Feb. 20, 1962 J. E. MINTY ET AL 3,021,962

CRANE CONTROL OPERATING MECHANISM

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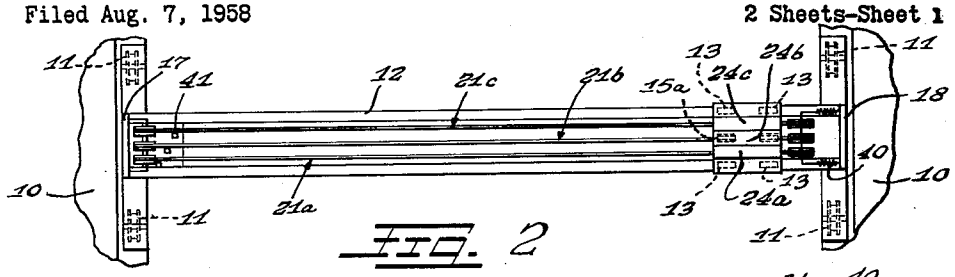


Fig. 2

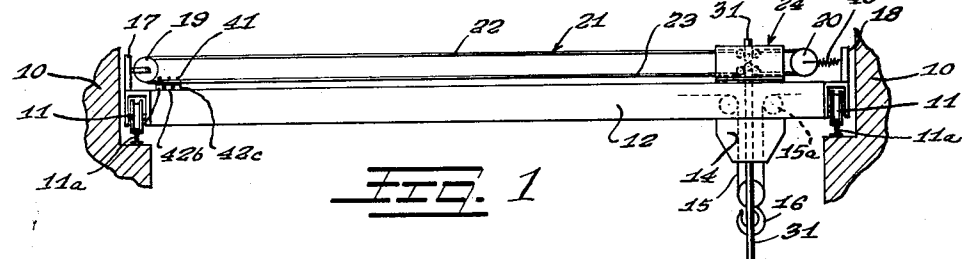


Fig. 1

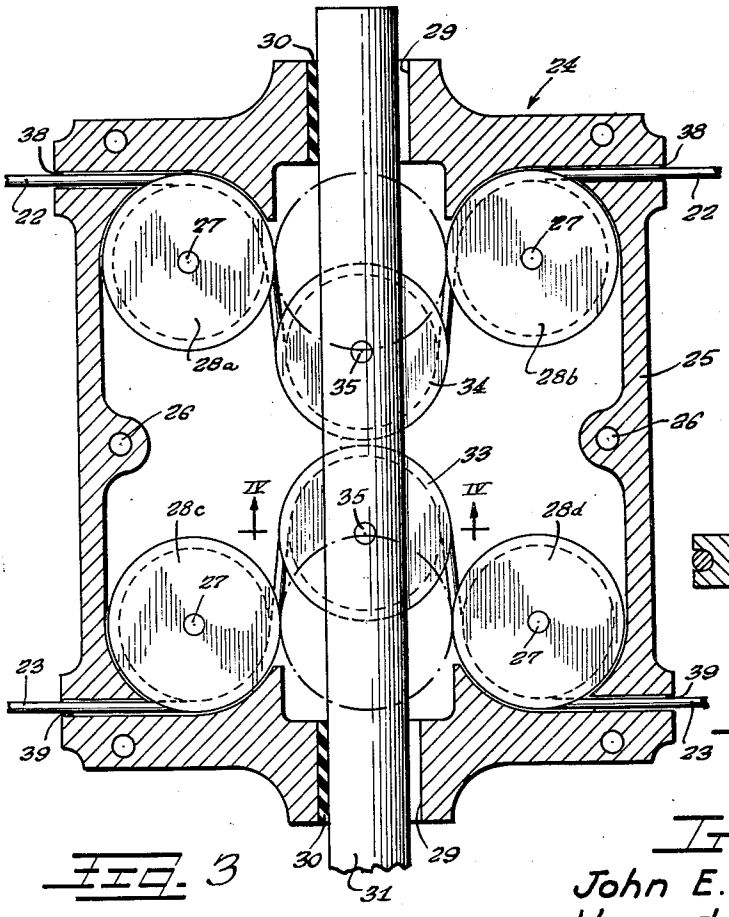


Fig. 3

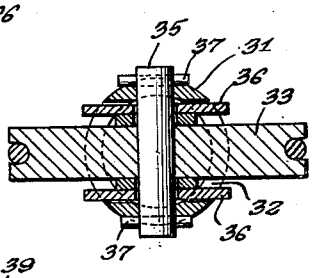


Fig. 4

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CRANE CONTROL OPERATING MECHANISM

