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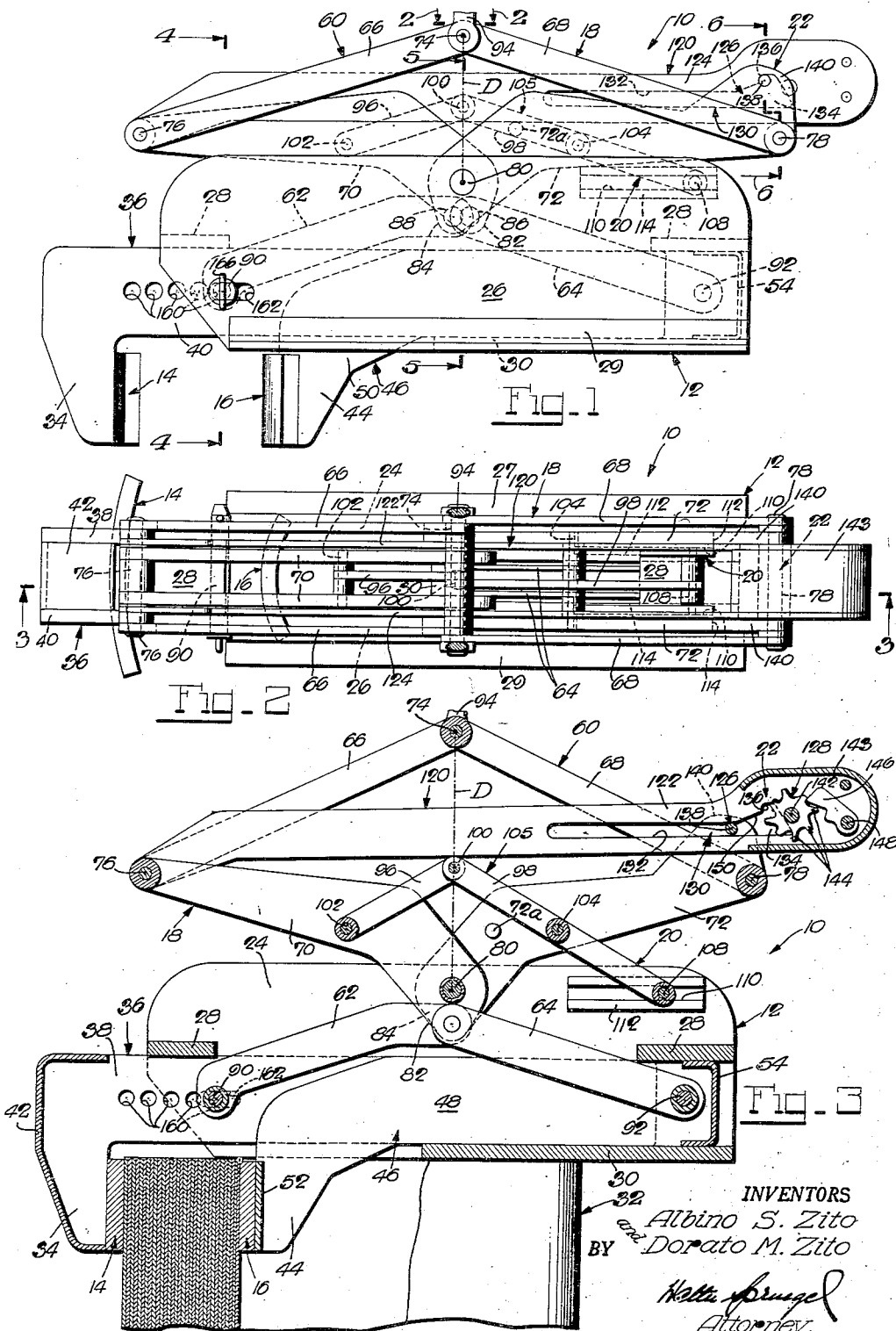
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LOAD-LIFTING DEVICE OF THE SELF-GRIPPING TYPE

