

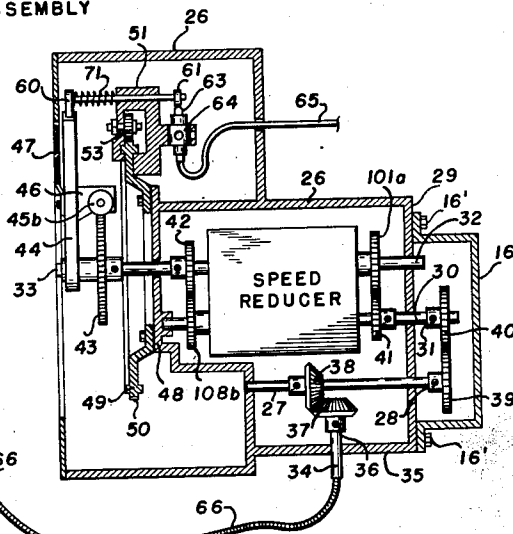
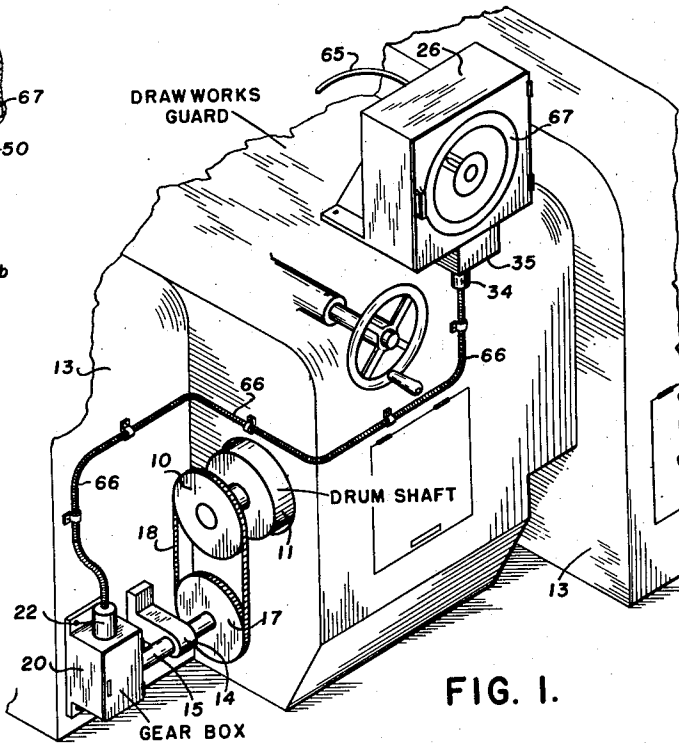
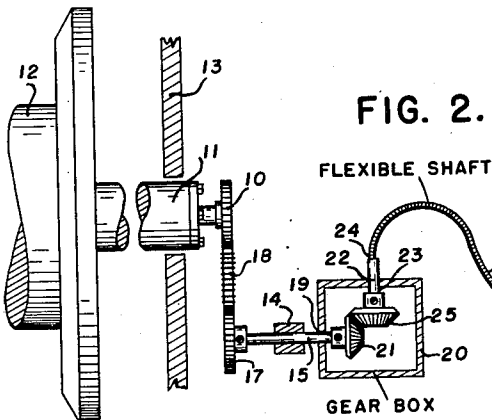
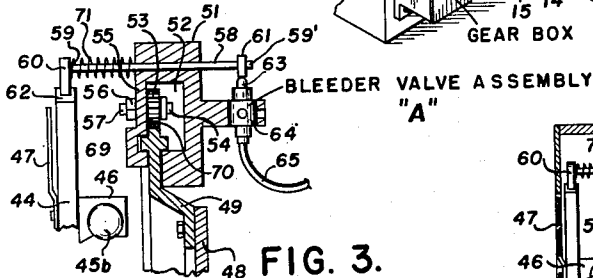
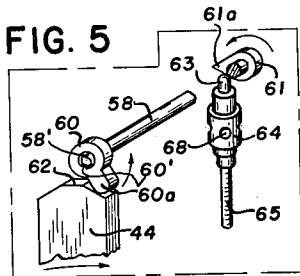
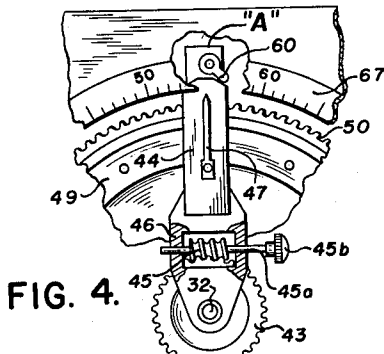
Oct. 20, 1953