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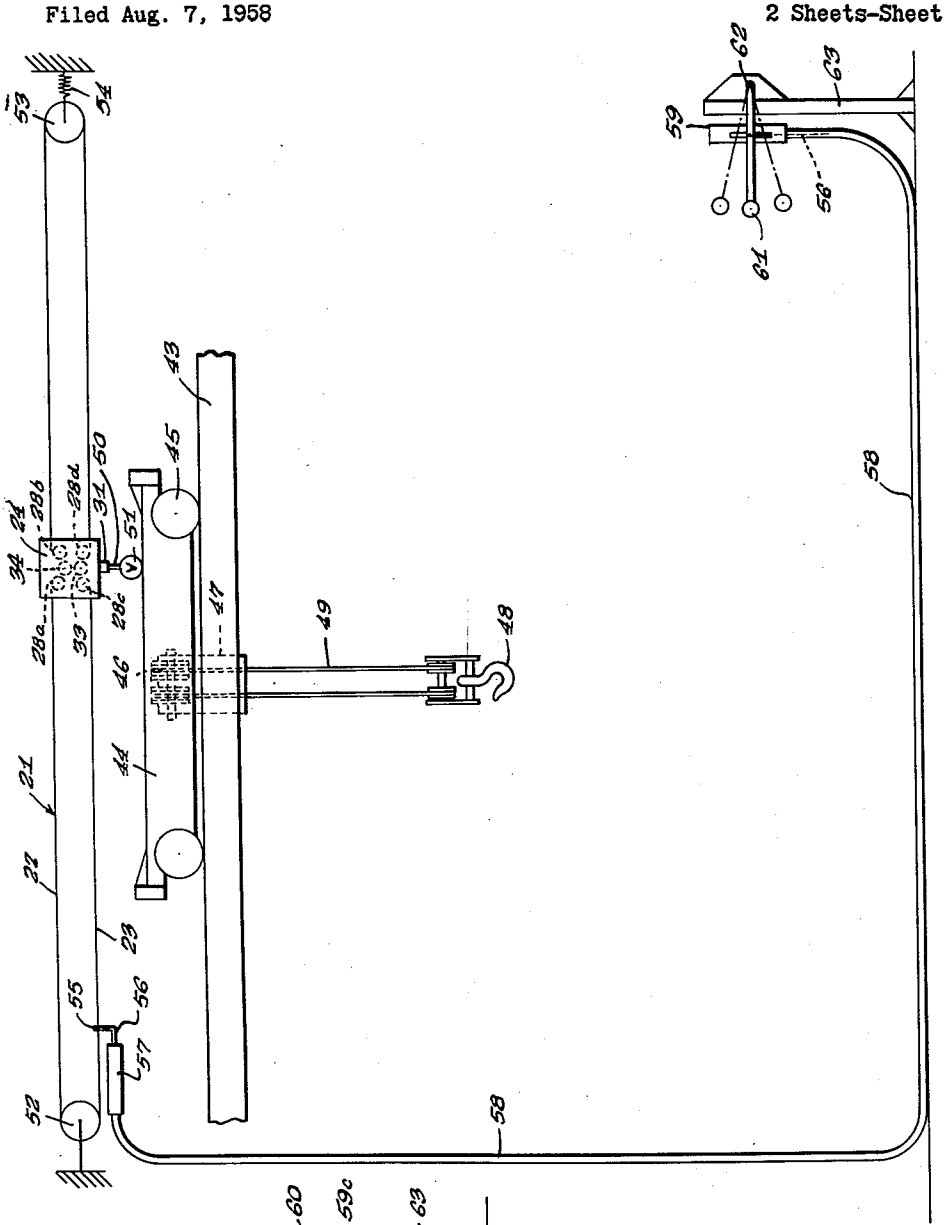


FIG. 5

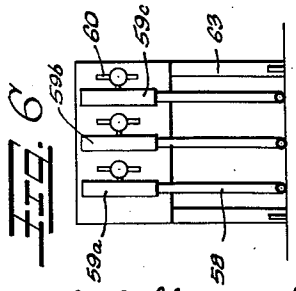


FIG. 6

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CRANE CONTROL OPERATING MECHANISM

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The present invention relates broadly to materials handling, and is more particularly concerned with a new and improved mechanism for controlling operation of a crane at a location remote therefrom.

