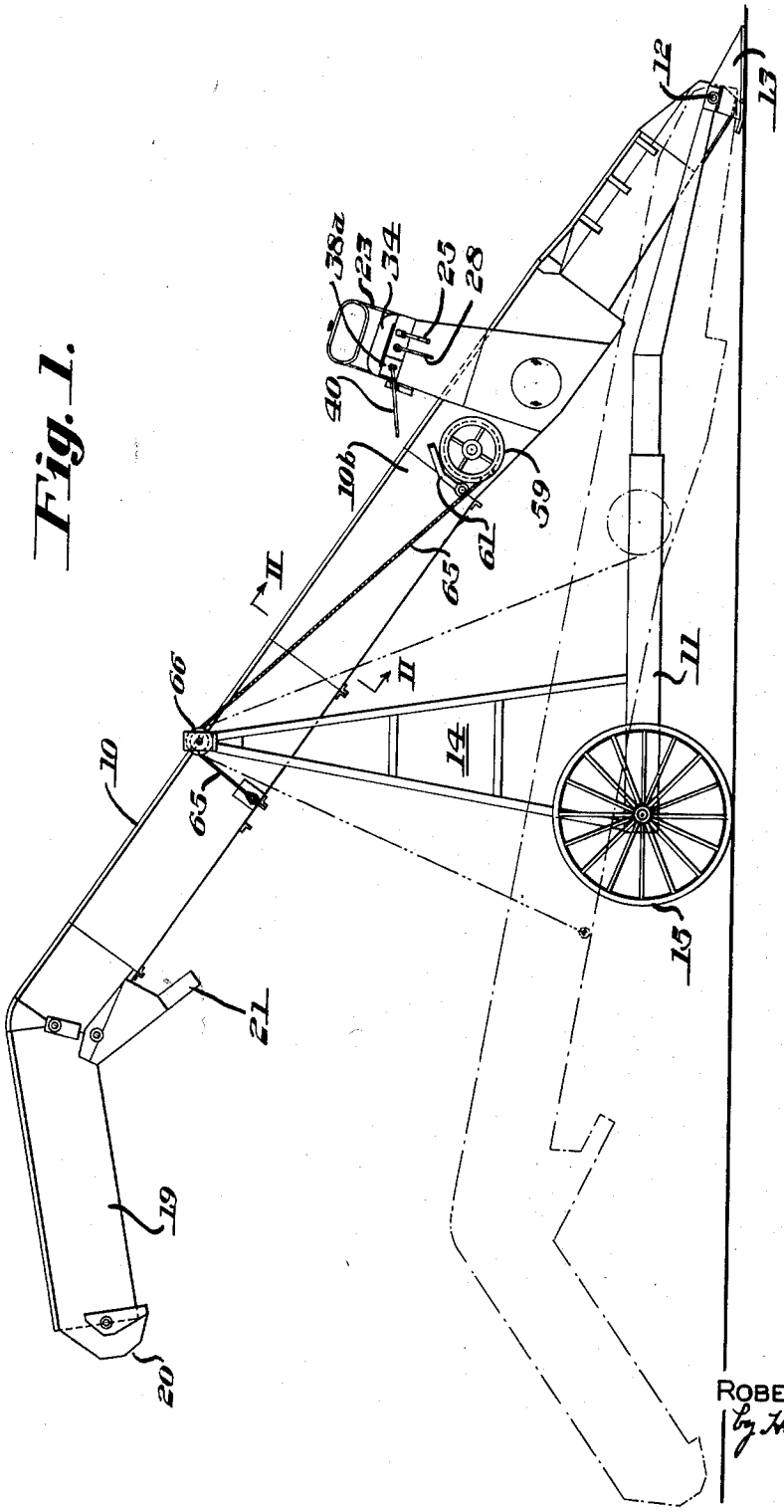
Dec. 30, 1952 R. N. BENNETT 2,623,629

CONVEYER BOOM HOISTING SYSTEM

Filed May 19, 1949

3 Sheets-Sheet 1

Fig. 1.