R. R. CROOKSTON
POSITION CONTROL DEVICE

2,656,027

Filed May 13, 1950

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

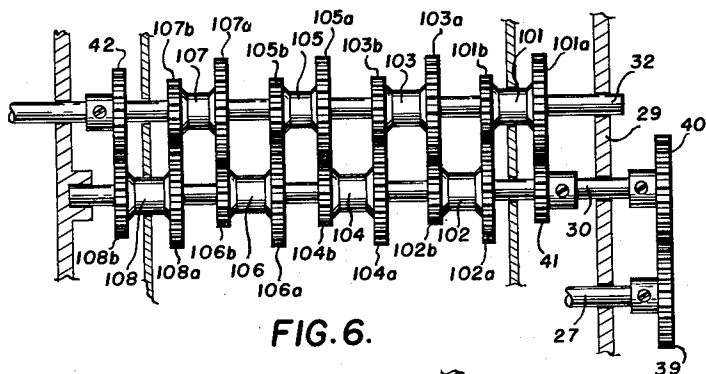


FIG. 6.

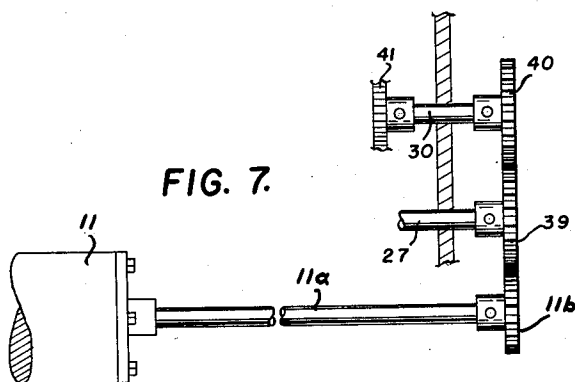


FIG. 7.

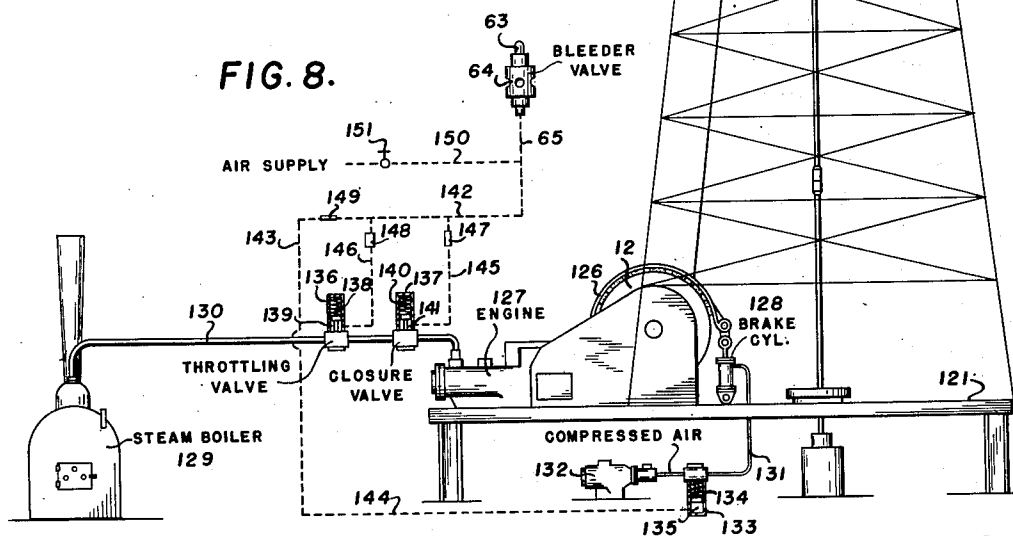


FIG. 8.

