July 17, 1962 F. P. HOPFELD 3,044,647

MANIPULATOR APPARATUS

Filed April 14, 1960 3 Sheets-Sheet 1

FIG. 1

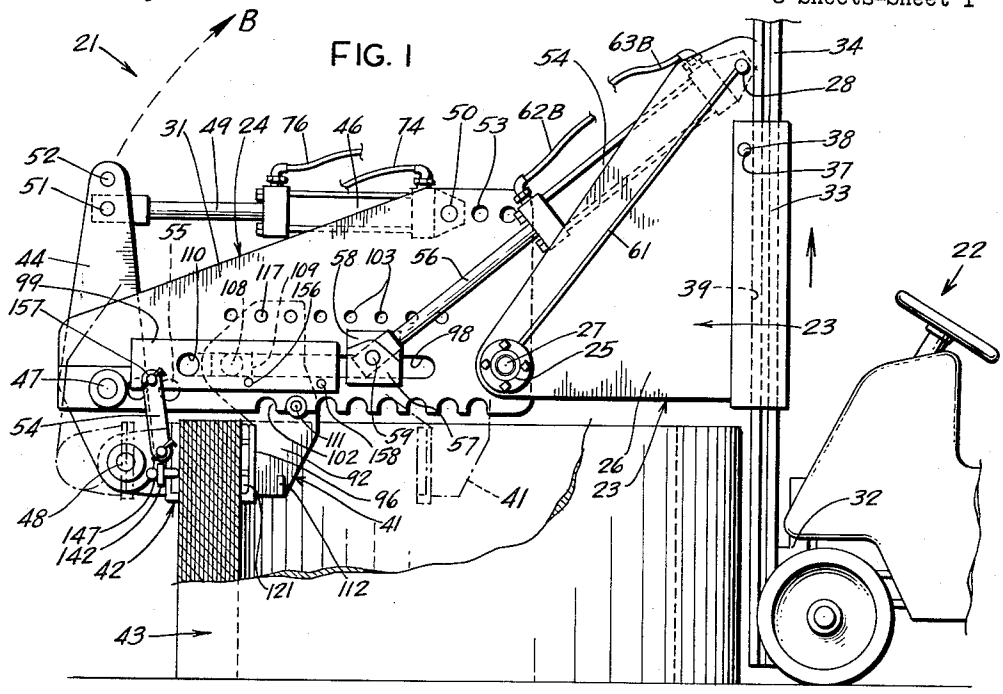
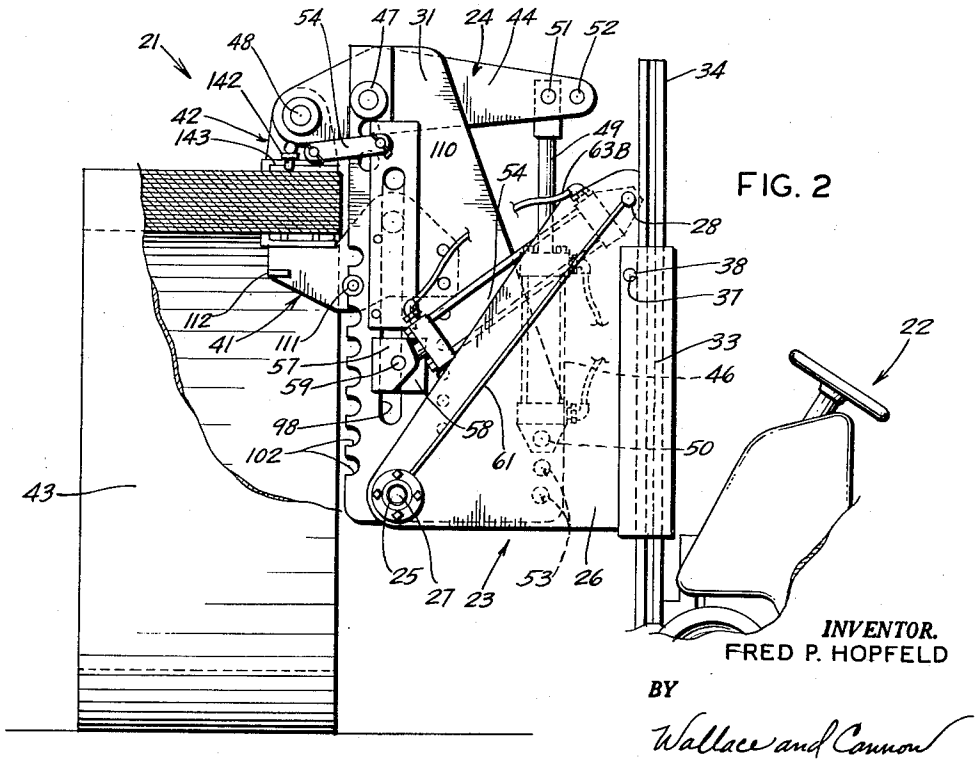


FIG. 2



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Filed April 14, 1960 3 Sheets-Sheet 2

