June 27, 1961 A. H. WILKINSON 2,990,136

AUTOMATIC SPOOLING OR REEVING DEVICE

Filed Feb. 20, 1958 3 Sheets-Sheet 1

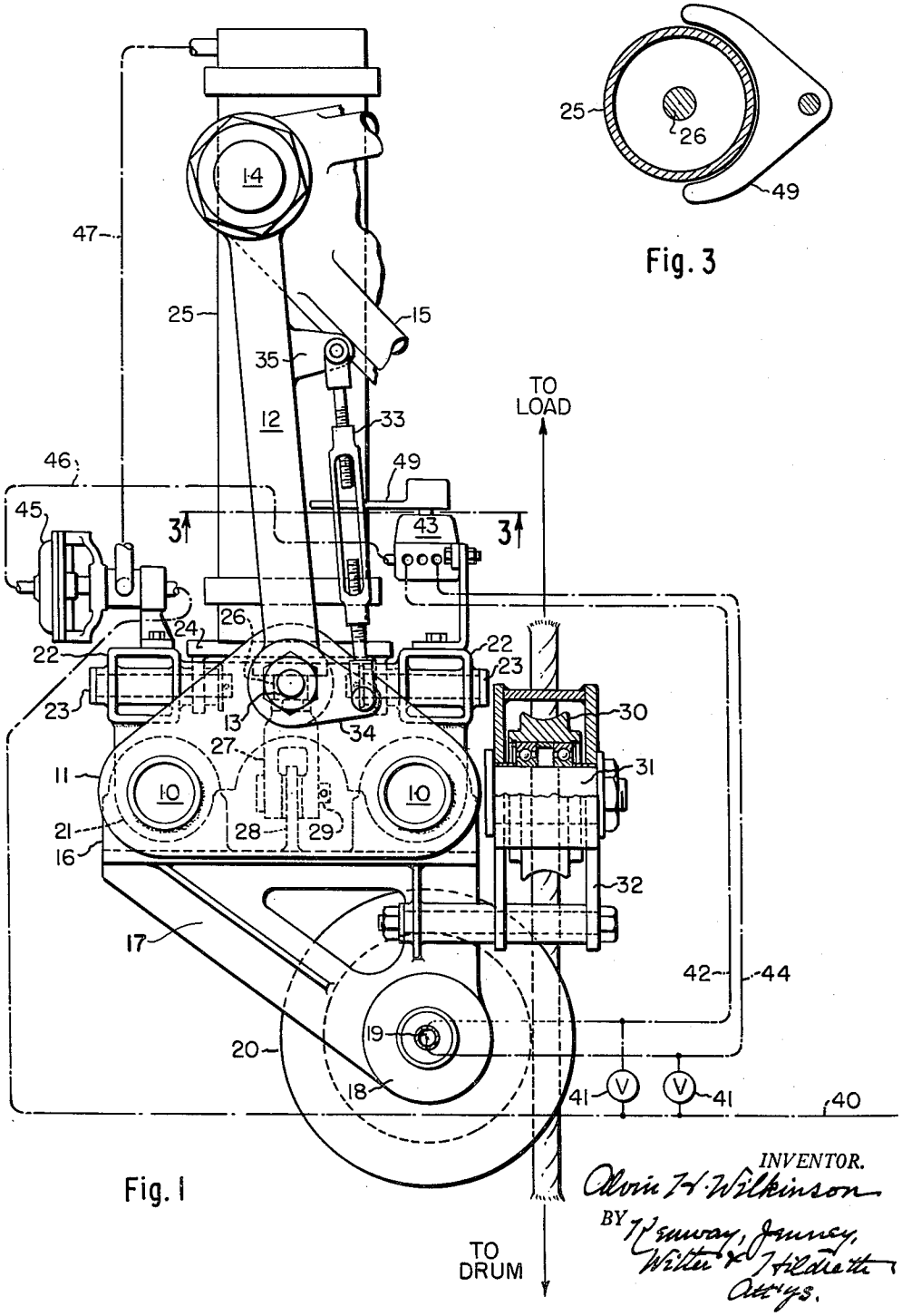


Fig. 1

Fig. 3

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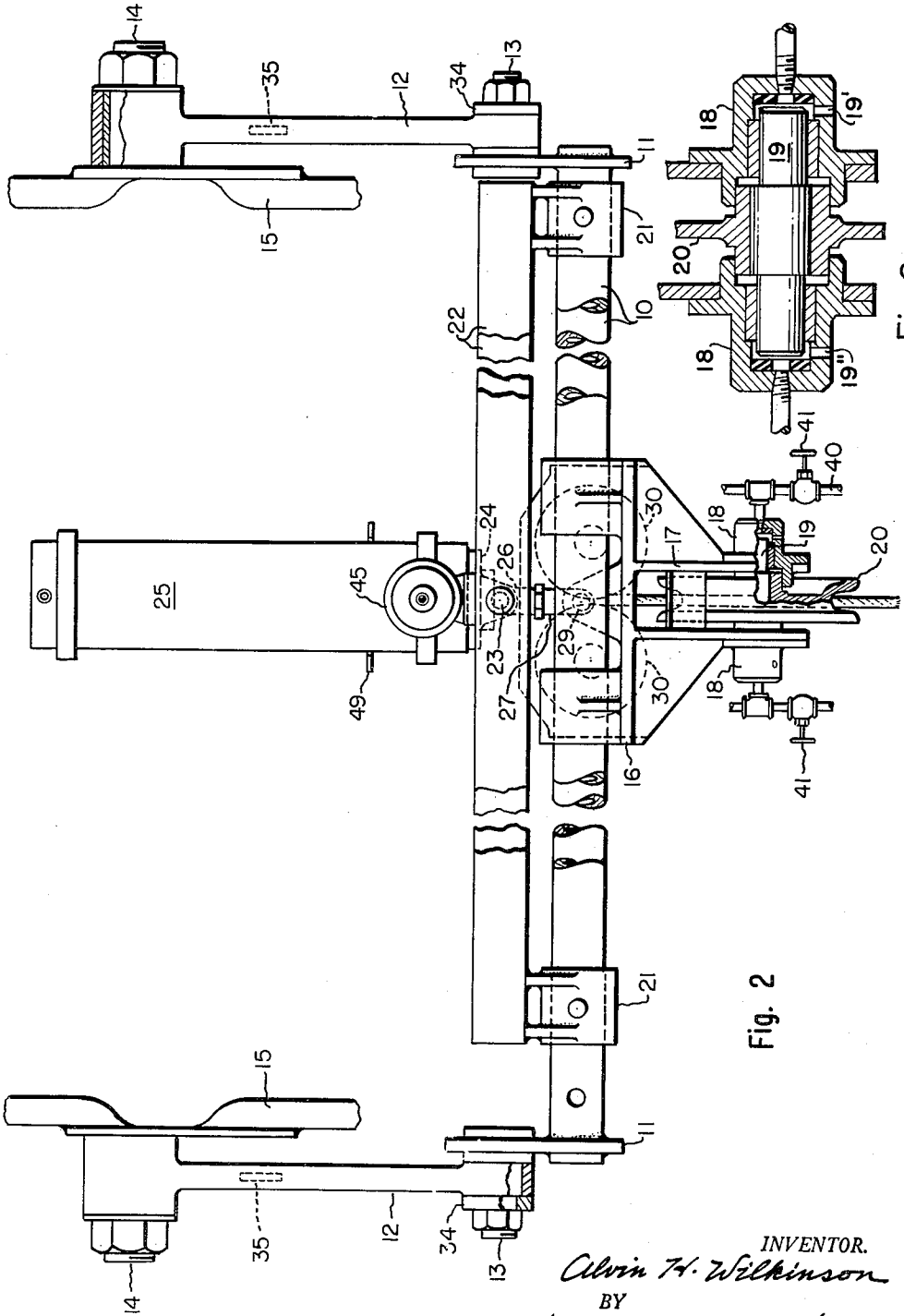