INVENTOR
ROBERT N. BENNETT
by Hopgood, Remers & Glenn
his attorneys.

Dec. 30, 1952 R. N. BENNETT 2,623,629

CONVEYER BOOM HOISTING SYSTEM

Filed May 19, 1949 3 Sheets-Sheet 2

Fig. 2.

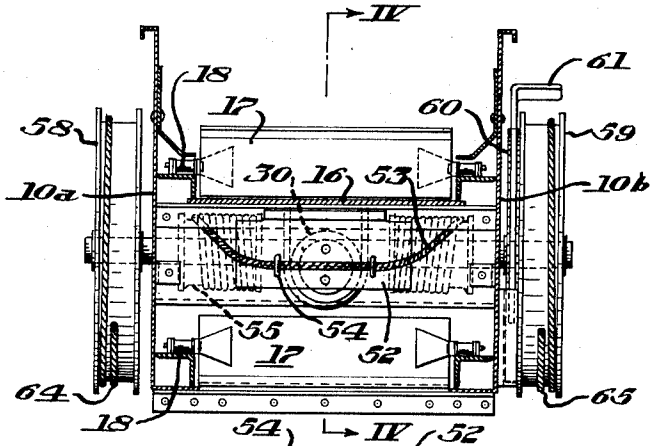
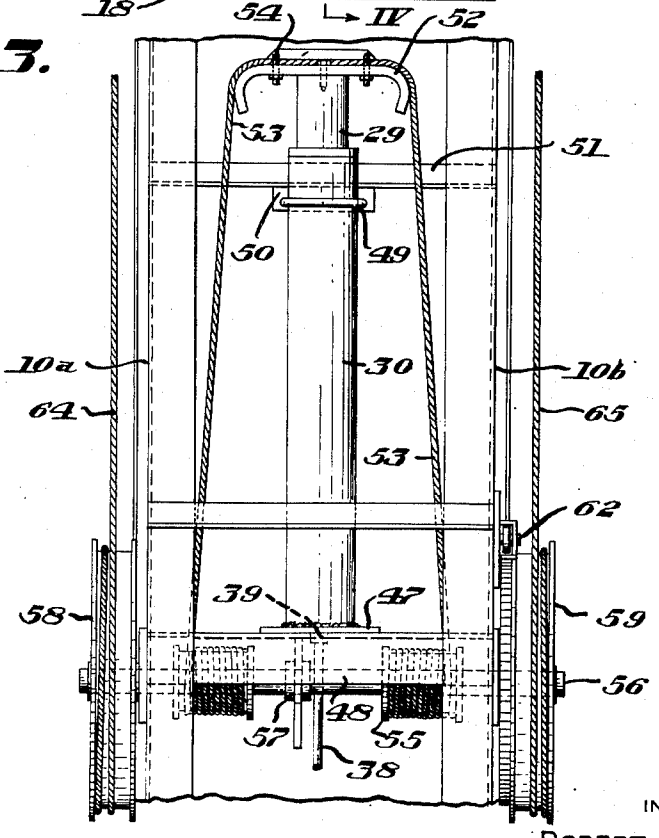


Fig. 3.



INVENTOR
ROBERT N. BENNETT
by Hopes, Lemars & Glenn
his attorneys.

Dec. 30, 1952 R. N. BENNETT 2,623,629

CONVEYER BOOM HOISTING SYSTEM

Filed May 19, 1949 3 Sheets-Sheet 3

Fig. 4.