FIG. 3

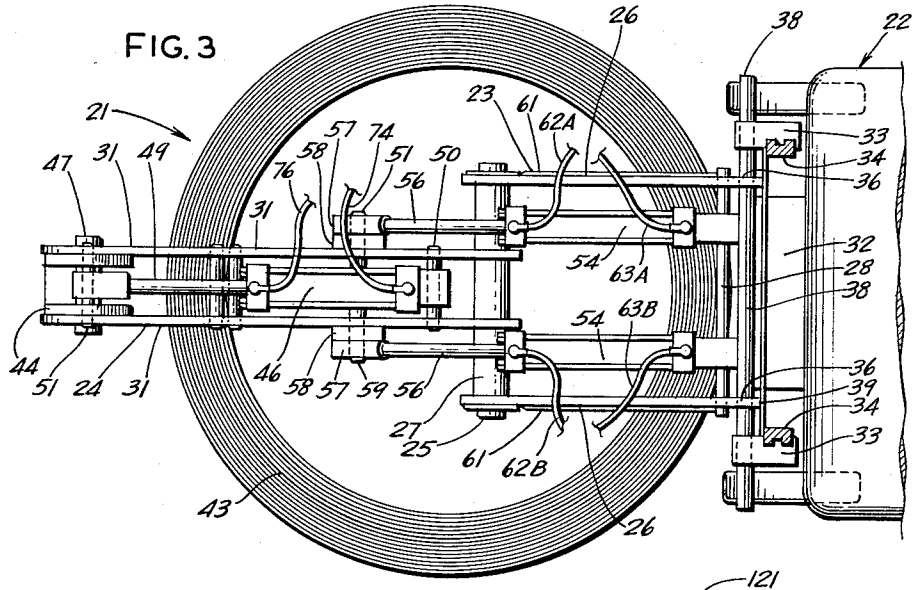

FIG. 3A

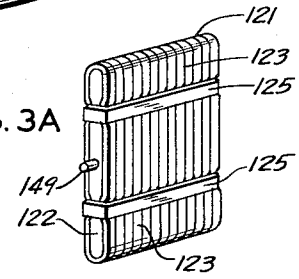

FIG. 4

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MANIPULATOR APPARATUS

Filed April 14, 1960 3 Sheets-Sheet 3

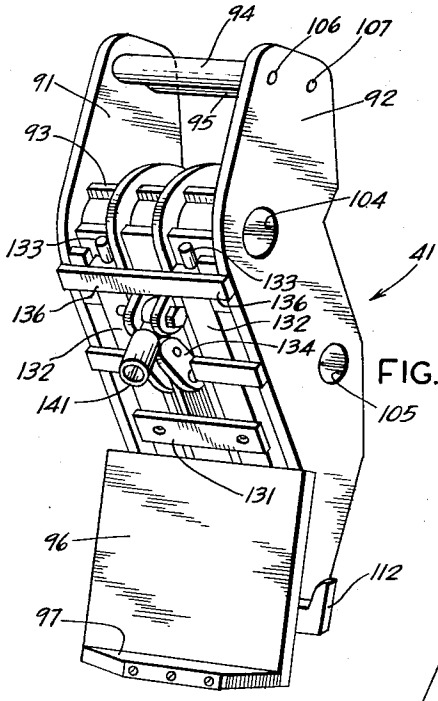
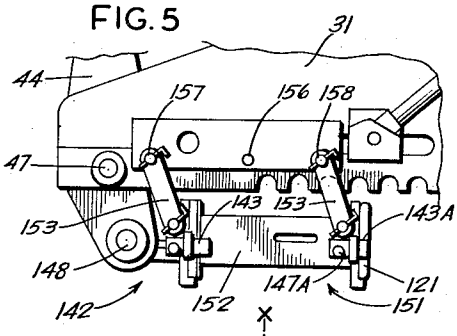


FIG. 7

FIG. 5



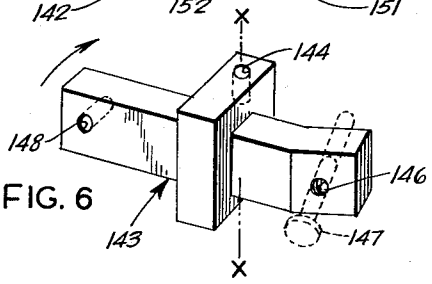


FIG. 6

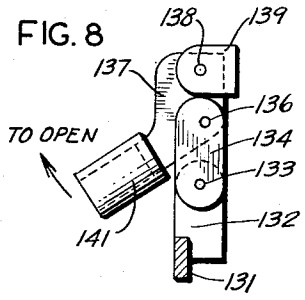


FIG. 8

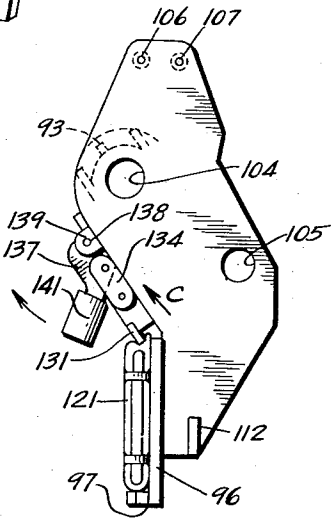


FIG. 9

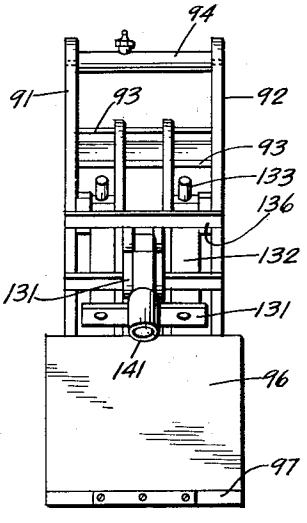


FIG. 10

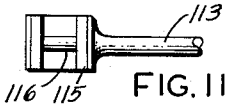


FIG. 11

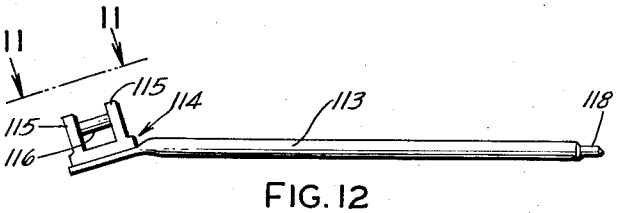


FIG. 12

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3,044,647

MANIPULATOR APPARATUS

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Filed Apr. 14, 1960, Ser. No. 22,264
8 Claims. (Cl. 214—652)

This invention relates to apparatus for manipulating coils and like open-ended cylindrical objects. This invention particularly relates to coil-manipulating apparatus adapted to be associated with the elevator structure of a conventional lift truck.

