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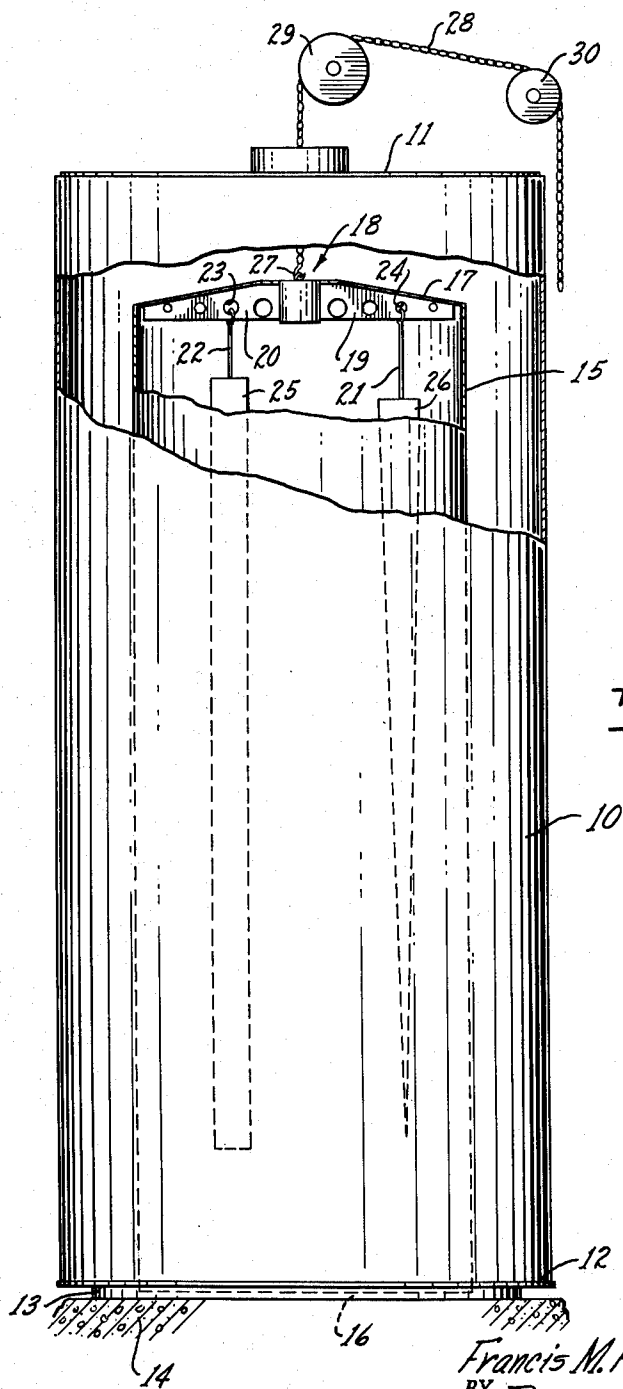
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3,072,430