It is an important aim of the present invention to provide a new and improved structural arrangement permitting normal crane operation from a distant point without loss in the sensitivity of feel or exactness of control over the crane.

Another object of the invention lies in the provision of a control mechanism constructed of a minimum number of reliable parts which may be readily assembled and disassembled.

Another object of this invention is to provide a novel combination of parts which may be employed with ease in the control of both electrically and hydraulically operated cranes from a point removed from the crane bridge.

A further object of the present invention lies in the provision of a crane control mechanism featuring in part one or more pairs of continuous ropes or the like trained over movable sheaves and connecting with valve means controlling one or more of the motions of hoist, traverse and bridge whereby sheave movement initiated from a distant location is effective to actuate the valve means and perform the motions noted.

Other objects and advantages will become more apparent during the course of the following description, particularly when taken in connection with the accompanying drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the same:

FIGURE 1 is an elevational view in schematic form showing a crane control arrangement constructed in accordance with the principles of this invention;

FIGURE 2 is a top plan view of the arrangement of FIGURE 1;

FIGURE 3 is a view with parts in section taken through a portion of the control mechanism and illustrating the arrangement of sheaves and control member therein;

FIGURE 4 is a longitudinal sectional view taken substantially along the line IV—IV of FIGURE 3, and showing one manner of mounting the movable sheaves;

FIGURE 5 is an elevational view in schematic form illustrating a remote control arrangement embodying the mechanism of FIGURES 2 and 3 to effect one or more of the normal motions of hoist, traverse and bridge; and

FIGURE 6 is a detail view of a control cable and panel arrangement for operating the structure illustrated in FIGURE 5.

The novel construction of this invention is particularly well suited to the control of an overhead crane from a location therebeneath and will be described in that connection herein. However, various other applications embodying the novel concepts disclosed will become apparent during the course of the description now to follow.

Referring now particularly to FIGURES 1 and2, there is shown a crane supporting structure of conventional construction with which the present invention is of proven utility. A runway 10 secured in any suitable manner to supporting structure provides by I beams or the like 11*a* a traveling surface for wheels 11 mounting a bridge 12 for longitudinal movement therealong to the extent

of the length of said runway. Supported upon wheels 13 for transverse travel upon the bridge 12 is a trolley 14 from which depends a cable or rope means 15 carrying at one end a crane hook 16, the rope means being trained over pulleys 15*a*.

Provided at opposite ends of the bridge 12 is a pair of supporting members 17 and 18, mounting respectively a rotary pulley 19 and a non-rotatable pulley 20 over which is trained a continuous cable, cord or the like 21. The rope or cable means 21 thereby consists of an upper run or section 22 and a lower run or section 23 each of which passes through a control mechanism generally designated by the numeral 24 supported upon the trolley 14.

It is known in the art that normal crane operation requires at least the two motions designated generally as hoist and bridge. Hoist movement refers to a raising or lowering of the crane hook 16 with or without a load thereon, while bridge movement connotes longitudinal travel of the bridge 12 upon the runway 10 in order to position the crane hook 16 in proximity to a load or to move said load from one location to another within the limits of the length of the runway 10. However, many modern crane constructions are characterized by provision of a third motion designated as traverse, and referring to travel of the trolley 14 transversely along the bridge 12 in a direction perpendicular to the length of the runway 10.

The present invention features control of all three motions of bridge, hoist and traverse and is illustrated in that connection herein. Accordingly, three pairs of pulley means 19 and 20, and rope or cable means 21*a*, 21*b* and 21*c* are shown. Further, the illustrative embodiment includes three control mechanisms 24*a*, 24*b* and 24*c*; however preferred manufacturing practice may dictate that the three control mechanisms be combined into a single unit through which the three cable means are trained. For ease of understanding, however, the control mechanisms 24 are shown as separate units, and since the construction of each is essentially identical, the structural features of only one of said units will now be described.

