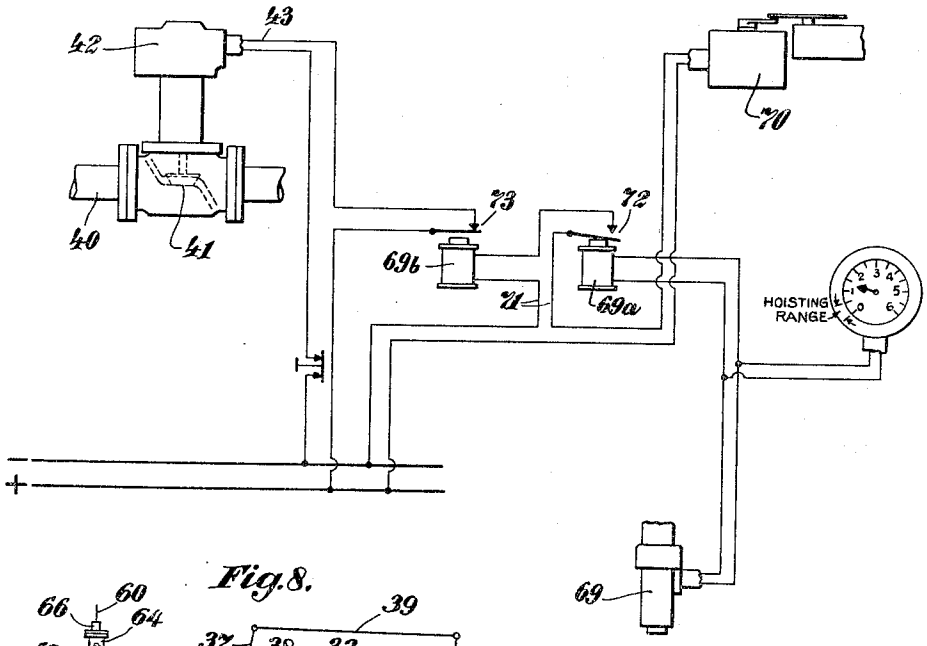
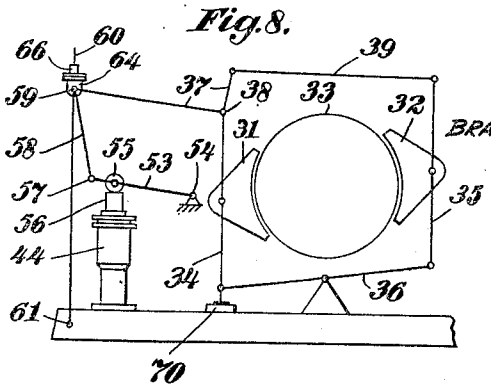
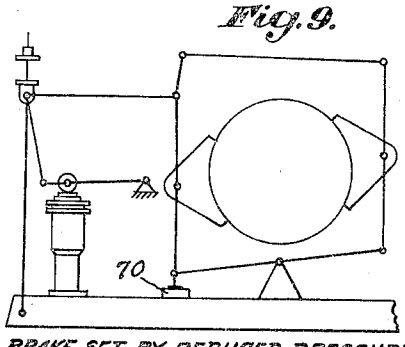


Fig. 8.



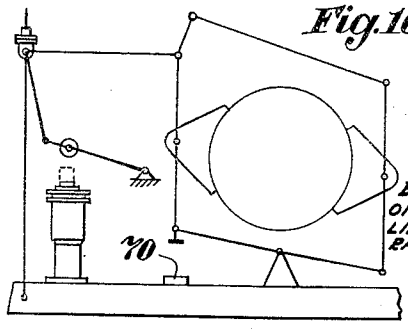
BRAKE RELEASED BY RAM.

Fig. 9.



BRAKE SET BY REDUCED PRESSURE IN RAM.

Fig. 10.