REMOTE CONTROL HOOKING AND UNHOOKING DEVICE

Filed April 11, 1960

4 Sheets-Sheet 1



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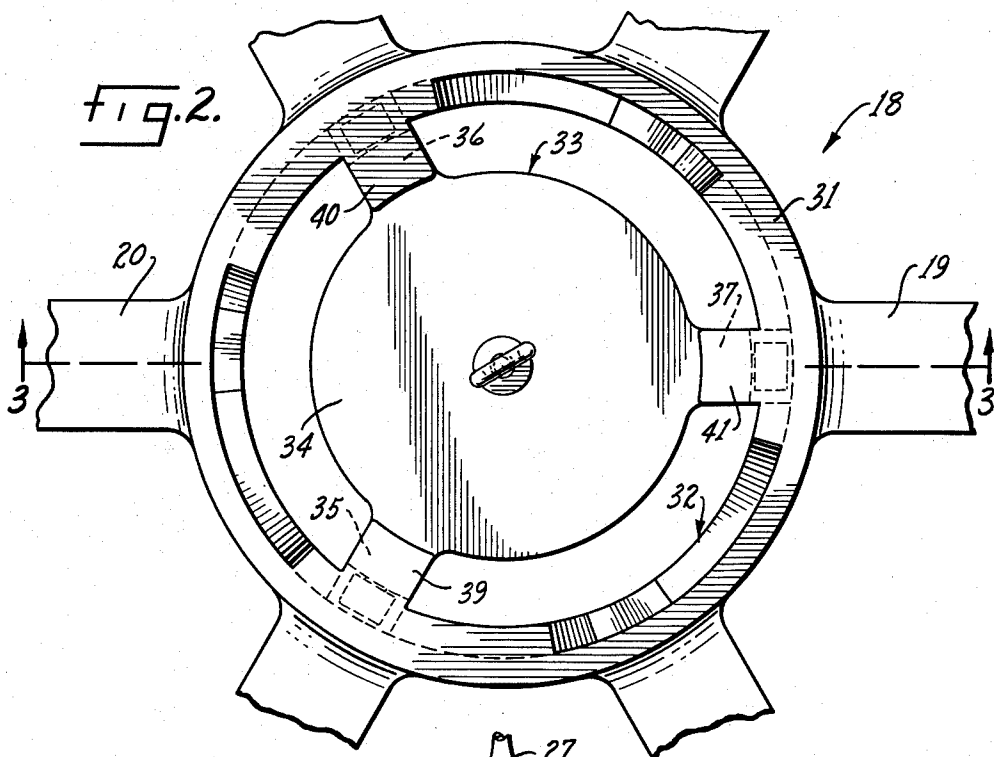
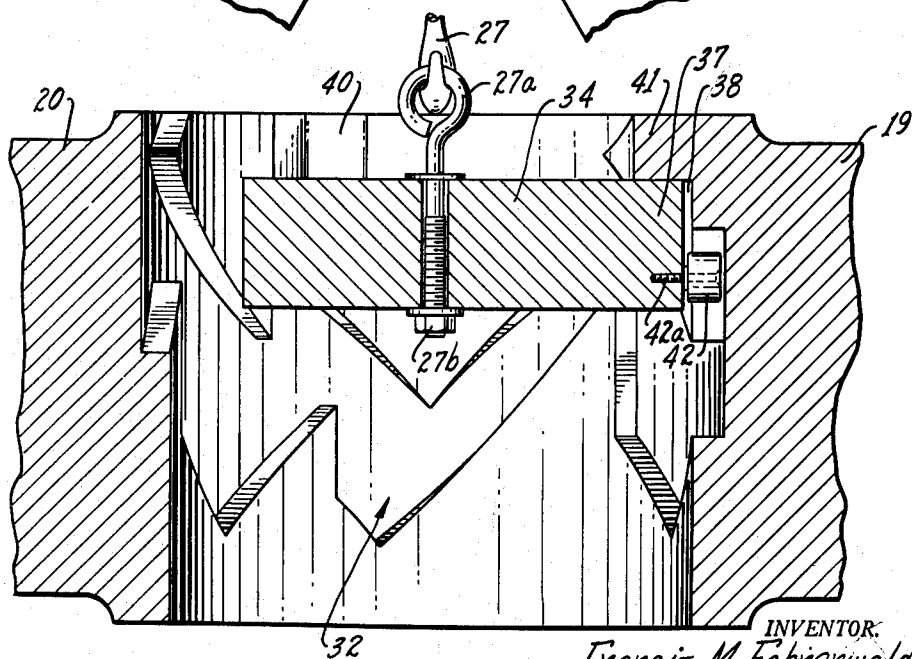


Fig. 3.