In the handling and particularly in the storage of coils and similar open-ended cylindrical objects, problems arise in turning the coils from a position wherein the coil rests on end to a position wherein the coil rests on its side, and vice versa. Thus, in many cases it is desirable to turn coils from side storage to end or edge storage so that the coils may be loaded on pallets and stacked one above another to reduce the floor space required to store the coils. At other times it may be necessary to turn a coil from an end or "eye-up" position, wherein the longitudinal axis of the coil is vertically disposed, to a side position, wherein the longitudinal axis of the coil is generally horizontally disposed.

Various approaches to this problem of manipulating coils or like objects have been taken. In one instance, a chain hoist and clamping tongs have been utilized. With such apparatus it is possible to turn a coil from side storage to end storage, or vice versa, but considerable manual manipulation of the chain hoist and clamping tongs is required, and the operation at best is a tedious and time-consuming one, and not without risk of injury to the personnel involved.

It has also been proposed to utilize a cradle which can be tilted through an arc of ninety degrees to accomplish the desired repositioning of coils or like objects. However, this method of manipulating coils and like objects is also subject to substantial disadvantages. Thus, the coil or coils to be repositioned must first be transported to the cradle from the area of storage of the coil, which may be quite remote from the location of the cradle, and subsequently loaded on the cradle by auxiliary apparatus, such as a lift truck. Thereafter, it may be necessary to again transport the coil or coils to an area which is remote from the location of the cradle. Thus, the methods of manipulation of coils and like objects heretofore utilized have been generally unsatisfactory, being both tedious and time consuming, and resultantly inefficient and costly, as well as generally inconvenient.

It is, therefore, a primary object of this invention to manipulate coils or like objects by novel apparatus which is especially adapted to be mounted on the fork plate or like elevator structure of a conventional lift truck. By reason of the manner in which the coil manipulator is thus associated with a lift truck substantially complete mobility of the manipulator is obtained and advantage is taken of the vertical positioning afforded by the existing elevator structure of the lift truck.

A manipulator constructed in accordance with the present invention incorporates a first frame assembly which is adapted to be mounted directly on existing structure of a lift truck with a minimum of modification to the lift truck. A second frame assembly, which affords a support for a coil-clamping structure, is pivotally connected to the first frame assembly mounted on the lift truck. A double-acting hydraulic ram, which may be associated with the hydraulic system of the lift truck, is connected between the first and second frame assemblies to rotate the second frame assembly through an arc and thereby move a coil or like object clamped within the

clamping structure to a desired position. To incorporate the foregoing features in novel coil-manipulator apparatus is another object of this invention.

The clamping structure referred to hereinabove includes a pair of opposed jaw units effective to engage the inner and outer surfaces of a sector of the coil or like object to be manipulated. Thus, a movable jaw unit is adapted to be moved, but only to a limited extent, toward and away from a stationary jaw unit. It is another object of the present invention to include provision for shifting the stationary jaw unit to any one of a number of fixed locations on the rotatable frame assembly to thereby accommodate coils of varied inner and outer diameters.

It is another object of this invention to include in the clamping structure hydraulically actuated apparatus for moving the other jaw unit toward the jaw unit which is fixed in position to insure application of a high clamping force on the portion of the coil clamped between such jaw units. It is a related object of this invention to include a linkage arrangement in the clamping structure for insuring that the movable jaw unit is maintained in predetermined alignment with the outer surface of a coil or like object to prevent cocking of the movable jaw unit with respect to the coil.

In accordance with the present invention each jaw unit is provided with clamping lips which are replaceably mounted on the jaw units so that clamping lips of varied curvatures can be utilized to match the contour of the coil or like object to be manipulated. It is another object of this invention to utilize lip clamping structure, on such jaw units, which enables the clamping lips to be readily and conveniently removed or replaced.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments of the present invention and the principles thereof and what are now considered to be the best mode for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention, and the purview of the appended claims.

In the drawings:

FIG. 1 is a side elevation view of a manipulator constructed in accordance with the present invention, showing the manipulator operatively associated with a conventional lift truck;

FIG. 2 is a side elevation view of the manipulator illustrated in FIG. 1, but showing the component parts thereof in an elevated position;

FIG. 3 is a plan view of the manipulator illustrated in FIG. 1;

FIG. 3A is a perspective view of a replaceable lip member utilized in the manipulator illustrated in FIG. 1;

FIG. 4 is a schematic view of a hydraulic circuit utilized in the manipulator illustrated in FIG. 1;

FIG. 5 is a detail view of a portion of the manipulator illustrated in FIG. 1, showing a jaw extension incorporated therewith;

FIG. 6 is a perspective detail view of a swivel piece utilized in lip clamping structure of the manipulator illustrated in FIG. 1;

FIG. 7 is a perspective view of a jaw unit utilized in the manipulator illustrated in FIG. 1;

FIG. 8 is a detail view of an over-center linkage clamping mechanism incorporated in the jaw unit illustrated in FIG. 7;

FIG. 9 is a side elevation view of the jaw unit illustrated in FIG. 7;

FIG. 10 is an end elevation view of the jaw unit illustrated in FIG. 7;

FIG. 11 is a fragmentary detail view of the socket end of a jaw adjustment handle and taken in the direction of the arrows 11—11 in FIG. 12; and

FIG. 12 is a plan view of the jaw adjustment handle.