BRAKE SET WITH LOAD ON LINE ROTATING BRAKE LINKAGE CLEAR OF RAM CONTROL

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2,256,154

WINCH

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Application October 15, 1938, Serial No. 235,205

11 Claims. (Cl. 254—172)

This invention relates to winches and particularly those of the type covered in co-pending Patents 2,163,231, June 20, 1939, and 2,178,305, October 31, 1939.

In the type of winch referred to the drum carrying the line is driven through the medium of a differential gear set and the reaction element of the gear set is arranged to drive a brake pump or other rotary braking device, which thus acts then to constantly limit the turning effort applied to the drum. Conversion from this constant tensioning to load hoisting can then be effected by simply holding the reaction element so that the full power of the operating motor will be applied to the driving of the drum.

The present invention is concerned particularly with the conversion from constant tensioning to load hoisting and vice versa.

Special objects of the invention are to simplify and improve the mechanism for accomplishing the change-over from constant tensioning to load hoisting and to conserve power, by utilizing energy present in the machine.

Other purposes and desirable results will appear in the course of the following specification.

The accompanying drawings illustrate one of the practical commercial embodiments of the invention. Structure, however, may be modified and changed, as regards this particular disclosure, all within the true intent and broad scope of the invention as hereinafter defined and broadly claimed.

Figure 1 is a broken plan view of the winch.

Figure 2 is a sectional end view of the booster pump which is connected with the brake pump, showing the valve means which controls flow and pressure generated by the booster pump, this view being taken as on approximately the plane of line 2—2 of Figure 1.

Figure 3 is a cross sectional view as on substantially the plane of line 3—3 of Figure 1, showing in particular the differential brake and the pressure cylinder by which the same is controlled from the booster pump.

Figure 4 is a vertical sectional detail of the control cylinder, taken on substantially the plane of line 4—4 of Figure 3.

Figure 5 is an enlarged sectional detail as on line 5—5 of Figure 4.

Figure 6 is a broken part sectional detail illustrating the means for yieldingly supporting the outer end of the main brake lever.

Fig. 7 is a circuit diagram.

Fig. 8 is a diagrammatic view of the differential brake mechanism during constant tensioning with pressure in the ram holding the brake shoes released.

Fig. 9 is a similar view showing how with reduction of pressure the control ram drops the brake shoes into engagement with the brake drum and Fig. 10 is a further view showing how with load on the line the drum will rotate the brake shoes and linkage to lock the brake in the set condition, clear of control, for the time, by the ram.

In the installation illustrated motive power is provided by an electric motor 7 driving through reduction gearing at 8, a manually and pressure controlled, variable speed and reversible hydraulic pump or A end 9 connected by piping 10 with a variable speed reversible, hydraulic motor or B end 11 of the automatic pressure regulated stroke type operating drive shafting 12.

As disclosed in Patent 2,178,305, the A end is controllable by a hand wheel 13 to start, stop, reverse and run the B end at different speeds and the two units are automatically regulated by increase in pressure in the hydraulic system occurring at the start of hoisting operations to change from high speed tensioning to slower speed load hoisting operation.

Also, in the present disclosure, the differential gear set is of the same design as shown in the patent referred to; that is, a pinion 14 on the drive shaft 12 in mesh with planetary pinions 15 carried by a spider 16, having a shaft 17 driving the drum 18 through gears 19, 20, said planetary pinions riding a ring gear 21 constituting the reaction element of the combination.

Constant tensioning is effected, as in the patent, by driving a brake pump 22 from the reaction member of the differential gear set through a line of gearing such as indicated at 23, said brake pump having a regulatable relief valve at 24 by which the pump pressure and hence the tensioning effect on the line can be predetermined.

To make up for leakage losses in the brake pump at low speeds there is provided in the present disclosure, as in the previous patent, a booster pump 25 connected with the brake pump by lines 26, 27. This booster pump is shown as constantly driven at 28 direct from the main power source, the motor 7. A radiator 29 equipped with fan 30 is shown interposed in the line 27 for dissipating heat generated by the brake pump during periods of constant tensioning.

