Feb. 5, 1963 L. G. KAPLAN ETAL 3,076,673

LIFTER MECHANISM WITH HORIZONTALLY EXTENSIBLE JAW-SUPPORTING ARMS

Filed Jan. 16, 1962 7 Sheets-Sheet 1

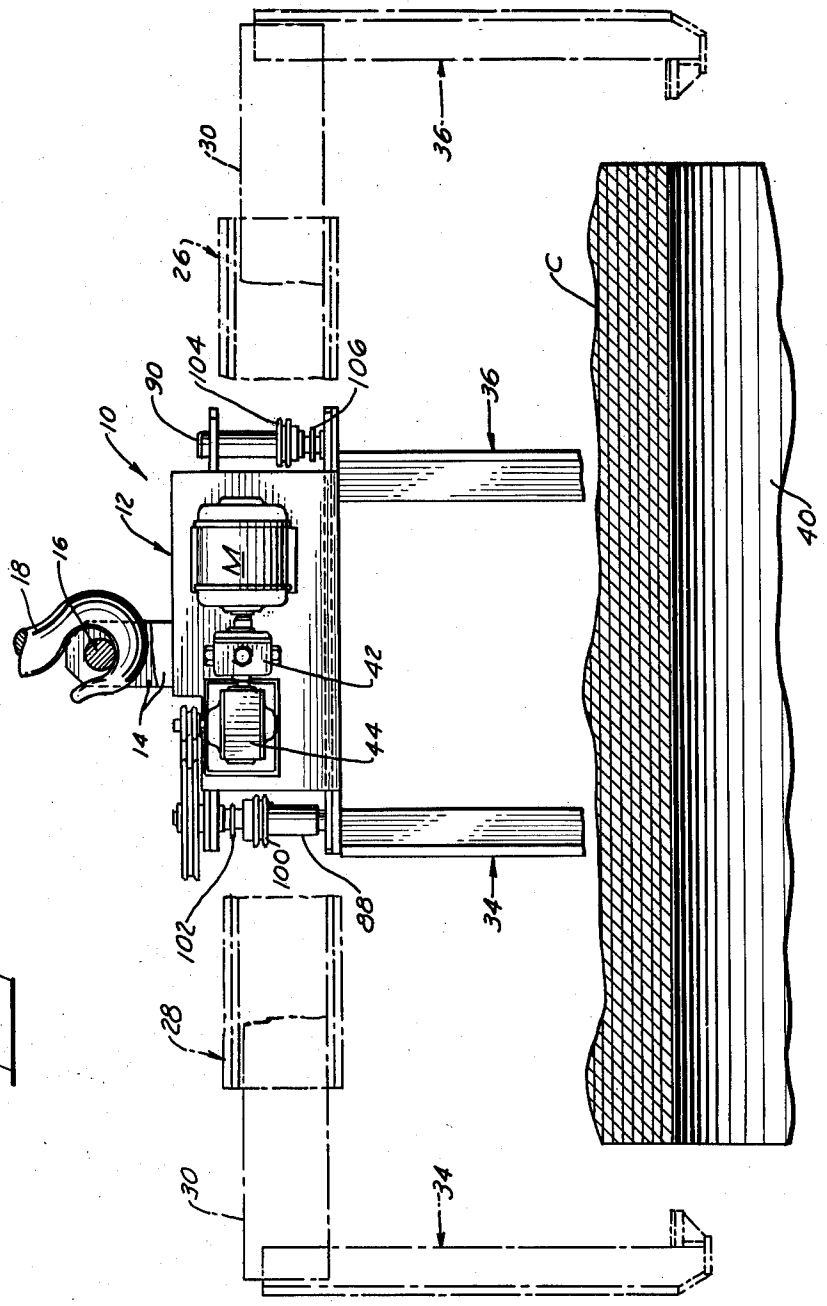


FIG. 1

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LIFTER MECHANISM WITH HORIZONTALLY EXTENSIBLE JAW-SUPPORTING ARMS

