March 14, 1961 R. J. CALHOUN, JR 2,974,995

COIL TILTER

Filed Nov. 20, 1958

4 Sheets-Sheet 1

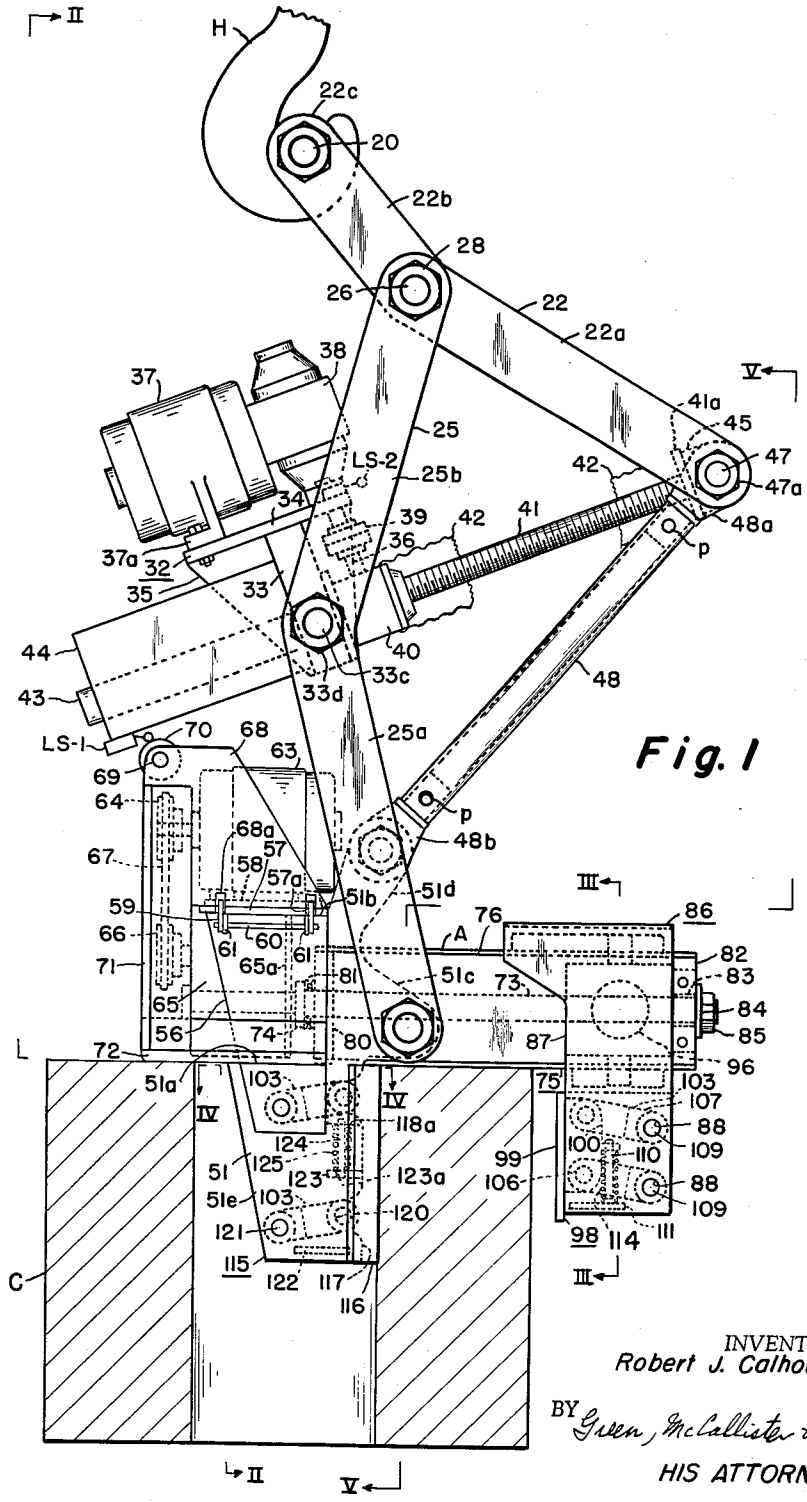


Fig. 1

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4 Sheets-Sheet 2

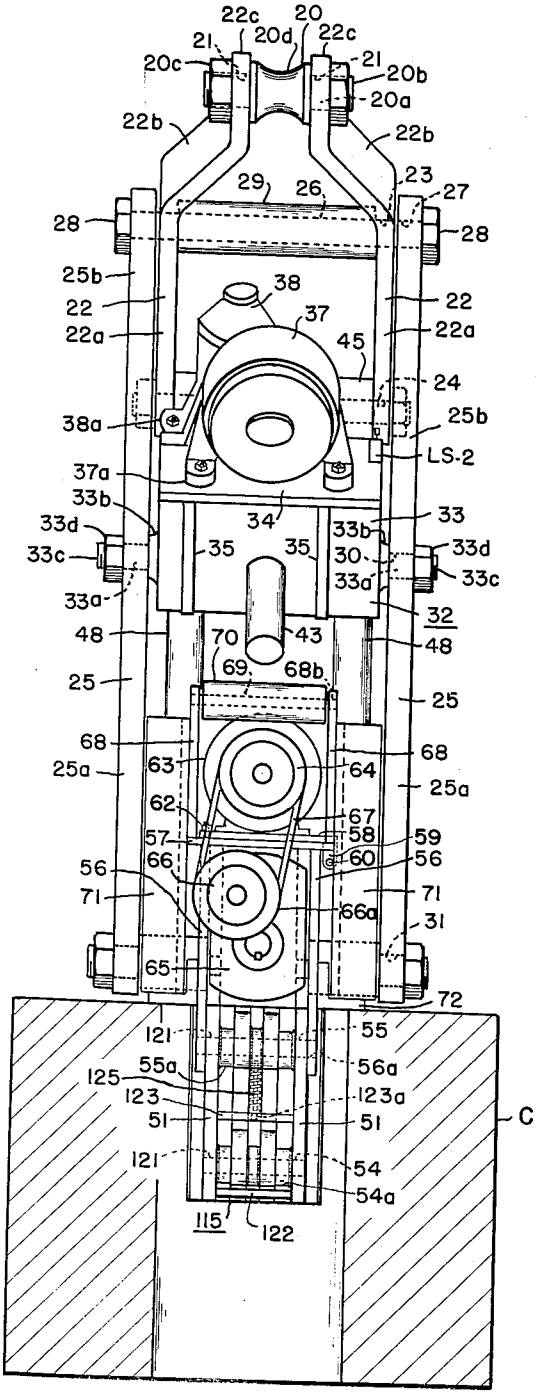


Fig. 2

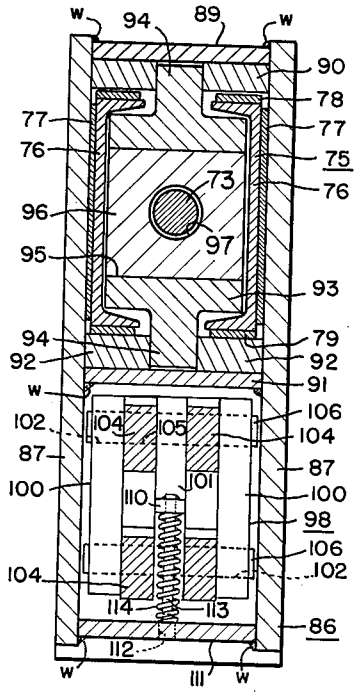


Fig. 3

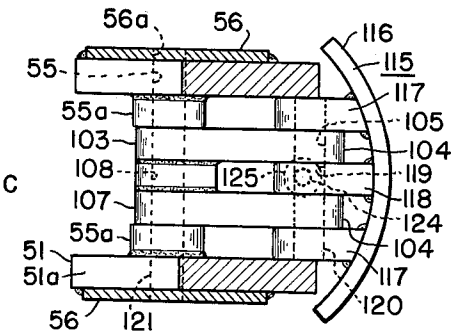


Fig. 4

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COIL TILTER

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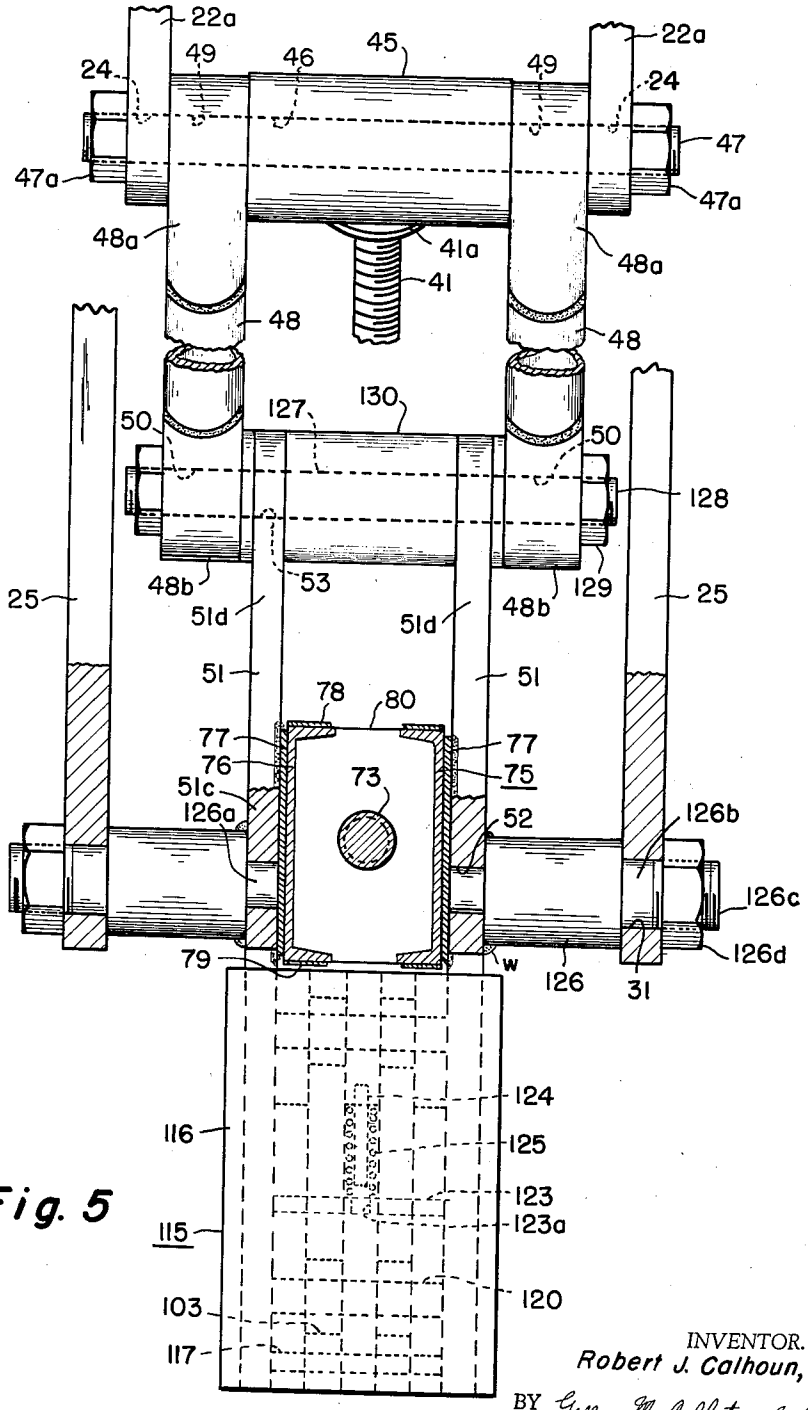


Fig. 5