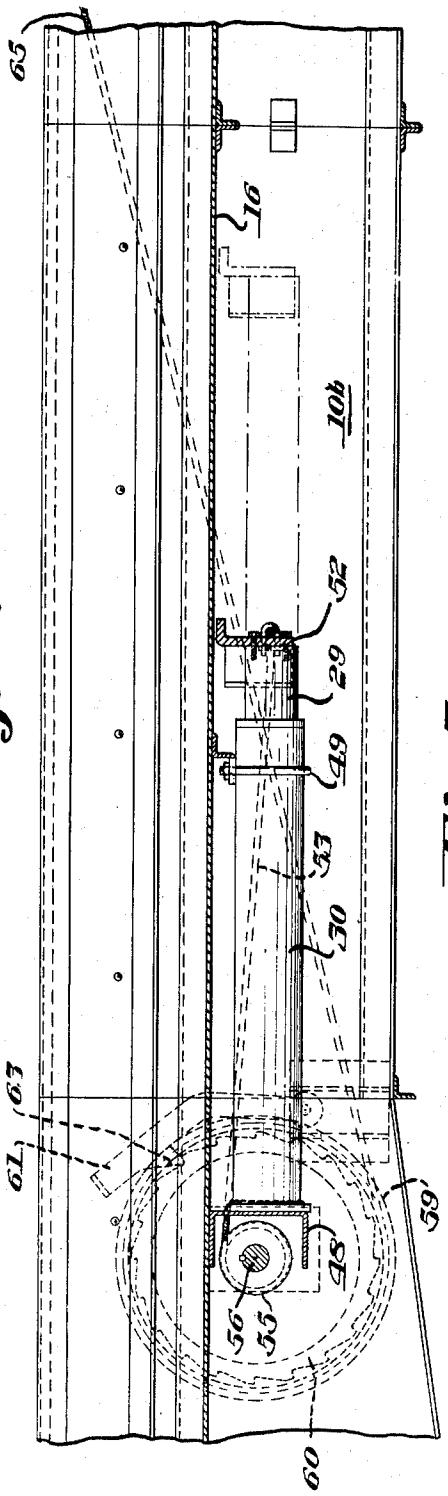
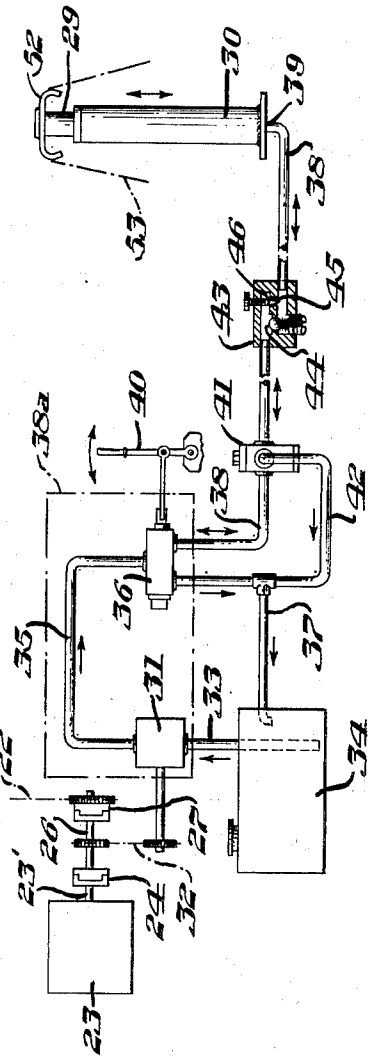


Fig. 5.



INVENTOR
ROBERT N. BENNETT
by Hopes, Leonard & Hann
his attorneys.

Patented Dec. 30, 1952

2,623,629

UNITED STATES PATENT OFFICE

2,623,629

CONVEYER BOOM HOISTING SYSTEM

Robert N. Bennett, McComb, Ohio, assignor to The Fairfield Engineering Company, Marion, Ohio, a corporation of Ohio

Application May 19, 1949, Serial No. 94,182

7 Claims. (Cl. 198—122)

1

This invention relates to conveyors for coal and the like and more particularly to means for raising and lowering a conveyor boom pivotally or otherwise movably mounted on a fixed or transportable supporting structure.