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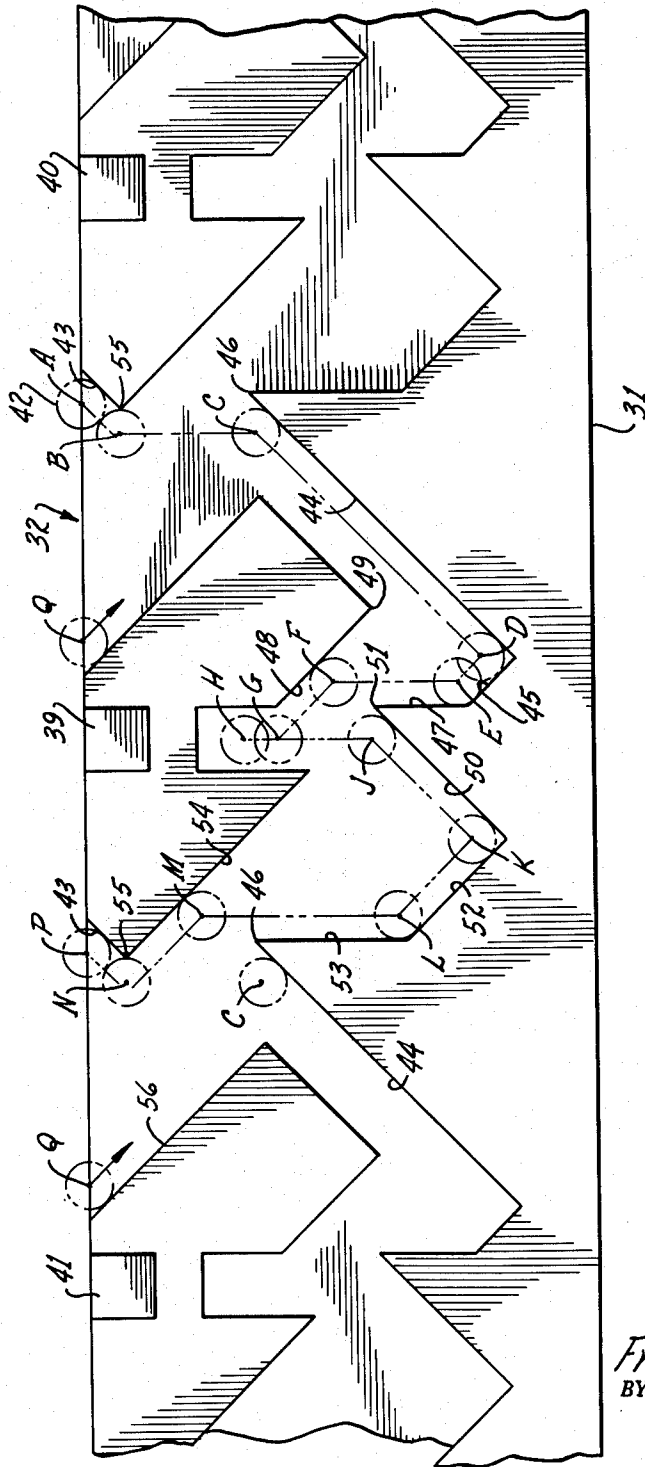


FIG. 4.

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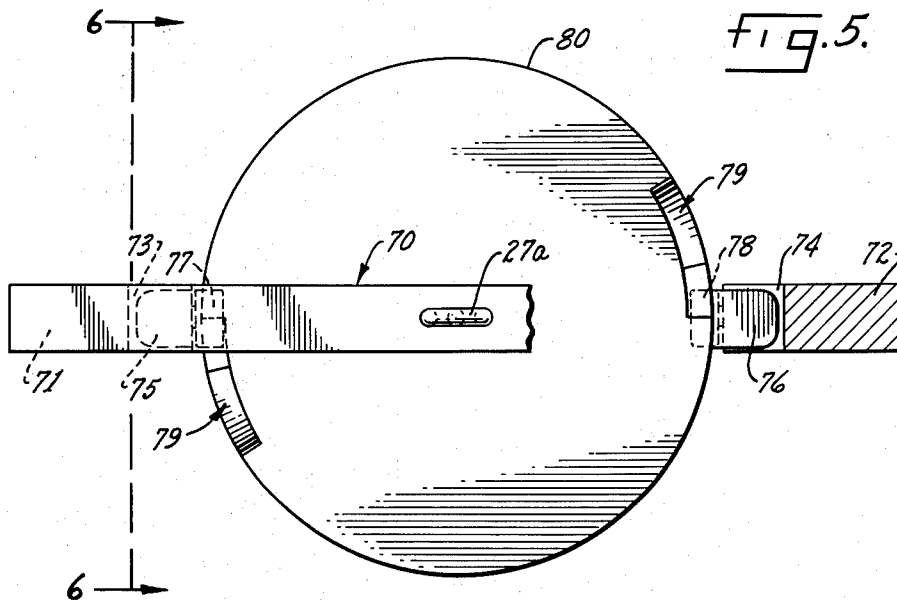
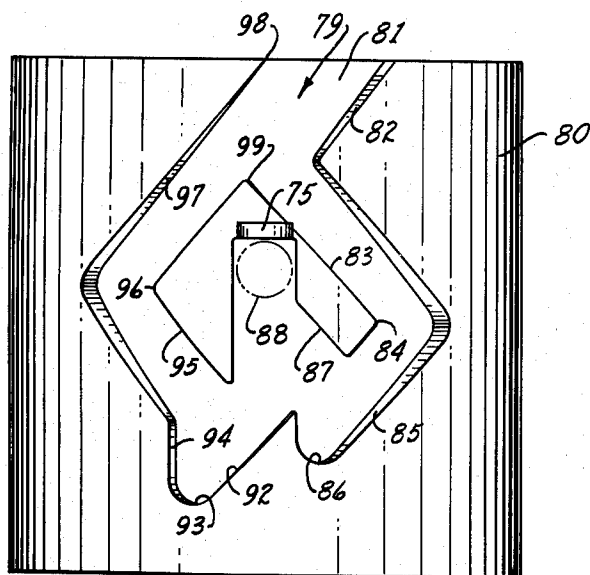