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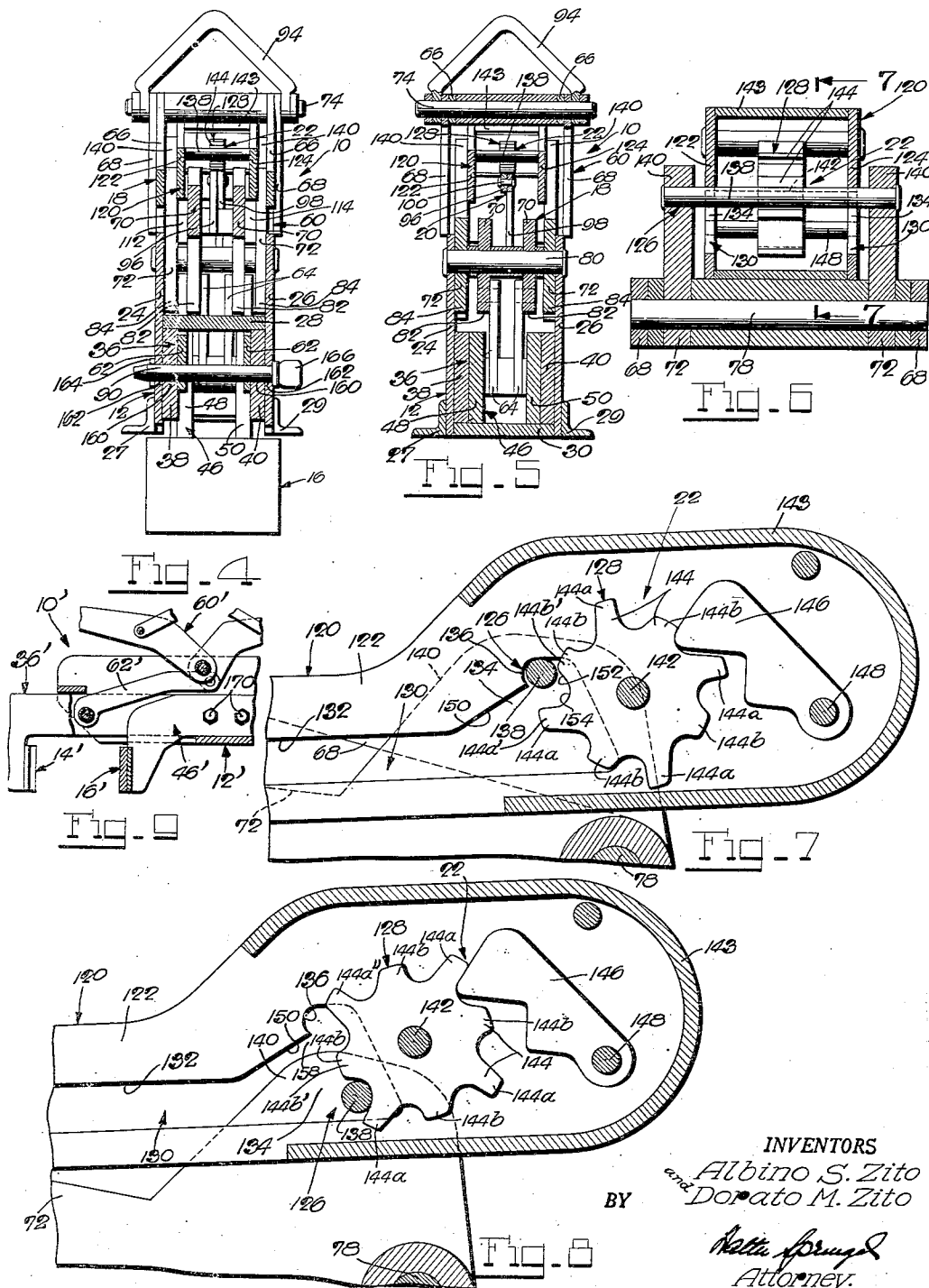
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LOAD-LIFTING DEVICE OF THE SELF-GRIPPING TYPE

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2 Claims. (Cl. 294—103)

This invention relates to load-lifting devices in general, and to load-lifting devices of a self-gripping type in particular.

The self-gripping load-lifting device to which the present invention relates is commonly referred to as a "grapple," and is characterized by relatively movable opposed jaws in a carrier frame of which the former are operatively connected with the shorter arms of a pair of pivotally connected double-arm levers the longer arms of which form part of a parallelogram-like link system adapted for suspension from an overhead hand or power-operated hoist. Since the jaws of the grapple open and close on vertically contracting and expanding its link system, respectively, it is customary to lower the suspended grapple until its carrier frame comes to rest on a load to be lifted, and to continue lowering of the grapple thereafter in order to permit sufficient contraction or collapse of the link system to open the jaws and admit them into gripping relation with the load. The suspended grapple is then raised by the hoist, with the result that the link system will initially expand upwardly until all play between the jaws and load therebetween is taken up, whereupon the jaws will suddenly exert on the load a gripping force which rapidly increases sufficiently to pick up the entire load in short order and safely lift it. On subsequently lowering the grapple with its load, the latter will first come to rest on any intended support, such as the floor, for instance, whereupon continued lowering of the grapple will cause the jaws to disengage from the load. In order to permit subsequent lifting by the hoist of the grapple clear of the released load without regripping the latter, so as to make the grapple available for lifting another load or loads, it has become customary to provide the parallelogram-like link system with a substantially diagonally arranged latch bar which at one end is pivoted to one side of the link system and has near its other free end a pin and bayonet-type slot connection with the opposite side of the link system, of which the longitudinal branch of the slot is somewhat longer than is required to permit relative movement between the latter and the pin commensurate with the normal intended operating range of the jaws within which the same may grip loads of different dimensions, while the lateral end branch of the slot will, on opening the jaws beyond their normal operating range, become interlocked with the pin and, in consequence, prevent on subsequent lifting of the grapple upward expansion of the link system and, hence, closing of the jaws. Accordingly, on lowering the grapple with its load onto the floor or any other support, the lowering of the grapple is continued until the jaws open sufficiently to bring about the aforementioned interlock between the lateral end branch of the slot and the pin of the connection between the latch bar and the link system. The grapple may then be lifted clear of the released load without regripping the latter, and may subsequently be lowered onto another load of permissible size directly into gripping relation therewith. In order