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COIL TILTER

2,974,995

Filed Nov. 20, 1958

4 Sheets-Sheet 4

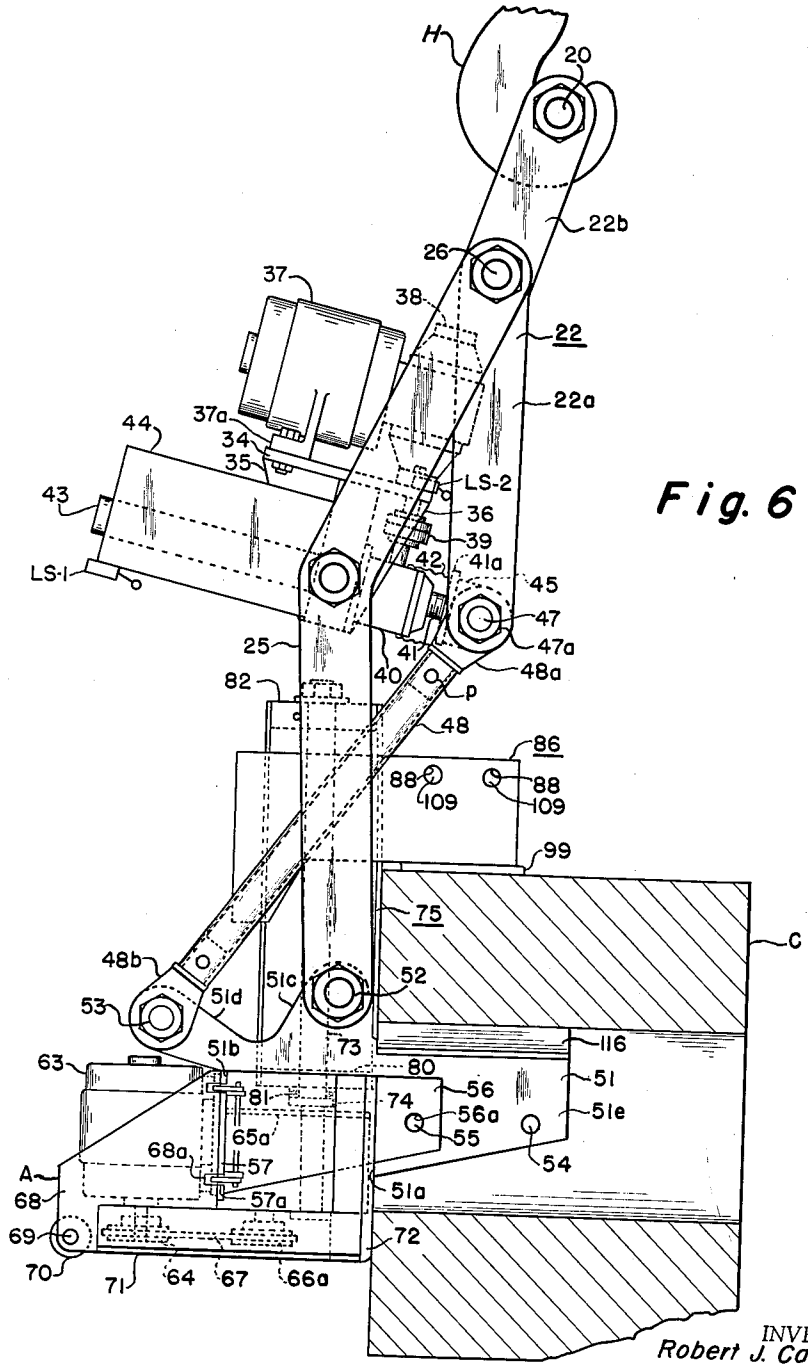


Fig. 6

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2,974,995

COIL TILTER

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Filed Nov. 20, 1958, Ser. No. 775,217

18 Claims. (Cl. 294—103)

This invention relates to an improved apparatus for manipulating work pieces, and particularly to an improved suspension apparatus for lifting and tilting work pieces having a hollow center, such as strip metal coils.