Filed Jan. 16, 1962 7 Sheets-Sheet 2

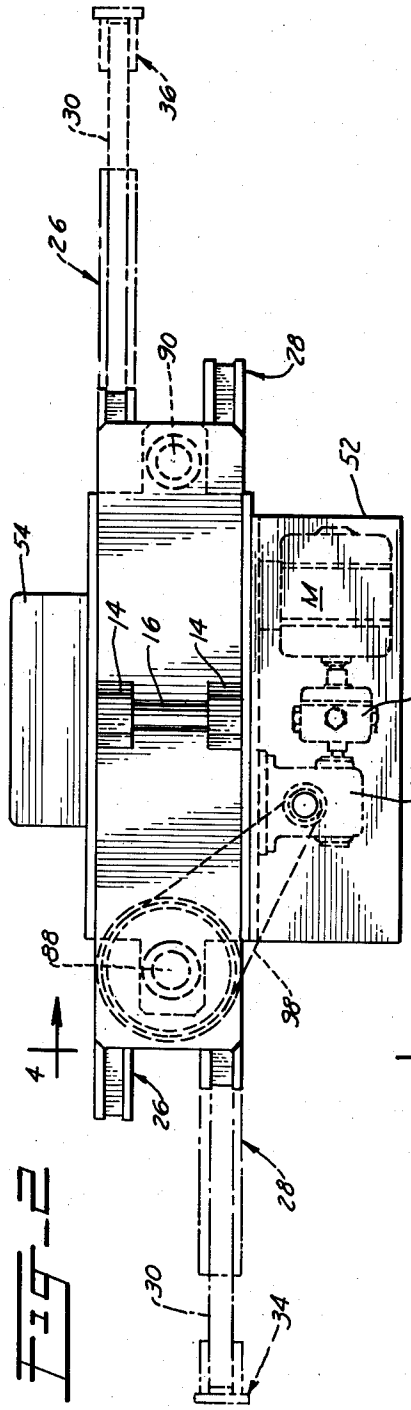


FIG-2

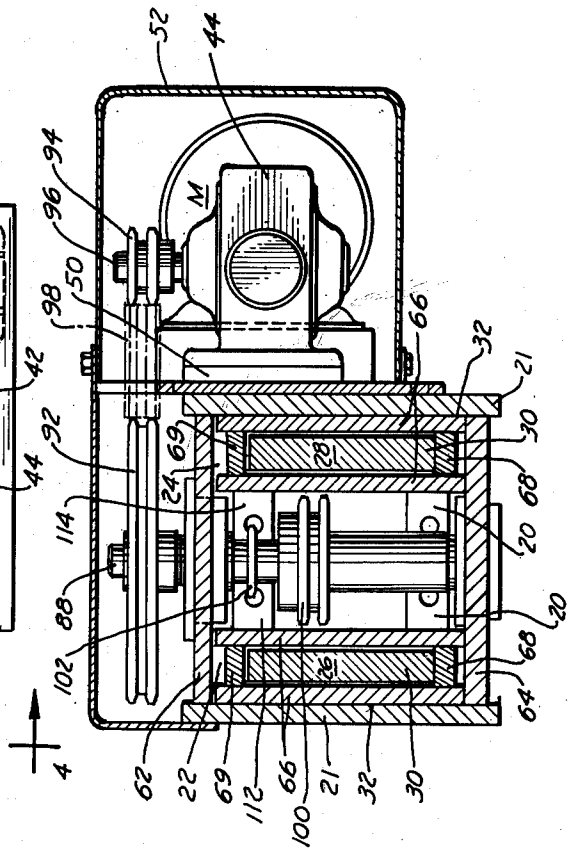


FIG-4

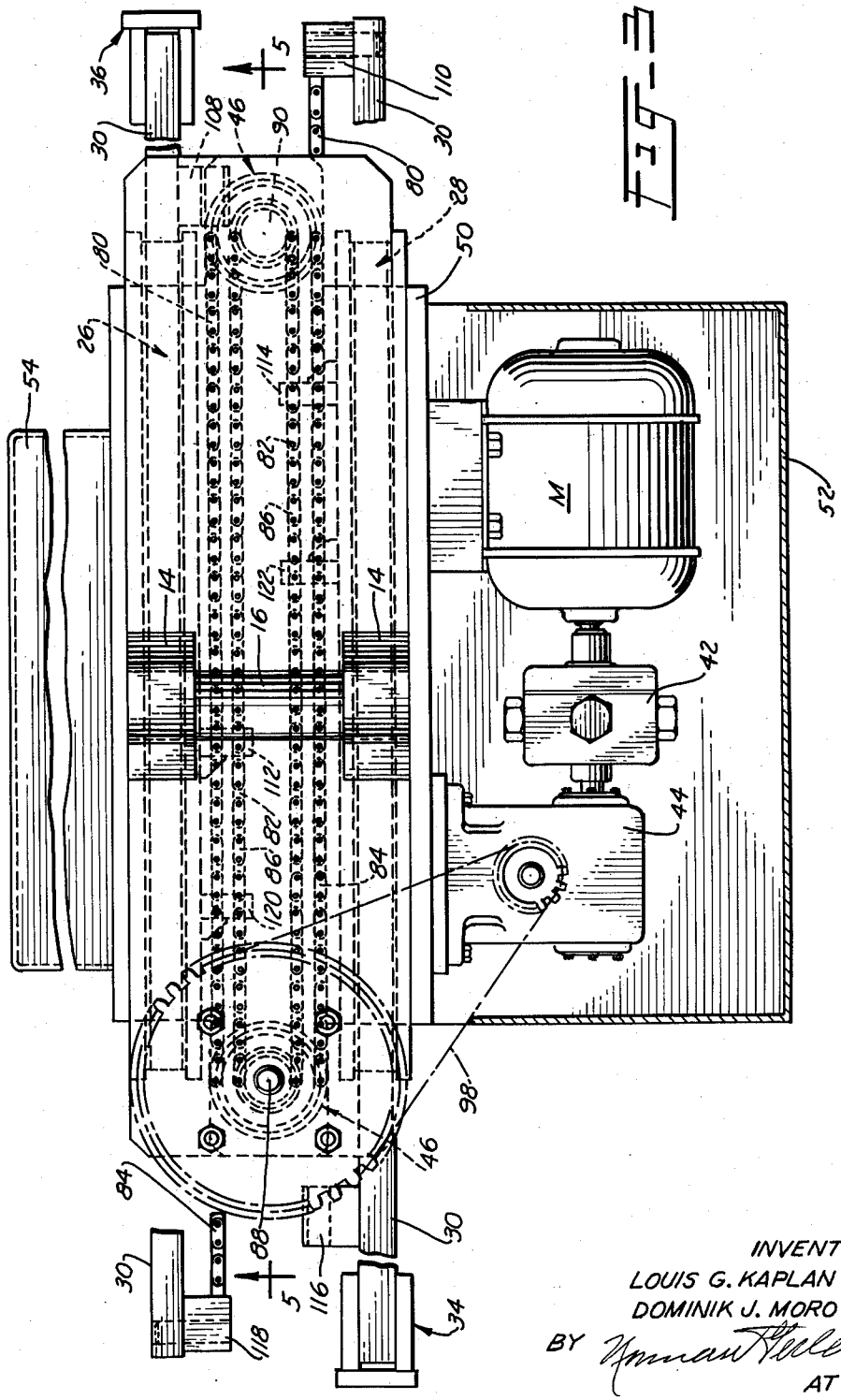
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LIFTER MECHANISM WITH HORIZONTALLY EXTENSIBLE JAW-SUPPORTING ARMS