Fig. 6.

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3,072,430 REMOTE CONTROL HOOKING AND UNHOOKING DEVICE

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16 Claims. (Cl. 294—83)

This invention relates generally to coupling devices and more particularly to a remotely controllable coupling assembly adapted to couple a framework or other work supporting structure to a lifting device such as a crane.

There are many instances in industry today in which one structure must be coupled to another for lifting or transferral purposes without manual control. In the heat treating industry for example objects undergoing heat treatment must be transferred from one station such as a soaking pit to another such as a liquid quench or draw furnace. Temperatures on the order of 2,000 to 2,400 degrees are often involved and consequently manual hooking and unhooking of the frame carrying the objects to be heat treated is impossible.

In other applications, such as the atomic energy field, an operator cannot manually hook and unhook the objects to be treated from the lifting device due to radiation. In other fields, such as the construction industry, the point of connection of the lifting device to the object to be lifted may be so remote and inaccessible that it would be impractical to have an operator manually make the attachment.

Accordingly, a primary object of this invention is to provide a coupling assembly that can be quickly and positively secured to an object to be lifted by remote control.

Yet another object is to provide a coupling assembly which can, by remote control, couple a lifting attachment to an object to be lifted completely independently of the flexibility or inflexibility of the lifting line.

Yet a further object is to provide a coupling assembly which always unseats from a lifting position upon release and subsequent imposition of tension in the lifting line, and which always seats in a lifting position upon imposition of tension in the lifting line at the start of a coupling operation.

Yet a further object is to provide a lifting attachment in which an unseated, released relationship between the object to be lifted and the attachment automatically sequentially follows a seated relationship upon release and subsequent imposition of tension in the lifting line.

Another object is to provide a lifting attachment in which the rolling parts which guide the cooperating lifting elements into lifting engagement are so positioned that the load is carried by reinforced bearing portions once the lifting members are in lifting engagement to thereby relieve the stress on the rolling parts.

Yet another object is to provide a coupling assembly capable of application to a wide variety of situations in which manual coupling is inconvenient, inefficient, or impossible.

Other objects will become apparent upon reading the following description of the invention.

My invention is illustrated more or less diagrammatically in the accompanying figures, in which:

FIGURE 1 is an elevational view with portions broken away for clarity of a typical application of my coupling assembly;

FIGURE 2 is a top plan view with portions broken away and others shown in broken lines of one embodiment of my invention;

FIGURE 3 is a view taken substantially along the line 3—3 of FIGURE 2;

FIGURE 4 is a layout to approximate scale of the cam track illustrated in FIGURES 2 and 3;

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FIGURE 5 is a top plan view of a modification of the invention; and

FIGURE 6 is an elevational view taken substantially along the line 6—6 of FIGURE 5.

Like reference numerals will be used to refer to like parts throughout the following description of the drawings.

A bottom quench gantry hardening furnace is illustrated diagrammatically in FIGURE 1. Although this specific structure has been chosen to illustrate the device, it will be understood that the invention is capable of wide application and this particular environment has been chosen for illustrative purposes only.

The furnace is composed of an outer tubular shell 10 which is sealed about its periphery to top and bottom plates 11 and 12, respectively. Bottom plate 12 rests on a base plate 13 which in turn is supported on any suitable base, such as the concrete foundation 14.