Holding of the reaction element to change-over from constant tensioning to load hoisting

is effected, the same as in the patent, by means of a brake, of the self-energizing type consisting of brake shoes 31, 32, Figure 3, engageable with the outer brake drum periphery 33 of the internal gear reaction element 21, said brake shoes being pivotally carried by levers 34, 35, pivotally supported on a rocker 36 and adapted to be drawn together or separated by a bellcrank lever 37 pivoted at 38 on lever 34 and having the crank arm of the same connected by a link 39 with the upper end of the other brake shoe lever 35. Lowering of the outer end of bellcrank lever 37 will set the brake and conversely the raising of this lever will open or release the brake.

During tensioning operations the booster pump is effective in making up leakage and resulting loss in pressure in the brake pump, enabling the brake pump to hold the line under proper tension, even at low speed operation. In load hoisting, however, when the reaction member of the differential is held by brake 31, 32 and the brake pump driven from said reaction member is stationary, the supplementing pressure of the booster pump is not required and the flow generated by the booster pump accordingly may be bypassed through a passage 40 connecting opposite sides of the pump, Figure 2. Control of this bypass is effected in the illustration by a valve 41 operated by magnet 42.

The booster bypass valve magnet 42 may be controlled automatically as disclosed in co-pending Patent 2,178,305, or be manually controlled, as desired. In either event, when the valve is open as would result from interruption of the magnet circuit, represented at 43, the booster pump. driven continuously from motor 7, will simply circulate liquid idly through bypass 40. When, however, this valve is closed, as during tensioning operations of the winch, the booster pump will add its circulation to make up leakage losses in the brake pump, aiding the latter to maintain substantially constant tension on the line.

The change from one condition to another, that is, from pumping the liquid in an idle bypass circuit to pumping against the flow from the brake pump and vice versa, results in substantially instantaneous changes of pressure.

These changes are in proper order and value to afford desired control of the reaction element for conversion from tensioning to load hoisting and vice versa and the present invention accordingly involves the practical utilization of such changing pressures.

The mechanism required for such purposes is relatively simple consisting in the present disclosure of a small power cylinder 44, connected by piping 45, with the pressure line 26 from the booster pump and having within it a piston or plunger 46, arranged to raise and hold the brake lever 37 in a brake released position.

To hold the plunger 46 in the lowered position, against such pressure as may be developed by the booster pump when it is idly circulating liquid through the bypass 40, springs 47, are shown bearing down on cross bars 48, pinned to the upper exposed end of the plunger at 49, the force of such springs being regulated by tension adjusting nuts 50, on the bolt rods 51, fastened to the power cylinder at 52.

The upward brake releasing movement is imparted to the brake lever in the illustration through the medium of a pair of levers 53, fulcrumed at 54, on the brake base structure, carrying between them a roller 55, resting on thrust member 56, on the plunger pin 49, the free ends of said levers having pivoted to them at 57, the spaced links 58, engaged with the ends of a pivot bolt 59, mounted to rock in the end of brake lever 37.

Action of the brake lever 37 is governed in the illustration by a bolt rod 60, pivoted on the base at its lower end at 61, and extending freely up through a bore 62, in the pivot pin 59, and through a corresponding bore 63, in the tubular guide 64, which as shown in Fig. 6, is sleeved over the pivot pin at 65.

An adjustable stop 66, at the upper screw-threaded end of the rod 60, serves when engaged by the upper end of sleeve 64, to limit the upward brake releasing movement of lever 37. A spring 67, supported on rod 60, by the adjustable abutment 68, provides a rest for cushioning the action of the lever in the lowering brake setting movement.

In operation, the booster pump 25, turns with the drive motor 7, and hence is in rotation while the machine is running. During constant tensioning, the bypass valve 41, is closed as indicated in Fig. 7, held so by magnet 42, or other means of control, and hence the booster pump supplements the pressure developed by brake pump 22, making up for normal leakage losses in the brake pump and enabling the latter to maintain proper tensioning of the line even during low speed operation of the brake pump.

