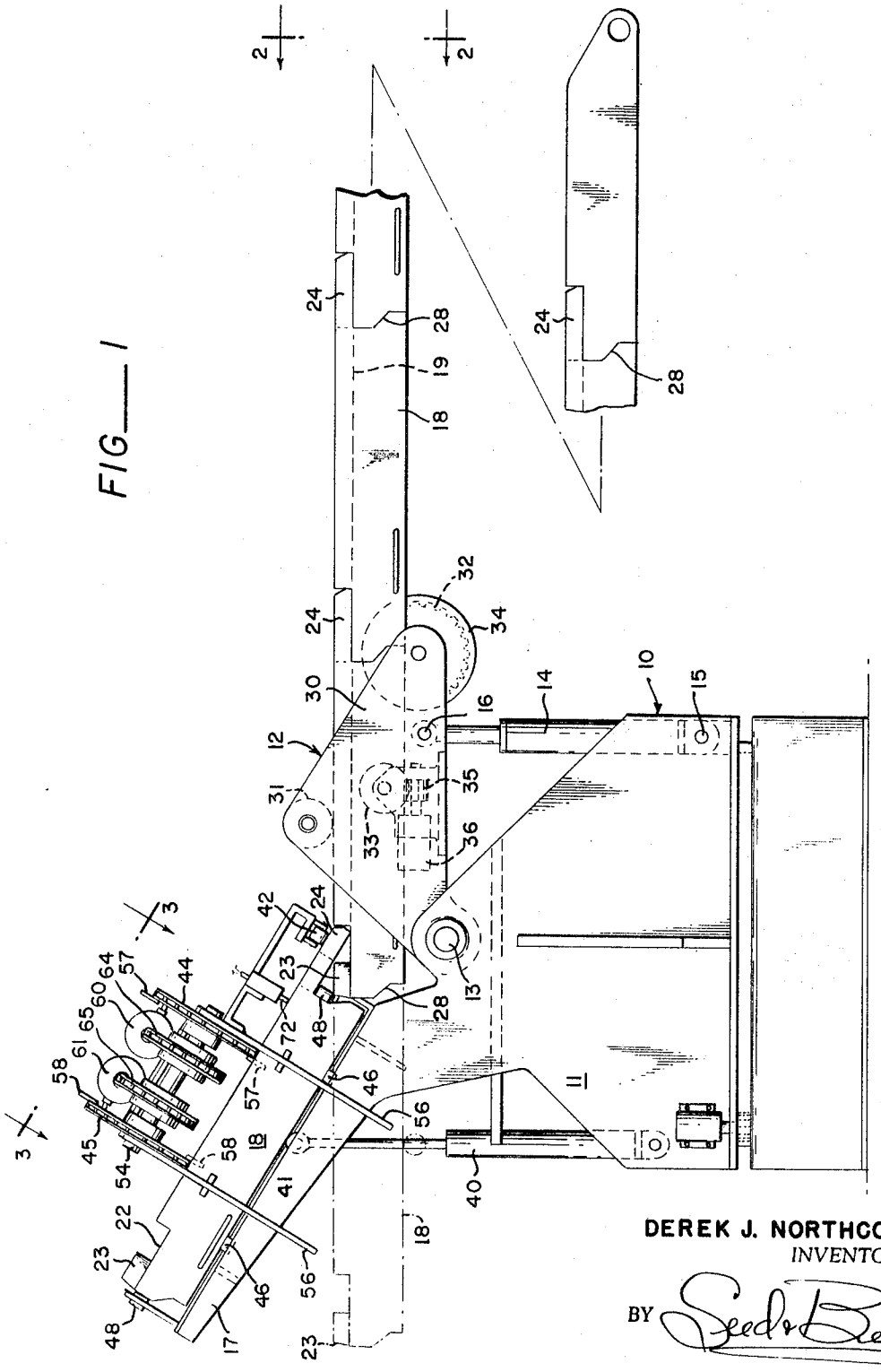
May 16, 1967 D. J. NORTHCOTT 3,319,803

RETRACTABLE CHAIN BOOM

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