In FIGS. 1–3 a manipulator constructed in accordance with one embodiment of the present invention is indicated generally by the reference numeral 21. In various figures of the drawings the manipulator has been shown as effective to manipulate a coil and will hereinafter be described in that respect. However, it should be recognized that the mechanism of the present invention can equally well be utilized to manipulate a wide variety of objects other than coils. The manipulator 21 is illustrated as associated with a conventional lift truck 22 and comprises both a first frame assembly 23 mounted on and vertically movable with the fork plate of the lift truck and a second frame assembly 24 pivotally mounted on the first frame assembly. Thus, the first frame assembly 23 comprises a pair of generally triangular side members 26 which are laterally spaced from one another by shoulders formed on a rod 27 (see FIGS. 1–3) abutting the inner-facing surfaces of the side members. The reduced diameter ends of the rod 27 are journalled for rotation within bearings 25 which are in turn bolted or otherwise affixed to the side members 26. Also, a rod 28 extends between and is suitably attached to the side members 26 at the upper ends thereof.

The second frame assembly 24 also includes a pair of spaced-apart and generally triangular side members 31, each of which is formed with a suitable opening in a lower corner portion thereof, as viewed in FIG. 1 enabling the side members 31 to be supported on and pivotal with the rod 27. Thus, the second frame assembly 24 may be swung through an arc, as indicated by the arrow B in FIG. 1, by suitable power means presently to be described.

As noted hereinabove, the entire coil manipulator 21 is adapted to be mounted on the fork plate of a conventional lift truck so as to be vertically movable therewith. In accordance with the present invention, the means affording such mounting of the coil manipulator on the lift truck are of a quite simple nature. Thus, and as best illustrated in FIG. 3, the lift truck 22 includes a fork plate 32 having guide flanges 33 engageable with the vertically extending tracks or rails 34 of the elevating mechanism of the lift truck. Each of the guide flanges 33 is formed with a circular opening 37 in the forward portion thereof and in alignment with the corresponding opening in the opposite guide flange. Each of the side members 26 is also formed with a circular opening 36, and a mounting bar 38 is inserted through the respective openings 36 and 37 to connect the first frame assembly 26 and the coil manipulator to the fork plate of the lift truck. Mounting of the coil manipulator on the lift truck can be quite easily accomplished merely by driving the lift truck up to the coil manipulator and adjusting the vertical height of the fork plate to align the respective openings 36 and 37. After insertion of the rod 38, the vertically extending rearward edges 39 of each of the side members 26 abut the forward face of the fork plate 32, and the coil manipulator 21 is thereby effectively supported by the fork plate 32.

The second frame assembly 24 serves as the support for the coil clamping structure of the coil manipulator 21. As best illustrated in FIGS. 1 and 2, the coil clamping structure of the present invention includes a pair of opposed jaw units indicated generally by the reference numerals 41 and 42. The jaw unit 41 is adapted to be positioned at any one of a series of fixed locations along the length of the frame assembly 24. The jaw unit 42 is adapted for a limited amount of axial movement toward and away from the fixed jaw unit 41 to clamp or release a section of a coil 43 therebetween. Thus, with the jaw unit 41 maintained in the position illustrated in FIGS. 1 and 2, the jaw unit 42 is movable toward and away from the jaw unit 41, between the positions indicated by the solid and phantom outlines in FIG. 1, by means which include a lever member 44 and a double-acting hydraulically actuated ram 46. The lever member 44 is pivotally mounted between the forwardmost end portions of the side members 31 by a pivot pin 47. The jaw unit 42 is in turn pivotally connected to a lower end portion of the lever member 44, as viewed in FIG. 1, by a pin 48, and the piston rod 49 of the fluid-powered ram 46 is pin jointed at 51 to an upper end portion of the lever member 44.

The lever member 44 is provided with a leverage adjustment hole 52 in the uppermost end portion thereof so as to enable the piston rod 49 to exert increased leverage on the lever member 44 and jaw unit 42 over that possible with the connection as illustrated. Thus, depending upon the fluid pressure applied to the ram 46, the pivot pin 51 may be inserted in either the lower hole, as illustrated, or the upper hole so as to provide the desired clamping force at the jaw units. The end of the ram 46 opposite that connected to the lever member 44 is connected to the side members 31 by a pin 50 at any one of a series of locations 53. Likewise, the pivot pin 47 may be disposed within any of several locations 53 (see FIG. 1).

To insure that the jaw clamping face of the jaw unit 42 is maintained substantially parallel to the outer surface of a coil or like object 43 to be clamped between the jaw units, a link member 54 is pivotally connected at opposite ends to the jaw unit 42 and a side member 31 to insure linear motion of the clamping face of the jaw unit. In this manner, canting and mismating of the jaw unit with the coil may be avoided.

Once the coil or other object is clamped between the jaw units 42 and 43, and the fork plate 32 and coil manipulator 21 have been elevated a sufficient distance above the floor, the frame assembly 24 and the coil or other object clamped thereby can be swung between the respective horizontal and vertical positions illustrated in FIGS. 1 and 2, or to any intermediate position therebetween, by reason of the pivotal connection afforded by the rod 27 described hereinabove.

Power means in the form of a pair of double-acting hydraulically actuated rams 54 are included in the coil manipulator 21 for this purpose. Thus, as best illustrated in FIG. 3, the upper ends of the outer casings of the rams 54 are rotatably mounted on the rod 28 extending between the side members 26 of the first frame assembly. The outermost ends of the piston rods 56 of the rams are affixed to plate members 57 which in turn abut plate members 58 affixed to the side members 31 of the second frame assembly 24. A pin 59 is passed through suitable openings formed in each of the plate members 57 and 58 and the side members 31 for transmitting a lifting or tilting force from the rams to the frame assembly 24. A strut 61 may preferably be welded or otherwise attached to side members 26 so as to run diagonally along the outer surfaces of the side members between the rods 27 and 28 to afford additional bracing and resistance to lateral buckling or deformation of the side members.