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that the jaws of the grapple may actually grip the new load and raise it on the next lift of the grapple, the operator must first manually release the latch bar from its aforementioned interlock with the link system so as to release the latter for upward extension and the jaws for closure on the load therebetween.

While the latch bar is highly advantageous by greatly facilitating the release of the grapple from a lowered load and its application to another load, the requirement that the latch bar be manually released from interlock with the link system for each new load to be lifted has been found to be highly objectionable in many applications. Thus manual release of the latch bar from interlock with the link system of the grapple requires in any event the personal attention of an operator while the grapple is being lifted sufficiently to cause a relative shift between the aforementioned slot and pin of adequate magnitude to prevent the latter from relocking with the former on release of the latch bar by the operator. If a single operator is called upon to handle both, the hoist and the suspended grapple thereon, then the task of holding the latch bar in released position while simultaneously operating the hoist for sufficient initial lifting of the grapple to permit release of the latch bar, is not only awkward but may well give rise to serious hazards, especially when the hoist is power-operated. On the other hand, if the grapple is suspended from an overhead crane which is power-operated by remote control, load lifting or shifting performance of the grapple requires two attendants, one to handle the grapple and the other to control the crane remote from the grapple. Furthermore, in either case an attendant, being compelled to manipulate the latch bar on the grapple, usually stays in potentially dangerous proximity to the grapple at the very period when a heavy load is just being raised and occasionally slips in the jaws for some distance before usually being safely regripped by the latter.

It is the primary aim and object of the present invention to provide on a grapple a latch arrangement which has all the advantages of the aforementioned latch bar, but which need not be in any way manipulated by an operator, thereby not only greatly facilitating the handling of the grapple by an attendant who may also be called upon to operate or control a hoist from which the grapple is suspended, but permitting in any event the use of the grapple with far greater safety to an attendant than was heretofore possible.

Thus, it is an object of the present invention to provide the aforementioned latch arrangement on a grapple such that the former acts through the link system to lock the fully open jaws against closure and release them for closure in response to successive descents, respectively, of the grapple into rest on a load or loads, thereby achieving locking and release of the open jaws in the natural order required for normal use of the grapple, namely, locking of the fully open jaws on lowering the loaded grapple not only to lower and release its load, but therebeyond to open the jaws fully, and release of the locked open jaws for closure on lifting the grapple following its descent into gripping relation with and rest on the next load to be lifted.

It is another object of the present invention to provide a grapple of this type in which one of the jaws is adjustable relative to the other jaw for variation of their operating range, to the end of requiring but inconsiderable further opening of the jaws into their locked fully-open position after their release of any load and regardless of its dimension, thereby to attain optimum efficiency in the performance of the grapple over a wide operating range thereof.

Other objects and advantages will appear to those

skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a side view of a grapple embodying the present invention;

Fig. 2 is a section taken on the line 2—2 of Fig. 1, with most of the grapple shown in top plan view;

Fig. 3 is a longitudinal section through the grapple as taken on the line 3—3 of Fig. 2;

Figs. 4 and 5 are cross sections through the grapple as taken on the lines 4—4 and 5—5, respectively, of Fig. 1;

Fig. 6 is an enlarged cross section through the grapple as taken on the line 6—6 of Fig. 1;

Fig. 7 is an enlarged fragmentary section through the grapple as taken on the line 7—7 of Fig. 6;

Fig. 8 is a section similar to Fig. 7, but showing certain operating parts of the grapple in different operating positions; and

Fig. 9 is a fragmentary longitudinal section through a modified grapple in which the present invention may be incorporated.

Referring to the drawings, and more particularly to Figs. 1 to 5 thereof, the reference numeral 10 designates a grapple having a base frame 12, load-gripping jaws 14 and 16, jaw-operating linkage 18, a linkage stabilizer 20, and an operating control 22 for the linkage 18. The base frame 12 comprises, in the present instance, opposite side panels 24 and 26 and longitudinal transverse ties 28 and 30 between and suitably secured to the side panels 24 and 26, as by welding, for instance. Welded or otherwise secured to the side panels 24 and 26 of the base frame 12 are bottom rails or angles 27 and 29, respectively, which afford considerable rest area when the base frame becomes seated on a load or any other support underneath.