FIG. 1



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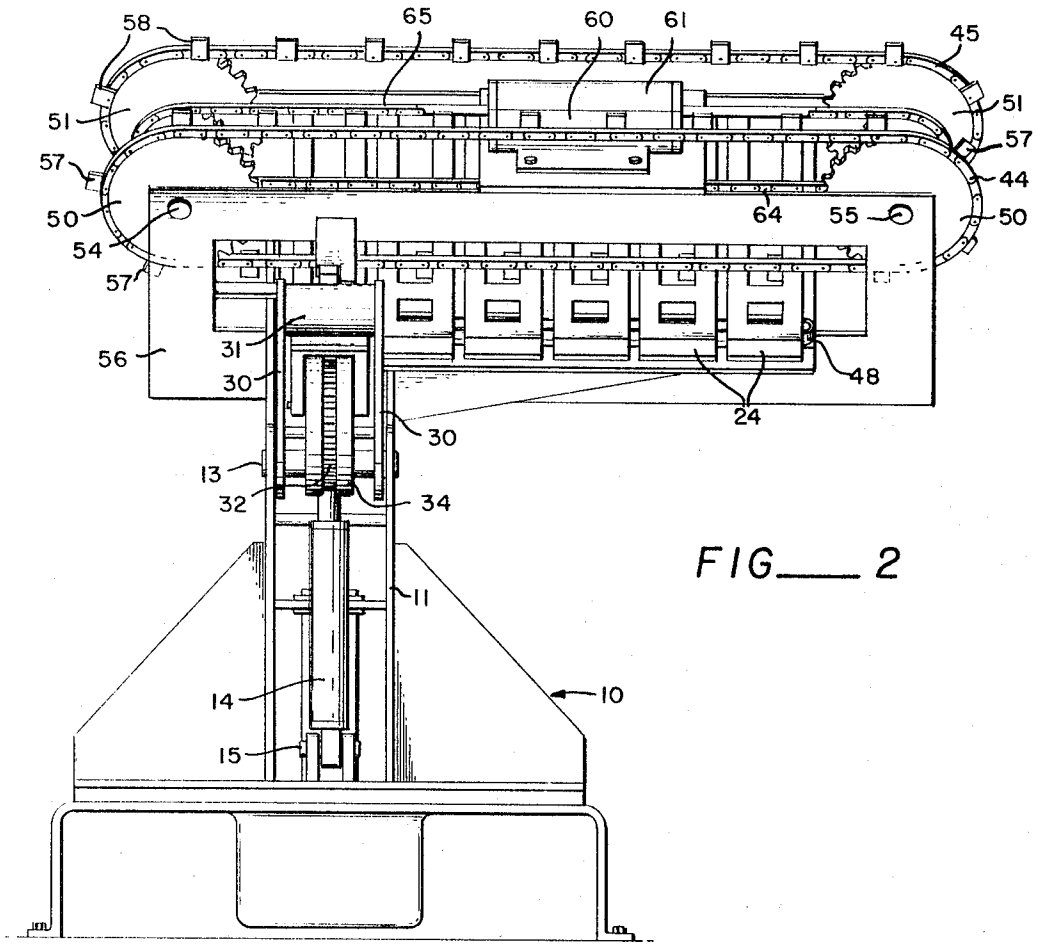