Filed Jan. 16, 1962 7 Sheets-Sheet 3

FIG. 3



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LIFTER MECHANISM WITH HORIZONTALLY EXTENSIBLE JAW-SUPPORTING ARMS

Filed Jan. 16, 1962 7 Sheets-Sheet 4

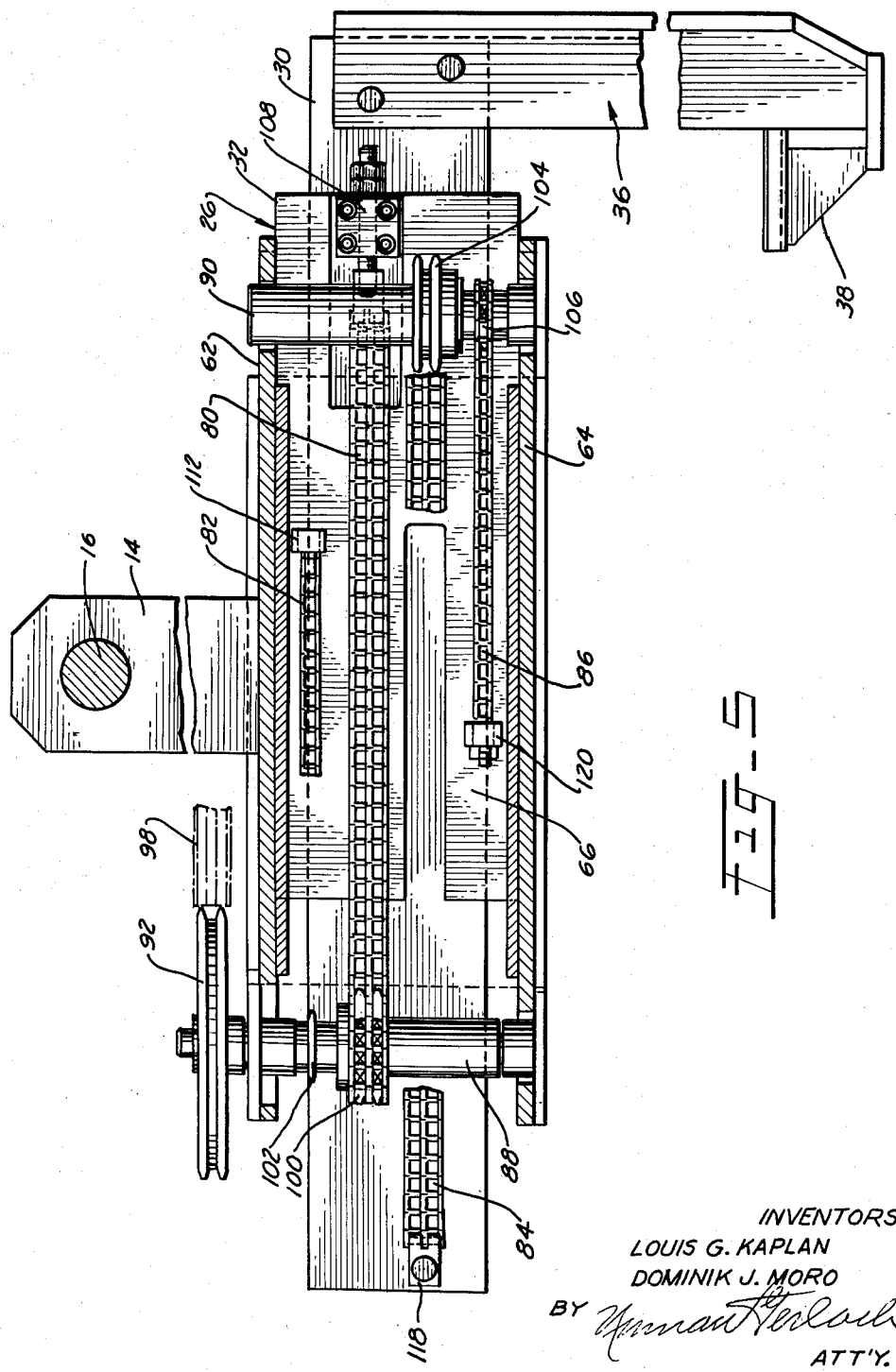


FIG. 5

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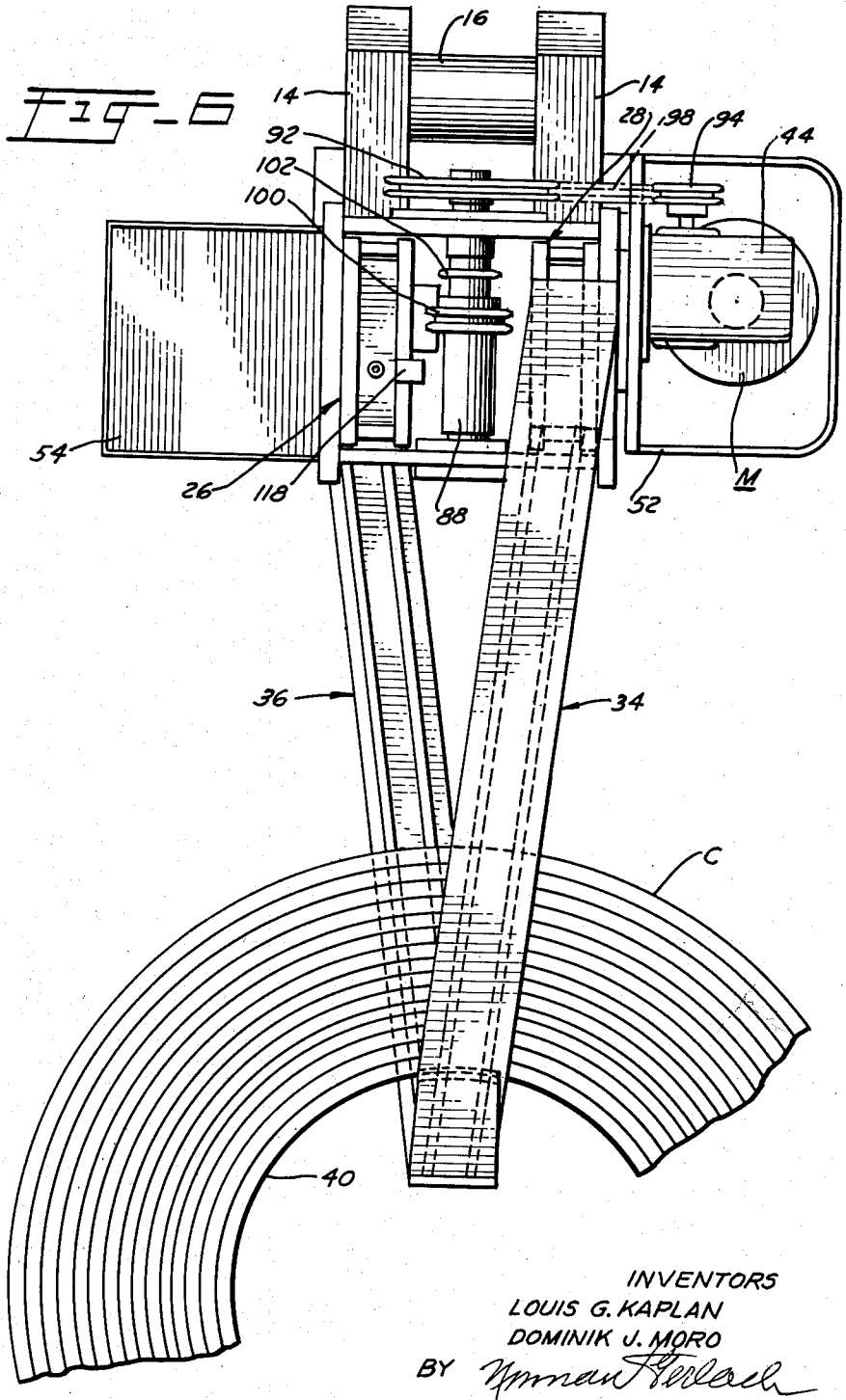
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LIFTER MECHANISM WITH HORIZONTALLY EXTENSIBLE JAW-SUPPORTING ARMS