Coil tilters are utilized in transporting finished coils from their place of origin to a storage area, also from the storage area to a shipping station, etc. Finished metal strip is usually wound into coils having their axes in a horizontal position, and accordingly, the nose of the coil tilter is rotated into a horizontal position, in order to project within the center of the coil, so that it may be lifted and transported to a storage area. The coils are then stored with their axes in either a vertical or horizontal position. Since storage area is at a premium, it is important that the coils are stored as close together as possible. I have therefore designed the lifting tong portion of my new apparatus with a minimum of overhang, so that the coils may be placed in close proximity to one another.

Previously known manipulators for metal coils, such as disclosed in the Douglas Patent No. 2,630,931, issued March 10, 1953, necessitate the use of bulky and cumbersome, arc-shaped gear segments or sectors which project outwardly of the nose part and prevent a close stacking of the coils, since a given distance must be maintained between the stacked coils to allow for the outwardly-projecting gear sectors.

A further disadvantage is encountered in the electro magnet type of manipulator. Such manipulators depend upon constant electric power to hold and magnetically grip the coil work pieces through the use of electro magnets. This type of lifting not only is dangerous, since the coil may be released and fall from the manipulator upon the occurrence of an electric power failure, and result in extensive personal injury and property damage, but also, electro magnet lifting limits the use of the coil tilter to metal coils composed of a magnetic material. Thus, these known type of manipulators for metal coils are inoperative for lifting non-metallic coils and metal coils composed of bronze and other non-magnetic metals.

It thus has been an object of my invention to provide a new and improved apparatus for lifting and tilting coils of strip material;

An additional object of my invention has been to provide a suspension type of manipulator for coiled work pieces, having a coil tong assembly rotatable between horizontal and vertical positions by means of a toggle linkage activated by a screw jack assembly;

A further object of my invention has been to devise a more efficient suspension manipulator whose operations are positively motivated and accurately controlled by minimum powered motor means;

A further object of my invention has been to provide a suspension type of manipulator having coil tong shoe assemblies which compressibly clamp onto a coil with a pre-determined compressive force and which provide a gripping mechanism for coil work pieces operable independently of the magnetic properties of the coils;

A still further object of my invention has been to provide a manipulator having a rotatable coil tong assembly provided with inner and outer shoe assemblies having means for wedgeably retaining a coil therebetween;

These and other objects of my invention will appear to those skilled in the art from the following disclosure and drawings in which:

Figure 1 is a side view in elevation of a device or apparatus constructed in accordance with my invention showing how it is suspended from an overhead conveyor, crane or hoist and further, illustrating the positioning of its parts or members when its pick-up means or nose part is in a vertical position for engaging a coil resting with its axis in a vertical position;

Figure 2 is a left end elevation taken along line II—II of the device shown in Figure 1, with motor starter boxes omitted for clarity of illustration;

Figure 3 is an enlarged section in elevation taken along line III—III of Figure 1;

Figure 4 is an enlarged fragmental horizontal view partially in section and taken along line IV—IV of Figure 1;

Figure 5 is an enlarged side elevation partially in section and taken along line V—V of Figure 1 and showing various pivot connections; and,

Figure 6 is a side view in elevation on the scale of and of the device shown in Figure 1, but illustrating the positioning of its parts or members when its pick-up means or nose part is in a horizontal position.

Referring now to the drawings and particularly to Figures 1 and 2, a crane hook H that is suspended from an overhead conveyor, crane or hoist operatively engages clevis shaft or cross pin **20**. The clevis shaft **20** has oppositely disposed journal portions **20***a* projecting through oppositely disposed bores **21** formed in an opposed and spaced-apart pair of rocker arms **22**. The rocker arms **22**, together with the clevis shaft **20** form a clevis for the hook H. The outer ends of the journal portions **20***a* terminate in threaded end portions **20***b* upon which nuts **20***c* are mounted for securing the clevis shaft **20** to the rocker arms **22**. A central concave drum portion **20***d* of the clevis shaft **20** acts as a spacer for the rocker arms **22**.

The rocker arms **22** have parallel opposed lower and outer portions **22***a*, inwardly-upwardly converging portions **22***b*, and parallel opposed upper end portions **22***c*. A bore **23** is formed through an upper end portion of each of the parallel opposed outer portions **22***a*, adjacent portions **22***b*. Rocker arms **22** are bent along their longitudinal lengths about the axis of the bores **23**, so that portions **22***b* and **22***c* form an obtuse angle with portion **22***a* (note Figure 1). The angle of this bend is important for optimum operation, and it is utilized for positioning the hook H substantially above the center of gravity of the coil, so that the coil will hang in a vertical position, when the axis of the coil is vertical and the nose part is in its vertical position, and so that the coil will be maintained in a horizontal position, such that its axis is horizontal, when the nose member is in its horizontal position. The lower end of each portion **22***a* also has a hole or bore **24** formed therethrough.

A pair of parallel, oppositely-disposed trunnion arms **25** are pivotally connected at one end to the rocker arms **22** by means of a pivot pin **26** passing through bores **23** and aligned bores **27** that are formed within upper ends of trunnion arms **25**. Pivot pin **26** is held in place by appropriate means, such as threaded nuts **28**. A spacer pipe or sleeve **29** circumscribes a central portion of the pivot pin **26** between the rocker arms **22** to maintain them in a pre-determined, spaced-apart position.

A bore or hole **30** is formed within each integral trunnion arm **25** intermediate its ends. The trunnion

arms 25 are bent about the axis of the bore 30, so that end portions 25*a* and 25*b* of each arm remain within the same plane and form an obtuse angle therebetween. A pair of bores 31 are formed adjacent the lower end of end portion 25*a* for pivotally mounting a rotatable, motorized coil tong assembly A.

A pivotally mounted trunnion assembly 32 is journaled for rotation within bores 30. The trunnion assembly comprises, a trunnion plate 33 having oppositely-extending journal portions 33*a* that are operatively positioned within the bores 30. The journal portions may be retained within the trunnion arm 25 by appropriate means, such as threaded end portions 33*c* and retaining nuts 33*d*. Spacing bosses 33*b* are provided between the trunnion plate 33 and the trunnion arms 25, thus centering the trunnion plate 33 between the trunnion arms.