FIG. 2

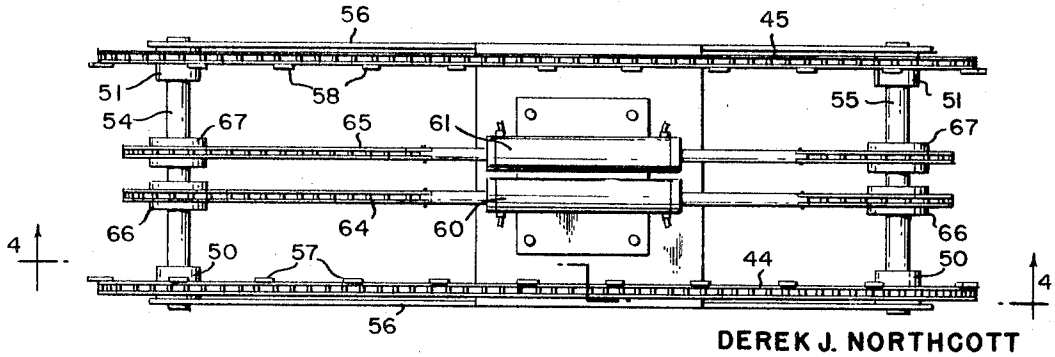


FIG. 3

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FIG_5

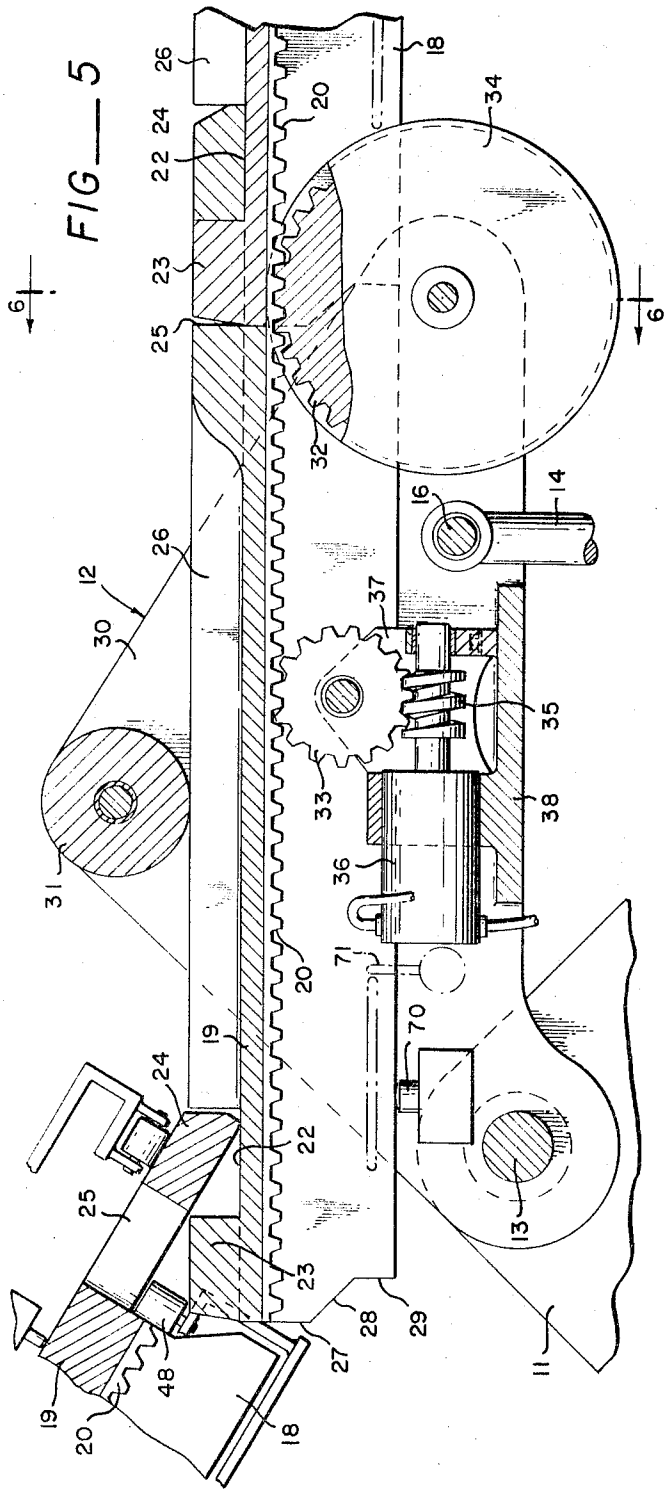
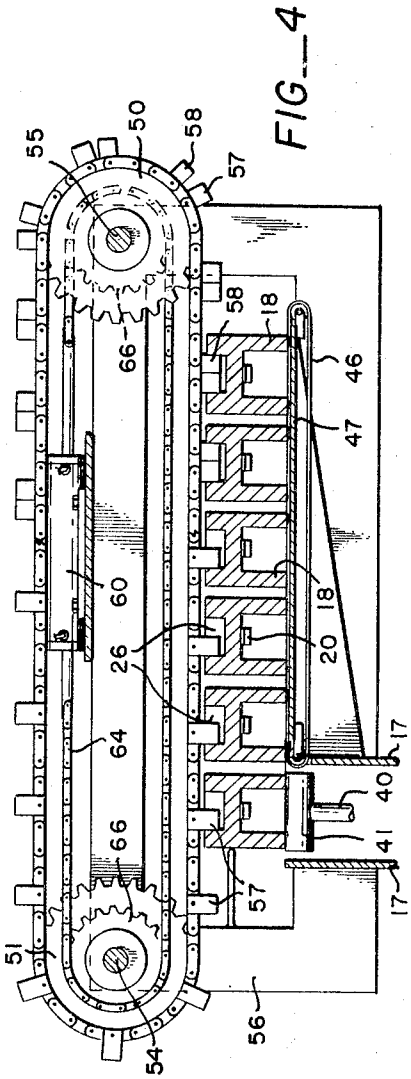