Filed Jan. 16, 1962

7 Sheets-Sheet 5

Fig. 6



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LIFTER MECHANISM WITH HORIZONTALLY EXTENSIBLE JAW-SUPPORTING ARMS

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7 Sheets-Sheet 6

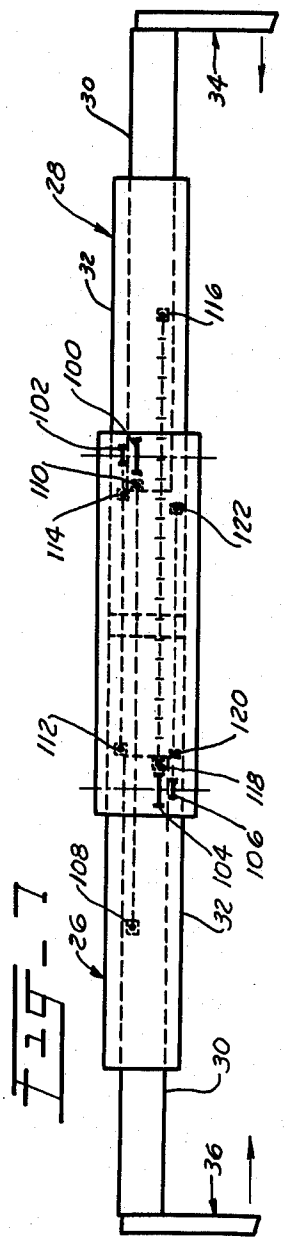


FIG. 7

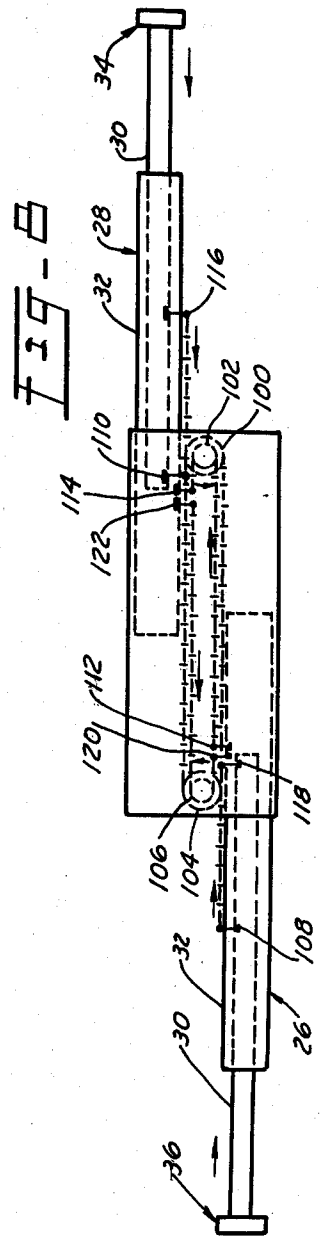


FIG. 8

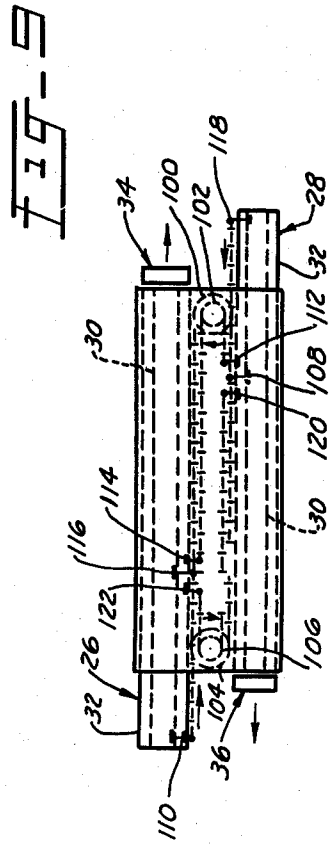


FIG. 9

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LIFTER MECHANISM WITH HORIZONTALLY EXTENSIBLE JAW-SUPPORTING ARMS

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7 Sheets-Sheet 7

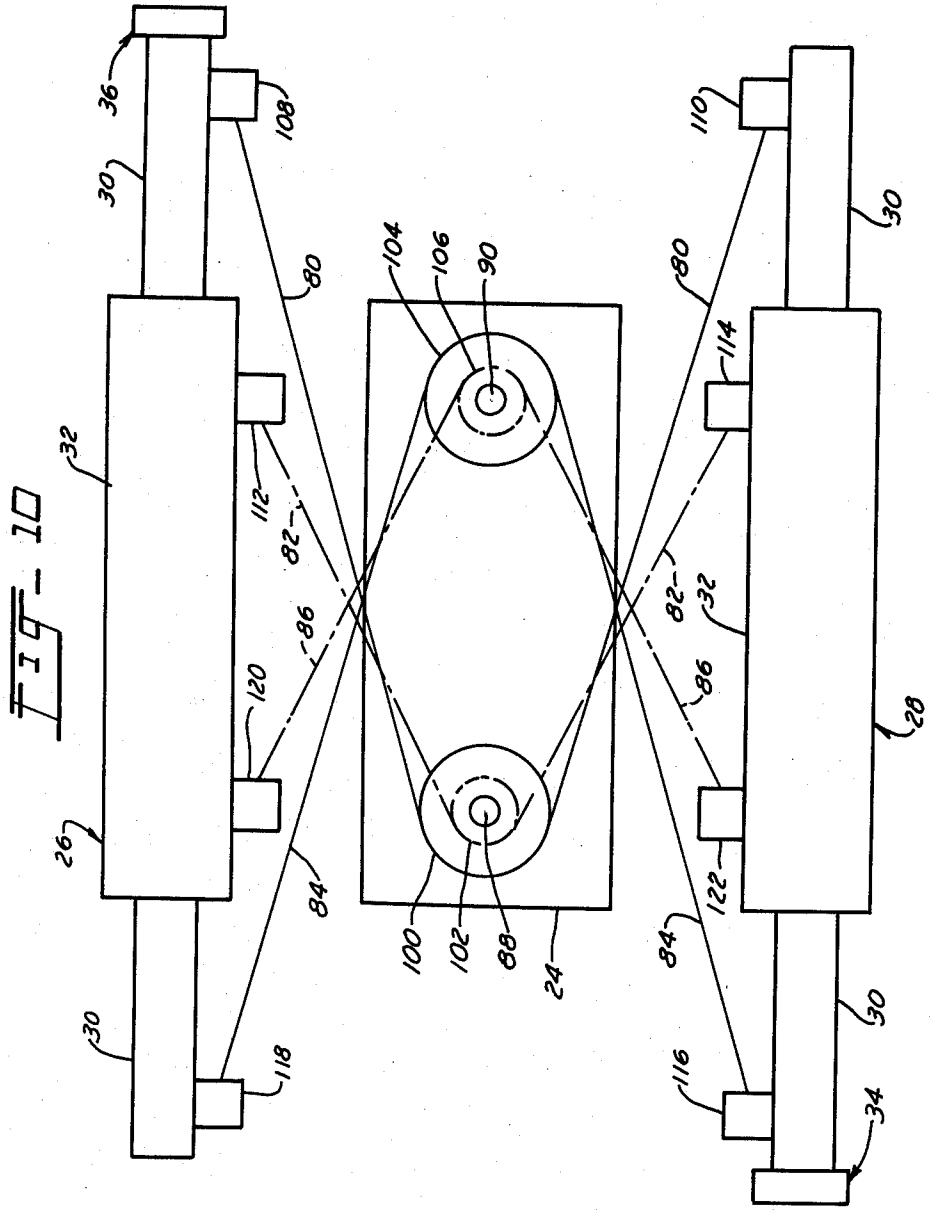


FIG. 10

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United States Patent Office

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LIFTER MECHANISM WITH HORIZONTALLY EXTENSIBLE JAW-SUPPORTING ARMS

Louis G. Kaplan, Evanston, and Dominik J. Moro, Villa Park, Ill., assignors to Cullen-Friestedt Company, Chicago, Ill., a corporation of Delaware

Filed Jan. 16, 1962, Ser. No. 168,011
10 Claims. (Cl. 294—65)

The present invention relates to lifter mechanisms and has particular reference to crane-supported lifters such as are commonly employed for lifting and transporting relatively massive objects, particularly convolute coils of sheet metal stock or stacks of flat sheet metal stock, the character of the work performed by the lifter being dependent upon the character of the jaw structure which is associated therewith. The invention is specifically concerned with a lifter mechanism having horizontally extensible telescopic jaw-supporting arms wherein each jaw proper is carried at the distal end of the inner telescopically slidable section of a composite two-piece telescopically extensible arm structure, such telescopically slidable section being slidable within an outer section which itself is slidable in the lifter framework.

A telescopic lifter mechanism of the aforementioned character makes possible a greater jaw spread than can be attained by the use of one-piece arm structures without increasing the over-all size of the lifter when the jaws are in their collapsed or closed positions. Additionally, increased lifting capacity for any given degree of jaw spread is attained due to the fact that the telescopic jaw sections provide mutual reinforcement for one another.

In the operation of a lifter, of the type under consideration, it has heretofore been the practice positively to drive the inside jaw section of the two composite jaw-supporting arms in timed relation to each other so that these two sections move toward and away from each other with equal relation to the lifter body or framework both as to speed of travel and amplitude of displacement. At such time as the inner sections assume their fully extended positions with respect to the outer surrounding sections, an abutment on each inner section engages a cooperating abutment or shoulder on the adjacent outer section so that this latter section will slide on the lifter framework and move toward its fully extended positions under the motivating influence of the inner section. Stated otherwise, the outside telescopic sections are floatingly and slidingly carried on the lifter framework for independent shifting movement between their respective advanced and retracted positions while the inside sections, which are telescopically slidable within the outside sections, are positively driven in opposite directions. At such time as the inside sections are fully extended relative to the outside sections, the latter sections become movable under the influence of the moving outside sections until such time as both sections become fully extended. At this time, the lifter jaws on the distal ends of the outside sections are in their fully extended or open positions.