In FIG. 4 there is schematically illustrated a hydraulic circuit utilized with the coil manipulator illustrated in FIGS. 1–3. As illustrated in FIG. 4, conduits 62 and 63 are adapted to convey fluid to and from the respective head end and rod end chambers in the rams 54. Thus, conduit 62 is divided into two branch conduits 62A and 62B by a T-joint or similar coupling 64 while the conduit 63 is divided into two branch conduits 63A and 63B by a T-joint coupling 66. Each of the conduits 62 and 63 is adapted to be connected to the hydraulic system of the fork lift truck, and for this purpose the conduits 62 and 63 include conventional quick disconnect couplings 67 and 68 respectively.

The movement of the pistons 56 within the cylinders of

the rams 54 is controlled by conventional manually operable valve means, not illustrated in FIG. 4, but included in a hydraulic system of the lift truck between the pump and the quick disconnect couplings 67 and 68. In those instances wherein quite heavy coils or the like are to be manipulated by the coil manipulator of the present invention, it is quite desirable that some provision be made for controlling the rate at which the coil and second frame assembly 24 is permitted to move from an upper position, as illustrated in FIG. 2 to a lower position, as illustrated in FIG. 1. For this purpose, a speed control valve indicated generally by the reference numeral 71 in FIG. 4 is included in the conduit 63 between the quick disconnect coupling 68 and the T-joint coupling 67. The valve assembly 71 includes a uni-directional check valve 72 which permits free flow of hydraulic fluid from the pump to the rod end of the cylinders of the rams 54 but which prevents any fluid flow in the return direction. The valve assembly 71 also includes an adjustable valve 73 affording a variable restriction in a flow path which by-passes the check valve 72. Thus, upon manipulation of the manually operated control valves noted hereinabove, but not illustrated in FIG. 4, fluid can be freely applied, under pressure, to the rod end of the rams 54 to tilt the second frame assembly 24 upwardly about the pivot rod 27, as viewed in FIG. 1. However, upon connecting the conduit 63 to drain, by suitable manipulation of the non-illustrated manually operable control valve mechanism noted hereinabove, the restriction afforded by the valve 73 comes into effect to control the return flow through the conduit 63 and thereby regulate the rate of descent of the second frame assembly 24 and the coil or like object clamped thereto. Inasmuch as the valve 73 is adjustable, flexibility of operation is achieved so that the rate of movement of the second frame assembly 24 can be quickly and conveniently adjusted to compensate for the size and weight of the coil to be manipulated.

The ram 46 is likewise adapted to be supplied with hydraulic fluid from the hydraulic system of the lift truck, and thus includes conduits 74 and 76 connected to the respective head end and rod end chambers of the cylinder of the ram 46. The conduits 74 and 76 also include conventional quick disconnect couplings 77 and 78. As illustrated in FIG. 4, an accumulator, indicated generally by the reference numeral 79, is preferably incorporated in the hydraulic circuit for the ram 46 for automatically releasing the movable jaw unit after the conduit 76 and head end of the ram 46 have been connected to drain. Thus, the accumulator 79 includes a cylinder 81 and a spring-biased piston 82. The cylinder 81 is connected to the conduit 74 by a T-joint coupling 83 and a branch conduit 84, and a fixed restriction 86 is included in the branch conduit 84. The accumulator assembly 79 also includes a uni-directional check valve 87 in the conduit 74 and a drain connection 88 between the conduits 74 and 76.

The coil manipulator of the present invention is adapted to handle a wide variety of coils or like objects of varying sizes, weights, and configuration. Thus, and as noted generally hereinabove, the jaw unit 41 can be positioned at any one of a series of fixed locations along the length of the side members 31 of the frame assembly 24 in a manner now to be described.

In FIGS. 1 and 2, it is seen that the members 31 of the frame assembly 24 are formed with elongated slotted openings 98 which extend parallel to the lower edge of the side members 31. A cover piece 99 is suitably affixed to the outer surface of the side members 31 to shield the greater portion of the guideways 98 from the entry of foreign matter. The lower edge of each side member 31 is formed with a series of semi-circular recesses 102, and a series of aligned circular openings 103 are disposed above the elongated opening 98 in the side members 31.

As best illustrated in FIG. 7, the jaw unit 41 comprises a pair of side plates 91 and 92 which are joined together by a series of cross struts 93 and sleeves 94 and 95 to afford a light weight yet quite rigid assembly. The jaw unit 41 also includes a plate member 96 formed with a projecting lower ledge portion 97, for mounting a replaceable coil clamping lip member, such as is illustrated in FIG. 3A.

As shown in FIG. 7, the side plates 91 and 92 of the jaw unit 41 are formed with two relatively large diameter openings 104 and 105 and two relatively small diameter openings 106 and 107, which latter openings are aligned with the respective sleeves 94 and 95. In assembling the jaw unit 41 with the frame assembly 24, the jaw unit is inserted between the side members 31 and a swivel pin 108 is inserted through the elongated openings 97 in the side members 31 and the openings 104 in the side plates of the jaw unit. Preferably, a shoe 109 (see FIG. 1) is included in the jaw unit 41 to facilitate sliding movement of the swivel pin 108 within the guideway afforded by the elongated openings 98. Also, the cover plate 99 is preferably formed with an opening 110 for facilitating insertion or removal of the swivel pin 108. With the swivel pin 108 thus supporting the jaw unit 41 from the guideway 98, the jaw unit 41 normally tends to swing to an angle wherein a support pin 111 (see FIG. 1), mounted within the openings 105 and side plates of the jaw unit (see FIGS. 1 and 7), is disposed beneath the lower edge of the side members 31 and free of the recesses 102. The jaw unit 41 may thus be moved to any desired position along the side members 31 to compensate for coils of varying thickness. In accordance with another feature of this invention a lug or pawl 112, best illustrated in FIG. 7, is attached to one of the side plates 92 so as to afford a V-shaped notch between the side plate and the lug. A handle 113 (see FIGS. 11 and 12) is formed with a socket 114 at one end thereof, and the socket includes a pair of lugs 115 and interconnecting strut 116 dimensioned to be received within the V-shaped notch defined by the lug 112. In this manner, the socket 114 may be engaged with the lug 112 and the jaw unit 41 shifted back and forth by the handle 114. The handle 113 not only affords leverage to facilitate positioning of the jaw unit 41 but also serves to keep the hands of an operator away from the jaw unit and frame assembly and thus avoids pinching.