Coal conveyors are provided in some cases with manually operated winding drums and cables for the purpose of raising and lowering their conveyor booms. Such manual operation requires considerable time and effort and is especially undesirable in the case of large conveyors. Various means of powering the hoisting means have been tried, particularly means powered by the same motor which drives the drag chains along the boom. For example, it has been known to mount a hydraulic ram and cylinder to extend transversely between the boom and the supporting structure in order to control the position of the boom by the direct action of the ram. This arrangement, however, has the disadvantage that the ram is located where it is exposed to the elements and either a very long ram has to be used or else the ram has to be located so close to the pivotal mounting of the boom that the portion of the boom extending beyond the ram is subject to severe bending stresses. Other hoisting mechanisms have been tried but have not been satisfactory, generally because of a large number of parts projecting on the outside of the conveyor which get in the way of the operator of the conveyor, which increase the hazard of injury to men around the conveyor, and which are exposed to damage by rough usage and the weather.

My apparatus for hoisting a conveyor boom uses a hydraulic cylinder and ram, a cable connected to the ram, and a drum on which the cable is wound, or a plurality of these elements, all mounted within the conveyor boom and out of the way of damage to or injury caused by these elements. The drum is preferably mounted near the end of the cylinder opposite to the ram in order to provide a compact arrangement, and the shaft carrying the drum projects outside of the boom to actuate the means which are directly connected to the boom to hoist it on the supporting structure. In my hoisting system this means comprises a drum or drums mounted on the shaft outside of the boom and a cable or cables wound thereon and extending between the boom and the supporting structure. In order to balance the hoisting mechanism and to enable a smaller diameter and therefore more flexible cable to be used, pairs of inner and outer drums and corresponding additional cables are preferably used, the inner drums being mounted

2

on opposite sides of the axis of the hydraulic cylinder and ram and the outer drums being mounted on the respective ends of the shaft projecting on opposite sides of the boom. The cables on the outside drums are wound oppositely to the cables on the inside drums so that when the ram moves outwardly from the cylinder the inner drums will unwind and cause the outer drums to wind in their cables, thereby lifting the boom, and when the fluid pressure in the cylinder is released the weight of the boom will draw the cables from the outer drums and cause the inner drums to wind up the cable connected to the ram, thereby retracting the ram.

I provide a hydraulic system which checks the outflow from the hydraulic cylinder in order to control the rate at which the boom is lowered and I provide a safety locking means to hold the boom in a raised position. My system is compact and protected from the elements and rough usage, has a minimum of protruding parts, and also is particularly useful for economy in manufacturing conveyors. It is desirable in the manufacture of conveyors to provide booms of varying lengths but to use as many standard subassemblies as possible. The power hoist mechanisms heretofore in use are not readily adjustable for the changing loads and shifts in center of gravity resulting from mounting booms of different lengths on a series of conveyors. My new hoisting system, on the other hand, is readily adjusted for different lengths of booms by changing the length of cable or cables on the outer drum or drums and, if necessary, changing the sizes of the drums or the relative diameters of the inner and outer drums. Also, in order to increase the power of my hoisting system, a ram and cylinder of a larger diameter or a plurality of parallel rams and cylinders may conveniently be substituted without requiring materially greater space within the boom.

Further novel features and advantages of the apparatus of my invention will become apparent from the following detailed description and in the accompanying drawings. I have shown in the drawings for purposes of illustration only the following preferred embodiment of my invention, in which:

Figure 1 is a side elevation of a conveyor for coal and the like incorporating my invention;

Figure 2 is a transverse sectional view of the conveyor bed taken on the line II—II in Figure 1,

Figure 3 is a partial bottom plan view of the conveyor bed shown in Figure 1;

Figure 4 is a partial longitudinal section taken

on the line IV—IV of Figure 2 (viewed in a direction opposite to the direction of view shown in Figure 1); and

Figure 5 is a diagrammatic representation of the hydraulic system of the conveyor, including the means for powering the hydraulic system.

Referring now more particularly to the drawings, a coal conveyor embodying my invention is illustrated in Figure 1 and comprises a boom 10 and an undercarriage 11. The undercarriage is generally in the form of a recumbent U with its ends extending on either side of the boom and with the tips of the ends carrying a cross-pin 12 on which one end of the boom is pivotally mounted. A shoe member 13 is also pivotally mounted on the pin 12 and rests on the ground while the conveyor is in operation. A pair of spaced tripod supports 14 are rigidly mounted on the undercarriage 11 and extend above and on either side of the boom 10 in order to provide a support for the hoisting means hereinafter described. A pair of wheels 15 are mounted on either side of the undercarriage beneath the supports 14 in order to facilitate moving the conveyor from place to place.