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UNITED STATES PATENT OFFICE

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POSITION CONTROL DEVICE

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Application May 13, 1950, Serial No. 161,883

4 Claims. (Cl. 192-138)

1

The present invention relates to a signalling device and, more particularly, relates to a signalling device adapted for use in connection with a hoisting device.

Movement of loads from one point to another in a relatively straight line is often accomplished by means of a wire line spooled on a power driven drum. In such devices the load may be moved in one direction by permitting the line to be paid off the drum and may be moved in a direction opposite from the aforesaid direction by means of spooling the line onto the drum. Such an arrangement is used, for example, in elevators, hoists employed in the building trade, and in rotary drilling rigs employed in the drilling of boreholes into subsurface formations. In the operation of such devices it is often necessary that the paying off and spooling on of the line off of and onto the drum be controlled so that the load being lifted may be stopped at any desired point in its travel. For example, in the case of a personnel elevator or of a hoist used in the building trade, it is necessary that the hoist or elevator be provided with devices which will enable the stopping of the elevator or hoist at a particular point in their vertical travel, such as at a floor level. It is, of course, also necessary that hoists or elevators be equipped with regulators which will prevent the elevator or hoist from striking the sheave over which the cable supporting the elevator or hoist in its shaft passes. Regulators must also be provided for preventing elevators and hoists from colliding with the floor at the bottom of the shaft. Without such regulators, elevators and hoists would, of course, be extremely dangerous to personnel using same.

A similar condition exists in drilling rigs employed for the drilling of boreholes into subsurface formations. In such rigs a cable spooled on a drum is used for lowering and raising loads within the derrick. The cable extends from the draw works drum over the top of suitable sheaves rotatably mounted in the crown block of the derrick and through the sheaves of a travelling block, one end of said cable being attached to some fixed point, usually the derrick itself. The travelling block is raised within the derrick by means of spooling the cable onto the drum and is lowered within the derrick by means of paying the cable off the drum. When the travelling block is moving upwardly within the derrick and when it is desired to stop this upward movement, the operator throttles and shuts off the draw works engine and may also apply a braking force to the drum for the purpose of quickly stopping its

2

rotation. When the travelling block is moving downwardly within the derrick and it is desired to stop such downward movement, the operator merely applies a braking force of sufficient magnitude to the drum to stop its rotation and, accordingly, further descent of the travelling block ceases.

Heretofore, drilling rigs have been equipped with devices intended to stop the movement of the travelling block at a fixed point within the derrick without intervention of the driller. Such devices are primarily intended to prevent the travelling block from striking the crown block as a result of the failure of the operator to stop the draw works drum at the proper time. It will be appreciated, of course, that a device of this type is highly desirable from the standpoint of the safety of the operating crew and also from the standpoint of preventing unnecessary destruction of equipment due to errors in judgment of the draw works operator. The ability of the operator to stop the upward travel of the travelling block before it strikes the crown block depends, of course, upon his ability to see the crown block and upon his estimate as to the rate of ascent of the travelling block. The elements may seriously interfere with both his vision and his estimate. Rain, snow, or even the sun, may seriously impair the vision of the operator and affect his estimate of the closeness of approach of the travelling blocks to the crown block, thereby allowing him to make an error in judgment which will permit the travelling block to strike the crown block.

While it is essential that the travelling block be stopped in its vertical ascent before it strikes the crown block, it is often desirable to stop the travelling block at a particular point in either its vertical upward travel or its vertical downward travel. For example, with modern drilling equipment, it may be desirable that the travelling block be stopped at a fixed distance from the floor of the derrick every time the travelling block is lowered within the derrick.

An object of the present invention is to provide a device arranged for providing a signal or a series of signals indicative of the position of a load movable between two extreme limits of travel, the load being associated with a line and the position of said load being alterable by rotation of the drum upon which the line is spooled. A further object is to provide a device which will supply a signal capable of being employed to prevent a load attached to a wire line spooled upon a drum from being moved by the operator

3

beyond a certain fixed point. A further object is to provide a device which is operated off the draw works drum itself.