The jaws 14 and 16 are, in the present instance, differently curved (Fig. 2) so as to grip exemplary ring-shaped loads of different outside and inside diameters on their outer and inner peripheries, respectively. Such an exemplary load is shown in Fig. 3 in the form of a coil 32 of wound stock, such as sheet metal, for instance. The outer jaw 14 is suitably secured, as by welding, for instance, to the short leg 34 of an L-shaped carrier 36 which in this instance is formed of spaced side members 38 and 40, preferably having at the front end thereof a filler piece 42 for appearance and reinforcing purposes. The side members 38 and 40 of the outer jaw carrier 36 are confined between and next to the side panels 24 and 26, respectively, of the base frame 12 (Fig. 4) and are guided for longitudinal movement in the latter between the transverse ties 28 and 30 thereof which are preferably in plate form (Figs. 3, 4 and 5). The inner jaw 16 is suitably secured, as by welding, for instance, to the short leg 44 of an L-shaped carrier 46 which, like the other jaw carrier 36, is formed of spaced side members 48 and 50 having, in the present instance, reinforcing filler pieces 52 and 54 at the front and rear (Fig. 3). The side members 48 and 50 of the inner jaw carrier 46 are confined between and next to the side members 38 and 40, respectively, of the outer jaw carrier 36 (Fig. 5) and are guided for longitudinal movement in the base frame 12 between the transverse tie plates 28 and 30 thereof (see also Fig. 3). Thus, the outer and inner jaws 14 and 16 are movable into and from gripping engagement with the load 32 by virtue of the described guidance of their respective carriers in the base frame 12.

The jaw-operating linkage 18 comprises a parallelogram-type link system 60 and link pairs 62 and 64 operatively connecting the link system with the outer and inner jaw carriers 36 and 46, respectively (Fig. 3). The link system 60 comprises, in the present instance, link pairs 66, 68, 70 and 72 which form the sides, respectively, of a parallelogram and are connected by pivots 74, 76, 78 and

80 (Fig. 3). The links of the pairs 66, 68, 70 and 72 may be coordinated with each other as shown in Figs. 2 to 5. Thus, the links of the pair 68 are outermost (Fig. 2) and the links of the pair 66 are arranged immediately inwardly thereof. The links of the pair 72 are arranged immediately inwardly of the links of the pair 66, and the links of the pair 70 are arranged inwardly of and spaced from the links of the pair 72 (Figs. 2, 4 and 5). Suitable collars are preferably provided on the various pivots 74, 76, 78 and 80 in order to hold the links of the respective pairs 66, 68, 70 and 72 in their proper spaced relation. The pivot 80, on which the adjacent ends of the links of the pairs 70 and 72 turn, is mounted with its ends in the opposite side panels 24 and 26 of the base frame 12 (Fig. 5), and the latter is thus suspended from the link system 60 by the pivot 80.

The ends of the links of the pairs 70 and 72 at the pivot 80 have extensions in the form of relatively short lever arms 82 and 84, respectively, which are pivotally connected at 86 and 88 with the inner ends of the operating links of the pairs 64 and 62, respectively (Figs. 1 and 3). The outer ends of the operating links of the pairs 62 and 64 have pivot connections 90 and 92 with the outer and inner jaw carriers 36 and 46, respectively (Figs. 1, 3 and 4).

It follows from the foregoing description that the jaws 14 and 16 will, through intermediation of their respective carriers 36, 46 and operating link pairs 62 and 64, be moved toward each other and into gripping engagement with the load 32 on expanding the parallelogram-like link system 60 in the direction of its diagonal D from a position like or similar to that shown in Fig. 1 to that shown in Fig. 3. Conversely, the jaws 14 and 16 will, through intermediation of the same parts 36, 46, 62 and 64, be moved away from each other and out of gripping engagement with the load 32 on contracting the link system 60 in the direction of its diagonal D from the position shown in Fig. 3 into a position like or similar to that shown in Fig. 1.

For their normal intended load lifting and lowering performance, grapples of this general type are customarily suspended from overhead hoists of any suitable kind, and the instant grapple is to this end provided at the top pivot 74 of its link system 60 with an eye 94 for suspension from a hook, for instance, of any suitable hand or power-operated overhead hoist (not shown).