The boom 10 has a conveyor bed 16 extending along its length with a series of paddles 17 carried by a pair of drag chains 18 for pushing coal along the length of the conveyor bed. At the other end of the boom 10 opposite to its pivotal mounting a coal screener 19 is mounted with an outlet 20 for the screened coal and an outlet 21 for the screenings. The drag chains 18 are driven through a chain drive 22 connected to a motor 23 mounted on the boom 10. The motor shown in the drawings is a gasoline-powered motor but any convenient form of motor may be used, such as an electric motor. The drive shaft 23' of the motor is connected through a friction clutch 24 controlled by a lever 25 to a shaft 26 which in turn is connected to the chain drive 22 through a jaw clutch 27 controlled by a lever 28. In the case of an electric motor the clutch 24 may be omitted.

A hydraulic ram 29 and cylinder 30 supply the power for hoisting the boom 10 on the supports 14 and in turn are supplied with power by a hydraulic pump 31 driven by a chain drive 32 from the shaft 26. The pump 31 is supplied through a conduit 33 with hydraulic fluid from a tank 34. A conduit 35 connects the outlet of the pump 31 to a valve 36. The valve 36 is a spool-type three-way valve of known construction and connects the conduit 35 with a return flow conduit 37 and with a conduit 38 which is connected to a port 39 opening into the interior of the cylinder 30. The spool within the valve 36 is connected to a lever 40 and is slidable by the lever 40 to three positions. In the first or driving position the valve 36 blocks the conduit 37 and connects the conduit 35 to the conduit 38 so that the pump 31 supplies fluid under pressure to the cylinder 30, thereby supplying power to the ram 29 to hoist the boom 10. In the second or neutral position the valve 36 connects the conduit 35 to the conduit 37 so that the pump 31 merely circulates fluid through itself to and from the tank 34 and blocks the conduit 38 so that the ram is held in an extended position and the boom 10 is thereby held in a raised position. In the third or release position the valve 36 connects both the conduit 35 and the conduit 38 to the return flow conduit 37 so that the pump circulates fluid through itself to and from the tank 34 and at the same time fluid in the cylinder 30 is free to flow through the conduits 38 and 37 back to the tank 34, thereby permitting the ram 29 to be retracted within the cylinder 30 during the lowering of the boom 10 as hereinafter described. The pump 31 and the valve 36 are shown in Figures 1 and 5 in the form of an integral unit 36–*a* (such as a Vickers "Power Pack"), but separate pump and valve units may be used if so desired. In order to release the ram 29 in the event of an excessive load a relief valve 41 is connected to the conduit 38 and the pressure relief outlet of the valve 41 is connected through a conduit 42 to the return flow conduit 37. In addition, a valve 43 is connected to the conduit 38 to control the rate of backflow through the conduit 38 when the valve 36 is in its release position. The valve 43 is a known form of valve in which ball check valve 44 is connected in parallel with a restricted orifice 45 controlled by an adjustable needle 46. The check valve 44 is arranged to open when fluid is being pumped toward the cylinder 30 and to close when fluid is returning from the cylinder 30. The result of this arrangement is that the valve 43 does not impede flow through conduit 38 while the pump 31 is filling the cylinder 30 but when the valve 36 is in its released position the restricted orifice 45 and the needle 46 in the valve 43 are effective to reduce the rate of backflow from the cylinder 30 to any desired rate so that the boom will be lowered at a controlled rate of speed.