Briefly, the device of my invention may be described as a device arranged to provide a signal or a series of signals indicative of the position of a member associated with a line between a first limit of travel and a second limit of travel along a straight path, the position of said member being alterable by rotation of the drum upon which the line is spooled. Since it is desired to employ the rotative motion of the drum for providing the aforementioned signal, a conventional speed reducing mechanism is operatively connected to the drum, the speed reduction being such that a shaft attached to the output side of the speed reducing mechanism rotates no more than one revolution for drum rotation sufficient to move the aforementioned member from its first limit of travel to its second limit of travel. This amount of speed reduction is necessary in order to permit control over the entire range through which the said member may be moved. In the case of a drilling rig, the travelling block may be moved from the floor, which may be regarded as one limit of travel, to the crown block, which may be regarded as the other limit of travel. A cam actuating arm is mounted on the aforementioned shaft for rotation therewith. Preferably, the cam actuating arm is adjustable with respect to the shaft so that minor adjustments may be made from time to time to correct for such things as wear of the cable or line. A signalling means, such as a bleeder valve, is spaced from the aforementioned shaft and is arranged to be actuated by a cam which is, in turn, actuated by the cam actuating arm. The signalling means and its actuating cam are arranged to be moved radially about the axis of the aforementioned shaft so that it may be so placed as to provide a signal at any selected point in the movement of the aforementioned member between its two limits of travel. It will be understood, of course, that a plurality of signalling means may be employed in conjunction with appropriate cams so that a plurality of signals may be provided. The signal or signals may, of course, be employed in any desired manner and may be used, for example, for ringing a bell, for activating a light bulb, or for throttling and/or stopping the draw works engine and/or for applying the brake to the drum.

A detailed description of the device of my invention will hereinafter be set out in conjunction with the drawing in which like numerals designate like parts throughout and in which:

Fig. 1 is an isometric view of the device of my invention mounted on the draw works of a drilling rig;

Fig. 2 is a detailed view, partly in cross-section, of the device shown in Fig. 1;

Fig. 3 is a detailed view, partly in cross-section, of a portion of the device shown in Fig. 2;

Fig. 4 is a detailed view, partly in cross-section, of another portion of the device shown in Fig. 2;

Fig. 5 is a detailed view of a portion of the showing of Fig. 3;

Fig. 6 is a detailed view of that portion of Fig. 2 designated diagrammatically as a speed reducer;

Fig. 7 is a modification of the device illustrated in Fig. 2; and

Fig. 8 is an illustration of one mode in which the device of the present invention may be used

4

in conjunction with the travelling block of a drilling rig.

Referring to the drawing, and particularly to Figs. 1 to 6, inclusive, the numeral 10 designates a gear which is mounted on draw works drum shaft 11 for rotation therewith. The draw works drum 12 is mounted on shaft 11, shaft 11 and drum 12 being supported by draw works guard 13. A bracket 14 is affixed to draw works guard 13 and supports shaft 15 for rotation about its longitudinal axis, the longitudinal axis of shaft 15 being substantially parallel to the longitudinal axis of draw works shaft 11. Gear 17 is mechanically affixed to shaft 15 for rotation therewith. Continuous chain 18 meshes with the teeth of gears 10 and 17 mechanically connecting said gears. The outer end 19 of shaft 15 terminates within gear box 20 and mounted on this outer end for rotation therewith is bevel gear 21. Shaft 22 is supported by the walls of gear box 20 and is adapted to rotate about its longitudinal axis. The inner end 23 terminates within gear box 20 and the outer end 24 terminates externally of gear box 20. Mounted on the inner end 23 of shaft 22 for rotation therewith is bevel gear 25, the teeth of which mesh with the teeth of bevel gear 21.