A top plate 34 is secured to the trunnion plate 33, as by welding, and is supported by a pair of rear gusset plates 35 and a pair of front gusset plates 36 (see Figures 2 and 6). A reversible electric motor 37 having mounting feet portions 37*a* is shown secured to the top plate 34. A gear reduction or speed reducer 38 having feet mounting portions 38*a* is operatively connected to the electric motor 37 and mounted on top plate 34 adjacent the motor. The output shaft of the speed reducer 38 is provided with a flexible coupling 39 and drives a worm gear jack 40 which is secured to trunnion plate 33. A rotationally stationary jack screw 41 is provided within the worm gear jack for longitudinal movement therewithin. The longitudinal axis of the jack screw 41 is on the center line of the journals 33*a* to avoid binding of the jack screw when the trunnion assembly 32 is pivoted. It is also possible to use a ball bearing nut and screw in place of the standard square or Acme screw and nut usually found in a worm gear jack.

An outer end of the jack screw 41 is provided with a circular disc 41*a* for attaching it to a pivotally operable member, such as a jack bracket. A flexible protector boot 42 (see Figure 6) surrounds the jack screw 41 to keep foreign matter out of the operating threads. A protector cap or pipe end 43 is secured to a back side of the trunnion plate 33 for receiving the jack screw 41 when it is in its retracted position, shown in Figure 6.

A pair of motor starter boxes 44 are secured to rearwardly-extending plates (not shown) that are attached to rear gusset plates 35. A limit switch LS–1 (see Figures 1 and 6) in secured to one of the rearwardly-extending plates to turn-off the worm gear jack drive motor 37 when the coil tilter reaches a pre-determined position, such as when a coil C is positioned in a vertical position, as shown in Figure 1. When the coil tong assembly A is being rotated from a horizontal position, as shown in Figure 6, to a vertical position, as shown in Figure 1, the contact arm of the limit switch LS–1 will contact a roller 70 that forms a part of the assembly A, and will thus de-energize the electric motor 37 and stop the worm gear jack 40 to thereby automatically stop the rotation of the assembly A when the coil C has reached a pre-determined desired vertical position. A second limit switch LS–2 is mounted on top plate 34, and its contact arm will abut an outer portion 22*a* of one of the rocker arms 22 when the coil C reaches a pre-determined horizontal position, as shown in Figure 6, to thus de-energize the electric motor 37 and stop the worm gear jack 40 and thus the rotation of the assembly A, when the rotatable coil tong assembly A is being rotated from the vertical position shown in Figure 1 to the horizontal position shown in Figure 6. Thus, the limit switches provide a safety stop to prevent overtravel of the jack. It is also possible to provide the rotatable coil tong assembly with a mercury switch which will automatically de-energize the motor 37 when the assembly reaches a horizontal position, and thus the mercury switch will automatically stop the rotation of the assembly to balance any width coil which may be acted upon in a horizontal position.

A jack bracket 45 (see Figures 1, 2 and 5), having a semi-cylindrical front portion and a planar back portion is pivotally mounted on a cross pin 47 that extends through a bore 46 within the jack bracket 45 and through the bores 24 of the rocker arms 22. A pair of spaced-apart push rods 48 having upper rod end portions 48*a* that are provided with bores 49 and lower rod end portions 48*b* that are provided with bores 50, are pivotally connected at their upper ends between rocker arms 22 and jack bracket 45 on cross pin 47 that passes through their bores 49. The pin 47 may be secured in place by means of nuts 47*a*. Rod end portions 48*a* and 48*b* may be secured to the rods 48 by means of pins *p* (see Figure 1) and/or by welding (see Figure 5).

The rotatable coil tong assembly a comprises a pair of oppositely-disposed parallel side frame plates 51 that have parallel, spaced-apart, offset surface portions 51*a* and 51*b* adjacent a back edge of the plate (see Figures 1 and 6). Each plate has a pair of angularly disposed projections 51*c* and 51*d* within the plane of and extending forwardly of the plates 51. Each projection 51*c* has a bore 52 (see Figure 6), and each projection 51*d* has a bore 53 for pivotally mounting the assembly A in a manner to be described hereinafter.

A nose portion 51*e*, adjacent the first offset surface portion 51*a*, has aligned bores 54 and 55 (see Figure 6) passing therethrough. Bosses 54*a* and 55*a* are welded on the inside of the plates 51 adjacent the bores 54 and 55, respectively (see Figure 2).

A pair of motor support plates 56 are shown welded to the outside of side frame plates 51 (see Figure 4) and have bores 56*a* in transverse alignment with bores 55 (see Figures 2 and 6). A top plate 57 is welded to motor support plates 56 (see Figure 1). The top plate 57 has a pair of slots 57*a* formed in one edge thereof. A tiltable motor mounting plate 58 is positioned on top of the top plate 57. A pair of lugs 59 are welded to one edge of the tiltable motor mounting plate 58 and extend downwardly through the slots 57*a*. The lugs 59 are pivotable on a pin 60 that is journaled in bearing blocks 61 that are welded to a bottom surface of top plate 57. A pair of screw and nut arrangements 62 provide means for spacing one side of the tiltable motor mounting plate 58 from the top surface of the top plate 57 and thereby pivot the top plate 58 on the lugs 59 about the pin 60.

A reversible electric motor 63 having a sheave or pulley wheel 64 on its drive shaft is mounted on tiltable plate 58 (see Figure 2). A speed reducer 65 having a torque limiter 66 on its input shaft, is mounted beneath the top plate 57 and is supported by a speed reducer mounting plate 65*a* (see Figure 6) that is welded between motor support plates 56. A V-belt 67 operatively connects pulley wheel 64 and a sheave or pulley wheel 66*a* on the torque limiter 66. Tension on the belt 67 is adjusted by tilting the tiltable mounting plate 58 by means of the screw and nut arrangements 62 (see also Figure 2).

A pair of motor side plates 68 are welded to project upwardly from the top plate 57 (see Figure 2). The side plate adjacent the lugs 59 is provided with slots 68*a* (see Figure 6), so that the lugs 59 may pass therethrough. Bores 68*b* are provided adjacent an outer edge of the motor side plates 68 (see Figure 2). A roller shaft 69 is journaled in bores 68*b* and has a cylindrical roller 70 rotatable thereon. The roller 70 projects radially-outwardly past the outer side edges of the motor side plates 68 to protect the side plates and the coil tong assembly A by providing an outwardly-projecting roller contact when the tong assembly is in its horizontal position, as shown in Figure 6. That is to say, should the tong assembly make contact with a horizontal surface, the roller 70 will be the first portion of the tong assembly to make this contact.

A pair of upright angle irons 71 (see Figures 1, 2 and

6) are welded on the outside of the motor side plates **68** to give added strength and rigidity. A pair of horizontal angle irons **72** are welded on the outside of the motor support plates **56** to provide a flat seating surface for the rotatable coil tong assembly A when it is positioned on the top of a coil, as shown in Figure 1.

A screw-type shoe drive shaft **73** is connected to the output of the speed reducer **65** (see Figure 6). The screw shaft has a radial flange **74** that projects outwardly intermediate its ends. A rectangular, longitudinally-extending shoe drive shaft frame **75** is welded to inside surfaces of the parallel, oppositely-disposed side frame plates **51** and extends forwardly thereof. The shoe drive shaft frame **75** comprises a pair of longitudinally-extending channel members **76** (see Figure 5) having side wear plates **77**, top wear plates **78**, and bottom wear plates **79** welded to the channel member (see also Figure 3).

An end plate **80** (see Figures 1 and 5) that is provided with bearings for the screw drive shaft **73**, is secured to one end of the channel members **76**. Thrust bearings **81** (see Figure 1) are provided between the radial flange **74** and the end plate **80** to eliminate longitudinal thrust in the speed reducer **65**. An end block **82** is bolted to the channel members **76** at the opposite end from the end plate **80**. The end block **82** is provided with bushings **83** for the end portion of the screw shaft **73**. The screw shaft **73** may be held in position adjacent the end block **82** by means of a washer **84** and a retaining nut **85** secured on its end.