The ram 29 and cylinder 30 are mounted within the boom 10 and extend generally along the axis of the boom beneath the conveyor bed 16. The base or closed end of the cylinder 30 is welded to a plate 47 which in turn is welded to a channeled cross-member 48 fastened to the bed 16 and to opposite side plates 10–*a* and 10–*b* of the boom 10. The port 39 extends from the interior of one end of the cylinder 30 through the plate 47 and member 48 to connect with the conduit 38, and the other end of the cylinder 30 is held by a U-bar 49 bolted to a member 50 secured to a boom cross-member 51. The ram 29 fits snugly and slidably within the cylinder 30 and one end of the ram protrudes from the cylinder and is bolted to a member 52 secured to a cable 53 by bolted U-bars 54. The two ends of the cable 53 extend back toward the base of the cylinder on either side of the cylinder and are wound in the same direction around and are dead-ended on a pair of drums 55 mounted on and keyed to a shaft 56. The shaft 56 extends through and is journaled in the side plates 10–*a* and 10–*b* and is also rotatably mounted in a bearing 57 located between the drums 55 and rigidly secured to the cross-member 48. The end of the shaft 56 extending through the side plate 10–*a* mounts and is keyed to a drum 58. The other end of the shaft 56 extending through the side plate 10–*b* mounts and is keyed to a drum 59. A rigid ratchet wheel 60 in the form of a ring is rigidly fastened to the drum 59 on the side of the drum next to the side plate 10–*b*. A handle 61 is pivotally mounted at its lower end on a stud 62 secured to the side of the plate 10–*b* and an integral tooth 63 projects from the handle 61 and is engageable with the ratchet wheel 60 to prevent the ratchet wheel from revolving in a clockwise direction as shown in Figure 1 (counter-clockwise as shown in Figure 4). The upper end of the handle 61 may be grasped by the operator of the conveyor to lift the tooth 63 out of engagement with the ratchet wheel but in the absence of such control the handle 61 is biased by gravity to swing against the ratchet wheel 60 so that the tooth 63 chatters on the ratchet wheel while the drums 58 and 59 are rotating in a counter-clockwise direction as shown

in Figure 1 and so that the tooth 63 locks the said ratchet wheel and drums against rotation in the other direction.

A cable 64 is dead-ended on the drum 58 and a cable 65 is dead-ended on the drum 59, cables 64 and 65 being wound in the same direction around the drums 58 and 59 but in a direction opposite to the winding of the ends of the cable 53 around the drums 55. On each of the supports 14 an idler pulley 66 is mounted above and on opposite sides of the conveyor boom 10. The cables 64 and 65 extend closely along opposite sides of the boom 10 from beneath the respective drums 58 and 59, over the respective pulleys 66, and down to respective fastening points adjacent opposite lower edges of the boom 10, where these cables are dead-ended. Equivalent cable rigging arrangements include mounting the pulleys 66 on the boom 10 and dead-ending the cables on the supports 14.

The operation of the hoisting mechanism is as follows, assuming that at the start the clutches 24 and 27 are disengaged and the boom 10 is in its lowered position as shown in dotted lines in Figure 1. After the motor is started clutch 24 is operated to connect shaft 23' to drive shaft 26 and thereby, through the chain drive 32, to drive pump 31. Valve 36 through lever 40 is then operated to connect conduits 35 and 38 so that the ram 29 is forced to move outwardly from the cylinder 30. This unwinds the ends of cable 53 from the drums 55 within the boom 10 and thereby causes the drums 55, the shaft 56 and the outside drums 58 and 59 to rotate in a counter-clockwise direction as shown in Figure 1 (clockwise as shown in Figure 4), with the tooth 63 chattering on the ratchet wheel 60. The cables 64 and 65 are thus wound up on the drums 58 and 59 and the ends of these cables fastened to the boom 10 are drawn up toward the pulleys 66 mounted on the supports 14. This action may be continued until the boom is raised to any desired position, such as that shown in full lines in Figure 1. The valve 36 is then changed by the lever 40 to its neutral position, in which the valve 36 blocks the conduit 38 so that the ram is locked in its extended position (unless an excessive load causes the relief valve 41 to open and bypass fluid from the cylinder 30 through conduit 42). The ratchet wheel 60 acts as a secondary holding mechanism in the event of failure of the hydraulic system. The conveyor being positioned for operation, the motor is connected to drive the drag chains 18 by disengaging the friction clutch 24, engaging the jaw clutch 27, and re-engaging the friction clutch 24. The drag-chain drive and the hoisting mechanism can be operated at the same time if desired but it is not necessary to impose both of these loads on the motor at the same time. The motor is needed to drive the hoisting system only while the boom 10 is being raised and at all other times the motor may be clutched and declutched or may be started and stopped for the purpose of driving and stopping the drag chains 18, without regard to the hoisting system. When the boom 10 is to be lowered the tooth 63 is lifted and held away from the ratchet wheel 60 by means of the lever 61 during the period of the lowering operation and the lever 40 is operated to move the valve 36 to its release position. The ram 29 is thus freed from fluid pressure within the cylinder 30 and the weight of the boom 10 lowers the boom and unwinds the cables from the drums 58 and 59, thereby rotating these drums, the shaft 56 and the inner drums 55 in