An alloy muffle 15 is disposed within the outer shell 10 and terminates a short distance 16 above the foundation 14. The muffle consists essentially of a circular tube similar to the outer shell 10 and is sealed about its upper periphery to an outwardly, downwardly dished top plate 17.

A coupling assembly, indicated generally at 18, is secured to the dished top plate 17, and a plurality of arms 19 and 20 extend radially outwardly from the coupling assembly and terminate a short distance from the muffle wall 15. Although only two supporting arms are illustrated in FIGURE 1, it will be understood that in operation any suitable number may be utilized. In FIGURE 2, six are illustrated for example. A plurality of hooks or other suitable suspending members 21, 22 are secured to the spider arms 19 and 20 at appropriate locations 23, 24. The hooks hang downwardly and are connected at their lower end to objects to be heat treated, such as the rotor blades 25 and 26. Again, although a specific object has been chosen for purposes of illustration, it will be understood that objects of practically any size or shape may be treated, and a plurality of individual objects may be suspended from any one spider arm.

An eyebolt or other suitable connecting member extends upwardly from the coupling assembly 18 (shown best in FIGURES 2 and 3) and a hook 27 is received therein. The hook in turn is connected to a lifting line, in this instance a flexible chain 28 trained about pulleys 29, 30, and operated by any suitable raising and lowering mechanism, not shown.

The details of the coupling assembly 18 are illustrated in FIGURES 2, 3 and 4. The assembly comprises essentially an outer sleeve or cam track member 31 to which the supporting or spider arms 19, 20 are secured. The cam track member, as best seen in FIGURE 3, is of substantial thickness, and a cam track indicated generally at 32 is formed in its inner surface. The track extends continuously about the inner surface and, as will be apparent from the description of FIGURE 4, is composed of a plurality of substantially identical repeating sections.

A cam follower or lifting member is indicated generally at 33. It consists essentially of a solid central disk-like body 34 from which project a plurality of lifting lugs 35, 36, 37. The extreme outer edge of the lifting lugs stop short of engagement with the inner peripheral wall of the cam follower member to provide a clearance therebetween, as indicated at 38 in FIGURE 3. A plurality of inwardly extending ears 39, 40, 41 are disposed about the inner upper periphery of the cam track member so as to overlie the lifting lugs when the members are properly positioned with respect to one another. An eyebolt 27a is anchored in lifting member 33 and engages lifting hook 27, as best illustrated in FIGURE 3. The eyebolt is secured to member 33 by a nut and washer

arrangement 27b threaded about the shank of the eyebolt.

A cam roller 42 is secured, by a suitable screw or other connecting means 42a, to the lower portion of each lifting lug. The roller is free to rotate with respect to the lug to which it is attached and is so positioned as to roll along the cam track 32 when the coupling assembly members move relative to one another. As illustrated in FIGURE 3, however, the roller 42 supports no weight when the lift member 33 and sleeve member 31 are in lifting engagement because there is a substantial clearance between the upper surface of the roller and the lower surface of the ear overlying it in the lifting position.

In FIGURE 4, the cam track in sleeve member 31 has been laid out diagrammatically to illustrate the relative position between the roller cams on the cam follower member 33 and the cam track member 31. In the following description of FIGURE 4, "inwardly" or "forwardly" will refer to movement to the left and "outwardly" or "backwardly" will refer to movement towards the right.

The cam roller 42, when in the position indicated at A, is positioned in an entry to the cam track and is guided downwardly and inwardly by a short land 43. As the roller follows land or run 43, it will reach position B, in which position it is no longer supported by a rolling surface. Consequently, it will fall vertically downwardly to position C where it engages a second downwardly and inwardly inclined run 44 which terminates in a short upwardly forwardly inclined run 45. Roller 42, in passing from position B to position C, will strike run 44 because the run extends rearwardly a distance sufficient to prevent backward movement of the roller. In other words, the starting point 46 of run 44 lies a substantial distance to the rear of the center of gravity of roller 42.

At the bottom of run 44, the roller will come to rest at position D in which position upwardly inclined run 45 prevents any further downward movement of the roller. For convenience of description, the travel of the roller from position A to position D may be defined as a first run.