FIG_4



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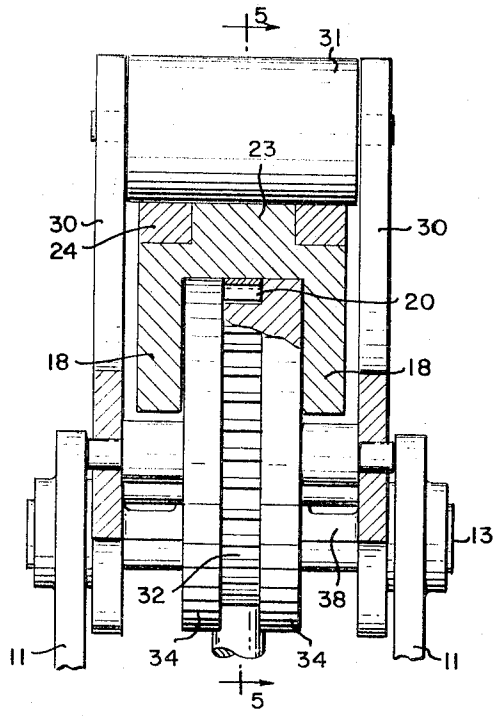
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RETRACTABLE CHAIN BOOM

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FIG 6



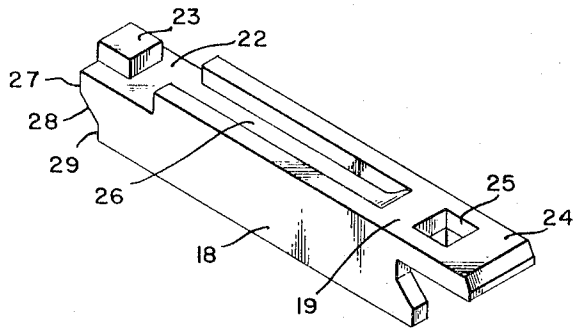


FIG 7

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3,319,803

RETRACTABLE CHAIN BOOM

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Filed Apr. 12, 1966, Ser. No. 542,077
12 Claims. (Cl. 212—55)

This invention relates to a chain boom, and namely a boom which permits extension and contraction movements and is composed of multiple links capable of being stored in a compact compass when not in use and formed so as to interlock and form a rigid straight arm when performing their boom function.

Extensible chain booms have heretofore commonly had an articulating joint between the links so that when the rigidifying connection is disengaged, incident to retracting the boom and storing the links, the links remain attached to one another. This has allowed the chain to be stored by the expedient of coiling the same.