In the operation of a lifter assembly or mechanism of this general character, it frequently happens that, due to the inequality of the frictional forces exerted by the inner sections on their respective outer sections during initial driving of the inner sections, one of the surrounding outer sections will slide in the lifter framework and move in unison with the inner section prior to the time that the abutment on such inner section engages the shoulder on such outer section. Such premature movement of the outer section may take place at the very outset of jaw-opening movements or it may take place

at any intermediate point prior to the time that the inner section has become fully extended with respect to the outer section which surrounds it. If the other outer section is not similarly prematurely moved toward its extended position, a disparity in weight on opposite sides of the lifter will result in a condition of unbalance wherein the crane-supported lifter will tilt in one direction or the other away from its normal horizontal position of equilibrium. This makes it difficult, if not impossible, for the operator to continue controlled operation of the lifter mechanism and, before the lifter can be brought into proper lifting register with a coil or a stack of sheets to be lifted, it is necessary selectively to manipulate the various lifter parts to bring the assembly into a condition of balance where the lifter jaws are at the same height. The unbalancing of a lifter of this type is not only inconvenient, but may constitute a hazard to persons and property inasmuch as when outward shifting of one outer jaw-supporting section takes place at the beginning of a jaw-spreading operation, the forces which impel such undesired shifting of the outer section are cumulative due to the rapid increase in the angle of repose of the lifter body augmented by a rapid increase in the moment of torque constantly being applied to the lifter body. A lifter of the character or type under consideration is thus likely to make sudden and unexpected gyrations and strike adjacent objects or persons with consequenf damage thereto or to the lifter assembly itself.

The lifter mechanism of the present invention is designed to overcome the above-noted limitations that are attendant upon the construction and use of conventional telescopic lifters and, toward this end, the invention contemplates the provision of a novel means for simultaneously and positively driving both the inner and outer sections of the composite jaw-supporting arms in unison, the rate of travel of the various sections being individually uniform and commensurate with the respective distances which must be bridged by the individual sections as they move between their fully retracted and their fully extended positions. The rate of travel of the inner sections will, therefore, be greater than the rate of travel of the outer sections, the difference in speed being such that both the inner and the outer sections will arrive at their fully extended positions simultaneously despite the difference in the distances involved.

The objects of the invention are manifold and principal among them is the provision of a novel driving mechanism for the jaw-supporting arms of a telescopic type lifter mechanism, such driving mechanism serving to effect uniform motion to the various jaw-supporting arms but at the desired proportional speeds, the mechanism being of a simplified character and involving fewer and less expensive parts than has heretofore been possible in connection with the driving mechanism for conventional telescopic type lifter assemblies.

In carrying out this object of the invention, it is contemplated that the two inner jaw-supporting arm sections which are capable of a relatively large amplitude of displacement be operatively connected together for movement in unison but in opposite directions by means of a flexible connector, preferably in the form of a chain which passes over a sprocket of large diameter; that the two outer jaw-supporting arm sections which are capable of a relatively small amplitude of displacement be similarly connected together for movement in unison and in opposite directions by a chain which passes over a sprocket of small diameter; that the two sprockets be fixedly mounted on a common drive shaft; and that the drive shaft be operatively connected in driven relationship to a reversible electric motor. The disposition of the interconnected sprockets and the manner in which the chains are looped over such sprockets are such that rotation

of the drive shaft in one direction will tend to extend both arm sections of one pair, and that rotation of the drive shaft in the other direction will tend to retract both arm sections of the other pair. In order that the extensible and retractible movements of the pairs of arm sections thus extended and retracted shall be transmitted to the counterpart pairs of arm sections, the invention further contemplates that the two inner jaw-supporting arm sections to be operatively connected together for movement in unison but in opposite directions by means of an additional chain which passes over an idler sprocket of large diameter; that the two outer jaw-supporting arm sections similarly be connected together for movement in unison and in opposite directions by a chain which passes over an idler sprocket of small diameter; and that these latter sprockets be so disposed and the chains looped thereover in such a manner that, in combination with the first mentioned two connecting chains, complete movement in unison of the respective inner and outer arm sections of each pair in either direction, but at the required rates of travel, will be effected. Stated otherwise, as the large drive sprocket operates to extend the one inner arm section of which it is capable of extending, the large idler sprocket will operate to extend the other or counterpart inner arm section. As this large drive sprocket operates to retract the one inner arm section of which it is capable of retracting, the large idler sprocket will operate to retract the other or counterpart inner arm section. As the small drive sprocket operates to extend the one outer arm section of which it is capable of extending, the small idler sprocket will operate to extend the other or counterpart outer arm section. As the small drive sprocket operates to retract the one outer arm section of which it is capable of retracting, the small idler sprocket will operate to retract the other or counterpart outer arm section. The two sets of chains thus, in effect, function as closed chain loops to which the inner and outer pairs of counterpart arm sections are connected so that as the loops shift so as to move the individual chain links endwise, movement of any one jaw-supporting arm section in either direction will be accompanied by a similar movement of the other or counterpart arm section.

By a driving arrangement of the character outlined above, many advantages accrue, one important advantage being that positive dual drives to both pairs of telescopic arm sections from the electric motor are not necessary, a single drive to one pair of arm sections through the media of the drive chains serving to effect movement of the other or counterpart arm sections through the media of the idler chains. Another advantage of such a construction resides in the fact that in the event the lifter becomes jammed as, for example, when the jaws become wedged between adjacent fixed objects during jaw opening movements, and as a consequence chain breakage occurs, it is a comparatively simple and inexpensive matter to replace a chain link to restore the chain drive, such a procedure being far less costly than the replacement of a gear, pinion or a rack when a tooth becomes broken, as becomes necessary in connection with conventional lifter drive mechanisms.

Yet another advantage that accrues from the use of the chain drive mechanism of the present invention resides in the convenient manner in which the entire drive mechanism may be positioned and installed upon the lifter framework, fewer parts and a judicious arrangement thereof contributing toward a drive mechanism which consumes but little space on the framework, which does not add materially to the over-all weight of the lifter, and which requires fewer mountings, such as brackets, supports, bearings and the like.

The provision of a lifter drive mechanism which is comprised of a minimum number of parts, particularly moving parts, and which, therefore, is unlikely to get out of order; one in which the various parts thereof are conveniently accessible for purposes of inspection of parts, replacement or repair thereof; one which is rugged and durable and which, therefore, will withstand rough usage; one which, in the manufacture thereof, involves a minimum of special machining operations; one which is smooth and silent in its operation, and one which, otherwise, is well adapted to perform the services required of it, are further desirable features which have been borne in mind in the production and development of the present invention.

Numerous other objects and advantages of the invention not at this time enumerated, will become more readily apparent as the following description ensues.

In the accompanying seven sheets of drawings forming a part of this specification, one illustrative embodiment of the invention has been shown.

In these drawings:

FIG. 1 is a side elevational view, partly in section of a lifter assembly constructed in accordance with the principles of the present invention;

FIG. 2 is a top plan view of the lifter assembly of FIG. 1;

FIG. 3 is an enlarged top plan view, partly in section, of the assembly of FIG. 1;

FIG. 4 is an enlarged sectional view taken on the line 4—4 of FIG. 2;

FIG. 5 is a sectional view taken on the line 5—5 of FIG. 3;

FIG. 6 is an enlarged end elevational view of the improved lifter assembly or mechanism;

FIG. 7 is a side elevational view, schematic in its representation, illustrating the nature of certain chain and sprocket drive mechanism employed in connection with the present invention;

FIG. 8 is a top plan view of the schematic representation of FIG. 7 with the lifter jaws in a position of maximum jaw opening;

FIG. 9 is a top plan view similar to FIG. 8 but with the lifter jaws in a position of minimum jaw opening; and

FIG. 10 is a schematic view illustrating purely in diagrammatic fashion the chain and sprocket arrangement of FIGS. 4 to 6 inclusive.