Meter housing 26 may be affixed to any suitable support and is shown in Fig. 1 as being affixed to a portion of the draw works guard 13. Housing 26 supports shaft 27 for rotation about its longitudinal axis, the outer end 28 of shaft 27 extending externally of housing 26 through the rear wall 29 thereof. Shaft 30 is also supported by housing 26, the outer end 31 of said shaft also extending externally of housing 26 through rear wall 29. Shaft 32 is supported by housing 26, one end 33 of said shaft extending externally of housing 26. Shafts 27, 30, and 32 are so arranged that their longitudinal axes are substantially parallel. Shaft 34 is supported by housing 26 for rotation about its longitudinal axis and extends through the lower wall 35 of said housing. The longitudinal axis of shaft 34 is substantially perpendicular to the longitudinal axis of shaft 27. Mounted on the end 36 of shaft 34 interior of housing 26 is bevel gear 37, the said bevel gear being arranged to rotate on rotation of shaft 34. Mounted on shaft 27 for rotation therewith interiorly of housing 26 is bevel gear 38, the teeth of bevel gear 38 being arranged to mesh with the teeth of bevel gear 37. Gear 39 is mounted on the outer end 28 of shaft 27 for rotation with said shaft, while gear 40 is mounted on the outer end 31 of shaft 30 for rotation with said shaft, the teeth of gear 39 meshing with the teeth of gear 40. Gears 39 and 40 are enclosed by means of closure cover 16 removably secured to housing 26 by means of bolts 16'. Gears 39 and 40 are transposition gears of a ratio equal to the square root of the number of lines for which the device might work. Gear 41 is mounted within housing 26 on shaft 30 for rotation therewith. Gear 42 is mounted within housing 26 on shaft 32 for rotation therewith. Shaft 22 and shaft 34 are mechanically connected by means of flexible shaft 66.

Numerals 101a and 108b form part of the speed reducing mechanism indicated diagrammatically in Fig. 2. This speed reducing mechanism is of conventional design and may suitably be constructed in the manner shown in detail in Fig. 6. In Fig. 6 a plurality of gears numbered 101 to 108, inclusive, are shown. Gears 101, 103, 105, and 107 are mounted on shaft 32 for free rotation

on said shaft while gears 102, 104, 106, and 108 are mounted for free rotation on shaft 30. Gears 101 to 108, inclusive, are identical in construction and each includes a large geared wheel designated by its respective numeral suffixed by the letter *a* and a small gear designated by its respective numeral and suffixed by the letter *b*. These gears are so arranged on shafts 30 and 32 that the teeth of gear 41 mesh with the teeth of gear 101*a*. The teeth of gear 101*b* mesh with the teeth of gear 102*a* while the teeth of gear 102*b* mesh with the teeth of gear 103*a*. The teeth of gear 103*b* mesh with the teeth of gear 104*a* while the teeth of gear 104*b* mesh with the teeth of gear 105*a*. The teeth of gear 105*b* mesh with the teeth of gear 106*a* while the teeth of gear 106*b* mesh with the teeth of gear 107*a*. The teeth of gear 107*b* mesh with the teeth of gear 108*a* while the teeth of gear 108*b* mesh with the teeth of gear 42. Since gears 41 and 42 are affixed to shafts 30 and 32, respectively, and since gears 101, 103, 105, and 107 rotate freely on shaft 32 while gears 102, 104, 106, and 108 rotate freely on shaft 30, shaft 32 rotates at a greatly reduced speed as compared to the rate at which shaft 30 is rotated.

Referring again to Figs. 1 to 5, mounted on shaft 32 for rotation therewith exteriorly of housing 20 is worm gear 43. Mounted adjacent worm gear 43 on the outer end 33 of shaft 32 is cam actuating arm 44. A worm 45 is affixed to shaft 45*a* which is rotatably mounted on bracket 46 which forms a part of cam actuating arm 44. The threads of worm 45 mesh with the teeth of worm gear 43. Cam actuating arm 44 is mounted slidably on shaft 32 and is adapted to be moved arcuately on said shaft when worm 45 and shaft 45*a* are manually rotated by turning knob 45*b*. Cam actuating arm 44 carries affixed thereto indicating needle 47. Affixed to the forward wall 48 of housing 46 is ring gear 49, the said ring gear being arranged concentrically with respect to shaft 32. Ring gear 49 carries a plurality of teeth 50 on its outer periphery. A bleeder valve assembly A is mounted on the outer periphery of ring gear 49.