The ram or power cylinder 44, being connected by piping 26, 45, with the pressure sides of the booster pump and brake pump is subjected to the combined pressure of these two pumps and the parts are so constructed and arranged that this pressure will be amply sufficient to lift the brake lever 37, through the connections 53, 55, 58, and to hold it in the brake released position indicated diagrammatically in Fig. 8. During tensioning therefore, the differential brake 31, 32, will be held released and the brake pump be operated from the outer reaction element of the differential gear set to maintain constant tension on the line, determined by the setting of the brake pump control valve 24.

The changeover from tensioning to load hoisting, as disclosed in Patent 2,178,305 may be controlled automatically or be under manual control, or a combination of both. For automatic control, a generator 69, may be used, operated by the gearing 23, driven from the reaction member of the differential gear set and connected to a no-voltage relay 69', 69*a*, Fig. 7, controlling the valve magnet 42. This control of the magnet valve is effected through the medium of a relay 69*b* interposed in a circuit 71, which is held open at 72, by the sensitive no voltage relay 69*a*. In series in this same circuit is a limit switch 70, which closes when a predetermined length of line is wound on the drum. Then, with the reaction member stationary or nearly so, as occurs when the line speed of the drum and the driving speed of the B-end are in synchronism and with a predetermined number of turns of line on the drum, the no-voltage control relay will be de-energized to permit closing at 72 of circuit 71, thus to cause relay 69*b* to break the magnet valve circuit at 73 to open the bypass of the booster pump. Opening of this bypass accomplishes an instant drop in pressure in the hydraulic circuit. The power cylinder, subjected to this pressure reacts immediately, lowering brake lever 37, as indicated in Fig. 9 to set the differential brake and hold the reaction member.

With load on the line and hence tendency of the drum to rotate in clockwise direction, the brake shoes will be rotated to the extent indicated, thus to lift the link or post 34 off its rest or stop 70 and through the linkage 39, 35, 36, set the brake shoes against the drum to an extent determined by the sleeve 64, at the end of lever 37, coming up against the stop 66. In this action, the raising of the lower lever 53, lifts the roller 55, clear of the ram and beyond the reach of the ram piston so that even if pressure were inadvertently admitted to the ram, it is under such conditions with load on the line unable to effect release of the differential brake. Hence danger of accidently dropping the load through admission of pressure to the ram is avoided. As soon however as the load is landed or taken off the line and the tendency of clockwise rotation is absent in the drum, the weight of the parts will rotate the brake shoes and brake linkage back to the Fig. 9 position, where the ram or pressure cylinder is again in control, either to leave the brake set as in Fig. 9, or to release the brake, as for constant tensioning as in Fig. 8. Under hoisting conditions therefore, the differential brake will remain set and free from control of the pressure cylinder and this condition will continue so long as the load is on the line, insuring safe handling of the load in raising, transporting and lowering the same to supported condition. With load off the line and the parts as represented in Fig. 9, with brake set, the winch may be controlled to raise or lower the empty hook, as for attachment of the next load.

Indication of the synchronous relation of hoisting and driving speeds may be provided, as in Patent 2,178,305 by pointers or lights or other forms of signals. Such signals are of particular value where manual control is used, enabling the operator to readily shift over from tensioning to load hoisting at a time when the drum is turning at maximum speed in the hoisting direction.

In all the several forms of control which may be used, the hydraulic ram provides a simple, direct, safe, reliable, positive and quick acting means for translating changes in pressure resulting from conversion of the booster pump from assisting to not assisting the brake pump, to afford control of the differential brake. This form of pressure controlled hydraulic power unit is particularly well adapted for use in airplane winches, but is not confined to this particular use. One important advantage is that no heating or loss in efficiency results from operation over extended periods of time, as in constant tensioning for mooring an airplane, boat or other object.