Fig. 2a

Fig. 2

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Fig. 4

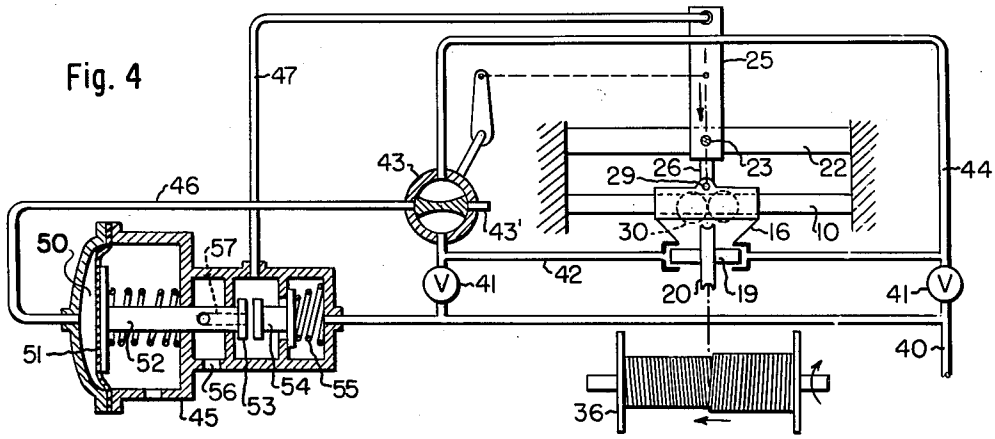


Fig. 5

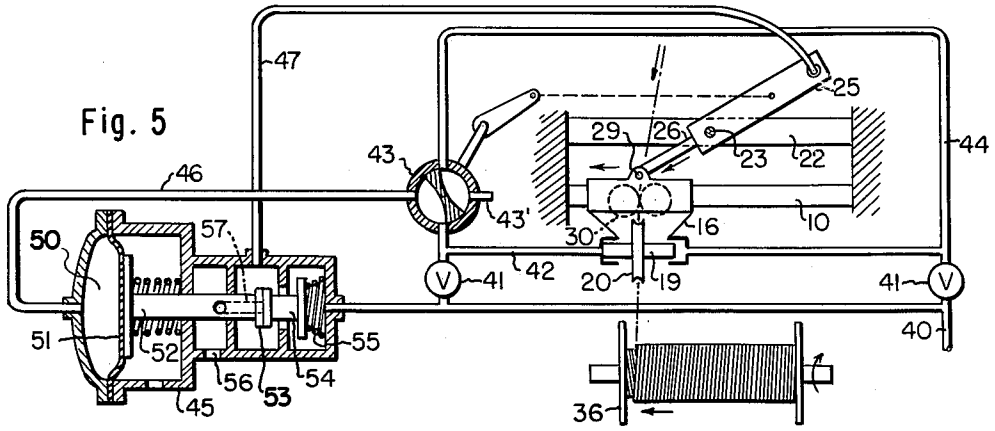
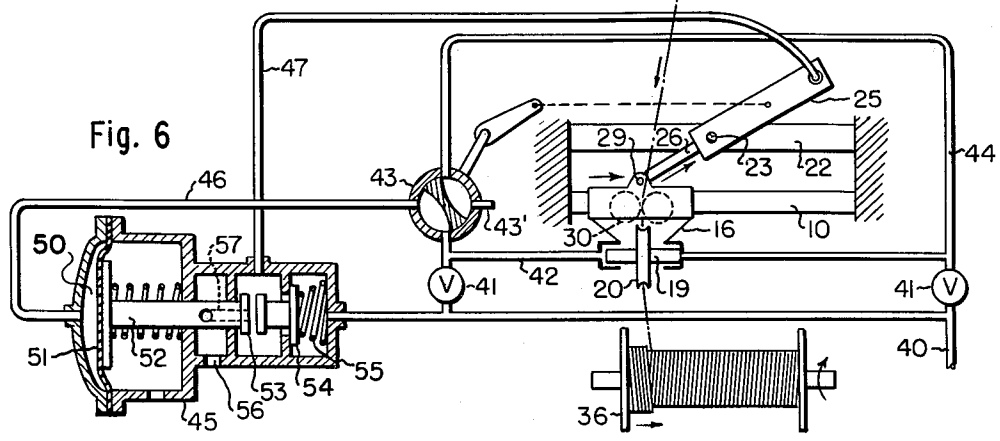


Fig. 6



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AUTOMATIC SPOOLING OR REEVING DEVICE

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13 Claims. (Cl. 242—157.1)

This invention relates to hoisting and towing apparatus and comprises a new and improved spooling or reeving device operating automatically to facilitate level winding of the cable on a drum.