As the roller continues its forward movement, it passes from position D up the short forwardly inclined run 45 to position E and thence vertically upwardly following vertical wall 47 to position F. When the roller reaches position F, upwardly, forwardly inclined run 48 directs the roller to position G where it will travel vertically into its final, lifting position, H.

There is no possibility of the roller moving from position D back up to position C because run 48 extends rearwardly a substantial distance beyond the center of gravity of the roller, as indicated at 49. The short forwardly upwardly inclined run 45 further insures movement of the roller to the left. At the same time, vertical wall 47 restrains forward movement of the roller and insures that it will impinge against run 48 approximately at position F.

When tension on the lifting line secured to eyebolt 27a is released, the roller will drop from position H to position G and thence downwardly to a forwardly, downwardly inclined run 50, striking this run at approximately position J. The rearward projection of the starting point 51 of run 48 lies substantially rearwardly of the center of gravity of the roller so that there is no chance for the roller to retrace its path along runs 48 and 44.

From position J, the roller will move to position K and thence up a third upwardly, forwardly inclined run 52 to position L. A second substantially vertical land 53 causes the roller to move straight upwardly and directs it against another upwardly, forwardly inclined run 54 at approximately position M. From this position, the roller moves upwardly to the position N at which point it clears the projecting tip 55 or terminal end of run 54.

It should be noted that the exit position P substantially coincides with the entry position to the succeeding cam track so that the three individual tracks disposed about the inner periphery of tubular member 31 form in effect a

continuous track. It should also be noted that the combination entry-exit to the cam track includes a downwardly, rearwardly inclined land 56. The funnel shaped maw formed by the downwardly converging lands 43, 56 insures that no matter what the angle of entry of the roller might be, it will proceed to progress forwardly along the cam tracks. Thus, should a roller enter at a position Q moving in the direction of the arrow, land 56 will direct it into engagement with the upper end of the first downwardly, forwardly inclined run 44 so that when it reaches position C, it will follow the same path through the next run as it did through the run just described.

Referring now to FIGURES 5 and 6, a modification of the invention is illustrated in which the relationship of the cam track and the cam follower have been substantially reversed. In this instance, the lifting member, indicated generally at 70, is formed in the shape of an inverted U hook. The lower ends of the legs 71, 72 of hook 70 terminate in inwardly directed lifting lugs 73, 73. Lifting pads or ears 75, 76 secured to the outer outside surface of the work holder member 80, overlie the inwardly directed lifting lugs. A pair of rollers 77, 78, are secured to the vertical edges of the lifting lugs 73, 74 and are adapted to roll along the cam track, indicated generally at 79 in FIGURE 6.

In FIGURE 6, the member 80 is illustrated in elevation to show the contour of the cam track along which the rollers 77, 78 roll. The cam track entry is indicated generally at 81. In describing the passage of the rollers along the cam track, the direction to the left of the point of entry 81 will be termed "forwardly," and the opposite direction "rearwardly." From the point of entry 81, the rollers will pass forwardly along downwardly inclined land 82 until they reach a point overlying the downwardly, rearwardly inclined land 83. The rollers, when no longer supported by land 82, will drop vertically downwardly until they strike land 83 and will continue to roll downward until they clear the terminal end 84 of that land. As soon as the terminal end 84 is cleared, the rollers will again drop vertically downwardly until they strike against a second forwardly, downwardly inclined land 85. Downward movement of the rollers is stopped initially by the seat 86 which provides in effect a first positive stop means.

From seat 86, the roller rises upwardly until it strikes an inwardly, forwardly inclined land 87, and then moves into the lifting position indicated in phantom at 88. It will be noted that the roller, when in lifting position, does not rest against the lower surface of the track. This is because the lifting surfaces of the lugs on U-shaped lifting hook 70 are located above the uppermost surface of the rollers. Weight is therefore transferred from the work holding member 80 to the lifting hook 70 through the ears 75, 76 and lifting lugs 73, 74, so that there is no possibility of causing axial misalignment of the rollers.

At the completion of the lift, the rollers drop downwardly from the lifting position 88 until they strike another downwardly, forwardly inclined land 92 and come to rest in a second seat 93. When the roller is again lifted, it travels upwardly alongside generally vertically oriented land 94 until it strikes upwardly forwardly directed land 95. As soon as the roller clears the end 96 of land 95, it moves vertically upwardly until it strikes upwardly, rearwardly directed exit land 97. The roller then moves up and out the exit opening which, in this instance, is identical to the inlet opening 81.