a clockwise direction as shown in Figure 1 (counter-clockwise as shown in Figure 4). Such rotation winds the cable 53 on the inner drums 55 and draws the ram 29 back within the cylinder 30. The rate of downward movement of the boom 10 is controlled by the valve 43 and the lowering operation may be halted or reversed by changing the setting of the valve 36, which thus affords a very convenient control. The valve 36 is spring-loaded to return the valve to neutral position so that the hydraulic system will become locked if the man operating the conveyor releases the lever 40 during the raising or lowering of the boom. Moreover, the man operating the conveyor has to hold the lever 61 away from the ratchet wheel 60 during the lowering operation so that if he loses control of the machine for any reason, such as falling off his platform on the undercarriage 11, the ratchet tooth 63 will swing against the wheel 60 and will prevent the boom from swinging down and causing injury to itself or to some other equipment or person. In the event of failure of the hydraulic system the ratchet arrangement is self-operating, or may be operated by the man holding the lever 61, to lock the boom 10 against downward movement.

While I have shown and described a present preferred embodiment of my invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced without departing from the spirit of the invention and within the scope of the following claims.

I claim:

1. Boom hoisting mechanism for a conveyor for coal and the like which has a supporting structure and an elongated conveyor boom pivotally mounted on the supporting structure, said mechanism comprising a hydraulic cylinder mounted within the boom and extending in the direction of the length of the boom, means to supply fluid under pressure to the cylinder, a ram extending from the cylinder, a shaft extending transversely through the boom, driving connections between the ram and a portion of the shaft within the boom so that relative movement of the ram in the cylinder causes the shaft to rotate, and means extending between the boom and the supporting structure and operable to hoist the boom on the supporting structure, said hoisting means being connected to be driven by a portion of the shaft projecting outside of the boom, whereby the shaft is rotatable by the ram to hoist the boom.

2. Boom hoisting mechanism for a conveyor for coal and the like which has a supporting structure and an elongated conveyor boom pivotally mounted on the supporting structure, said mechanism comprising a hydraulic cylinder mounted within the boom and extending in the direction of the length of the boom, means to supply fluid under pressure to the cylinder, a ram extending from one end of the cylinder, a shaft rotatably mounted adjacent the other end of the cylinder and extending transversely through the boom, a drum mounted on and fixed to the shaft within the boom, a flexible tension member connecting the ram and drum, and hoisting means extending between the boom and the supporting structure and connected to be driven by a portion of the shaft projecting outside of the boom, whereby the ram rotates the shaft to drive the boom hoisting means.

3. Boom hoisting mechanism for a conveyor

for coal and the like which has a supporting structure, an elongated boom pivotally mounted on the supporting structure, conveying means extending along the boom, and a motor connected to drive said conveying means, said hoisting mechanism comprising a hydraulic pump, driving means connecting the motor and pump, a hydraulic cylinder mounted within the boom, a conduit connecting the pump and cylinder, a ram extending from the cylinder, a shaft rotatably mounted on and extending through and outside of the boom, driving means mounted within the boom and connecting the ram and shaft so that movement of the ram rotates the shaft, and means connected to a projection of the shaft outside of the boom and drivable by the shaft to hoist the boom on the supporting structure.