The present invention aims to provide a non-articulating type of chain boom, one more especially in which the links can be completely detached from one another for purposes of storage, having at the ends of the links a perfected means for establishing a rigidifying connection, and to devise a perfected means and method for storing the links and making and breaking the connection between the same automatically in course of extending and retracting the boom.

In the accompanying drawings:

FIGURE 1 is a fragmentary side elevational view illustrating a chain boom constructed to embody preferred teachings of the present invention and showing, by full and phantom lines in the respective instance, positions occupied by links of the boom as the latter are moved from a magazine in which the links are stored into an operating location whereat each link automatically interlocks with a next adjacent link to produce a straight arm.

FIG. 2 is an end elevation viewed from the vantage point shown at 2—2 in FIG. 1.

FIG. 3 is a top plan view of the magazine, viewed from the vantage point indicated at 3—3 in FIG. 1. For simplicity in illustration the view deletes any showing of the links or of the base which serves as a mounting for the magazine and the extended boom.

FIG. 4 is a fragmentary transverse vertical sectional view on the jogged line 4—4 of FIG. 3.

FIG. 5 is a fragmentary longitudinal vertical sectional view drawn to an enlarged scale on line 5—5 of FIG. 6.

FIG. 6 is a fragmentary transverse vertical sectional view on line 6—6 of FIG. 5; and

FIG. 7 is a perspective view showing one of the links of the chain boom, with the scale corresponding to that of FIGS. 1–4, inclusive.

Referring to said drawings, the numeral 10 denotes a base presenting a standard which is furcate in form to provide two upright arms 11 lying in paralleling spaced relation. A driver foot designated generally by 12 has its heel end received between the arms and is hinged thereto by trunnion pins 13 for vertical swing movement about a tranverse horizontal axis. A hydraulic jack 14 pivoted at 15 to the base and connecting by a wrist pin 16 with the driver foot at a point on the latter spaced forwardly from the hinge aixs controls the swing movement of the foot. The function of the driver foot is (1) to feed the links of the chain boom to and from a loading station which is functional to the magazine in which the links are stored, and (2) to give support to the root end of the chain boom when the latter is extended as a straight arm.

The magazine will be hereinafter more particularly described but suffice it to here say that the same lies to the rear of the driver foot and receives its support from legs 17 prolonged upwardly as planar extensions of the arms 11. The loading station lies below the magazine in the space between said legs 17.

The links of the chain boom can be made rather long, say 4 feet, and are identical in form with a rectangular plan configuration. Viewed from the ends, the links have an inverted-U shape to provide side walls 18 depending from a head wall 19. A rack 20 extends the length of the link along the underside of the head wall, being fixed thereto in a position centered with respect to the side walls.

A rabbet 22 interrupted adjacent the outer edge by a centered upwardly facing tenon 23 is formed in the head wall at the rear end of the link, and at the front of the link there is provided a mating counterpart comprised of a tongue 24 with a mortise 25. A parallel-sided groove 26 extends inwardly from the rabbet along the longitudinal median line of the link for very nearly the entire length of the link. The rabbet portion of one link interfits with the tongue portion of a following link. Considered in profile, the front and rear edges of the side walls 18 of the links are also formed in mating correspondence so that a butting interfit is established between end edges of adjoining links. For each said end, the butt surfaces have a jogged configuration with an upper shoulder 27, a rather long median shoulder 28, and a lower shoulder 29. The median shoulder is sloped approximately 45° from the upper and lower shoulders which, in each instance, lie normal to the plane of the head wall. The direction of slope is such that at the rear end of the link the upper part of the side wall projects beyond the lower part, i.e. overhangs the latter. The rear face of the tenon 23 and the front face of the tongue 24 are each relieved in the degree necessary to permit an inner link in the chain to easily free itself from its interfit with the abutting outer link by swinging upwardly about its lower front edge as a fulcrum.