Referring now also to FIGURES 3 and 4, the control mechanism 24 comprises a housing 25 which may be in the form of an aluminum sand casting of two sections bolted together or otherwise secured one to the other at locations designated at 26. Mounted in the four corners of the housing 25 upon shafts 27 journaled in suitable bearings (not shown) are sheaves 28*a*, 28*b*, 28*c* and 28*d*. Opposite ends of the housing 25 are bored generally centrally at 29 and within the opening thus provided is located a bushing 30 preferably of the oilite type within which is axially movable a tubular control rod or member 31.

As appears more clearly in FIGURE 4, the control tube 31 is slotted at spaced locations 32 along its length to receive a pair of axially or vertically movable sheaves 33 and 34. One manner of mounting the sheaves 33 and 34 upon the tubular control rod 31 comprises a stud shaft 35 mounting washer means 36 on opposite surfaces of the sheaves 33 and 34 and receiving roll pins or the like 37 to effect a firm assembly. The opposite end of the control rod 31 depends downwardly from the trolley 14 and is of a length sufficient to permit its manipulation by an operator located upon the floor beneath the trolley. Three control rods 31 would normally be required to effect the hoist, traverse and bridge motions; however, if the control mechanism 24 is embodied in a composite or single unit, the three individual rods 31 may be received at their lower ends in a mounting panel or the like to facilitate their separate operations.

The upper and lower runs 22 and 23 of the cable or cord 21 pass through openings 38 and 39, respectively, provided in the housing 25. It may be noted that the upper run or part 22 of the cable 21 is reeved over the sheaves 28*a* and 28*b* and under the movable sheave 34, while the lower run or section 23 of the continuous cable 21 is reeved under the sheaves 28*c* and 28*d* and over the axially or vertically movable sheave 33. It may further be noted that a tensioning force is applied to the cable 21 by provision of spring means 40 connecting between the pulley 20 and mounting bracket 18 supported at one end of the bridge 12. An additional benefit derived from this arrangement is that the control rod or member 31 is maintained in a neutral position, particularly since the weight thereof is insignificant when the fabricating material is relatively small diameter aluminum tubing.

Connecting with lower run 23 of each of the cables 21*a–c* is a valve handle or lever 41 on each of three valve means 42*a*, 42*b* and 42*c* supported by the bridge 12 and controlling, respectively, the motions of hoist, traverse and bridge. Hydraulic or electrical connections of known construction are of course provided to the conventional cable mechanism, trolley mechanism, and bridge mechanism, respectively.

Since the operation of each of the control mechanisms 24*a–c* is essentially identical, the action of only a single mechanism in controlling one of the motions of hoist, traverse or bridge will be described. Assuming an operator located on the floor beneath the trolley 14 wishes to raise the crane hook 16, he thereupon moves the hoist control rod 31*a* upwardly which moves the sheaves 33 and 34 a corresponding distance. Control rod movement in an upward direction releases tension or produces a slack in the upper cable run 22 passing under the movable sheave 34, and simultaneously said slack is taken up by the lower movable sheave 33, drawing the lower run 23 of the cable 21 in a direction to the right as viewed in FIGURE 1. The valve lever 41*a* connecting with the cable lower run 23 and valve means 42*a* is moved from an upright or neutral position clockwise or to the right to initiate the cable raising action. Downward movement of the control rod 31*a* after the operation described returns the valve operating lever 41*a* to a neutral position, and upon further downward travel of said control rod 31*a*, the valve lever or handle is rotated counter-clockwise to lower the crane hook 16. Similar movement of the traverse and bridge control rods 31*b* and 31*c* cause corresponding actions of the valve means 42*b* and 42*c* to initiate transverse travel of the trolley 14 or longitudinal travel of the bridge 12, as the case may be. It may now be seen that the control mechanism 24 and parts associated therewith are of relatively simple but extremely reliable construction, thereby providing an arrangement of parts having long and effective life under strenuous operation conditions. Without sacrifice of utility, the outline of the control mechanism 24 may be confined to approximately 36 square inches, the sheaves 28, 33 and 34 therein for most applications being only approximately 1⅝″ in diameter. Further, while particular applications may dictate different requirements, practice has demonstrated that 1/16″ aircraft cable having a breaking strength of about 500 pounds is generally sufficient.