Bleeder valve assembly A consists of a housing 51 defining gear chamber 52 in which a gear 53 is rotatably mounted on bolt 54 which passes through wall 55 of the housing and carries nut 56 on the outer threaded end 57 thereof. The teeth of gear 53 mesh with the teeth 50 of ring gear 49. Cam shaft 58 is rotatably mounted within housing 51, the longitudinal axis of said shaft being substantially parallel to the longitudinal axis of shaft 32. Arranged on one end 59 of shaft 58 exteriorly of housing 51 is cam 60. Cam 60 is free to move arcuately on shaft 58 in one direction while it rotates shaft 58 when moved in the other direction. This may be accomplished by providing a shoulder 60' on cam 60 and a stop 58' on shaft 58. Spring 71 on shaft 58 is affixed at one end to housing 51 and at its other end to cam 60. Spring 71 biases shoulder 60' against stop 58'. Cam 61 is mounted on the other end 59' of shaft 58 exteriorly of housing 51 for rotation with said shaft. Cam 60 is so positioned on shaft 58 that the eccentric portion 60*a* thereof lies in the path of the outer end 62 of cam actuating arm 44. Cam 61 is positioned on shaft 58 so that the eccentric portion 61*a* thereof makes engaging contact with plunger element 63 of bleeder valve 64. Bleeder valve 64 is supported by housing 51 in fixed relation with respect to cam shaft 58 and is fluidly connected

by means of line 65 to a mechanism or mechanisms which control the vertical position of the travelling blocks within the derrick.

Having described the various parts of the embodiment shown in Figs. 1 to 6, inclusive, and having described the relation of these parts to each other, the operation of this embodiment will now be described.

Rotation of shaft 11 and consequently gear 10 is transmitted by means of endless chain 18 to gear 17. Rotary motion of gear 17 is transmitted by means of shaft 15 to bevel gear 21 and through bevel gear 25 and flexible shaft 66 to bevel gear 37. Since bevel gear 37 meshes with bevel gear 38, rotation of bevel gear 37 is transmitted by bevel gear 38 to shaft 27. Rotary motion of shaft 27 is transmitted by gears 39 and 40 to shaft 31 and to gear 41. The speed reducing mechanism mounted on shaft 31 and on shaft 32 reduces the rate at which shaft 32 rotates as compared to shaft 31. This reduced rotary motion is picked up by gear 42 and is transmitted thereby to shaft 32. Since worm gear 43 is affixed to shaft 32 and is in engagement with worm 45, which is affixed to cam actuating arm 44, cam actuating arm 44 must rotate in cooperation with shaft 32. It will be understood, of course, that the relative radial position of cam actuating arm 44 with respect to shaft 32 may be altered from time to time by manually rotating worm 45. Inasmuch as needle 47 is affixed to cam actuating arm 44, it rotates with said arm adjacent meter face 67 which may be scaled or marked as indicated in Fig. 4. As cam actuating arm 44 moves past cam 60, the upper end 62 thereof engages with eccentric portion 60*a* of cam 60 and moves shaft 58 arcuately. Since cam 61 is affixed to shaft 58, it will also be moved arcuately and eccentric portion 61*a* will engage with plunger element 63 of valve 64, pushing plunger element 63 downwardly and causing said valve to permit air to bleed from conduit 65 through port 68. The bleeding of air from conduit 65 actuates the mechanism or mechanisms which control the vertical height of the travelling block within the derrick.

The point at which bleeder valve 64 may be actuated will, of course, be determined by the radial position occupied by bleeder valve assembly A on ring gear 49. Bleeder valve assembly A may be positioned at any point on ring gear 49 desired by merely loosening nut 56 sufficiently to permit gear 53 to rotate about bolt 54 as an axis. With nut 56 so loosened, bleeder valve assembly A may be moved along the outer periphery of ring gear 49, gear 53 rotating about bolt 54 as the assembly is so moved. When bleeder valve assembly A has been moved to the desired point on ring gear 49, it may be affixed thereto at this point and further movement prevented by means of tightening nut 56 on the threaded end 57 of bolt 54. Tightening of nut 56 forces the side surface 69 of gear 53 against an inner surface 70 of housing 51, the two surfaces developing sufficient friction to prevent rotation of gear 53.