Assuming that the instant grapple 10 is thus suspended from an overhead hoist and held suspended over the load 32 which may rest on the floor or any other support underneath, with the jaws 14 and 16 of the grapple held locked against closure from the open position shown in Fig. 1 by the linkage operating control 22 in a manner described hereinafter, and assuming further that it is desired to lift the load 32 from the floor or other support, the hoist is lowered until the bottom rails 29 of the base frame 12 of the grapple come to rest on top of the load 32, care being taken that the open jaws 14 and 16 will straddle the load on the outside and inside thereof during the descent of the grapple onto the same. In thus seating the grapple on the load 32, the linkage operating control 22 will, in a manner described hereinafter, release the open jaws 14 and 16 for closure on the following expansion of the link system 60 in the direction of its diagonal D. Hence, on raising the hoist while the base frame 12 of the grapple 10 rests on the load 32, the link system 60 will be thus expanded and the open jaws 14 and 16 will, in consequence, move toward each other into gripping engagement with the load 32 (Fig. 3). On continued raising of the hoist, the link system 60, in tending to expand beyond the extent shown in Fig. 3, will cause the jaws 14 and 16 to grip the load 32 with an increasing force which almost immediately reaches a magnitude that is assuredly sufficient to lift the load from the floor or other support, the link system 60 being thus prevented by the gripped load from expanding beyond the extent

shown in Fig. 3. The load 32 thus gripped by the jaws 14, 16 of the grapple may be lifted to any extent on raising the hoist accordingly, and the raised load may also be shifted to any other horizontal location if the hoist is capable of such movement. In order subsequently to lower the raised load onto the floor or any other support in the same or a new horizontal location, it is merely necessary to lower the hoist. In thus lowering the hoist, the jaws 14 and 16 of the grapple hold the load 32 securely gripped until the latter comes to rest on the floor or other support. On continued lowering of the hoist thereafter, the link system 60 of the grapple will immediately contract in the direction of its diagonal D sufficiently to release the lowered load from the grip of the jaws 14 and 16, and will continue to contract and, hence, open the jaws further, while the base frame 12 of the grapple rests on top of the lowered load. In accordance with the performance to be described of the linkage operating control 22, the hoist is lowered while the base frame 12 of the grapple rests on top of the lowered load 32, until the link system 60 has contracted slightly beyond the extent shown in Fig. 1 in order to condition the linkage operating control 22 automatically to lock the link system 60 against expansion in the direction of its diagonal D immediately on subsequent raising of the hoist, so that the jaws 14, 16 of the grapple remain in their fully open position and will not regrip the lowered load 32 as the grapple is with its jaws lifted clear of the load. This completes a load lifting and lowering cycle of the grapple 10, and the same will, under the linkage operating control 22, repeat the same cycle for the next and subsequent loads to be attended to.

The linkage stabilizer 20, which is entirely conventional in grapples of this general type, comprises two bars 96 and 98 which are pivotally connected with each other at 100 and with the link pairs 70 and 72 of the link system 60 at 102 and 104, respectively (Figs. 1, 2 and 3). As best shown in Fig. 3, the bars 96 and 98 and the link pairs 70 and 72 to which the former are pivotally connected at 102 and 104, as described, form an auxiliary parallelogram-like link system 105 which expands and contracts with the primary link system 60. The arm 98 of the auxiliary link system 105 extends beyond its pivot connection 104 with the link pair 72 (Fig. 3) and carries at its free end a transverse pin 108 the ends of which project into opposing grooves 110 in guide blocks 112 and 114 on the inside of the side panels 24 and 26, respectively, of the base frame 12. Since the stabilizer link 98 of the auxiliary link system 105 is of equal lengths on both sides of its pivot connection 104 with the link pair 72 (Fig. 3) and since the grooves 110 in the guide blocks 112 and 114 extend longitudinally of the base frame 12, it stands to reason that the linkage stabilizer 20, while permitting expansion and contraction of the link system 60 in the direction of its diagonal D, will lock this link system to the base frame 12 of the grapple against such diagonal expansion and contraction in any direction other than at right angles to the longitudinal axis of the base frame 12. Hence, despite the arrangement of both jaws 14 and 16 in the instant exemplary grapple 10 on one side of the diagonal D of the link system 60 and the location in many instances of the centers of gravity of loads thereon at some lateral distance from this diagonal D, the base frame 12 is prevented from tilting excessively from its normal horizontal disposition under any normal eccentric load thereon, the tilting of the loaded base frame being restricted to that of the link system 60 about the top pivot 74 thereof, and the tilting of the link system under these circumstances being to all practical intents and purposes inconsequential due to the relatively short lever arm of the average eccentric load on the top pivot 74 of this link system.

The grapple described so far, with the exception of certain functional aspects of the linkage operating control 22 already referred to hereinbefore, is entirely conven-

tional and forms no part of the present invention. In accordance with an important aspect of the present invention, however, the linkage operating control 22 embodies a feature which greatly enhances the facility of the operation of the grapple and the safety in its use, and also permits its use at far greater efficiency than heretofore. The linkage operating control 22 comprises a latch lever 120, a pin and bayonet-type slot connection 126, and a control member 128 (Fig. 3). The latch lever 120 is presently formed by spaced side arms 122 and 124 which at one end are connected with an turnable on the pivot 76 of the link system 60 on one side of the diagonal D thereof (Figs. 1 to 3). The connection 126 is, in the present example, formed by aligned bayonet slots 130 in the side arms 122 and 124 of the latch lever 120, and a transverse pin 138 which extends through the bayonet slots 130 and is mounted with its ends in ear formations 140 on the links 72, respectively, of the link system 60 (Figs. 1 to 3 and 6 to 8). Each bayonet slot 130 has a longitudinal branch 132 and an enlarged lateral end branch 134, including a lock shoulder 136. The control member 128 is in the form of a wheel turnable on a transverse stud 142 between and carried by the free ends of the side arms 122 and 124 of the latch lever 120. For appearance and reenforcement purposes, the free ends of the side arms 122 and 124 of the latch lever 120 are preferably closed by a filler piece 143. The wheel 128 is provided with a plurality of teeth 144, preferably peripherally thereof, which for a reason soon apparent are of even number and equiangularly spaced, and alternate teeth are of different forms. Thus, the teeth 144a are higher than the teeth 144b with which they alternate. Cooperating with the teeth 144 of the control wheel 128 is a pawl 146 which is pivoted on a cross-pin 148 on the latch lever 120 and prevents clockwise rotation of the control wheel (Fig. 7) but permits counterclockwise rotation of the latter in normal indexing direction.

In operation of the instant grapple 10, and assuming that the same presently carries the load 32 (Fig. 3) and the latter is to be lowered, the hoist is lowered until the load 32 comes to rest on the floor or other support. On continued lowering of the hoist, the jaws 14 and 16 of the grapple will immediately release their grip from the load and will open while the base frame 12 of the grapple rests on top of the lowered load. In thus lowering the hoist, the link system 60 will contract more and more from its expanded condition in Fig. 3, and the pin 138 will in the course of the continued contraction of this link system ride out of the longitudinal branches 132 of the bayonet slots 130 in the latch lever 120 and be guided by the inclined edges 150 of the lateral end branches 134 of these slots into interlock with the shoulders 136 thereof (Fig. 7), the free end of the latch lever 120 having freedom to descend by gravity sufficiently to permit entry of the pin 138 into interlock with the shoulders 136. The link system 60 has by this time contracted to the extent shown in Fig. 1, but it is in accordance with the present invention that the hoist be lowered still further in order to permit even further contraction of the link system beyond the extent shown in Fig. 1. Thus, it is during this further contraction of the link system 60 that the pin 138 is moved by the latter further to the right from its lock position in Fig. 7 while the latch lever 120 is compelled to follow the outwardly moving pivot 76 of the link system 60 in a direction opposite to the motion of the pin 138, and it is during this relative motion in opposite directions of the latch lever 120 and pin 138 that the latter reacts with the adjacent flank 152 of the nearest shorter tooth 144b' of the control wheel 128 which faces the lock shoulder 136 (Fig. 7) and is cammed thereby out of interlocking relation with the shoulders 136. Still during the same relative motion between the latch lever 120 and pin 138 after the latter is cammed out of interlocking relation with the shoulders 136, the pin 138 will engage the bottom 154 of the gap between the presently active tooth 144b'

and the last active tooth 144a' and commence to index the control wheel 128 in counterclockwise direction (Fig. 8). The abovementioned further contraction of the link system 60 in response to further lowering of the hoist is continued until the control wheel 128 is indexed at least one full tooth in order that the pawl 146 may lock the control wheel in the newly indexed position (Fig. 8) in which the tooth 144b' is the only obstacle to reentry of the pin 138 into interlocking relation with the shoulders 136. Since the links of the pair 72 are provided, in fairly close proximity to the pivot 80, with inwardly projecting lugs 72a (Figs. 1 and 3) on which the side arms 122 and 124, respectively, of the latch lever 120 come to rest when the link system 60 is contracted to the extent shown in Fig. 1 in which the pin 138 is in interlock with the shoulders 136, it stands to reason that on further contracting the link system 60 the latch lever 120, by virtue of its rest on the lugs 72a on the link pair 72, will not only descend with the latter but will also have a superimposed counterclockwise motion about the lugs 72a by virtue of the greater descent of its pivot 76. Hence, while the latch lever 120 and pin 138 have, on the aforementioned further contraction of the link system 60, relative motion in opposite directions longitudinally of the latch lever 120, they have also relative rotary motion in opposite directions, and it is this latter relative motion which primarily makes for quick and complete camming of the pin 138 from interlock with the shoulders 136 and indexing of the control wheel 128, as will be readily understood. Having thus indexed the control wheel 128 into the new position shown in Fig. 8, and this may readily be perceived by the click of the relocking pawl 146, the hoist is raised in order to expand the link system 60 of the grapple, and the latch lever 120 and link pair 72 of the link system 60 will immediately respond and relatively move the control wheel 128 and pin 138 away from each other from their relation in Fig. 8. After short relative motion between the control wheel 128 and the pin 138 in this fashion, the latter clears the tooth 144b' (Fig. 8) and, by virtue of the shortness of the latter, is then free to reenter into interlocking relation with the shoulders 136 through the gap 158 between the latter and the tooth 144b', it being the previously raised free end of the latch lever 120 which is then free to drop by gravity until its shoulders 136 are relocked with the pin 138. It is thus obvious that the pin 138 becomes relocked with the shoulders 136 almost immediately on raising the hoist and, in consequence, expanding the link system 60 of the grapple, so that on continued raising of the hoist the grapple with its jaws 14 and 16 wide open will be lifted from the lowered load without regripping the same.