Referring now to Figures 1 and 3, a slidable bracket assembly **86** is slidably driven on the drive shaft frame **75** by means of screw shaft **73**. The slidable bracket assembly **86** comprises a pair of parallel, opposed, side plates **87** (see Figure 3). The side plates **87** are provided with a pair of bores **88** circumscribed adjacent the inner faces of the plate by spacing bosses (see Figures 1 and 6). A top cover plate **89** is welded, such as at *w*, between the opposed side plates **87** adjacent the top thereof (see Figure 3). A pair of split removable top wear plates **90** are retained within the top cover plate **89**. A bottom cover plate **91** is welded, such as at *w*, between the opposed side plates **87** adjacent the bottom of the shoe drive shaft frame **75**. A pair of split, removable, bottom wear plates **92** are retained within the bottom cover plate **91**. A yoke member **93** has oppositely-disposed, upper and lower journal portions **94**. One of the journal portions projects within an arcuate recess formed between the top wear plates **90**, and the other journal portion projects within an arcuate recess formed between the bottom wear plates **92**. The yoke member **93** is provided with a cylindrical bore **95**. A cylindrical yoke nut **96** is mounted within the bore **95**, so that it may have some rotational movement therein about the longitudinal axis of the cylindrical nut. The cylindrical nut **96** has a threaded central bore **97** which cooperably engages the threaded portions of the screw shaft **73** that extend therethrough.

An outer shoe assembly **98** (see Figure 3) is housed beneath shoe drive shaft frame **75** and between the opposed side plates **87**. The outer shoe assembly **98** comprises a movable outer shoe member **99** (see Figure 1) whose forward outer surface is preferably concave. The back surface of the outer shoe member **99** is provided with two outer support plates **100** and an inner support plate **101** (see Figures 1 and 3). The plates **100** and **101** are provided with aligned transverse bores **102** adjacent the top and bottom of the plates. A pair of bifurcated links **103** (see Figure 4) are provided. Each link **103** has a bifurcated end portion **104** provided with a transverse bore **105** and are pivotally connected to and between the support plates **100** and **101** (see Figure 3), by means of a transverse pivot pin **106** that passes through the bores **102** in the support plates and the bores **105** in the bifurcated end portion **104** of the links **103**. It should be noted that the bifurcated links **103**, utilized in the outer shoe assembly **98**, are the same links as are utilized in the inner shoe assembly, as shown in Figure 4.

A unitary end **107** of the links **103** has a bore **108** formed transversely therethrough. A pin **109** extends through the bore **108** of each link **103** and through opposed bores **88** formed in the side plates **87** to pivotally connect the unitary end **107** of each link to the side plates **87**. It thus can be seen that the pivot pins **109** provide stationary pivots, but that the pivot pins **106** provide movable pivots.

A projection lug **110** (see Figure 1) is mounted backwardly from the inner support plate **101** (see Figure 3). A horizontal stop plate **111** is welded at *w* between the opposed side plates **87** adjacent the bottom thereof to maintain the links **103** in a positive, inclined, angular position with respect to the stop plate **111**. These links must be maintained between an angle of 2 and 10 degrees with the horizontal stop plate **111**, in order to provide an operable gripping structure. The stop plate **111** has a bore **112** projecting therethrough. A guide pin **113** that is welded to the projection **110**, is slidable within the bore **112**. A compression spring **114** mounted on the guide pin **113** is compressibly retained between the stop plate **111** and the projection **110** to urge the links **103** and accordingly, the movable outer shoe **99**, towards their uppermost positions.

An inner shoe assembly **115**, shown in Figures 1, 2 and 4, operates basically in the same manner as does the outer shoe assembly **98**. The inner shoe assembly **115** comprises a curved, inner movable shoe **116** having a convex outer surface. The back surface of the movable inner shoe **116** is provided with a pair of outer support plates **117** and an inner or intermediate support plate **118** that are secured thereto. The support plates **117** and **118** are provided with a pair of transversely-aligned and longitudinally-disposed bores **119** (Figure 4). A pair of bifurcated links **103** having transversely-aligned bores **105** in their bifurcated end portion **104** are pivotally connected to and between the support plates **117** and **118** by means of a transverse pin **120** that passes through the bores **119** of the support plates **117** and **118** and bores **105** of the links **103**. The unitary opposite end **107** of each link **103** is pivotally connected to the side frame plates **51** by means of a pin **121** passing through the bores **108** in the unitary end **107** of the links **103** and through the opposed bores **54** or **55** of the side frame plates **51**. Here again, it can be seen that the pins **121** provide stationary pivot connections, where as the pins **120** provide movable pivotable connections.

A stop plate **122** (see Figure 2) is welded between the side frame plates **51** adjacent a bottom end thereof and limits the downward movement of the links **103** and maintains them within a positive inclined angle with respect to the stop plate **122** which is necessary for operable gripping results. A guide plate **123** is welded to the side frame plates **51** and has a bore **123***a* passing therethrough. The inner or intermediate support plate **118** has a backward projection **118***a* to which is welded a guide pin **124** (see Figures 4 and 5). The guide pin **124** is slidable within bore **123***a* and has a compression spring **125** mounted thereon which is retained in compression between the guide plate **123** and the projection **118***a* to urge the links **103** and accordingly, the inner shoe member **116**, upwardly.

The rotatable coil tong assembly A is pivotally connected to the trunnion arms **25** by means of frame studs **126** (see Figure 5), each having an inner end projection **126***a*, and an outer end journal portion **126***b* having a threaded portion **126***c*. The projections **126***a* of the frame stubs **126** project into bores **52** that are formed in projections **51***c* of the side frame plates **51**, and are retained therein by means of welds *w*. The journal portions **126***b* of the frame stubs **126** are journaled for rotation within bores **31** of the trunnion arms **25**. The

arms 25 may be maintained on the journal portion 126*b* by means of the threaded portion 126*c* and nuts 126*d*.

The push rods 48 are pivotally secured at their lower end portions 48*b* (see Figure 5) to projection 51*d* of the side frame plates 51 by means of a cross pin 127 that passes through bores 53 of the side plates and bores 50 of the lower end portions 48*b* of the push rods 48. The pin 127 may be retained in place by means of threaded end portions 128 and nuts 129. A spacer sleeve 130 circumscribes the pin 127 between the side frame plates 51 and thereby maintains them in a spatial relation with one another. It thus can be seen that the trunnion arms 25, the rocker arms 22, and the push rods 48 provide a supporting frame for the rotatable coil tong assembly A, and that the rocker arms 22 and the push rods 48, forming a part of the frame, provide a toggle linkage for rotating the coil tong assembly.

The coil tilter apparatus, thus described, may be operated, either by remote controls, such as from the cab of an overhead crane, or it may be operated by pendant controls. In operation, with the apparatus having its coil tong assembly in a vertical position, as shown in Figure 1, the coil tilter is lowered vertically over a coil C in such a manner that the nose portion 51*e* will project downwardly into the center of the coil. When completely lowered therein, the pair of horizontal angle irons 72 that are welded on the outside of the motor support plates 56, will provide a flat seating surface for the coil tong assembly A as it rests on top of the coil C. As noted in Figure 1, the nose portion 51*e* projects into the center of the coil C a distance greater than one-half the width of the coil. By extending the nose portion 51*e* to such a distance, it is possible to utilize the coil tong assembly A as a C-bar when transporting coils in a horizontal position, without fear of the coils C having a tendency to roll off the nose portion 51*e*.