This particular arrangement of the lands is such as to insure movement of the rollers along the cam track in only one direction. Thus, even if a roller be presented to the cam track at the terminal end 98 of the exit land 97, it will proceed downwardly along run 83 because the upper end 99 of that run lies a substantial distance forwardly of the center of gravity of the roller.

The use and operation of the invention is as follows:

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To manipulate a lifting spider of the type indicated at 19 and 20 of FIGURE 1 quickly, positively and without manual control, the structure illustrated in FIGURES 2, 3 and 4 may advantageously be employed. Referring to FIGURE 4, the lifting member 33, which may be chain suspended as illustrated in FIGURE 1, rolls along the top of the work holder member until the rollers 42 overlie the large funnel-shaped opening A—Q in the supporting member 31. The operator then relaxes the tension on the lifting line and lets the lifting member fall by gravity down to a first stop position. As soon as the tension on the lifting chain goes slack, the operator knows that the lifting member is in position D. The operator then increases the tension to raise the lifting member which causes it to move via the path previously described into the lifting position H. The spider and the objects it supports are then lifted and conveyed to the desired new location.

To disengage the lifting member from the supporting member, the operator slacks off on the lifting line whereby the lifting member 33 falls via path H, G, J, to the position illustrated at K in FIGURE 4, where the lifting line again goes slack. When the line goes slack, the lifting operator knows that lifting attachment has reached its bottom, disengaged position. As tension is put on the line, the rollers travel upwardly along path K, L, M, N to P or Q, the exit positions.

It will thus be seen that the overall movement of the lifting member will occur in a generally forward direction from entry to exit due to the overlapping of the direction changing runs. If the follower enters the exit at point Q, its first component of horizontal movement will be rearwardly, and if it leaves the exit along path N—P its last component of horizontal movement will be rearwardly and along runs 53, 47 and G—H there is no horizontal movement. Nevertheless, the overall movement from entry to exit is forwardly and the terms "overall movement," "generally directed" and "only one direction" when used in this specification and the appended claims are intended to describe the previously discussed path of travel, including the minor variations mentioned in the preceding sentence.

The operation of the embodiment illustrated in FIGURES 5 and 6 is substantially the same, except in this instance the relationship of the cam track and the follower member have been reversed.

Although a flexible lifting line has been illustrated, it is entirely feasible to utilize an inflexible line because the stop and lifting positions will preclude further vertical movement of the line.

Although two embodiments of the invention have been illustrated and described, it will be understood that the above showing is illustrative only, and accordingly the scope of the invention should only be limited by the scope of the following appended claims.

I claim:

1. A coupling assembly especially adapted for use in remotely controlled lifting operations, said coupling assembly including, in combination, a first member to which objects to be lifted may be secured, a second member adapted for attachment to a lifting line, said first and second members being completely disengageable, one from the other, whereby said first member may be permanently secured to objects to be lifted and said second member may be transferred from place to place with said lifting line when disengaged from said first member, and means for positively coupling the members to one another during a lifting, lowering, or transferring operation, said means including a cam track formed in one of the members, said track having an entry, an exit, and a single lifting position between the entry and exit, a cam follower carried by the other member, said track and follower being so dimensioned that overall movement of the follower along the track can occur in only one direction as the follower moves along the track from the entry to the exit.

2. The coupling assembly of claim 1 further char-

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acterized in that the entry is so dimensioned that the cam follower is directed to the lifting position independently of the direction in which the cam follower enters the cam track.

3. The coupling assembly of claim 1 further characterized in that a plurality of substantially identically contoured cam tracks are formed in said one member, the entry and exit of each successive track being co-extensive to thereby form a substantially continuous track, and said other member carries a plurality of cam followers whereby the members may be coupled to one another at a plurality of locations simultaneously.