4. Boom hoisting mechanism for a conveyor for coal and the like which has a supporting structure, an elongated boom pivotally mounted on the supporting structure, conveying means mounted on and extending along the boom, and a motor connected to drive said conveying means, said hoisting mechanism comprising a hydraulic pump, driving means connecting said motor and pump, a hydraulic cylinder mounted within the boom, a conduit connecting said pump and cylinder, a ram extending from the cylinder, a shaft rotatably mounted on and extending through and outside of the boom, a drum mounted on and fixed to the shaft inside of the boom, a flexible tension member connecting the ram and the drum, a drum mounted on and fixed to the shaft outside of the boom, and a flexible tension member extending from the outside drum to the boom and to the supporting structure, said flexible members being wound in opposite directions around said drums so that one member will be wound on its drum while the other member is unwound from the other drum.

5. Boom hoisting mechanism for a conveyor for coal and the like which has a supporting structure, an elongated boom pivotally mounted on the supporting structure, conveying means mounted on and extending along the boom, and a motor mounted on the boom and connected to drive said conveying means, said hoisting mechanism comprising a hydraulic pump, driving means connecting said motor and pump, a hydraulic cylinder mounted within the boom, a conduit connecting said pump and cylinder, a ram extending from the cylinder in the direction of the length of the boom, a shaft rotatably mounted on and extending through and outside of the boom, a drum mounted on and fixed to the shaft inside of the boom, a flexible tension member connecting the ram and the drum, a drum mounted on and fixed to the shaft outside of the boom, and a flexible tension member deadended on the outside drum and asociated with the boom and the supporting structure to lift the boom on the supporting structure, the said flexible members being wound in opposite directions around said drums and said outside drum being of greater diameter than said inside drum, whereby a short stroke of the ram causes a larger movement of the flexible tension member which lifts the boom on the supporting structure.

6. Boom hoisting mechanism for a conveyor for coal and the like which has a supporting structure, an elongated boom pivotally mounted on the supporting structure, coal conveying means mounted on and extending along the boom, and a motor mounted on the boom and connected to drive said coal conveying means, said hoisting mechanism comprising a hydraulic pump, driving means connecting said motor and pump, a hydraulic cylinder mounted within the boom, a conduit connecting said pump and cylinder, a ram extending from the cylinder in the direction of the length of the boom, a shaft rotatably mounted on and extending through and outside of the boom, said shaft being disposed transversely of the axis of the ram adjacent the opposite end of the cylinder from the ram, a pair of drums mounted on and fixed to the shaft inside of the boom, said inside drums being mounted on opposite sides of the axis of the ram, a flexible tension member dead-ended on each of said inside drums and engaged by the ram, a pair of drums each mounted on and fixed to opposite ends of the shaft projecting outside of the boom, idler pulleys mounted on opposite sides of the boom, and flexible tension members each secured at one end to one of said outside drums and secured at the other end to said supporting structure above the boom, the intermediate portion of each of the last-mentioned flexible members passing over one of said idler pulleys.

7. A conveyor for coal and the like comprising a supporting structure, an elongated boom pivotally mounted on the supporting structure, conveying means mounted on and extending along the boom, a motor mounted on the boom and connected to drive said conveying means, a hydraulic pump driven by the motor, a hydraulic cylinder rigidly secured to the boom, a conduit connecting said pump and cylinder, a ram extending from the cylinder in the direction of the length of the boom, means extending between the boom and the supporting structure and operable to hoist the boom on the supporting structure, and driving connections between the ram and said means operable to hoist the boom.

ROBERT N. BENNETT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
856,759	Beebe et al.	June 11, 1907
1,090,670	Zimmerman	Mar. 17, 1914
1,784,872	Hartman	Dec. 16, 1930
2,116,905	Mercier et al.	May 10, 1938
2,354,336	Sloane	July 25, 1944
2,427,461	Johnson	Sept. 16, 1947