Once the jaw unit 41 has been moved to a desired position in the manner described above, the jaw unit is lifted to seat the support pin 111 within a recess 102, and a locking pin 117 is inserted through a pair of openings 103 in the side members 31 and the openings 106 and sleeve 94 of the jaw unit 41. In this manner, the jaw unit 41 is retained in a fixed location. It may be noted that the end of the handle 113 opposite the socket 114 is formed with a punch 118 which can be utilized to drive the locking pin 117 out of a side member 31 whenever it is desired to shift the jaw unit 41 to a different position. As a safety measure, the openings 107 and sleeve 95 of the jaw unit 41 enable a second locking pin or rod to be inserted therein in the event that the pin 117 should become lost or misplaced.

As noted hereinabove, the jaw unit 41 includes a plate 96 formed with a projecting ledge 97 for mounting a replaceable lip member thereon. One form of a lip member which may be utilized with the jaw unit is illustrated in FIG. 3 and indicated by the reference numeral 121. The lip member 121 comprises a block or plate 122 which may have one face formed to afford a convex or concave surface, as the case may be, complementary to the surface of the coil or like object to be engaged therewith. Thus, a lip member to be used with the jaw unit 41 is formed with a face having a convex curvature complementary to the inner diameter of the coil, while a lip member to be used with the jaw unit 42 is formed with a face having a concave curvature. It has been found advantageous to wrap the plate or block 122 with parallel

and vertically disposed strands of cotton rope, such as sash cord, as indicated by the reference numerals **123** in FIG. 3A. Such strands of rope are compressible by the clamping forces exerted on the jaw units to obtain an effective and continuous grip on the surface of the coil or like object to be manipulated. Bands **125** may preferably be utilized to retain the strands in position.

In accordance with the present invention, each jaw unit includes clamping structure for enabling a lip member to be readily removed from or replaced on the jaw unit. In FIGS. 7–9 the clamping structure for the jaw unit **41** is illustrated. Thus, in FIG. 7 it is seen that a clamping piece **131** is slidable in a trackway which comprises a pair of guide rails **132** and guide bars **133** mounted between the side plates **91** and **92** by a pair of struts **136**. In the position illustrated in FIG. 9 the clamping piece **131** is engaged with an upper end of the lip member **121** to retain the lip member **121** in the position illustrated. The clamping piece **131** is shiftable upwardly, in the position indicated by the arrow C in FIG. 9, to release the lip member **121** by a linkage arrangement shown separately in FIG. 8. Thus, the clamping piece **131** is attached to an end of a link **132** which is pin-jointed at **133** to a second link **134**. The second link **134** is in turn joined by a pin **136** to a third link **137** which is also pin-jointed at **138** between a pair of lugs **139** attached to the jaw unit **41**. A tube or pipe **141** is connected to the link **137** so that a screw driver or the like member can be inserted within the pipe or tube **141** to flip the link **137** in the direction indicated by the arrow in FIG. 8. The resultant movement of the linkage is effective to slide the rods **133** within the trackways **132** and raise the clamping piece **131** to release the lip member **121**. It should be noted that no springs or other apparatus are included in the linkage arrangement illustrated in FIGS. 7–9 for retaining the linkage in the lip clamping position. Instead, the pin joint **136** is disposed slightly to one side of a line passing through the pin joints **133** and **138**, as best illustrated in FIG. 7, so that the over-center arrangement thus afforded is effective to retain the linkage in the disposition illustrated in FIG. 8 until a positive force is exerted on the link **137** in the manner described above to move the linkage from the clamping position.

The jaw unit **42** is also provided with clamping mechanism. As illustrated in FIGS. 1 and 2 the jaw unit **42** includes a bracket **142** on each side thereof which bracket mounts a swivel piece **143** for pivoting movement therein. The swivel piece **143** is shown separately in FIG. 6 in enlarged detail. The swivel piece **143** is adaptable to be swingable about an axis XX, as illustrated in FIG. 6, by means of a pivot pin extending through an opening **144** in the swivel piece, which pivot pin is connected to the bracket **142**. One end of the swivel piece **143** is formed with a tapped opening **146** which receives a set screw **147**, indicated in phantom outline in FIG. 6. The opposite end of the swivel piece **143** is adapted to engage a side of the clamping lip such as the clamping lip **121** illustrated in FIG. 3A. Preferably, the swivel piece **143** is formed with an opening **148** at the end engageable with the clamping lip, and the clamping lip is formed with a projecting stub **149** receiveable within the opening **148**. Thus, whenever the set screw **148** is turned inwardly of the threaded opening **146** the inner end of the set screw engages the jaw unit **42** to pivot the swivel piece about the axis X in the direction indicated by the arrow in FIG. 6 to engage the swivel piece with the side of the clamping lip and thereby clamp the lip in position on the jaw unit.