The worm 45 on cam actuating arm 44 and worm gear 43 on shaft 32 are provided for the purpose of making such slight adjustments in the instrument as would be made when new lines are strung or when events might be slightly repositioned.

While in the drawing only one bleeder valve assembly A has been shown, it will be understood that one or more such assemblies may be employed, each assembly indicating and/or controlling one or more events in the vertical travel

of the travelling blocks within the derrick. For example, it may be desirable to employ a second bleeder valve assembly similar in construction to bleeder valve assembly A so that travelling block 123 may be stopped automatically a predetermined distance from the derrick floor 121 as the travelling block moves downwardly within the derrick. This is accomplished by merely setting the second bleeder valve assembly at the proper point on the outer periphery of ring gear 49.

One specific mode of using the device of the present invention to control the vertical height of the travelling block within the derrick is illustrated diagrammatically in Fig. 8. In this figure a conventional derrick 120 mounted on a suitable platform 121 is shown. Mounted in the top of the derrick 120 is crown block 122 and suspended from crown block 122 is a travelling block 123 carrying a string of pipe 124, travelling block 123 being suspended from crown block 122 by means of wire line 125. Wire line 125 is wrapped on draw works drum 12 equipped with brake shoe 126. Draw works drum 12 is adapted to be rotated in one direction for raising travelling block 123 by means of engine 127 and is adapted to be rotated in the opposite direction for lowering travelling block 123. Brake shoe 126 is adapted to be engaged with and disengaged from brake drum 12 by means of brake cylinder 128. Engine 127 is powered by means of steam furnished from steam boiler 129 through conduit 130. Brake cylinder 127 causes brake shoe 126 to be engaged with draw works drum 12 when compressed air is supplied thereto through line 131, the compressed air being furnished by means of air compressor 132. A spring pressed valve 133 is positioned in line 131. Valve 133 is so designed that spring 134 will open said valve to permit air to flow through conduit 131 to brake cylinder 128 when air is exhausted from the lower end 135 thereof. The supply of steam to engine 127 from steam boiler 129 is controlled by throttling valve 136 and closure valve 137 positioned in line 130. Throttling valve 136 is so designed that spring 138 tends to close said valve to reduce the amount of steam flowing through line 130 when air is bled from portion 139 of said valve. Valve 137 is so designed that spring 140 tends to close said valve to cut off the supply of steam through conduit 130 when air is allowed to bleed from portion 141 of said valve. Portion 135 of valve 133 is fluidly connected with conduit 65 by means of line 142, branch line 143, and branch line 144. Portion 141 of closure valve 137 is fluidly connected with conduit 65 by means of line 142 and branch line 145. Throttling valve 136 is fluidly connected with conduit 65 by means of line 142 and branch line 146. An orifice 147 is positioned in line 145 while orifice 148 is positioned in line 146 and orifice 149 is positioned in line 142 downstream of the point at which lines 145 and 146 join line 142. Compressed air is supplied from an outside source, not shown, to conduit 65 through line 150 which may be controlled by valve 151.

Orifices 147, 148, and 149 are of such size that air may bleed from throttling valve 136 before air is bled from closure valve 137 and that air is bled from both throttling valve 136 and closure valve 137 before air is bled from valve 133 in line 131. With this arrangement the actuation of bleeder valve 64 permits air to bleed first from throttling valve 136, thereby reducing the amount of steam supplied to engine 127 from steam boiler 129 through conduit 130. Next air bleeds from

closure valve 137, thereby cutting off the supply of steam from steam boiler 129 to engine 127. Air next bleeds from valve 133, permitting compressed air to flow through conduit 131 into brake cylinder 128, thereby actuating brake cylinder 128 to cause brake shoe 126 to engage with draw works drum 12 to completely stop the rotation of said drum.

It will be apparent from the foregoing description with respect to Fig. 8 that actuation of bleeder valve 64 initiates the aforementioned sequence of events. The particular point in the vertical travel of travelling block 123 at which bleeder valve 64 is actuated will depend upon the position at which bleeder valve assembly A is set on the outer periphery of ring gear 49. It may be set, for example, to prevent the travelling block 123 from striking crown block 122.