After the rotatable coil tong assembly A has been positioned on top of the coil C, as shown in Figure 1, the electric motor 63 is activated, thereby rotating the sheave 64 that is mounted on its drive shaft. Power is transmitted from the rotating sheave 64 to the sheave 66*a* that is attached to the torque limiter 66 and mounted on the input shaft of speed reducer 65, by means of V-belt 67 which operatively connects sheaves 64 and 66*a*. The output shaft of the gear reducer 65 is connected to screw shaft 73 which is journaled for rotation within bushings provided in end plate 80 and bushings 83 in end block 82. The screw shaft 73 is thus rotatably driven by the output shaft of the speed reducer 65.

Screw shaft 73 operatively engages threaded bore 97 of cylindrical nut 96 that is mounted within bore 95 of the yoke member 93 (see also Figure 3). As the screw shaft 73 rotates within yoke nut 96, the slidable bracket assembly 86 is slidably driven on the drive shaft frame 75 toward the outer surface of the coil C. As the slidable bracket assembly 86 slides on the drive shaft frame 75, it should be noted that the top wear plates 90 (see also Figure 3) that are retained by the top cover plate 89, slide on the top wear plates 78 that are welded to the channel members 76, and that the bottom wear plates 92 that are retained within the bottom cover plate 91, slide along the bottom wear plates 79 welded to the channel members 76. In addition, the yoke member 93, having trunnion portions 94 housed in the removable top wear plates 90 and the removable bottom wear plates 92, together with the cylindrical yoke nut 96, provides a universal type joint between the slidable bracket assembly 86 and the screw shaft 73 to eliminate binding of the screw shaft 73 and to compensate for deflection of the assembly 86 as the assembly is slid along the frame 75. Further, the thrust bearings 81 operatively engage the radial flange 74 that is formed on the screw shaft 73, to eliminate undesirable longitudinal thrust within the speed reducer 65, as the slidable bracket assembly 86 is slid into operable position against the outer surface of the coil C. As the slidable bracket assembly 86 engages the outer surface of the coil C, the drive motor 63 continues to operate through the torque limiter 66 and compresses or holds the coil C between the outer shoe assembly 98 and the inner shoe assembly 115. When the compressive force between the inner and outer shoe assembly reaches a pre-determined amount, the compressive force transmitted to the screw shaft 73 will cause the torque limiter 66 to slip and disengage the speed reducer 65 from the motive power of the electric motor 63. The electric motor 63 is then de-energized.

It will be noted that when the coil tong assembly is initially clamped to the coil C, the outer shoe member 99 and the inner shoe member 116 are in their uppermost position, as shown in Figure 1, due to the compressive force of the springs 114 and 125, respectively, pushing upwardly on the center support plate of each shoe member. The pivotable connecting links 103 are also in their uppermost positions when the shoes are in this initial position, and form a positive inclined angle with the horizontal.

After the coil tong assembly A has been clamped to the coil C in the manner previously described, the hook H is raised upwardly, thereby lifting the entire coil tilter apparatus and raising the coil C off of its supporting surface. As the coil tilter is raised upwardly, the weight of the coil C will tend to pull the outer shoe member 99 and the inner shoe member 116 downwardly against the action of compression springs 114 and 125, respectively. The shoes 99 and 116 are pulled downwardly, due to their frictional engagement with the outer and inner surfaces, respectively, of the coil C. As the outer and inner shoe members move downwardly, they are also moved inwardly towards each other in compression against opposed surface portions of the coil, and thereby form a wedging action against these surfaces.

The downward movement of the outer shoe member 99 and inner shoe member 116 is limited by the horizontal stop plate members 111 and 122, respectively, which limit the downward rotational movement of the links 103 in such a manner that the links 103 will always be in an inclined angular relation with the horizontal stop plate members. However, in practice, it has been found that the wedging action derived from the shoe members 99 and 116 is completed before the links 103 contact the horizontal stop plate members 111 and 122. It should be noted that this wedging action imparted to the shoes 99 and 116 can also be derived from a pair of opposed wedge members operatively positioned adjacent the back surface of the respective shoes which will force the shoes outwardly upon a downward movement imparted to the shoes, such as by the weight of the coil C.

With the coil now in a lifted position, it is possible to rotate it in such a manner that its axis is rotated from a vertical to a horizontal position. To so rotate the coil, motor 37 is activated. Motive power is therefore transferred through speed reducer 38 and flexible coupling 39 to the worm gear jack 40. Jack screw 41 is accordingly moved backwardly through the worm gear jack 40 from the position shown in Figure 1 to the position shown in Figure 6. The jack screw 41, itself, does not rotate, but is moved longitudinally backwardly by means of a rotating nut within the worm gear jack 40. The outer end of the jack screw 41 is attached to a jack bracket 45 that is pivotally connected to rocker arms 22 and push rods 48 by means of pin 47.

The pivotal connection of the rocker arms 22 and push rods 48 about pin 47 is, in effect, a toggle joint with the rocker arms 22 and push rods 48 acting as toggle bars. As the jack screw 41 moves backwardly (without rotation) through the worm gear jack 40 (to the left, as viewed in Figure 1), it closes the toggle members 22 and 48. The endwise forces on the toggle members 22 and 48 increase as the angle between mem-

bers 22*a* and 25*b* decreases, and therefore, the push rods 48 produce a high, endwise pressure on the projection 51*d* of the side frame plates 51. Accordingly, the coil tong assembly A is rotated within bores 31 of the trunnion arms 25 (see Figure 2) by means of the frame stubs 126, that are journaled therein (see Figure 5). By utilizing such a toggle assembly, I have been able to rotate coils of considerable magnitude with a minimum of power. In addition, I have utilized the upper portion 22*b* of the toggle arm 22 to simultaneously move the hook H in such a manner that the hook will substantially remain over the center of gravity of the coil (note Figures 1 and 6) when the coil is rotated from one position to another, so that the coil will hang in a vertical position when the coil tong assembly is in its vertical position (see Figure 1), and will hang in a horizontal position when the coil tong assembly is in a horizontal position (see Figure 6).

When the coil tong assembly is being rotated from its vertical position to its horizontal position, the limit switch LS–2 will contact one of the rocker arms 22 to de-energize the electric motor 37 and stop the worm gear jack 40 when the coil has reached a pre-determined horizontal position. The coil C may now be transported to a new position by means of the overhead conveyor. It is to be understood, of course, that the coil may be transported in its vertical position without first rotating to the horizontal position. In addition, the coil may be picked up in a horizontal position rather than in a vertical position, as heretofore described. When this is the case, the rotatable tong assembly A is first rotated to a horizontal position by energizing the motor 37 in a manner previously described. The tong assembly is then moved horizontally into engagement with the coil C, so that the nose portion 51*e* will project within the center of the coil C.

Since the nose 51*e* extends into the center of the coil C a distance greater than one-half the width of the coil, it is not necessary that the shoe assemblies 98 and 115 be clamped to the coil, especially if the coil is to be deposited at its new station in a horizontal position. However, if the coil is to be deposited in a vertical position, then the motor 63 is activated, as heretofore described, and the shoe members 99 and 116 compressibly engage the coil C with a pre-determined force applied thereto by means of the rotating screw shaft 73 which is disengaged from the motive force 63 by means of the torque limiter 66 when the pre-determined compressive force is obtained.