With reference to FIG. 2 it will be recognized that coils or like objects having an overall diameter less than the distance between the clamping face of the movable jaw unit **42** and the rearward or lowermost edge of the side members **31** could not be conveniently stacked on their sides, inasmuch as the lower surfaces of the coil manipulator **21** would prevent the side surface of the coil from being placed on the floor. To accommodate coils of relatively small thickness and overall diameter, the present invention utilizes a jaw extension structure for the movable jaw unit.

Thus, in FIG. 5 a jaw extension **151** is shown operatively associated with the jaw unit **42** and the side members **31**. The jaw extension **151** includes an extension piece **152**, which can be connected by bolts or other suitable fastening means to the jaw unit **42**. The extension piece **152** is further supported from the side members **31** by links **153** which serve to maintain alignment of the coil-engaging face of the jaw extension **151** and prevent canting in the same manner as the links **54** described hereinabove with reference to the jaw unit **42**. Additionally, the jaw extension **151** includes lip clamping structure such as the swivel piece **143A** and a set screw **147A** like the corresponding lip clamping structure of the movable jaw unit **42**. Thus, by using a jaw extension on the movable jaw unit **42**, the jaw unit **41** can be placed adjacent the end of the frame assembly **24** to avoid any possibility of the frame assembly **24** obstructing movement of a coil clamped thereto.

Inasmuch as it is necessary only to attach the extension piece **142** to the jaw unit **42** and connect the link **143** to the side members **31**, the jaw extension **151** can be quickly installed on or removed from the coil manipulator of the present invention. The jaw extension illustrated in FIG. 5 enables coils or like objects of minimum thickness and overall dimension to be manipulated and stacked in a desired attitude without obstruction by the lower portion of the frame assembly **23** and **24**. If necessary, a jaw extension of intermediate length can be utilized, and for this purpose, a pin **156** is located between the pins **157** and **158** supporting the respective links **154** and **153**. As illustrated, the links **154** and **153** are retained in position by cotter keys or the like, so that removal or installation of such links is simplified.

Thus, in accordance with the present invention there is afforded novel apparatus which is especially adapted for mounting on the fork plate of a lift truck to enable coils or like objects of varying sizes, shapes, and weights to be quickly and conveniently manipulated and transported to any desired position and location. The manipulator apparatus of the present invention incorporates structural features which provide a high degree of flexibility in operation so that coils or like objects of widely varying physical characteristics can be accommodated with a minimum of modification of the manipulator apparatus and associated lift truck.

Hence, while I have illustrated and described a preferred embodiment of my invention, it is to be understood that this is capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. A manipulator for moving an open-ended coil or the like between a first position, wherein the longitudinal axis of the coil is substantially vertically disposed, and a second position, wherein the longitudinal axis of the coil is substantially horizontally disposed, said manipulator comprising: a first frame for supporting said manipulator from a supporting structure; a second frame for supporting coil clamping structure thereon; mounting means for mounting said second frame on said first frame for pivotal movement only about a single horizontal axis, said second frame projecting outwardly of said first frame, from said axis, by a distance greater than the outside radius of the largest coil to be manipulated; first jaw means, mounted on said second frame and facing outwardly of said first frame, for engaging the inner surface of a coil to be manipulated; second jaw means, mounted on said second frame at a location diametrically displaced, relative to said coil, outwardly of said first frame, for

engaging the outer surface of a coil opposite said first jaw means; means for exerting a force on one of said jaw means to clamp a coil between said first and second jaw means to permit manipulation of the coil; and means, connected to said first and second frame means, for selectively rotating said second frame about said horizontal axis to move a coil between said first and second positions.

2. A manipulator for moving an open-ended coil or the like between a first position, wherein the longitudinal axis of the coil is substantially vertically disposed, and a second position, wherein the longitudinal axis of the coil is substantially horizontally disposed, said manipulator comprising: a first frame for supporting said manipulator from a supporting structure; a second frame for supporting coil clamping structure thereon; mounting means for mounting said second frame on said first frame for pivotal movement only about a single horizontal axis, said second frame projecting outwardly of said first frame, from said axis, by a distance greater than the outside radius of the largest coil to be manipulated; first jaw means, mounted on said second frame at any one of a series of fixed positions and facing outwardly of said first frame, for engaging the inner surface of a coil to be manipulated; second jaw means, mounted on said second frame at a location diametrically displaced, relative to the coil, outwardly of said first frame for engaging the outer surface of the coil opposite said first jaw means, said second jaw means including a lever member pivotally connected, at a location intermediate the ends thereof, to the second frame, and a jaw member engageable with the coil and pivotally connected to an end of the lever member; means for exerting a force on said lever member to clamp a coil between said first jaw means and said jaw member to permit manipulation of the coil; and means, connected to said first and second frame means, for selectively rotating said second frame about said horizontal axis to move a coil between said first and second positions.

3. A manipulator for moving an open-ended coil or the like between a first position, wherein the longitudinal axis of the coil is substantially vertically disposed, and a second position, wherein the longitudinal axis of the coil is substantially horizontally disposed, said manipulator comprising: a first frame for supporting said manipulator from a supporting structure; a second frame for supporting coil clamping structure thereon; mounting means for mounting said second frame on said first frame for pivotal movement only about a single horizontal axis, said second frame projecting outwardly of said first frame, from said axis, by a distance greater than the outside radius of the largest coil to be manipulated; first jaw means, mounted on said second frame and facing outwardly of said first frame, for engaging the inner surface of a coil to be manipulated; second jaw means, mounted on said second frame at a location diametrically displaced, relative to the coil, outwardly of said first frame for engaging the outer surface of the coil opposite said first jaw means, said second jaw means including a lever member pivotally connected, at a location intermediate the ends thereof, to the second frame, and a jaw member engageable with the coil and pivotally connected to an end of the lever member; alignment means, included in said second jaw means, for maintaining a predetermined angular orientation of said jaw member with respect to said second frame, said alignment means including a link member pivotally connected at opposite ends to the jaw member and to the second frame; means for exerting a force on said lever member to clamp a coil between said first jaw means and said jaw member to permit manipulation of the coil; and means, connected to said first and second frame means, for selectively rotating said second frame about said horizontal axis to move a coil between said first and second positions.