It is the practice to wind cable on a drum in transmitting power for hauling, hoisting or towing, and in such work it is important that the cable should be properly wound on the drum. Since the cable leading from the load usually travels in a predetermined direction and the drum on which it is to be wound has appreciable length, the angle of approach of the cable to the drum will vary. The angle between the cable and a line perpendicular to the axis of the drum at the winding point is called the fleet angle. When the fleet angle is excessive it causes scuffing of the cable approaching the drum against the cable that is already wound thereon. As the cable pull on the drum is exerted over an increasing fleet angle, a corresponding increase in side thrust will develop. This not only causes objectionable wear on the cable but may become so excessive as to deflect the level winding of the approaching cable and cause it to jump the cable already wound. The result is uneven winding and piling up of the cable that may cause jamming of the winch and interruption of its operation.

In one aspect the present invention comprises a spooling device constructed and arranged to overcome the ill effects of an unfavorable fleet angle. It includes an assembly of components providing a source of power to oppose the lateral thrust of the cable due to the fleet angle and take it off the drum and the cable wound thereon. It also includes means for sensing the fleet angle and thereby controlling the force required to oppose the increasing or decreasing lateral force due to varying fleet angles.

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

FIG. 1 is a view in end elevation showing certain parts in section and connections indicated diagrammatically,

FIG. 2 is a similar view in front elevation,

FIG. 2*a* is a detail view of the valve of the sensing element,

FIG. 3 is a fragmentary detail view, and

FIGS. 4–6 are diagrammatic views showing the device in different operative positions.

As herein shown the components of the device are mounted on a stationary but adjustably supported frame comprising horizontally disposed parallel guide tubes **10**, arranged one above the other as shown in FIG. 2 and fixed at their opposite ends in triangular plates **11**. The plates **11** are pivotally connected to the free ends of parallel arms **12** by bolts **13**. The arms **12** are connected at their other ends by bolts **14** to a stationary frame including tubular arms **15** upon which the device as a whole is mounted. The bolts **14** are disposed in axial alignment and in the horizontal axis about which the arms **12** may be rocked in making a preliminary adjustment of the spooling device to the conditions under which it is to be operated.

A carriage **16** is arranged to slide freely upon the horizontal guide tubes **10** and is provided with a downwardly extending bracket **17** having bearings **18** for a solid shaft

19 to which is secured a grooved pulley **20** constituting the sensing element of the device. The shaft **19** is not only rotatable in the bearings **18** but axially movable therein so that it may serve the function of a valve as will be presently explained.

The guide tubes **10** are provided at opposite ends with collars **21** having flanges which are welded or otherwise secured to a pair of parallel tubes **22** square in cross-section and located above or behind the guide tubes **10**. The collars **21** are fixed to the guide tubes **10** by clamping screws and may be adjusted longitudinally in order properly to locate the supporting tubes **22** to the best advantage under the current operating conditions.

In each of the supporting tubes **22** is formed a socket for a hinge pin **23** and these are located in alignment with each other as best shown in FIG. 1. A fluid pressure cylinder **25** having a head **24** is pivotally connected to the hinge pins **23** by perforated lugs thus permitting the cylinder to swing from right to left as shown in FIG. 2. The cylinder is provided with a piston and piston rod **26** having a head **27** and this is pivotally connected to a lug **28** on the carriage **16** by means of a pivot pin **29** disposed in parallel relation to the pivot pin **23** of the cylinder head. It will be apparent from the description thus far that if the carriage **16** is moved in either direction, shifting the pivot **29** with respect to the pivot **23**, the cylinder **25** will be correspondingly rocked in one direction or the other.

The carriage **16** is provided with a pair of opposed guide pulleys **30** each mounted by ball bearings on a shaft **31** secured in a bracket **32** which is fast to the carriage **16**. The cable passes into the spooling device between the pulleys **30** and is guided by them as it then passes to the sensing pulley **20** and thence to the winding drum.