After the coil C has been transported to its new position and it is desired to set it down in a vertical position, the motor 37 is activated to move the jack screw 41 forwardly (to the right as viewed in Figure 1) and thereby rotate the coil tong assembly A about the journal portions 126*b*, from a horizontal position shown in Figure 6 to a vertical position, shown in Figure 1, by means of the toggle arms 22 and 48. When the coil tong assembly A is so rotated, the weight of the coil C will then move the outer shoe member 99 and inner shoe member 116 downwardly to form a wedging action thereagainst in the manner heretofore previously described. When the coil tong assembly A is rotated from a horizontal to a vertical position, limit switch LS–1 contacts the roller 70 as shown in Figure 1, and de-energizes the electric motor 37 to stop the rotation of the assembly A in a pre-determined vertical position.

When the coil is lowered into a desired position, the electric motor 63 is activated in a reverse direction to rotate the screw shaft 73 in such a manner so as to move the slidable bracket assembly 86 outwardly, away from the coil C. Upon release of the compressive force between the outer shoe member 99 and inner shoe member 116, the compression springs 114 and 125 will urge the outer shoe member 99 and inner shoe member 116, respectively, upwardly to their uppermost positions, such as shown in Figure 1. The links 103 will accordingly also be urged upwardly, and it is noted that the links 103 form a pair of pivotable parallel arms which always maintain the shoe members 99 and 116 in a parallel opposed relationship.

Although I have illustrated an embodiment of my invention, I do not wish to limit it to such embodiment, as many modifications may be made within the scope of the appended claims, without departing from the spirit of my invention.

What I claim is:

1. A suspension apparatus for lifting, carrying, tilting, and lowering coiled material, such as strip metal coils, comprising, a pair of substantially parallel trunnion arms, a rotatable coil tong assembly pivotally connected intermediate its longitudinal extent to a common lower end portion of said trunnion arms, a pair of substantially parallel rocker arms pivotally connected intermediate their ends to a common upper end portion of said trunnion arms, a clevis shaft secured to and extending transversely between a common upper end portion of said rocker arms to receive a hook member for suspending the apparatus, a pair of substantially parallel push rods pivotally connected at their upper ends to a common lower end portion of said rocker arms, said rocker arms and said push rods forming a toggle linkage having a toggle joint connection therebetween, said push rods being pivotally connected at their lower ends to a portion of said rotating coil tong assembly about an axis which is parallel to and spaced-apart from the axis of the pivotal connection between said trunnion arms and said coil tong assembly, platform support means pivotally connected to and positioned between said trunnion arms intermediate their ends, jack means connected to said platform support means, reversible electric motor means mounted on said platform support means and connected to said jack means for supplying motive power thereto, a jack screw positioned within said jack means and connected at an outer end portion to said toggle joint formed between said rocker arms and said push rods, wherein said electric motor means drives said jack means to change the longitudinal position of said jack screw and thereby activate the toggle linkage connected to the tong assembly to rotate said coil tong assembly about the lower end portion of said trunnion arms.

2. In an apparatus for carrying, tilting and further manipulating coiled work pieces having, a support frame, a rotatable coil tong assembly pivotally mounted on said support frame adjacent one end thereof, toggle means forming a part of said support frame for rotating said coil tong assembly, and screw jack means mounted on said support frame for activating said toggle means; said rotatable coil tong assembly comprising, a drive shaft frame, a screw shaft rotatably mounted within said drive shaft frame, motor means secured to said drive shaft frame for operatively driving said screw shaft, a nose portion projecting transversely-outwardly from said drive shaft frame for insertion within the center of a hollow coiled work piece; an inner shoe assembly, said nose portion housing said inner shoe assembly, said inner shoe assembly having an inner shoe member engageable with an inner surface of the coiled work piece, an outer shoe assembly, a slidable outer brack assembly housing said outer shoe assembly, said outer shoe assembly having an outer shoe member compressibly engageable with an outer surface of the coiled work piece, and said slidable outer bracket assembly being slidably driven on said drive shaft frame by said screw shaft to operatively engage the coiled work piece in compression between the inner and outer shoe members.

3. An apparatus for tilting coiled work pieces as defined in claim 2 wherein, said nose portion projects outwardly from said drive shaft frame a distance greater than one-half the width of the coiled work piece to be carried

thereby, so that the rotatable coil tong assembly may be utilized as a C-bar when the nose portion is in a horizontal position.

4. An apparatus for tilting coils as defined in claim 2 wherein, said inner and outer shoe assemblies are oppositely disposed and mounted on said coil tong assembly for relative horizontal movement therebetweeen, means connecting each of said shoe members to its respective shoe assembly for both horizontal and vertical movement with respect to such shoe assembly while maintaining opposed surfaces of said inner and outer shoe members parallel to each other, and spring means for urging said shoe members upwardly being compressed downwardly by the weight tof a coiled work piece frictionally retained betweeen said shoe members as the coil work piece is lifted to permit said shoe members to wedge inwardly in compression against opposed surfaces of the coiled work piece for optimum gripping action.

5. An apparatus for tilting coils as defined in claim 2 wherein, the outer shoe assembly comprises, an outer shoe member having a plurality of spaced-apart parallel support members secured thereto, upper and lower transverse bores formed through said support members, upper and lower bifurcated links pivotally mounted at their bifurcated ends to said support members adjacent the upper and lower bores, respectively, said links being pivotally connected at their unitary ends to spaced-apart points on said slidable bracket assembly, so that the links are parallel to one another, a stop plate secured adjacent the bottom of said slidable bracket assembly having a bore therein, a projection extending backwardly from one of said support members and having a guide pin secured thereto in alignment with said bore, and a compression spring mounted around said guide pin and compressibly engaged between said stop plate and said projection to resiliently urge said outer shoe member upwardly.

6. An apparatus for tilting coils as defined in claim 2 wherein, said inner shoe assembly comprises, an inner shoe member having a plurality of spaced-apart parallel support members secured to the back thereof, a pair of parallel bifurcated links pivotally secured at their bifurcated ends to said parallel support members at spaced-apart points and at their unitary ends to spaced-apart points on said nose member, a guide pin welded to a projection on one of said parallel support members, a guide plate having a bore in alignment with said pin secured to said nose member, and a compression spring mounted on said guide pin and between said guide plate and said projection to resiliently urge said inner shoe member upwardly.

7. A coil tilting apparatus as defined in claim 2 wherein said motor means for driving said screw shaft comprises, a speed reducer having its output shaft operatively connected to said screw shaft, an electric motor mounted in spatial relation with said speed reducer, means for transmitting power between a drive shaft of said electric motor and the input shaft of said speed reducer, and a torque limiter on the input shaft of said speed reducer for automatically disengaging said electric motor from said speed reducer when the outer shoe assembly has compressibly engaged the coiled work piece acted upon between the inner and outer shoe members with a pre-determined compressive force.

8. A lifting tong apparatus for engaging and transporting individual work pieces, including a frame structure; a pair of oppositely disposed work-engaging members adjustably mounted on said frame structure for relative sliding movement therebetween, means for slidably moving one such member along said frame structure toward and away from the other such member; a suspension support comprising a rocker arm adapted to be supported at one end by an overhead conveyor, a trunnion arm pivotally connected at one end to an intermediate portion of said rocker arm, and a push rod at one end connected to and forming a toggle joint with the other end of said rocker arm; a pivot support on said trunnion arm pivotally mounting said frame structure on said suspension support; the other end of said push rod being pivotally connected to said frame structure about an axis which is parallel to and spaced-apart from said pivot support, electric motor actuated means mounted on said suspension support and connected to said toggle joint for motivating said toggle joint and through said push rod tilting said frame structure about said pivot support to different positions relatively to said suspension support.