On lowering the hoist for the next load-lifting performance of the grapple, the hoist may uninterruptedly be lowered until the fully open jaws of the grapple straddle the new load on the floor or other support. However, since the linkage operating control 22 at this stage of the new performance of the grapple still locks the link system 60 against expansion from the contracted condition shown in Fig. 1, raising of the hoist at this time would merely lift the grapple without permitting its jaws 14, 16 to grip the new load. Accordingly, the linkage operating control 22 will first have to perform its additional function of releasing the link system 60 for expansion before the hoist may be raised. To this end, the hoist is lowered until the base frame 12 of the grapple comes to rest on the new load, and the hoist is thereafter even further lowered, even without interruption. It is during this further lowering of the hoist that the link system 60 of the grapple is permitted to contract beyond the extent shown in Fig. 1, in the course of which the ensuing relative movement between the control wheel 128 and pin 138 toward each other (Fig. 7) causes cooperation between the latter and the nearest tooth 144, which now is the longer tooth 144a'' (Fig. 8), in camming the pin 138 from interlocking relation with the shoulders 136 and indexing the control

wheel 128 the distance of one tooth. Hence, on sufficiently lowering the hoist, the pin 138 will be in the same relation to the control wheel 128 as shown in Fig. 8, except that now the longer tooth 144a'' is in the position of the shorter tooth 144b' in Fig. 8, with the result that the longer tooth 144a'' will block reentry of the pin 138 into interlocking relation with the shoulders 136, and instead will guide the pin beyond the shoulders 136 and against the inclined edges 150 of the lateral end branches 134 which assume further guidance of the pin into the longitudinal branches 132 of the bayonet slots 130, all on raising the hoist after the last mentioned indexing of the control wheel 128. Hence, on thus raising the hoist this time, the link system 60 of the grapple, being now released for expansion, will expand and, in consequence, cause the open jaws 14, 16 to close on the new load and, on engagement therewith, grip the same with a force which is assuredly adequate to lift it. The control wheel 128 now assumes an angular position identical to that shown in Fig. 7, i. e., a short tooth 144b is nearest to the shoulders 136, ready to cooperate with the pin 138 after lowering the present load on the floor or other support and continuing to lower the hoist thereafter until the control wheel 128 is again indexed so that on subsequent raising of the hoist the pin 138 will relock with the shoulders 136 and thus permit raising of the grapple from the lowered load without regripping the latter with its jaws, as will be readily understood.

It follows from the preceding that the instant linkage operating control 22 acts alternately to release the open jaws 14, 16 of the grapple for closure and lock them against closure, i. e., in the logical sequence required for picking up each load and subsequently lowering the load and removing the grapple therefrom for the pick-up of another load, simply by lowering the hoist, for each pick-up of a load and for the lowering of each picked-up load, slightly further than is required to rest the base frame of the grapple on top of the load in each instance. Thus, the instant linkage operating control is highly advantageous in that it requires no manipulation whatever by an operator, and for that reason not only greatly facilitates the operation of the grapple by an attendant, but permits the use of the grapple with far greater safety to the attendant than was heretofore possible, as has already been explained hereinbefore. Moreover, the unique performance of the instant linkage operating control, to the end of requiring hardly any deviation from the accustomed use and operation of grapples of this type and additionally eliminating altogether cumbersome and even hazardous manipulation of the previous latch provisions, enhances the efficient use of the instant grapple far beyond that of previous grapples of this general type.

In accordance with another aspect of the present invention, one of the jaws of the grapple may be adjusted relative to the other jaw so as to accommodate the grapple to loads of different sizes without incurring too much lost motion in closing the jaws on the load and releasing them therefrom. This feature is especially advantageous in view of the performance of the hereinbefore described linkage operating control 22, in that the adjustability of one of the jaws relative to the other jaw and, hence, of the operating range of the jaws, permits the adaptation of the instant grapple to loads of different sizes without detracting in the slightest from the highly advantageous quick response of the linkage operating control in its designated actions to natural lowering of the grapple-carrying hoist, for each pick-up of a load and for the lowering of each picked-up load, slightly further than is required to rest the grapple on top of the load in each instance.

In the present instance, it is the outer jaw 14 which is adjustable, and to this end, the side members 38 and 40 of its carrier 36 are provided with a plurality of spaced pairs of aligned holes 160 with either of which the pivot 90 may be connected. The pivot 90 is to this

end a pin which is removable from the outer jaw carrier 36 and operating links 62 (Fig. 4) and extends through elongated slots 162 in the opposite side panels 24 and 26 of the base frame 12, having at one end a removable cotter pin 164, or the like, and at its other end a handle 166 for manipulating the pin. The slots 162 in the opposite side panels 24 and 26 of the base frame 12 are sufficiently elongated to permit free motion of the pivot pin 90 with the outer jaw carrier 36 throughout its operating range.

While in the grapple 10 described hereinbefore both jaws 14 and 16 move in response to expansion and contraction of the link system 60 in the direction of the diagonal D thereof, all the described advantages of the present invention are as fully secured if only one of the jaws of the grapple moves in response to diagonal expansion and contraction of the link system 60, while the other jaw remains stationary. An example of this modified arrangement is shown in Fig. 9 in which the outer jaw 14' on the carrier 36' is moved in response to expansion and contraction of the link system 60' by virtue of the operating links 62' which connect the former with the latter, while the inner jaw 16' on its carrier 46' is held stationary in the base frame 12' of the grapple 10' by virtue of the attachment of the jaw carrier 46' to the base frame 12' by means of bolts 170, or the like.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

What is claimed is:

1. In a grapple having mechanism, including pivotally connected links arranged in a parallelogram system with suspension means at one end of one diagonal thereof, relatively movable jaws, and means connecting said jaws with said links at the other end of said diagonal to close and open said jaws on expanding and contracting said link system in the direction of said diagonal, the combination of a lever pivoted with one end to said link system on one side of said diagonal thereof and having a bayonet-type slot with a longitudinal branch and a lateral end branch with a lock shoulder; a pin on said link system on the other side of said diagonal thereof and extending into said slot, said pin riding in said longitudinal slot branch during expansion and contraction of said link system within a range in said longitudinal branch terminating at the end thereof next to said end branch, and said lever, on contraction of said link system beyond said end of said range, gravitating in one direction about its pivot axis whereby said lateral end branch and lock shoulder thereof registers and interlocks with said pin for locking said link system against expansion; a toothed wheel rotatably mounted on said lever farther from the pivot axis of the latter than said lateral end branch so that teeth of said wheel extend into said lateral end branch; pawl means carried by said lever and engaging said wheel to limit rotation of the latter to one direction and arrest the same against rotation in the opposite direction, said teeth being alternately of different heights so as to project substantially across and only partly into said lateral end branch, respectively, a gap between successive teeth being in alignment with said pin in said lateral end branch whenever said pawl means

arrests said wheel against rotation, said tooth gap camming said pin from said lateral end branch whereby said pin will index said wheel a single tooth on each successive contraction of said link system beyond said range, the higher teeth of said wheel blocking reentry of said pin into the said lateral end branch and camming the same into said longitudinal slot branch, and the lower teeth guiding said pin into said lateral end branch, alternatively on successive expansions of said link system into said range.

2. In a grapple having mechanism, including pivotally connected links arranged in a parallelogram system with suspension means at one end of one diagonal thereof, relatively movable jaws, and means connecting said jaws with said links at the other end of said diagonal to close and open said jaws on expanding and contracting said link system in the direction of said diagonal, the combination of a lever pivoted with one end of said link system on one side of said diagonal thereof and having a bayonet-type slot with a longitudinal branch and a lateral end branch with a lock shoulder; a pin on said link system on the other side of said diagonal thereof and extending into said slot, said pin riding in said longitudinal slot branch during expansion and contraction of said link system within a range in said longitudinal branch terminating at the end thereof next to said end branch, and said lever, on contraction of said link system beyond said end of said range, gravitating in one direction about its pivot axis whereby said lateral end branch and lock shoulder thereof registers and interlocks with said pin for locking said link system against expansion; a toothed wheel rotatably mounted on said lever farther from the pivot axis of the latter than said lateral end branch so that teeth of said wheel extend into said lateral end branch; pawl means carried by said lever and engaging said wheel to limit rotation of the latter to one direction and arrest the same against rotation in the opposite direction, said teeth being alternately of different heights so as to project substantially across and only partly into said lateral end branch, respectively, a gap between successive teeth being in alignment with said pin in said lateral end branch whenever said pawl means arrests said wheel against rotation, said tooth gap camming said pin from said lateral end branch whereby said pin will index said wheel a single tooth on each successive contraction of said link system beyond said range, the higher teeth of said wheel blocking reentry of said pin into the said lateral end branch and camming the same into said longitudinal slot branch, and the lower teeth guiding said pin into said lateral end branch, alternatively on successive expansions of said link system into said range; and a lug on one of the links extending to said other end of said diagonal, said lug being engaged by and turning said lever about its pivot axis in a direction opposite to said one direction on each contraction of said link system beyond said range.

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