It may at times be desired to control one or more of the motions of hoist, traverse and bridge from a location even more remote than an operator's position beneath the crane trolley. A structural embodiment of the invention featuring remote control of the noted motions is shown in FIGURES 5 and 6, and reference is now made thereto.

As constructed in accordance with the principles of this invention, the structural arrangement shown therein comprises a conventional runway 43 extending longitudinally of the area being served, the runway supporting a movable bridge 44 provided with wheels 45 and mounting for transverse travel upon wheels 46 a trolley 47. A crane hook 48 is supported from the trolley 47 by cable or rope means 49 to effect the customary load lifting and lowering.

The structural features of the control mechanism 24 as earlier described remain the same in the embodiment of the invention shown in FIGURES 5 and 6; however, the control mechanism in this form of the invention is supported by the bridge 44 in any suitable manner. The slotted control rod 31 of the mechanism 24 connects with a valve operating handle 50 on a four-way valve 51 also supported upon the bridge 44 and connecting with known mechanisms effective to perform the motions of hoist, traverse and bridge. As described previously, the control mechanism 24 may comprise three separable units, or may be housed in unitary structure. The cable, cord or rope 21 is reeved about the sheaves 28, 33 and 34 of the control mechanism 24 in the manner previously noted, and in the embodiment of FIGURES 5 and 6 the cord means 21 is trained around a rotary pulley 52 and a non-rotatable pulley 53 attached to structure, which may be a wall of a building housing the apparatus shown. Spring means 54 connecting with the pulley 53 and supporting structure maintains tension on the cord or rope 21 as earlier noted.

The lower run 23 of each of the rope means 21*a–c* is connected at 55 with plunger means 56 movable within a slotted tube or the like 57 mounted on supporting structure, which again may be a wall at one end of the runway 43. The opposite end of the plunger 56 connects with cable means 58, preferably of the Controlex type, which in the arrangement shown is routed along one wall of the building, across the floor thereof and is received in another slotted tube 59 which may be mounted in the manner shown in a distant control room. Connecting with each of the plungers 56 and received within the slotted portion 60 of each of the tubular members 59 is a control lever 61 pivoted at 62 at one end upon a stand or other structure 63 supported by the floor or in any other suitable manner.

Each of the control levers 61 for the motions of hoist, traverse and bridge are preferably pivotally movable through an arc of approximately 3″ upwardly or downwardly to effect a corresponding amount of travel of the lower run 23 at the connection 55 with the opposite end of the plunger 56. Accordingly, movement of one of the control levers 61 in a downwardly direction causes the lower run 23 of the rope means 21 to move to the right as viewed in FIGURE 5, thereby slackening the lower run 23 reeved about the sheaves 28*c*, 33 and 28*d*. The slack produced is taken up by the upper rope run 22 to raise the movable sheave 34, and control rod connected therewith approximately 1½″, and thereby raising the connecting valve operating handle 50 and opening the valve 51 to a full speed position. Depending upon the particular valve controlled, either the crane hook 48, trolley 47, or bridge 44 will be operated at maximum speed, assuming the control lever 61 is moved to the maximum of its downward vertical pivotal movement. A movement of the handle or the lever 61 less than the 3″ travel permitted in the exemplary embodiment shown will produce a lesser speed in that motion. Accordingly, the infinite variable speed characteristic of the crane is maintained and under full control of the operator of the lever 61, regardless of the position in which the bridge 44 may be on the runway 43 at a particular moment.

The connection between the valves 51 and mechanisms known to the art for accomplishing motions of hoist, traverse and bridge may be made in suitable manner, and with regard to the slotted tube 31 axially movable within the control mechanism 24 of FIGURES 5 and 6, the only essential change therein over the corresponding member from FIGURES 1 and 2 is the decrease in length thereof. For accomplishment of the purposes of the arrangement of FIGURES 5 and 6 the control mechanism may be increased in size to accommodate 3″ sheaves over which

are reeved 3/16" flexible rope or cord 21. As thus constructed, the sheaves 28, 33 and 34 have been found to revolve at a speed of approximately 250 r.p.m. at a bridge speed of approximately 200 ft. per minute. It will of course be appreciated that the diameter of the sheaves may be reduced; however a corresponding increase in rotative speed of the sheaves would result, and under particular circumstances, a speed increase may be found not entirely desirable.