As above explained the spooling device may be bodily adjusted by swinging the arms **12** about the stationary axis of the pivot bolts **14**. Provision for a supplementary fine adjustment is made by connecting a turnbuckle **33** between a short arm **34** splined to the pivot bolt **13** and an arm **35** projecting from the left hand arm **12** as shown in dotted lines in FIG. 2. It will be seen that by shortening the turnbuckle **33** the spooling device will be rocked in a counter-clockwise direction about the axis of the pivot bolts **13**. This supplementary adjustment is useful in bringing the sensing pulley **20** into engagement with the cable as it passes from the guide pulleys **30** to the winding drum **36**.

Actuating fluid pressure in the form of compressed air is supplied through the system of pipes **40** to valve seats in the bearings **18** at both ends of the shaft **19**. Air flow may be manually regulated by the valves **41** located in the pipe connections shown diagrammatically in FIGS. 4–6. An outlet pipe **42** extends from the left valve seat to a relay selector valve **43**, and a corresponding pipe **44** extends from the right valve seat to the same valve. The relay valve **43** is arranged to actuate the main power valve **45** and this is provided with a flexible outlet pipe **47** which leads to the outer end of the cylinder **25**.

In initially setting up the spooling device for operation the carriage **16** is brought into substantially central position and the sensing pulley **20** is adjusted to engage the cable as it passes directly from the guide pulleys **30** of the carriage to approximately central position on the drum **36**. Under these conditions compressed air supplied by the system **40** is allowed to escape at both ends of the shaft **19** through outlet vents **19′** and **19″** in the bearing **18**. No pressure is transmitted to the relay valve **43** which remains in closed position as indicated in FIG. 4.

If now the winding of the cable on the drum **36** proceeds so that the sensing pulley **20** is moved toward the left, the shaft **19** is moved to the left, as suggested in FIG.

5, the right hand valve is opened to the atmosphere through the vent 19' and the left hand valve operated to direct compressed air to the relay valve through the pipe line 42 thus initially opening the relay valve 43. At the same time the carriage 16 is moved toward the left by the pull of the cable and the power cylinder 25 is rocked toward the right into some such position as shown in FIG. 5 by the relative movement of the pivots 23 and 29. Further opening of the relay valve 43 is caused by the swing of the cylinder acting through an encircling yoke 49 connected to the spindle of the valve as shown in FIG. 3.

Fluid pressure is now transmitted to the power valve 45 through the pipe line 46 and the full pressure of the system transmitted through the pipe line 47 to the outer end of the cylinder 25 with the result that the piston is advanced and the carriage 16 forcibly moved toward the left, thus reducing the fleet angle and improving the lead of the cable to the drum 36 as suggested in FIG. 5.

The power valve 45 has a pressure chamber 50 divided by a diaphragm 51 which engages the head of a spring-pressed plunger 52 guided for longitudinal movement in the body of the valve. The valve 45 has a tubular portion separated into three sections of which the innermost has an outlet 56 to the atmosphere and the intermediate section contains a flat head 53 at the end of the plunger 52 and the opositely disposed head a valve body 54. The third section contains a compression spring 55 and an inlet opening for connection with the supply piping system 40.

Initially the spring 55 holds the valve body 54 in closed position with all communication cut off between the outer and intermediate sections of the valve. However, when the relay valve 43 is opened as above explained by endwise movement of the shaft 19, pressure against the diaphragm 51 moves the plunger 52 to the right as seen in FIG. 5 and moves the valve body 54 against the spring 55 to open position so that the full pressure of the system is admitted to the pipe line 47 and the cylinder 25.

The stem of the plunger 52 contains a longitudinal passage 57 opening into the innermost section of the valve body which has the outlet 56 and at its other end in the head 53. Thus, when fluid pressure is being transmitted to the pipe line 47, the passage 57 is closed as shown in FIG. 5. On the other hand, when the diaphragm 51 is not subjected to fluid pressure transmitted through the pipe line 46, the plunger 52 is moved by its spring into position to open the passage 57 so that fluid pressure from the cylinder 25 may be exhausted to the atmosphere through the passage 57 and the outlet 56, all as suggested in FIG. 6.

The device is thus set for operation as required when the cable is being wound from left to right on the drum 36 as suggested in FIG. 6. This action is brought about at the instant when the shaft 19 is moved to the right by the pull of the cable on the sensing pulley 20. When this occurs, the left hand valve is opened and the right hand valve operated by the shaft 19 to transmit fluid pressure through the pipe line 44 to the relay valve 43.