4. A remotely controllable coupling assembly for use with lifting devices, said coupling assembly including, in combination, a cam follower member and a cam track member, one of said members being adapted for connection to a lifting line of a lifting device and the other to objects to be lifted, said cam follower and cam track members being completely disengageable, one from the other, whereby the member adapted for connection to the lifting line may be transferred from place to place with said lifting line when disengaged from the other member, and means for positively coupling the members to one another, said means including a cam track on the cam track member, said track having an entry, a first generally downwardly inclined run terminating in first stop means, a first generally upwardly inclined run terminating in a lifting position, a second generally downwardly inclined run terminating in second stop means, and a second generally upwardly inclined run terminating in an exit, said runs following one another in the above described sequence, said coupling means further including a cam follower carried by the cam follower member, the sequentially inclined runs of the cam track overlapping one another so that impingement of the cam follower against any succeeding run induces a reaction between the follower and track having a component generally directed toward the exit whereby the cam follower is urged toward the exit at all times it is in motion.

5. The coupling assembly of claim 4 further characterized in that the cam follower member includes a cam element adapted to roll along the cam track as the members move relative to one another and a bearing surface adapted to abut an opposing bearing surface on the cam track member when the members are in lifting engagement whereby lifting pressure is transmitted from one member to the other substantially entirely through the abutting bearing surfaces, said bearing surfaces being so dimensioned that the cam element is out of force transmitting contact with the cam track when the members are in lifting engagement.

6. The coupling assembly of claim 4 further characterized in that the entry to the first downwardly inclined run is generally funnel shaped so that the cam follower is directed toward the lifting position independently of the angle of approach of the cam follower to the entry.

7. The coupling assembly of claim 4 further characterized, firstly, in that a plurality of substantially identically contoured cam tracks are formed in the cam track member, the exit of one track terminating in the entry of the next to form, in effect, a continuous cam track, and, secondly, in that a plurality of cam followers are carried by the follower member whereby the members may be coupled to one another at a plurality of locations simultaneously.

8. In a remote control lifting and releasing assembly which includes a liftable element and a lifting element and remotely operable means for raising and lowering the lifting element, track means on one of said elements and one or more lifting projections on the other said element positioned and adapted to interpenetrate with said track means, said track means including portions positioned to direct said lifting projections, in response to a predetermined downward movement of the lifting element, to a position in which, in response to a subsequent upward

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movement of the lifting element, the interpenetrating projections engage an overlying portion of the liftable element for a direct upward lift of said liftable element, said track means including portions shaped and positioned to deflect the lifting projections in response to a predetermined downward releasing movement of the lifting element to a position in which, in response to a subsequent upward lift of the lifting element, said projections are free to move to release position, whereby the liftable element is freed from the lifting element.

9. The coupling assembly of claim 3 further characterized in that the continuous cam track is substantially circular and the cam followers are generally radially disposed about a common center.

10. The coupling assembly of claim 9 further characterized in that the continuous track is formed on an internal surface of said one member and the followers are formed on an external surface of the other member.

11. The coupling assembly of claim 9 further characterized in that the continuous track is formed on an external surface of said one member and the followers are formed on an internal surface of the other member.

12. The coupling assembly of claim 7 further characterized in that the continuous cam track is substantially circular and the cam followers are generally radially disposed about a common center.

13. The structure of claim 8 characterized in that the lifting and liftable elements are concentrically arranged, the lifting element being free to rotate about a vertical axis centrally located in relation to the liftable element, said liftable element including a generally cylindrical track supporting portion.

14. The structure of claim 8 characterized in that the means for lifting the lifting element include a flexible tension member.

15. A coupling assembly for use in remotely controlled lifting operations, said coupling assembly including, in combination,

a first member to which objects to be lifted may be secured,

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a second member adapted for attachment to a lifting line, said first and second members being completely disengageable, one from the other whereby said first member may be permanently secured to objects to be lifted and said second member may be transferred from place to place with said lifting line when disengaged from said first member, and

means positively coupling the members to one another during a lifting, lowering, or loaded transferring operation,

said means including a cam track formed in one of the members, said track having an entry, an exit, and a single lifting position between the entry and exit, a cam follower carried by the other member, said track and follower being so dimensioned that overall movement of the follower along the track can occur in only one direction as the follower moves along the track from the entry to the exit.

16. The coupling assembly of claim 15 further characterized by and including opposed bearing surfaces on the cam follower and cam track members so positioned that they engage one another when the members are in lifting engagement whereby lifting pressure is transmitted from one member to the other substantially entirely through the opposed, abutting bearing surfaces, said bearing surfaces being so dimensioned that the cam follower is out of force transmitting contact with the cam track when the members are in lifting engagement.

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