The present invention has been described particularly in connection with control and operation of a hydraulic type crane, however, equal utility exists therefor in connection with electric type cranes. Thus, a variable speed drum controller may be mounted upon the crane bridge 12 or 44 and motions of hoist, traverse and bridge controlled in a similar manner. The control mechanism as herein disclosed is believed to have substantial advantages, particularly by way of the degree of control, over an arrangement employing solenoid valves to operate the three motions of the crane. As is known, a solenoid valve generally has only a completely open or completely closed position, and accordingly, the fine degree of control obtained by hydraulic cranes would be sacrificed to a large measure.

It may be seen from the foregoing that applicants have provided a novel crane control operating mechanism embodying features of equally successful application to both hydraulically and electrically operated cranes. No sacrifice is found in the sensitivity of feel or the exactness of control over the crane, and construction of the mechanism herein disclosed requires only a minimum number of parts and each of these features reliability in every detail. The entire structure may be readily assembled and disassembled, and it may now be seen that the control mechanism is characterized by utilization of upper and lower rope runs permitting operation of a device such as a valve handle in both directions from a central or neutral position.

With further reference to the control mechanism, actual practice has demonstrated that as the upper and lower runs 22 and 23 of the rope 21 pass over the movable sheaves 33 and 34, the sections of this looped portion should be parallel to one another and to the vertical axis of the control mechanism 24. The advantage of this is that the mechanism develops an identical amount of slack and take-up. As shown in FIGURE 3, a parallel relation between the rope sections may readily be accomplished by increasing the diameters of the sheaves 33 and 34, or by moving the centers thereof inwardly.

Various modifications and changes may be made to the structures herein disclosed without departing from the novel concepts of the invention.

We claim as our invention:

1. A control mechanism for effecting one or more crane motions of hoist, traverse and bridge, comprising a housing, a plurality of rotatable and axially immovable sheave members mounted within said housing, a plurality of rotatable and axially movable sheave members supported within the housing for simultaneous movement in the same direction between and away from the axially immovable sheave members, control means mounting the last-named sheave members for axial movement, and cable means comprising a pair of vertically spaced cable runs extending outwardly from each of the opposite ends of the housing receivable upon the axially immovable and axially movable sheave members and upon effective slackening and tightening thereof and upon movement of the control means to effect one or more motions of hoist, traverse and bridge, one only of said axially movable sheave members being positioned between a pair of axially immovable sheave members during maximum slackening of the cable run received thereon.

2. In crane operating apparatus which includes mechanisms for performing one or more motions of hoist, traverse and bridge, the improvement which comprises a generally vertically stationary housing, a plurality of rotatable and axially immovable sheave members mounted within said housing, a plurality of rotatable and axially movable sheave members supported within the housing for simultaneous movement in the same direction between and away from the axially immovable sheave members, control means mounting the last-named sheave members for axial movement, and cable means connecting with the mechanisms for performing one or more motions of hoist, traverse and bridge and comprising a pair of vertically spaced cable runs extending outwardly from each of the opposite ends of the housing receivable upon each of the sheave members and effective upon slackening or tightening thereof to initiate operation of the mechanism connected thereto to effect hoist, traverse or bridge movements, one only of said axially movable sheave members being positioned between a pair of axially immovable sheave members during maximum slackening of the cable run received thereon.

3. In crane operating apparatus which includes mechanisms for performing one or more motions of hoist, traverse and bridge, the improvement which comprises a control device including a housing and a plurality of stationary sheave members mounted for rotation in each of the opposite corners thereof and a pair of vertically aligned and vertically movable rotatable sheave members supported for simultaneous movement in the same direction, cable means comprising vertically spaced upper and lower runs received in the stationary and movable sheave members and extending outwardly from each of the opposite ends of the housing, one of said runs connecting with one of said mechanisms, and means for slackening one of the runs and simultaneously tightening the other of said runs to actuate one of the mechanisms and initiate one of the motions of hoist, traverse and bridge, one only of said movable sheave members being positioned between a pair of stationary sheave members during maximum slackening of the cable run received thereon.