The fleet angle is now such that the cable tends to pull the carriage 16 toward the right and accordingly the pressure of the piston rod 26 should be released to permit such movement to take place. Fluid pressure transmitted through the pipe line 44 moves the relay valve 43 to the position shown in FIG. 6, opening the outlet 43' to the atmosphere so that compressed air from the pipe line 44 is exhausted at that point in the system.

Meanwhile pressure on the diaphragm 51 is relieved and the plunger 52 is moved by its spring to open the passage 57 and vent to the atmosphere compressed air from the cylinder 25 as the piston is moved outwardly in the swing of the cylinder in counter clockwise direction. This continues until the fleet angle is reduced to zero and the parts restored to the position of FIG. 4.

When the fleet angle crosses the zero position and the carriage 16 is shifted toward the right, the spooling device operates in a manner similar to that already described but with the cylinder 25 inclined in the opposite direction to that shown in FIGS. 5 and 6. The valve at the left end of the shaft 19 is operated to transmit pressure through the pipe line 42 to the relay valve 43, causing it to direct compressed air to the power valve 45 and from there to the cylinder 25. The carriage 16 is thus forced toward the left and the cable directed at a low fleet angle to the drum until the winding reaches its right hand flange. Reverse movement then takes place with air from the cylinder being discharged from the outlet 56 of the valve 45.

The two valves 41 are used as flow restriction valves to minimize the loss of air. When the shaft 19 is in its mid-position shown in FIG. 4 the air that passes through the valves 41 is vented to the atmosphere at both ends of the shaft; therefore no pressure will build up in the lines 42 and 44.

In FIG. 5 the vent at the left end of the shaft 19 is shown as closed and pressure will build up in the line 42 thereby actuating the valve 45. Air passing from the valve 41 toward line 44 wil bleed off to the atmosphere at the right end of the shaft 19 and also at the valve 43.

In FIG. 6 the vent at the left end of the shaft 19 is shown as open and the air from the valve 41 plus the air from the chamber 50 of the valve 45 will be vented to the atmosphere and this, in turn, will allow air from the cylinder 25 to be vented to the atmosphere through the valve 45 and its port 56. The vent at the right hand end of the shaft 19 is closed but the air that is passing through the valve 41 is being vented by way of line 44 at valve 43 through the vent 43'. In fact, if the vent 43' were closed air pressure would build up in the line 44, but since it is not directed to valve 45 by the relay valve 43 it would have no effect on the operation of the system and would prevent unnecessary waste of air that would normally be flowing through valve 41 into the line 44.

Throughout the description the valve 43 has been referred to as a relay valve although its function is to select the flow from either one of the pipe lines 42 and 44 and direct it to the valve 45 while the other line is directed to exhaust through the vent 43'. It would therefore be in order to refer to the valve 43 as a directional control valve or a selector valve. The valve 45 has been referred to as the main power valve. Pressure applied to the diaphragm 51 of this valve through the line 46 is transmitted to the line 47, yet air from the line 46 does not flow past valve 45.

Having thus disclosed my invention and described in detail a preferred embodiment thereof, I claim as new and desire to secure by Letters Patent:

1. A cable spooling device comprising a normally stationary but adjustable frame including transverse supporting members, a fluid pressure cylinder pivotally connected at one end to one of said members, a carriage movable on another of said members and connected to the piston and rod of said cylinder, means for leading a cable through said carriage, and sensing means on the carriage having fluid pressure valved controlling connections with said cylinder whereby movement of the carriage is effected in response to valve operating action of the sensing means.

2. A cable spooling device comprising a stationary frame including spaced supporting members arranged in parallel relation, a fluid pressure cylinder pivotally connected to one of said members and a carriage slidable on another member, a piston in the cylinder having a rod pivotally connected at its outer end to the carriage, guide pulleys mounted in the carriage for guiding a cable, and a sensing member mounted in the carriage and having fluid pressure valved connections with said cylinder, whereby movement of the carriage is effected in response to valve operating action of the sensing member.