When the brake pump is stationary, the pressure is that produced by the booster pump alone. In any event, the available pressure is that predetermined by the setting of the regulating valve on the brake pump, designed for maintaining a certain constant pressure and thus constant tension.

The spring 67, in addition to forming a cushioning rest for the brake lever 37, has the important function of balancing the weight of the overhanging parts 53, 56 and 37. The balancing of these parts permits a light load to revolve the brake in a clockwise direction, Fig. 10, and thus to make it impossible then for the hydraulic cylinder to release the brake. This is particularly important as overcoming any possibility of dropping the load, should the cylinder 44 be provided with pressure by inadvertent or accidental energizing of solenoid 42, to close the bypass around the booster pump. The load on the hoist line with the brake closed as in in Fig. 9 has the effect of rotating the internal gear 33, in clockwise direction, which movement produces an upward movement of link 34, which then carries with it linkage 53, to remove the latter out of the range of movement of the plunger of hydraulic cylinder 44. Thus the brake can not be released by this power cylinder when a load is on the line. As the tensioning operation applies a pull usually of approximately 500 lbs. then with a 500 lb. load on the line, the brake will revolve as described, to prevent release and insure a safe condition for load hoisting.

What is claimed is:

1. In apparatus of the character disclosed, the combination of a hoisting drum, a brake pump, a motor, differential drive gearing from said motor to said drum and brake pump, including a driving member operated by said motor, a driven member operating said drum and a reaction member arranged to drive the brake pump, a brake for holding said reaction member, pressure responsive means for controlling said brake, a booster pump, means for transmitting the pressure created by said booster pump to said brake pump and for relieving said brake pump of said booster pump pressure and pressure connections from said booster pump to said pressure responsive means.

2. In apparatus of the character disclosed, the combination of a hoisting drum, a brake pump, a motor, differential drive gearing from said motor to said drum and brake pump including a driving member operated by said motor, a driven member operating said drum and a reaction member arranged to drive said brake pump, a brake for holding said reaction member, a power cylinder, a piston therein positioned to operate said differential brake, a booster pump and pressure supply connections from said booster pump to said brake pump and to said power cylinder and piston.

3. A winch of the character disclosed, comprising in combination, a motor continuously running while the winch is in operation, a booster pump driven by said motor, a fluid transmission including an A-end driven by said motor and a B-end operated from said A-end, a hoisting drum, a brake pump, differential drive gearing from said B-end to said drum and brake pump including a drive member operated by said B-end, a driven member operating said drum and a reaction member operating said brake pump, a brake for holding said reaction member, a pressure controlled hydraulic power unit for operating said differential brake, pressure connections between said booster pump and brake pump and a pressure conduit from said pressure connections to said pressure controlled power unit.

4. A winch of the character disclosed, comprising in combination a hoisting drum, a driving motor, a brake pump, differential drive gearing including a driving member operated by said motor, a driven member operating said drum and a reaction member operating said brake pump, a brake for holding said reaction member, a booster pump connected with said brake pump, a pressure controlled hydraulic power unit connected with said booster pump, brake controlling means actuated by said power unit upon increase of pressure to effect release of said

brake and said brake being self-energizing upon decrease in pressure.

5. In apparatus of the character disclosed, the combination of a motor, differential drive gearing including a drive member operated by said motor, a driven member and a reaction member in connection with said driving and driven members, a brake pump operated by said reaction member, a booster pump connected with said brake pump, a brake for holding said reaction member, controllable means for by-passing flow created by said booster pump in a closed circuit, to thereby relieve said brake pump of fluid pressure created by said booster pump, a pressure controlled hydraulic power unit connected with said booster pump and means operable thereby to effect control of said reaction member holding brake.