4. In crane operating apparatus which includes mechanisms for performing one or more motions of hoist, traverse and bridge, the improvement which comprises a control device including a housing and a plurality of stationary sheave members mounted for rotation in each of the opposite corners thereof and a plurality of vertically movable rotatable sheave members supported for simultaneous movement in the same direction, cable means comprising vertically spaced upper and lower runs received in the stationary and movable sheave members and extending outwardly from each of the opposite ends of the housing, one of said runs connecting with one of said mechanisms, and a control rod connecting with each of the movable sheave members and having a portion thereof received in the control device housing for movement therewithin, said control rod being movable in opposite directions to simultaneously move the movable sheave members in the same direction to slacken one of the cable runs and simultaneously tighten the other of said runs to actuate one of the mechanisms and initiate one of the motions of hoist, traverse and bridge, one only of said movable sheave members being positioned between a pair of stationary sheave members during maximum slackening of the cable run received thereon.

5. In crane operating apparatus which includes mechanisms for performing one or more motions of hoist, traverse and bridge, the improvement which comprises a control device including a vertically stationary housing and a plurality of stationary sheave members mounted for rotation in opposite corners thereof and a plurality of vertically aligned and vertically movable rotatable sheave members supported for simultaneous movement in the same direction, cable means comprising vertically spaced upper and lower runs received in the stationary and movable sheave members and extending outwardly from each of the opposite ends of the housing, valve means connecting with one of the runs and with one of

the mechanisms, and a control rod supporting the movable sheave members for simultaneous movement in opposite vertical directions to slacken one of the cable runs and simultaneously tighten the other of said runs and actuate the valve means connected thereto to initiate one of the motions of hoist, traverse and bridge, one only of said movable sheave members being positioned between a pair of stationary sheave members during maximum slackening of the cable run received thereon.

6. In crane operating apparatus which includes a traveling bridge and hoist and mechanisms for moving the same, the improvement which comprises a control device associated with said bridge and comprising a generally vertically stationary housing and a plurality of axially immovable sheave members and a plurality of axially movable sheave members located therein, a control member carrying said axially movable sheave members for rotation thereon and simultaneous vertical movement therewith in the same direction under control of an operator between and away from the axially immovable sheave members, pulley means supported on the bridge and a main cable trained thereover extending outwardly from each of the opposite ends of the housing and having an upper run reeved under one of the axially movable sheave members and over a pair of axially immovable sheave members and a lower run reeved over another of the axially movable sheave members and under a pair of axially immovable sheave members, and valve means connecting with the bridge and hoist and having a lever connecting with one of the cable runs so that upon movement of the control member in one direction by the operator the axially movable sheave members are simultaneously moved in the same direction and a cable run tensioned to actuate the valve means connected thereto and cause motion of the bridge or hoist, one only of said axially movable sheave members being positioned between a pair of axially immovable sheave members during maximum slackening of the cable run received thereon.

7. In crane operating apparatus which includes a traveling bridge and hoist and mechanisms for moving the same, the improvement which comprises a control device comprising a generally vertically stationary housing carried by the bridge and a plurality of axially movable rotatable sheave members and a plurality of axially immovable sheave members located within said housing, a control member supporting said axially movable sheave members for simultaneous vertical movement in the same direction, pulley means and a main cable trained thereover and having an upper run reeved under one of the axially movable sheave members and over a pair of axially immovable sheave members and a lower run reeved over another of the axially movable sheave members and under a pair of axially immovable sheave members, valve means connecting with the bridge and hoist and having a lever attached to the control member, and a control cable connecting with the main cable and movable from a remote point to cause travel of the main cable linearly and a tensioning of one of the runs thereof moving the control member and axially movable sheave members in the same directions simultaneously and moving the valve lever connected thereto cause motion of the bridge or hoist, one only of said axially movable sheave members being positioned between a pair of axially immovable sheave members during maximum slackening of the cable run received thereon.

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