3. A cable spooling device comprising a frame including parallel guide rods, a carriage slidable thereon and having a sensing member and a pair of guide pulleys

bodily movable therewith, a cylinder pivotally mounted in the frame and having a piston and rod connected to the carriage, fluid pressure valved connections to the cylinder, and means for controlling the fluid pressure therein from said sensing member, whereby movement of the carriage is effected in response to valve operating action of the sensing member.

4. A cable spooling device comprising a frame including a guide rod, a carriage slidable on said rod and having a pair of guide pulleys and a movable sensing member located at the cable leaving side of said pulleys and having rotary and sliding movement, a fluid pressure cylinder pivoted at one end to the frame and having a piston and rod connected to the slidable carriage, and fluid pressure connections to said cylinder including a valve controlled by the sliding movement of the sensing member in either direction from its initial position in the carriage.

5. A cable spooling device as described in claim 4 further characterized in that the sensing member comprises an idle pulley having an endwise movable shaft cooperating at either end with a valve seat in said fluid pressure connections to the cylinder.

6. A cable spooling device operating to direct a cable to a winding drum, and including in its structure a frame having a transverse guide arranged to be disposed parallel to the drum, a carriage slidable on the guide and having mounted therein a pair of guide pulleys and an idle sensing pulley freely rotatable on the cable leaving side of the guide pulleys together with an endwise movable shaft, a fluid pressure cylinder pivoted to the frame and having a piston rod pivoted to said carriage, fluid pressure connections to said cylinder including valves located at either end of said movable shaft and controlled thereby to advance the piston rod when the cylinder is swung out of its initial position by movement of the carriage.

7. A cable spooling device as defined in claim 6 in which the fluid pressure connections to the cylinder include a relay valve and a main valve operated therefrom to admit fluid pressure to the cylinder or exhaust it therefrom.

8. A cable spooling device as defined in claim 6 in which the frame has a pair of spaced transverse supports disposed in parallel relation to the said transverse guide and the cylinder has aligned hinge connection with both of said supports.

9. In a cable spooling device having a movable cable-guiding carriage, sensing mechanism comprising spaced bearings each having a valve seat therein, a shaft freely rotatable and movable endwise in said bearings to close one valve seat or the other, and a grooved cable-receiving pulley fast on the shaft for transmitting thereto the component of lateral cable stress, together with fluid pressure connections between the cable-guiding carriage and said valve seats, whereby the position of the carriage is determined in accordance with the closing of one or the other of said valve seats.

10. A cable spooling device for operation in connection with a winding drum and comprising a frame having a guide disposed parallel to the drum and a carriage slidable thereon, a sensing pulley movable with the carriage, a cylinder pivotally mounted on the frame and having a piston rod operatively connected to the carriage, a fluid pressure system connected to the cylinder and controlled by said sensing pulley, whereby fluid pressure is admitted to the cylinder when the sensing pulley is moved by lateral stress in the cable passing from the carriage to the winding drum.

11. A cable spooling device for operation in connection with a winding drum and comprising a carriage supported for movement to and fro in a path spaced from and parallel to the drum, a sensing member mounted in position between the carriage and the drum and movable in response to transverse cable pressure, a fluid pressure system for moving the carriage to reduce the fleet angle, and means for controlling the fluid pressure therein from said sensing member, the fluid pressure system including a cylinder, a power valve for directing compressed air thereto and a relay valve for actuating the power valve, together with means providing an exhaust outlet from the cylinder.

12. A cable spooling device for operation in association with a winding drum and comprising a carriage supported for movement in a path adjacent to the drum and substantially parallel thereto, a sensing pulley movable laterally in the carriage, and a fluid pressure system including a cylinder and piston operatively connected to the carriage for imparting transverse movement thereto for reducing the fleet angle of the cable in approaching the drum, the fluid pressure cylinder being pivotally mounted and so connected to the carriage as to be swung in either direction by corresponding lateral movement of the carriage, valves in the fluid pressure system set initially to cut off fluid pressure to the cylinder when the fleet angle is approximately zero, and means operated by the sensing pulley to admit fluid pressure to the cylinder when the sensing pulley is moved in either direction from its initial position.

13. A cable spooling device as described in claim 12 in which the sensing pulley is fast upon a shaft movable longitudinally between two valve seats in response to lateral pressure on the pulley.

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