6. In apparatus of the character disclosed, the combination of a motor, differential drive gearing including a drive member operated by said motor, a driven member and a reaction member in connection with said driving and driven members, a brake pump operated by said reaction member, a booster pump connected with said brake pump, a brake for holding said reaction member and a pressure controlled hydraulic power unit connected with said booster pump and arranged to effect control of said differential brake, said connections between said booster pump and brake pump including a by-pass and means for controlling same and said pressure controlled power unit being connected at one side of said by-pass.

7. In combination, a hoisting drum, a motor for operating same, differential gearing interposed between said motor and drum, including interconnected driving, driven and reaction elements, said driving element being operated by said motor, said driven element being connected to operate said drum, a fluid pressure brake pump connected for operation by said reaction element, a brake for holding said reaction element stationary, a fluid pressure cylinder and piston combination, brake controlling means controlled by said fluid pressure cylinder and piston combination arranged to control operation of said reaction element holding brake, a fluid pressure connection from said reaction element driven brake pump to said fluid pressure cylinder and piston combination and means for effecting a control of the fluid pressure in said fluid pressure connection from said brake pump to said cylinder and piston combination to thereby effect control of said brake for holding the reaction element stationary.

8. In apparatus of the character disclosed, the combination of a motor, differential drive gearing including a drive member operated by said motor, a driven member and a reaction member in connection with said driving and driven members, a variable pressure generating rotary braking member operated by said reaction member, a brake for holding said reaction member, a pressure responsive device for controlling said reaction member holding brake and pressure transmitting connections between said variable pressure generating member and said pressure responsive brake controlling member.

9. In apparatus of the character disclosed, the combination of a motor, differential drive gearing including a drive member operated by said motor, a driven member and a reaction member in connection with said driving and driven members, a variable pressure generating rotary braking member operated by said reaction member, a brake for holding said reaction member, a pressure responsive device for controlling said reaction member holding brake, pressure transmitting connections between said variable pressure generating member and said pressure responsive brake controlling member, said reaction member holding brake including a brake drum operated by said reaction member, cooperating brake shoes and linkage connecting said brake shoes and shiftable in one direction with said brake drum, means operated by the driven member of said differential drive gearing and operative through said reaction member to impart rotative movement to the brake drum in said direction and said pressure responsive control device being connected with said brake through connections adapted to be interrupted by said rotary movement imparted by the brake drum to said brake linkage.

10. In a winch having a drum, a motor and an interposed differential gear set between the motor and drum, said differential gear set including a driving member operated by said motor, a driven member operating said drum and a rotatable reaction element connected with said driving member, a self-energizing brake for said reaction element, including a brake drum operated by said reaction element, brake shoes engageable with said brake drum, linkage connecting said brake shoes and shiftable in one direction with said brake drum to automatically effect the self-energizing holding of the brake drum by said brake shoes, a brake releasing lever connected with said brake linkage and movable by said linkage in said self-energizing action of said brake, a brake releasing device and interruptable connections between said brake releasing device and said brake releasing lever including relatively separable members, one connected with said brake linkage through said brake releasing lever and the other actuated by said brake releasing device, the latter member having a limited movement and said first member having a movement in said self-energizing movement of said brake linkage out of the range of reach of said second member and whereby said device will be ineffective to release the reaction element brake when self-energized as described.

11. In a winch, the combination of a drum and motor, an interposed differential gear set between said motor and drum, including a driving member operated by said motor, a driven member operating said drum and a reaction element connected with said driven member, a self-energizing brake for holding said reaction element and including a brake drum operated by said reaction element, brake shoes engageable with said brake drum, linkage connecting said brake shoes and shiftable in one direction with said brake drum to effect the self-energizing cooperation of said brake shoes with said brake drum, a brake releasing lever connected with said linkage and shiftable by said linkage in said self-energizing movement of said linkage, a fluid pressure actuated piston and interruptable operating connections between said piston and brake releasing lever, including cooperable connecting members partly carried by said linkage and separable by said shifting of the linkage in said self-energizing movement of the same and whereby said piston will be ineffective to accomplish release of the brake after self-energizing action of the same.

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