The driver foot provides spaced paralleling cheek plates 30, and the guided path of the links is in the space between these cheek plates. A roller 31 journaled from the cheek plates bears from above upon the head wall 19, and two sprocket wheels 32 and 33 which lie to the front of the roller engage the teeth of the rack 20 to sustain the link from below. The sprocket wheel 32 is an idler wheel and receives its journal from the cheek plates. Means are provided, including flanges 34 upon the idler sprocket wheel, to hold the link centered between the cheek plates. The sprocket wheel 33 is a live wheel performing the foot's driving function, and is powered by a worm gear 35 from a reversing hydraulic motor 36. A mounting for the motor, and journals for the worm gear and the driver wheel, are provided by a casting 37 bolted to a web 38 which extends between the cheek plates. When the hydraulic motor is inactive its fluid system establishes a hydraulic lock upon the worm gear to hold the chain boom against any motion endwise to the driver foot.

Clarity in an understanding of the structural nature of the magazine and the correlation of its parts to the driver foot will be advanced by here noting that the links, in their retraction travel, move at interrupted intervals the length of one link horizontally inwardly beyond the driver foot to occupy the lower level of a two-level elevator shaft. Working in the shaft is an elevator comprised of a cross-arm 41 surmounting the non-turning piston rod of a fixedly mounted double-acting hydraulic ram 40. Entering said elevator shaft the side walls of the link rest upon the lowered cross-arm. Elevation of the link by extension of the ram raises only the outer end of the link in that the inner end is constrained by a roller 42, and the link thus swings about the lower edge

of its inner end as a fulcrum into the inclined position shown by full ines in FIG. 1. So elevated, the link clears the tenon over which it is hooked and is free to move bodily in a horizontal direction laterally of said guided path along which the link had previously moved in its endwise travel.

A pair of power-driven endless conveyor chains **44** and **45** move each of a succession of the links in said bodily lateral travel, first shifting the same off the cross-arm onto a magazine floor comprised of free-moving endless belts **46**, and then at interrupted intervals advancing the same along said floor until the magazine is filled. An underlying table **47** gives firm support to the upper runs of said floor belts. Free-moving endless flank belts **48** complement the floor belts and serve to hold the stored links against endwise displacement within the magazine.

The conveyor chains operate in planes which parallel the minor axis of the stored links, and lie moderately close to said minor axis at opposite sides thereof. The chains are trained about respective sets of sprocket wheels **50—50** and **51—51**. Live shafts **54** and **55** common to the two sets of sprocket wheels receive a journal from C-plates **56** of a magazine framework. The sprocket wheels are fixed to these shafts. Flights are provided upon the conveyor chains, and in their lower-run travel move the links by entering the upwardly facing grooves **26** of the latter. The flights on each chain are spaced one from another distances somewhat greater than the width of the links. The span of each flight is less than the width of said grooves, and the flights of one chain are slightly advanced beyond those of the other chain so that, entering the groove of a link, the concerned flight of one chain bears against one side wall of the groove and the concerned flight of the other chain bears against the opposite side wall. To reflect the different functions which the two chains perform, chains **44** and **45** will be hereinafter termed the input chain and the output chain, respectively. Their flights are denoted by **57** and **58**, respectively.

Shafts **54** and **55** are driven interruptedly, turning in one rotary direction (counter-clockwise as viewed from the vantage point of FIGS. 2 and 4) to cause flights **57** of the input chain **44** to feed the links from the cross-arm **41** into the magazine and in the other direction (clockwise) to cause the flights **58** of the chain **45** to return the links from the magazine to the cross-arm. Their interrupted turning movements are made to alternate with a cycle of movement of the elevator. The run travel of the chains in each of said interrupted movements corresponds to the center-to-center spacing of the flights, and is so correlated to the position occupied by an elevator-carried link that a pair **57–58** of said flights is localized during null periods of the chains in a position which will register with the groove of said link.

The interrupted driving of the chains is performed by a pair of selectively operated double-acting hydraulic rams **60** and **61**. These are cross-head rams in the sense that the piston rods are exposed from both ends, and are contained within the length of a respective one of two endless chains. Denoted by **64** and **65** the chains are trained over sets of sprocket wheels **66—66** and **67—67** carried by the live shafts **54** and **55**. Unidirectional clutches are provided between the sprocket wheels and the shafts, responsively turning the shafts counter-clockwise when the cross-head of the ram **60** is powered in the left to right stroke of its reciprocatory movement, and responsively turning the shafts clockwise when the cross-head of the other ram **61** is powered in the right to left stroke of its reciprocatory movement. The clutches overrun the shafts in the return strokes of reciprocation.

The normal position of the elevator is at the upper level of its travel. When the chain boom is fully retracted, all but two of the links are stored on the floor of the magazine. The outermost link occupies the driver foot and the next adjacent link rests upon the cross-arm **41**, occupying an inclined position within the elevator shaft co-

planar with the stored links. A master control is provided for operating the boom. When placed in its "extension" position a repeating timed sequence of operations commences. The elevator descends to place the #**2** link in-line with the #**1** link and coincidentally cause the two to become locked together. The hydraulic motor **36** is now activated and moves said interlocked links outwardly until the #**2** link occupies the position upon the driver foot previously occupied by the #**1** link. Following this outward movement the cross-arm of the elevator again rises to the upper level, prepared to receive from the magazine the #**3** link which is now moved thereto by the output ram **61** as the cross-head of the latter operates in its outward stroke of reciprocation, this being left to right as viewed in FIG. 4. Upon the following return of the cross-head, one cycle in the boom's repeating sequence of operation will have been completed. In the circumstance of a terminal link which occupies the driver foot moving outwardly by the initiation of a cycle after the magazine has been emptied, a stop switch **70** comes into play, inactivating the motor when such terminal link has moved no more than a short distance.

When the master control is placed in its "contraction" position, a substantial reverse of the described operation takes place, albeit in this instance the input ram **60**, rather than the output ram **61**, is made active. Two of several limit switches responsible for an automatic performance of the described sequential steps are denoted by **71** and **72**.

As here illustrated, with the magazine receiving its support from the base, it is a prerequisite to either an extension or contraction of the projecting portion of the boom that the driver foot occupy a horizontal position. While this is satisfactory for most operations, the structure can be easily adapted, so as to permit adjustment of the boom's length while the boom is in an inclined position, by supporting both the magazine and the elevator from the driver foot.

It is believed that the invention will have been clearly understood from the foregoing detailed description of my now-preferred illustrated embodiment. Changes in the details of construction may be resorted to without departing from the spirit of the invention and it is accordingly my intention that no limitations be implied and that the hereto annexed claims be given the broadest interpretation to which the employed language fairly admits.

What I claim is:

1. A retractable chain boom structure comprising a row of links detachably connected in a rigid straight-arm assembly to form the boom, a driver foot receiving the inner end of the boom and guiding the same for endwise movement so that the boom can be extended or retracted, means for moving the boom in said extension and retraction movements, and means operating automatically as a then inner link in the boom reaches a predetermined point in course of said extension and retraction movements for adding or removing, in the respective instance, one link to or one link from the inner end of the boom and coincident with said addition or removal making or breaking, as the case may be, the rigidifying connection between the boom and said link which is added or removed therefrom.

2. A retractable chain boom structure as claimed in claim **1** wherein the means last recited performs its function of making and breaking the rigidifying connection by swinging the concerned link about its forward end as a fulcrum between a connected position in which the link lies co-axial with the other links in the boom and a disconnected position whereat the link lies angular to the axial line of the boom.

3. A retractable chain boom structure as claimed in claim **2** wherein said means last recited, in course of performing its function of adding a link to or removing a link from the boom, moves the concerned link bodily to or bodily from, as the case may be, said angular location.

4. A retractable chain boom structure as claimed in claim 1 in which each of said links which admit of being added to or removed from the boom are identical.

5. A retractable chain boom structure as claimed in claim 4, the rear ends of said identical links presenting an upstanding tenon and along the rear edge having a bearing shoulder which slopes downwardly and forwardly, the front end having a forwardly extending tongue which overhangs a front edge formed as the mating counterpart of said sloping shoulder and within the length of said tongue providing a mortise which fits over the tenon of a next adjacent link when the sloping front and rear edges of the two links are in bearing engagement, an inner link being detached from a next adjacent outer link by swinging the inner link upwardly about the lower front edge of its tongue as a fulcrum.

6. A retractable chain boom structure as claimed in claim 1 having a magazine providing a supporting floor on which the removed links are stored, the means last recited including an elevator which underlies the rear end of said inner link and performs the function of making and breaking the rigidifying connection by swinging the concerned link vertically about its front end as a fulcrum between a connected position in which the link lies coaxial with the other links in the boom and a disconnected position whereat the link lies angular to the axial line of the boom and co-planar with said floor of the magazine, a conveyor being provided for moving the links bodily in a lateral direction between said elevator and the magazine.

7. A retractable chain boom structure as claimed in claim 6 wherein said conveyor, said elevator, and the means for extending and retracting the boom are each operated by power and interruptedly so that the same work in sequence.

8. A retractable chain boom structure as claimed in claim 6 in which the links provide a longitudinally extending groove in their upper surface and wherein the conveyor comprises an endless chain selectively driven in either of two opposite directions of travel and trained about sprocket wheels so that a lower run of the chain overlies the links both when the links occupy the floor of the magazine and an elevated position upon the elevator, the chain having flights which register with the grooves of the links and by engagement with the side walls of said grooves shift the links bodily in a lateral direction either from the magazine toward the elevator or from the elevator toward the magazine depending upon whether the conveyor chain is driven in one or the other of its opposite directions of travel.

9. For use in a chain beam, a row of links detachably connected in a rigid straight-arm assembly and characterized in that each link has an upstanding tenon at its rear end, is formed along the rear edge with a bearing shoulder which slopes downwardly and forwardly at an angle of approximately 45° from the plane of the connected links, and at the front end has a forwardly extending tongue overhanging a front edge which is formed as the mating counterpart of said sloping shoulder and within the length of the tongue presents a mortise which snugly fits the tenon of a next adjacent link in the row when the sloping front and rear edges of the two links are in bearing engagement, the tenon rising from a flat which lies coplanar with the lower face of the tongue.

10. Structure as claimed in claim 9 in which a parallel-sided groove extends longitudinally along the upper face of the link in both directions from center, the groove functioning as a socket to receive the flight of an overhead conveyor chain for moving the detached links to a storage compartment.

11. In combination with a retractable chain boom comprised of a row of links detachably connected in a straight-arm assembly, a support for the inner end of the chain boom, intermittently acting means operable when the boom is retracted for disconnecting the then inner link from the boom and feeding the same to a way station, a magazine for storing the disconnected links side-by-side and including the way station as one of its storage spaces, and a conveyor structure operating in each of a succession of interrupted movements to shift the links laterally from one to a next adjacent space in the magazine, the conveyor structure comprising an endless reversible conveyor chain trained about sprocket wheels so that a run of the chain lies overhead and at right angles to links occupying said spaces, flights on the conveyor chain functional to engage and shift the links occupying said spaces in either of two opposite lateral directions depending upon the direction in which the conveyor chain moves, live shafts on which said sprocket wheels are fixed, a pair of independently operated double-acting rams, and an operative interconnection between the rams and the shafts operating to turn the shafts in one direction by cyclic operation of one ram and in the other direction by cyclic operation of the other ram, the amount of said turn, measured in terms of flight travel, moderately exceeding the width of a boom link.

12. Structure as claimed in claim 11 in which means are provided causing the means which feeds the links between the boom support and the way station to operate in timed sequence with a cyclic operation of a selected one of the rams.

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