4. A manipulator for moving an open-ended coil or the like between a first position, wherein the longitudinal axis of the coil is substantially vertically disposed, and a second position, wherein the longitudinal axis of the coil is substantially horizontally disposed, said manipulator comprising: a first frame for supporting said manipulator from a supporting structure; a second frame for supporting coil clamping structure thereon; mounting means for mounting said second frame on said first frame for pivotal movement only about a single horizontal axis, said second frame projecting outwardly of said first frame, from said axis, by a distance greater than the outside radius of the largest coil to be manipulated; first jaw means, mounted on said second frame at any one of a series of fixed positions and facing outwardly of said first frame, for engaging the inner surface of a coil to be manipulated; second jaw means, mounted on said second frame at a location diametrically displaced, relative to the coil, outwardly of said first frame, for engaging the outer surface of the coil opposite said first jaw means, said second jaw means including a lever member pivotally connected, at a location intermediate the ends thereof, to the second frame, an extension member mounted on said lever member, and a jaw member engageable with the coil and pivotally mounted on one end of the extension member; alignment means, included in said second jaw means, for maintaining a predetermined angular orientation of the jaw member with respect to said second frame, said alignment means including first and second link members, each pivotally connected at one end to the second frame and having their opposite ends pivotally connected to respective opposed ends of the extension member; means for exerting a force on said lever member to clamp a coil between said first jaw means and said jaw member to permit manipulation of the coil; and means, connected to said first and second frame means, for selectively rotating said second frame about said horizontal axis to move a coil between said first and second positions.

5. A manipulator for moving an open-ended coil or the like between a first position, wherein the longitudinal axis of the coil is substantially vertically disposed, and a second position, wherein the longitudinal axis of the coil is substantially horizontally disposed, said manipulator comprising: a first frame for supporting said manipulator from a supporting structure; a second frame for supporting coil clamping structure thereon; mounting means for mounting said second frame on said first frame for pivotal movement only about a single horizontal axis, said second frame projecting outwardly of said first frame, from said axis; first jaw means, mounted on said second frame and facing outwardly of said first frame, for engaging the inner surface of a coil to be manipulated; second jaw means, mounted on said second frame at a location diametrically displaced, relative to said coil, outwardly of said first frame, by a distance greater than the outer radius of the largest coil to be manipulated, for engaging the outer surface of a coil opposite said first jaw means; means for exerting a force on one of said jaw means to clamp a coil between said first and second jaw means to permit manipulation of the coil; and means, connected to said first and second frames, for selectively rotating said second frame about said horizontal axis to move a coil between said first and second positions.

6. A manipulator for moving an open-ended coil or the like between a first position, wherein the longitudinal axis of the coil is substantially vertically disposed, and a second position, wherein the longitudinal axis of the coil is substantially horizontally disposed, said manipulator comprising: a first frame for supporting said manipulator from a supporting structure; a second frame for supporting coil clamping structure thereon; mounting means for mounting said second frame on said first frame for pivotal movement about a horizontal axis, said second frame projecting outwardly of said first frame, from said axis; first jaw means, including a lip member, mounted on said second frame and with said lip member facing outwardly

of said first frame, for engaging the inner surface of a coil to be manipulated; second jaw means, mounted on said second frame at a location diametrically displaced, relative to said coil, outwardly of said first frame, by a distance greater than the outer radius of the largest coil to be manipulated, and including a lip member for engaging the outer surface of a coil opposite said first jaw means; first and second clamping means for mounting said lip members in fixed position in said first and second jaw means, said clamping means comprising an over-center linkage mechanism associated with one of said jaw means and including a clamping piece locked in engagement with a lip member in one position of the over-center linkage mechanism; means for exerting a force on one of said jaw means to clamp a coil between said first and second lip members to permit manipulation of the coil; and means, connected to said first and second frames, for selectively rotating said second frame about said horizontal axis to move a coil between said first and second positions.

7. In apparatus for manipulating coils or the like of the kind wherein a movable jaw unit is movable toward and away from a stationary jaw unit for clamping a portion of the coil therebetween and wherein said movable and stationary jaws are adapted to mount lip members of different configurations thereon, clamping means for retaining said lip members in fixed position on said jaw units, said clamping means comprising an over-center linkage mechanism associated with said stationary jaw unit and including a clamping piece which is locked in engagement with a lip member in one position of the over-center linkage mechanism.

8. In apparatus for manipulating coils or the like of the kind wherein a movable jaw unit is movable toward and away from a stationary jaw unit for clamping a portion of the coil therebetween and wherein said movable and stationary jaws are adapted to mount lip members of different configurations thereon, clamping means for retaining said lip members in fixed position on said jaw units, said clamping means comprising an over-center linkage mechanism associated with said stationary jaw unit for retaining a lip member thereon, and said clamping means comprising a swivel piece and manually adjustable set screw effective to rotate said swivel piece about a fixed axis with respect to the movable jaw and into gripping engagement with a side of a lip member on the movable jaw.

References Cited in the file of this patent

UNITED STATES PATENTS

2,817,450	Ulinski	Dec. 24, 1957
2,827,184	Mueller	Mar. 18, 1958
2,974,995	Calhoun	Mar. 14, 1961