Referring now to the drawings in detail and in particular to FIGS. 1 and 2, a lifter assembly constructed according to the present invention has been designated in its entirety by the reference numeral **10**. The lifter assembly as illustrated herein is designed for use in engaging, lifting and transporting relatively massive objects, such as the involutely wound coil C of sheet metal stock fragmentarily shown in FIGS. 1 and 6. Briefly, the lifter assembly **10** involves in its general organization a lifter body or framework **12** of generally open-ended box-like design and including a pair of spaced, upstanding suspension posts **14** across which there extends a bail or lift pin **16**, the latter being designed for lifting engagement with the lifting hook **18** associated with a conventional lifting crane or the like (not shown) and by means of which the lifter assembly or mechanism may be operatively lifted and transported bodily during normal operation.

The box-like framework **12**, as best seen in FIG. 4, includes two pairs of guide rails **20** which, in combination with the side members **21** of the framework **12**, establish two spaced apart, parallel, longitudinally extending guideways **22** and **24**, within which guideways there are slidable two pairs of composite extensible and contractible telescopic jaw-supporting arm assemblies **26** and **28**, respectively. As best seen in FIGS. 1 and 2, the telescopic jaw-supporting arm assembly **26** is capable of being extended outwardly of the framework **12** to the left, while the telescopic jaw-supporting arm assembly **28** is capable of being extended outwardly of the framework to the right.

Each assembly **26** and **28** includes an inner arm section **30** and an outer tubular arm section **32**, the former

section being telescopically slidable within the latter section and the latter section being itself slidable within one of the open-ended guideways **22** or **24**, as the case may be. The distal end of each inner arm section **30** carries a depending jaw assembly, the two jaw assemblies being designated at **34** and **36**, respectively.

The jaw assemblies **34** and **36** are of more or less conventional construction and each assembly includes a lower foot portion **38** which, when the two jaw assemblies are closed about a coil, such as the coil C of FIG. 1, is adapted to enter the central bore or opening **40** which extends through the coil so that these foot portions will underlie the upper regions of the coil rim for coil-lifting purposes when the lifter assembly as a whole, is elevated bodily.

When the jaw assemblies **34** and **36** are in their fully closed or retracted positions, the outer arm sections **32** are substantially encompassed by the guideways **22** and **24** which surround them and in which they are telescopically and axially slidable, while the inner arm sections **30** are substantially encompassed by the outer tubular sections **32** associated therewith so that the various parts assume their full line positions shown in FIGS. 1 and 2. In the advanced or open position of the jaw assemblies **34** and **36**, the outer arm sections are projected outwardly of the guideways **22** and **24** in which they are slidable and the inner arm sections are projected outwardly of both the guideways and of the outer arm sections with which they are associated. Stated in other words, the guideways **22** and **24**, the outer arm sections **32**, and the inner arm sections **30**, constitute three-part telescopic members which are capable of extensible and contractible movements as briefly outlined above.

According to the present invention, means are provided for positively effecting sliding movement of both the inner and outer arm sections of each arm assembly **26** and **28** in such a manner that the inner arm section moves uniformly between its fully retracted position and its fully extended position, while the outer arm section likewise moves uniformly between the two extreme positions of which it is capable of assuming. Since the inner arm sections are possessed of a greater amplitude of displacement than the outer arm sections, the uniform movements of the outer and inner sections must necessarily be at different rates of driving speed. Movement of the various arm sections is effected under the control of an electric motor M which is operatively connected through a torque limiting slip clutch assembly **42** and gear reduction device **44** to a series of chain and sprocket driving connections which, collectively, have been designated in their entirety at **46** and the nature and function of which will be described presently. These chain and sprocket driving connections constitute one of the principal features of the present invention.

The motor M, slip clutch assembly **42** and gear reduction device **44** are operatively disposed on a mounting plate **50** associated with the machine framework and are enclosed within a suitable housing or guard **52** on one side of the machine framework. On the other side of the framework **12**, there is provided a counterweight box **54** by means of which the weight of the driving instrumentalities may be equalized to prevent undue tilting of the apparatus during actual operation thereof and during such time as the same is elevated from the supporting surface.

As best seen in FIG. 4, the framework **12** of the apparatus includes the previously mentioned side plates **21**, an upper or top plate **62** and a bottom plate **64**, the four plates providing a closed generally tubular structure. The upstanding suspension posts **14** are welded to the side and top plates **21** and **62**. The outer arm sections **32** include spaced, vertical side plates **66** which are bridged by transverse horizontal lower plates **68** a slight distance above the lower edges thereof, and by upper plates **69** a slight distance below the upper edges thereof. The inner arm sections **30** may be in the form of solid elongated bars which slide telescopically within the closed tubular structure afforded by the plates **66**, **68** and **69**.

The sliding movements of the inner and outer arm sections **30** and **32** of the jaw-supporting arm assemblies **26** and **28** are effected under the control of the motor M operating through the previously mentioned chain and sprocket driving connections **46**. These driving connections appear variously through the several views of the drawings but they are best seen in the schematic representations of FIGS. 7, 8 and 9. The driving connections include a series of four flexible chains and two sprocket shafts, the chains being designated at **80**, **82**, **84** and **86**, and the shafts being designated at **88** and **90** (see also FIG. 5).

The two shafts **88** and **90** are rotatably mounted at their ends in the upper and lower plates **62** and **64** of the framework **12** and they extend vertically at spaced regions adjacent the opposite ends of the framework and between the two arm assemblies **26** and **28** (see FIG. 4). The shaft **88** is a driven shaft, while the shaft **90** is an idler shaft. The driving connection for the driven shaft **88** comprises a dual driven sprocket **92** carried by the shaft outside of the tubular framework, a dual driving sprocket **94** carried at the end of the output shaft **96** of the gear reduction device **44**, and a dual chain **98** which passes over the sprockets **92** and **94**.

Referring now to FIGS. 1 and 5, the driven shaft **88** has mounted thereon a lower dual sprocket **100** of large diameter and an upper single sprocket **102** of small diameter. The idler shaft **90** similarly has mounted thereon an upper dual sprocket **104** of large diameter and a lower single sprocket **106** of small diameter. The chain **80** is a comparatively wide chain and it passes around the large lower dual sprocket **100**, has one end anchored as at **108** (see FIGS. 7 to 10 inclusive) to the inner telescopic arm section **30** of the arm assembly **26** adjacent the jaw-carrying end thereof, and has its other end anchored as at **110** to the inner telescopic arm section **30** of the arm assembly **28** adjacent the end which is remote from the jaw-carrying end thereof. The chain **82** is a comparatively narrow chain and it passes around the small upper single sprocket **102**, has one end thereof anchored as at **112** to the outer telescopic arm section **32** of the arm assembly **26**, and has its other end anchored as at **114** to the outer telescopic arm section **32** of the arm assembly **28**.

The chain **84** is a comparatively wide chain and it passes around the large upper dual sprocket **104**, has one end thereof anchored as at **116** to the inner telescopic arm section **30** of the arm assembly **28** adjacent the jaw-carrying end thereof, and has its other end anchored as at **118** to the inner arm section **30** of the arm assembly **26** adjacent the end which is remote from the jaw-carrying end. The chain **86** is a comparatively narrow chain and it passes around the small lower single sprocket **106**, has one end thereof anchored as at **120** to the outer telescopic arm section **32** of the arm assembly **26**, and has its other end anchored as at **122** to the outer telescopic arm section **32** of the arm assembly **28**.

The representation of the chain and sprocket driving connections **46** which has been made in FIG. 10 is to a large degree schematic but it best illustrates the positional relationship of the four chains **80**, **82**, **84** and **86** with respect to their respective sprockets **100**, **102**, **104** and **106**, and shafts **88** and **90**. The labelling of FIG. 10 supplies the third dimension of an otherwise two dimensional view and obviates the necessity of providing a detailed three dimensional perspective disclosure of the chain and sprocket driving mechanism **46**. It will be seen from an inspection of this view that the two inner jaw-supporting arm sections **30** which have the largest amplitude of horizontal displacement in moving between their advanced and retracted positions are driven by the large diameter dual sprockets **100** and **104** which occupy

positions at intermediate sprocket levels in the driving assembly. The two outer jaw-supporting arm sections 32, which have displacements of approximately one-half the displacement of the inner arm sections 30, are driven by the small diameter single sprockets 102 and 106 which occupy positions at the uppermost and lowermost sprocket levels, respectively, of the assembly. It will also be observed that, by reason of the fact that the two inner arm sections 30 of the arm assemblies 26 and 28 are connected together by a fixed chain length 80 with the chain passing around a pulley 100 and being maintained taut thereby, the two arm sections are connected together for movements in opposite directions and in see-saw fashion, so to speak, when reaction forces are applied to the arms tending to move them to the right as viewed in FIG. 10. These two inner arm sections 30 are also connected together for movements in opposite directions and in see-saw fashion by the chain 84 which passes around the pulley 104 when reaction forces are applied to the arm sections tending to move them to the left as viewed in this figure. Thus a movement of either arm section in one direction will result in a corresponding movement of the other arm section in the opposite direction.

The two outer arm sections 32 of the two assemblies 26 and 28 are similarly connected together in see-saw fashion by reason of the chains 82 and 86 associated therewith, connected thereto, and passing around the small sprockets 102 and 106, respectively.

In the various views of the drawings, only such instrumentalities as are pertinent to the present invention have been illustrated. It will be understood that various auxiliary functional operating instrumentalities may be incorporated in the lifter assembly 10 as, for example, suitable control mechanism for the reversible motor M, limit switches and electrical circuitry therefor whereby the operation of the motor may be terminated when the jaws 34 and 36 reach their limiting positions, or when they encounter an obstruction. Irrespective, however, of such auxiliary details, the essential features of the invention are at all times preserved.

In the operation of the lifter assembly 10 described above, assuming that the lifter jaw assemblies 34 and 36 are in their contracted or closed positions, as shown in full lines in FIG. 1, in order to operatively engage a coil such as the coil C shown in this view and in FIG. 6, it is necessary that the jaws 34 and 36 be spread apart or opened to such an extent that the foot portions 38 of the jaws will clear the ends or rims of the coil. Accordingly, the motor M will be operated in a direction to effect extension of the telescopic sections of the jaw-supporting arm assemblies 26 and 28. It will be understood, of course, that, in connection with lifter mechanism of this general character, the motor M will have associated therewith suitable control circuitry whereby the same may be started or stopped at will, or actuated in either direction, as desired. No such control mechanism for the motor M has been illustrated herein, but one such mechanism suitable for use in connection with the present apparatus has been shown and described in a copending application of Louis G. Kaplan, Serial No. 796,506, filed on March 2, 1959 and entitled, "Control Mechanism for Electrically Operated Lifters."

As shown in FIGS. 1 and 9, in the retracted positions of the two telescopic jaw-supporting arm assemblies 36 and 38, the distal jaw-supporting ends of the various arm sections are substantially retracted within the confines of the tubular framework 12 while the proximate ends of these arm sections project outwardly beyond the confines of the framework. In the extended positions of these assemblies, the proximate ends of the arm sections are withdrawn into the confines of the framework while the distal ends thereof are projected outwardly from the framework.

In initially extending the various arm sections for coil-clearance purposes, as mentioned above, the motor M is energized so that torque is applied to the driven shaft 88 so as to rotate the same in a clockwise direction, as viewed in FIG. 10, for example, thus constraining the two sprockets 100 and 102 to turn in the same direction. The effective circumferential extent of the small sprocket 102 in the upper region of the shaft 88 is commensurate with the amplitude of displacement or "throw" of the outer arm sections 32 of the two jaw-supporting assemblies 26 and 28, while the effective circumferential extent of the large sprocket 100 in the lower regions of the shaft 88 is commensurate with the amplitude of displacement or "throw" of the inner arm sections 30 of these assemblies. Thus, if, for purposes of illustration, the throw of the inner arm sections 30 is twice the throw of the outer arm sections 32, then the diameter of the large sprocket 100 will be twice the diameter of the small sprocket 102. Turning of the sprocket 102 in a clockwise direction, as stated above, will apply tension to the portion of the chain 82 which leads from the anchor point 114 so that the outer arm section, section 32, of the jaw-supporting assembly 28 will be drawn to the left as viewed in FIG. 10. Similarly, turning of the sprocket 100 in a clockwise direction will apply tension to the portion of the chain 80 leading from the anchor point 110 so that the inner arm section 30 of the jaw-supporting assembly 28 will also be drawn to the left. The rate of travel of the arm section 30 will be twice the rate of travel of the outer arm section 32. The two arm sections 30 and 32 will thus be impelled toward their fully extended positions.

Due to the flexibility of the chains 82 and 86, clockwise turning movement of the driven shaft 88 and sprockets 100 and 102 in a clockwise direction will have no direct effect upon the movements of the arm sections 30 and 32 of the jaw-supporting assembly 26, the tendency being merely to place slack in the portions of the chains 82 and 80 which extend from the anchor points 108 and 112. However, the positive movement of the arm sections 30 and 32 associated with the jaw-supporting assembly 28 to the left will cause the two chains 84 and 86 to be placed under tension around their respective sprockets 106 and 104, thus drawing both the inner arm 30 and the outer arm 32 of the jaw-supporting assembly 26 to the right and toward their fully extended positions, the idler shaft 90 yielding to the movements of the chains and thus rotating in a clockwise direction.

After the various arms 30 and 32 have been thus moved to their fully extended positions, or after they have been moved to at least such an extent that the two opposed jaws 34 and 36 are sufficiently spaced as to clear the end faces of the coil C to be engaged therebetween, the direction of rotation of the motor M may be reversed so as to contract the jaws and cause them to engage the coil C therebetween. The operation of the various chains 80, 82, 84 and 86, and of their respective sprockets 100, 102, 104 and 106, in retracting the arm sections 30 and 32 is the reverse of that described in connection with the extension of these arm sections and, consequently, need not be described in detail, suffice it to say that the sprockets 100 and 102 and shaft 88 will turn in a counterclockwise direction as viewed in FIG. 1, as will also the sprockets 104 and 106 and shaft 90.

From the above description, it will be apparent that the positions of the two outer arm sections 32 will, at any time during the operation of the lifter mechanism, be a function of the positions of the inner arm sections. Thus, positive partial extension of the inner arm sections has been attained. At such time as the inner arm sections attain their fully extended positions, the outer arm sections will be only partially extended from the tubular guideways 22 and 24, albeit they will be ex-

tended to the fullest extent to which they are capable of being extended. The outer arm sections will, therefore, lend appreciable reinforcement to the inner sections which they encompass. Moreover, since the extent of movement of both the inner and outer arm sections on opposite sides of a medial plane through the lifter framework is of equal magnitude, but of opposite direction, precise balance of the lifter assembly as a whole will at all times be attained when the lifter is in its free state.

Although only one specific and preferred form of the lifter assembly by means of which the principles of the present invention may be carried out has been illustrated and described herein, it will be understood that this form of the invention does not by any means indicate the only form contemplated. For example, although the invention has been shown and described herein as being operatively applied to an electrically driven lifter construction, it is obvious that, by suitable modification, the same is applicable to hydraulically driven or to hand-powered lifter. The form illustrated herein is only one which has been developed for one specific commercial application of the invention.

The invention, therefore, is not to be limited to the exact details described since these may be modified within the scope of the appended claims without departing from the spirit of the invention.

Having thus described the invention what we claim as new and desire to secure by Letters Patent is:

1. In a lifter of the character described and having a pair of jaw-supporting arms which are extensible for jaw-opening movements and collapsible for jaw-closing movements, in combination, a lifter framework including means whereby the same may be operatively engaged by a crane lifting hook or the like, said framework providing a pair of adjacent parallel longitudinally extending guideways, one for each arm, each arm being slidably disposed in a respective guideway and movable between a retracted position wherein a major portion thereof is disposed within the linear confines of the guideway and an extended position wherein a major portion thereof is projected outwardly beyond the linear confines of the guideway, a jaw carried at the distal end of each arm, a driven traction wheel rotatably mounted on said framework adjacent one end thereof, an idler traction wheel rotatably mounted on said framework adjacent the other end thereof, a first flexible connector having its opposite ends secured to said arms, respectively, and tractionally engaging said driven traction wheel, a second flexible connector having its opposite ends secured to said arms, respectively, and tractionally engaging said idler traction wheel, and means for rotating said driven traction wheel selectively in opposite directions.

2. In a lifter of the character described, the combination set forth in claim 1 and wherein said driven and idler traction wheels are in the form of sprockets, and wherein said flexible connectors are in the form of cooperating chains.

3. In a lifter of the character described, the combination set forth in claim 1 and wherein the flexible connectors are secured to the respective arms at widely longitudinally spaced regions therealong.

4. In a lifter of the character described and having a pair of sectional telescopic jaw-supporting arms which are extensible for jaw-opening movement and collapsible for jaw-closing movements, in combination, a lifter framework including means whereby the same may be operatively engaged by a crane lifting hook or the like, said framework providing a pair of adjacent parallel, longitudinally extending guideways, one for each arm, each arm including an outer arm section slidably disposed in one of said guideways and movable between a retracted position wherein a major portion thereof is disposed within the linear confines of said guideway and an extended position wherein a major portion thereof projects outwardly beyond one end of said guideway, and an inner arm section slidably disposed within and encompassed by said outer arm section and movable between a retracted position wherein it is disposed substantially within the linear confines of the outer arm section and an extended position wherein a major portion thereof is projected outwardly beyond said linear confines, a jaw carried at the distal end of each inner arm section, a first pair of sprockets mounted on said framework at longitudinally spaced regions therealong, a second pair of sprockets mounted on said framework at longitudinally spaced regions therealong, a first flexible chain length having its opposite ends secured to said inner arm sections, respectively, and passing tractionally around one sprocket of the first pair, a second flexible chain length having its opposite ends secured to said inner arm sections, respectively, and passing tractionally around the other sprocket of the first pair, a third flexible chain length having its opposite ends secured to said outer arm sections, respectively, and passing tractionally around one sprocket of the second pair, a fourth flexible chain length having its opposite ends secured to said outer arm sections, respectively, and passing tractionally around the other sprocket of the second pair, and means for rotating said first pair of sprockets in unison selectively in opposite directions.

5. In a lifter of the character described, the combination set forth in claim 4 and wherein the first and second chain lengths have corresponding ends secured to each inner arm section at widely and longitudinally spaced regions therealong, and wherein the third and fourth chain lengths have corresponding ends secured to each outer arm section at widely and longitudinally spaced regions therealong.

6. In a lifter of the character described, the combination set forth in claim 4 and wherein the sprockets of the first pair are of equal diameter, wherein the sprockets of the second pair are of equal diameter, and wherein the diameter of the sprockets of the first pair is greater than the diameter of the sprockets of the second pair.

7. In a lifter of the character described, the combination set forth in claim 4 and wherein the first and second chain lengths have corresponding ends secured to each inner arm section at widely and longitudinally spaced regions therealong, and wherein the third and fourth chain lengths have corresponding ends secured to each outer arm section at widely and longitudinally spaced regions therealong, the sprockets of the first pair being of equal diameter, the sprockets of the second pair being of equal diameter, and the diameter of the sprockets of the first pair being greater than the diameter of the sprockets of the second pair.

8. In a lifter of the character described and having a pair of sectional telescopic jaw-supporting arms which are extensible for jaw-opening movement and collapsible for jaw-closing movements, in combination, an elongated lifter framework including means whereby the same may be operatively engaged by a crane lifting hook or the like, said framework providing a pair of adjacent parallel guideways, one for each arm, each arm including an outer arm section slidably disposed in one of said guideways and movable between a retracted position wherein a major portion thereof is disposed within the linear confines of said guideway and an extended position wherein a major portion thereof projects outwardly beyond one end of said guideway, and an inner arm section slidably disposed within and encompassed by said outer arm section and movable between a retracted position wherein it is disposed substantially within the linear confines of the outer arm section and an extended position wherein a major portion thereof is projected outwardly beyond said linear confines, a jaw carried at the distal end of each inner arm section, a driven shaft rotatably mounted on said framework for rotation about a vertical axis and adjacent one

end of the framework, an idler shaft rotatably mounted on said framework for rotation about a vertical axis and adjacent the other end of the framework, first and second sprockets fixedly mounted on each shaft for rotation in unison therewith, a first flexible chain length having its opposite ends secured to said inner arm sections, respectively, and passing tractionally around the first sprocket of the driven shaft, a second chain length having its opposite ends secured to said inner arm sections, respectively, and passing tractionally around the first sprocket of the idler shaft, a third chain length having its opposite ends secured to said outer arm sections, respectively, and passing tractionally around the second sprocket of the idler shaft, a fourth chain length having its opposite ends secured to said outer arms, respectively, and passing tractionally around the second sprocket of the idler shaft, and means for rotating said driven shaft selectively in opposite directions.

9. In a lifter of the character described, the combination set forth in claim 8 and wherein said first and second

chain lengths have corresponding ends secured to each inner arm section at widely and longitudinally spaced regions therealong, and wherein the third and fourth chain lengths have corresponding ends secured to each outer arm at widely and longitudinally spaced regions therealong.

10. In a lifter of the character described, the combination set forth in claim 8 and wherein the first and second chain lengths have corresponding ends secured to each inner arm section at widely and longitudinally spaced regions therealong, and wherein the third and fourth chain lengths have corresponding ends secured to each outer arm section at widely and longitudinally spaced regions therealong, the sprockets of the first pair being of equal diameter, the sprockets of the second pair being of equal diameter, and the diameter of the sprockets of the first pair being greater than the diameter of the sprockets of the second pair.

No references cited.