It will be apparent that various modifications may be made in the device hereinbefore described without departing from the scope of the present invention. For example, Fig. 7 illustrates a means for transmitting the rotary motion of draw works drum shaft 11 to gear 39 which differs from the means shown in Fig. 2. Referring to Fig. 7, a shaft 11a is mechanically connected with draw works drum shaft 11 so that shaft 11a rotates in cooperation with draw works drum shaft 11. A gear 11b is affixed to shaft 11a for rotation therewith, the teeth of gear 11b meshing with the teeth of gear 39.

Having fully described and illustrated the device of the present invention, what I wish to claim as new and useful and to secure by Letters Patent is:

1. A device arranged to control the position of a load attached to one end of a line, the other end of said line being spooled on a rotatable drum, said load being movable by said drum and said line from a first limit of travel to a second limit of travel, comprising a shaft mounted for rotation about its longitudinal axis; a speed reducing mechanism connecting said drum and said shaft for transmitting the rotary motion of said drum to said shaft, said speed reducing mechanism being arranged to rotate said shaft no more than one revolution for rotary drum motion sufficient to move said load from its first limit of travel to its second limit of travel; a cam actuating arm mounted on said shaft for rotation therewith; an assembly radially spaced from said shaft, said assembly carrying a bleeder valve having an inlet, a conduit containing fluid under pressure fluidly connected with said inlet, and an exhaust port for bleeding fluid from said conduit when said bleeder valve is actuated, said assembly carrying a rotatable cam shaft having a first cam mounted on said cam shaft for rotation therewith in a first direction and for rotation thereon in a second direction and a second cam affixed thereto, said first cam being disposed in the path of said cam actuating arm and said second cam being arranged to actuate said bleeder valve when said first cam is rotated in said first direction by said cam actuating arm; and a valve member in said conduit arranged to stop the rotation of said drum when fluid is bled from said conduit by said bleeder valve.

2. A device arranged to control the position of a travelling block suspended from a line in a drilling derrick for vertical movement in the derrick between the floor and crown thereof, the vertical position of said travelling block being alterable by rotation of the drum upon which said line is spooled, said drum being rotatable by an engine

9

for raising said travelling block, comprising, in combination, a shaft mounted for rotation about its longitudinal axis; a speed reducing mechanism connecting said drum and said shaft for transmitting the rotary motion of said drum to said shaft, said speed reducing mechanism being arranged to rotate said shaft no more than one revolution for rotary drum motion sufficient to move the travelling block from the floor to the crown of the derrick; a cam actuating arm mounted on said shaft for rotation therewith; an assembly radially spaced from said shaft, said assembly carrying a bleeder valve having an inlet, a conduit containing fluid under pressure fluidly connected with said inlet, and an exhaust port for bleeding fluid from said conduit when said bleeder valve is actuated, said assembly carrying a rotatable cam shaft having a first cam mounted on said cam shaft for rotation therewith in a first direction and for rotation thereon in a second direction and a second cam affixed thereto, said first cam being disposed in the path of said cam actuating arm and said second cam being arranged to actuate said bleeder valve when said first cam is rotated in said first direction by said cam actuating arm; a first valve member in fluid communication with said conduit arranged to reduce the supply of energy to said engine when fluid is bled from said conduit by said bleeder valve; a second valve member in fluid communi-

10

cation with said conduit arranged to cut off the supply of energy to said engine when said fluid is bled from said conduit by said bleeder valve, said second valve member being arranged to be actuated subsequent to the actuation of said first valve member; a third valve member in fluid communication with said conduit arranged to stop rotation of said drum when fluid is bled from said conduit by said bleeder valve, said third valve member being arranged to be actuated subsequent to the actuation of said second valve member.

3. A device in accordance with claim 1 in which an indicating needle is mounted on said actuating arm and a face is mounted adjacent thereto.

4. A device in accordance with claim 2 in which an indicating needle is mounted on said cam actuating arm and a face is mounted adjacent thereto.

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