9. In a suspension apparatus for tilting coil work pieces having a support frame, clevis means on said frame for engaging an overhead suspension hook, gripping means pivotally suspended from said support frame for gripping and rotating a coiled work piece, toggle means forming a part on said support frame connected to said gripping means, jack means pivotally secured to said frame for actuating said toggle means to apply endwise force to said gripping means for rotating said gripping means about its pivotal suspension on said support frame, and motor means mounted on said support frame for activating said jack means; a motorized rotatable coil tong assembly forming said gripping means, said rotatable coil tong assembly comprising a nose portion housing an inner shoe assembly, a rotatable screw shaft, a drive shaft frame housing said screw shaft, an outer shoe assembly, a slidable bracket assembly housing said outer shoe assembly, said slidable bracket assembly being slidably driven on said drive shaft frame by means of said screw shaft, motive means for actuating said screw shaft to grip a coiled work piece independently of the actuation of said toggle means, and support means on said rotatable coil tong assembly for operatively supporting said motive means.

10. An apparatus as defined in claim 9 wherein, said slidable bracket assembly is operatively driven on said drive shaft frame by said screw shaft through a universal joint connection to avoid binding on the screw shaft and to compensate for deflection in the slidable bracket assembly which universal joint connection comprises: a yoke member journaled for rotation about an axis which is normal to the longitudinal axis of the screw shaft, and a cylindrical yoke nut operatively engaging said screw shaft and mounted for relative rotation within said yoke member about an axis which is normal to both the longitudinal axis of said screw shaft and the axis of rotation of said yoke member.

11. An apparatus as defined in claim 9 wherein, said drive shaft frame has wear plates secured thereto, and said slidable bracket assembly has a removable split top wear plate operatively engageable with a wear plate on the top of said drive shaft frame, a top cover plate is secured adjacent the top of said slidable bracket assembly for operatively retaining said removable split top wear plate, a removable split bottom wear plate is operatively engageable with a wear plate on the bottom of said drive shaft frame, and a bottom cover plate is mounted on said slidable bracket assembly adjacent the bottom of said drive shaft frame to operatively retain said removable split bottom wear plate.

12. An apparatus as defined in claim 9 wherein the inner and outer shoe assemblies are provided with inwardly wedgeable and vertically movable inner and outer shoe members which are resiliently urged towards their uppermost positions by compressive means.

13. An apparatus as defined in claim 9 wherein said screw shaft is mounted for rotation within said drive shaft frame, and said motive means for driving said screw shaft comprise: a motor mounted on said support means, a sheave mounted on the drive shaft of said motor, a speed reducer mounted on said support means in a spatial relation with said motor and having a sheave mounted on its input shaft, a belt operatively connecting the sheave of said motor to the sheave of said speed reducer, and said

speed reducer having an output shaft operatively connected to said screw shaft.

14. An apparatus as defined in claim 13 wherein, said support means has a tiltable plate pivotally connected thereto to mount said motor, and means are provided for adjustably tilting said tiltable plate, so that the tension on said belt may be adjusted for maximum efficiency.

15. A manipulator device adapted to be suspended from an overhead support for picking-up, rotating and transferring hollow work pieces, such as coils of strip material, comprising, a support structure having means at its upper end for suspending the manipulator from an overhead support, said support structure comprising a pair of spaced-apart horizontally-opposed trunnion arms, a pair of opposed, horizontally-spaced-apart rocker arms pivotally connected intermediate their ends to a common end of said trunnion arms, support means positioned between and pivotally mounted on said trunnion arms about a horizontal axis intersecting said trunnion arms intermediate their ends, jack means carried by said support means and pivotaliy connected at one end to a common end of said rocker arms, means for activating said jack means, a rotatable coil tong assembly pivotally mounted intermediate its ends on said trunnion arms about a horizontal axis intersecting the common lower end of said trunnion arms, a pair of push rods pivotally connected at one end to said common end of said rocker arms and at their other end to said rotatable coil tong assembly about an axis which is parallel to and spaced-apart from said last mentioned horizontal axis, said rocker arms and said push rods forming a toggle joint which is driven by said jack means connected thereto to produce endwise force through said other end of said rocker arms and rotate said coil tong assembly about said last mentioned horizontal axis, and means on said coil tong assembly for securely gripping and holding a coiled work piece independently of the position of said coil tong assembly.

16. A device as defined in claim 15 wherein said rotatable coil tong assembly is rotatable through an arc of approximately 90 degrees between horizontal and vertical positions, and wherein limit switch means are connected to said platform means to automatically de-energize said motor means during the rotation of said coil tong assembly when it reaches its pre-determined end positions.

17. In a coil tilter apparatus having a rotatable coil tong assembly pivotally suspended intermediate its ends from one end of a frame support, means for rotating said coil tong assembly comprising: toggle linkage forming a part of said frame support connected to a portion of said rotatable coil tong assembly spaced-apart from the pivotal suspension of said frame support; said frame support comprising a trunnion arm pivotally suspending said coil

tong assembly from its lower end, a rocker arm pivotally mounted intermediate its ends on the upper end of said trunnion arm, a push rod pivotally connected at one end to and forming a toggle joint with one end of said rocker arm, and at its other end pivotally connected to said rotatable coil tong assembly about an axis which is parallel to and spaced-apart from the pivotal suspension of said coil tong assembly on said trunnion arm; platform means pivotally mounted on said frame support intermediate its ends, jack means mounted on said platform means, motor means on said platform means for activating said jack means, and said jack means being connected to said toggle joint to activate said push rods and thereby rotate the rotatable coil tong assembly about its pivotal suspension and relative to said frame support.

18. A suspension apparatus for manipulating hollow work pieces comprising a suspendable support frame, a rotatable coil tong assembly pivotally mounted on the lower end of said support frame, toggle means forming a part of said frame pivotally connected to said rotatable coil tong assembly for imparting rotational movement to said assembly; said support frame comprising a trunnion arm upon the lower end of which said coil tong assembly is pivotally mounted, a rocker arm, and a push rod; said toggle means comprising said rocker arm pivotally mounted intermediate its ends on the upper end of said trunnion arm, and said push rod at one end connected to and forming a toggle joint with one end of said rocker arm and at its other end pivotally connected to said coil tong assembly about an axis which is parallel to and spaced-apart from the pivotable mounting between said coil tong assembly and said trunnion arm; motor means pivotally mounted on said frame intermediate its ends, and jack means on said frame connected to said toggle joint and activated by said motor means to motivate said toggle means and apply endwise force through the other end of said push rod to operatively rotate said coil tong assembly about the axis of its pivotal mounting on the lower end of said support frame.

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UNITED STATES PATENT OFFICE

CERTIFICATION OF CORRECTION

Patent No, 2,974,995 March 14, 1961

Robert J. Calhoun, Jr.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 47, for "in" read -- is --; column 4, line 17, for "a", first occurrence, read -- A --; column 6, line 66, for "studs" read -- stubs --; column 10, line 64, for "brack" read -- bracket --; column 11, line 14, for "tof" read -- of --.

Signed and sealed this 8th day of August 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents