United States Patent [19]

Mandrup

[11] **3,842,729**

[45] **Oct. 22, 1974**

[54] **REFUSE COMPACTOR**

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[73] Assignee: **Matador Industries, Inc.,** Temple City, Calif.

[22] Filed: **Aug. 14, 1972**

[21] Appl. No.: **280,533**

[52] **U.S. Cl.** ..... **100/229 A,** 74/521, 100/52, 100/53, 100/287, 100/294, 151/41.76, 100/295

[51] **Int. Cl.** **B30b 1/18,** B30b 15/14

[58] **Field of Search** ..... 151/41.76, 41.7, 54; 85/32 K; 100/229 A, 24 S, 287, 289, 294, 295, 285, 53, 52; 74/521; 254/122, 126

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Attorney, Agent, or Firm—Christie, Parker & Hale

[57] **ABSTRACT**

Pantographic linkages of a refuse compacting ram assembly of a refuse compactor are driven through oppositely threaded screws acting on associated floating nuts captured in trunnions between the linkage and the nuts. Each nut is prevented from rotating with its screw by a key on the nut received in a key slot of a cover plate. Removal of the plates exposes the keys of the nuts. The keys can be wrenched to unloosen the nut. Removal of each of the nuts from the screws drops the pantographic linkage from its drive to facilitate repair of the compactor. A control circuit box containing the circuit elements for operator actuation is carried by a face panel and is electrically coupled to the operating circuits of the compactor through a male plug and and female plug receptacle so that upon removal of the face panel the control and operating circuits are unplugged without unwiring.

5 Claims, 7 Drawing Figures

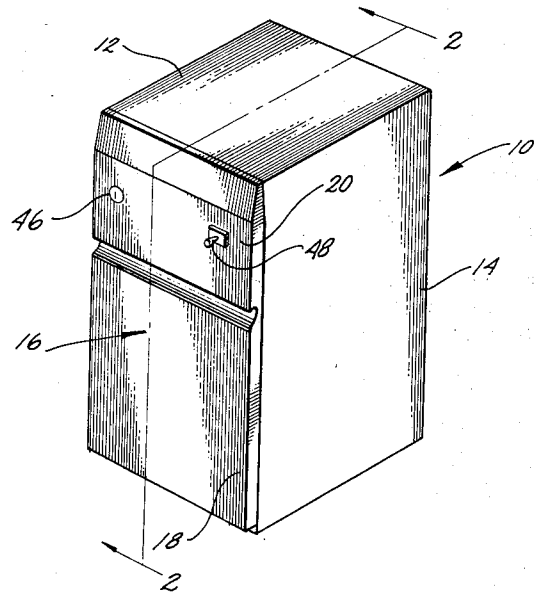


Fig. 1

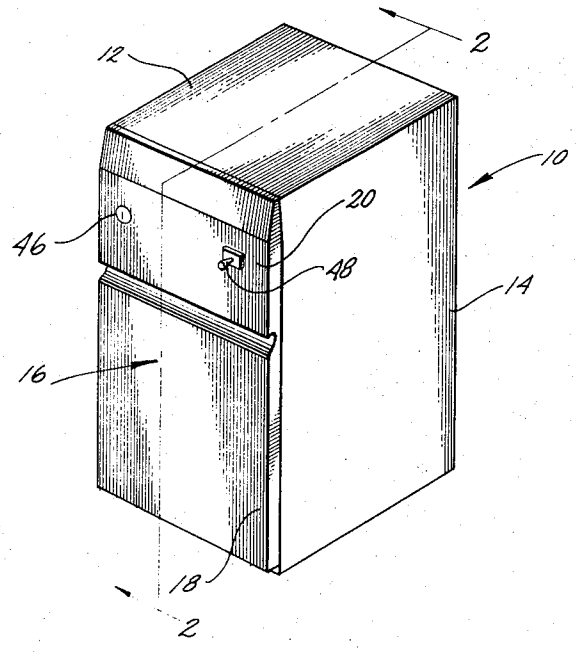

12
2
10
20
46
48
14
16
18
2

Fig. 7

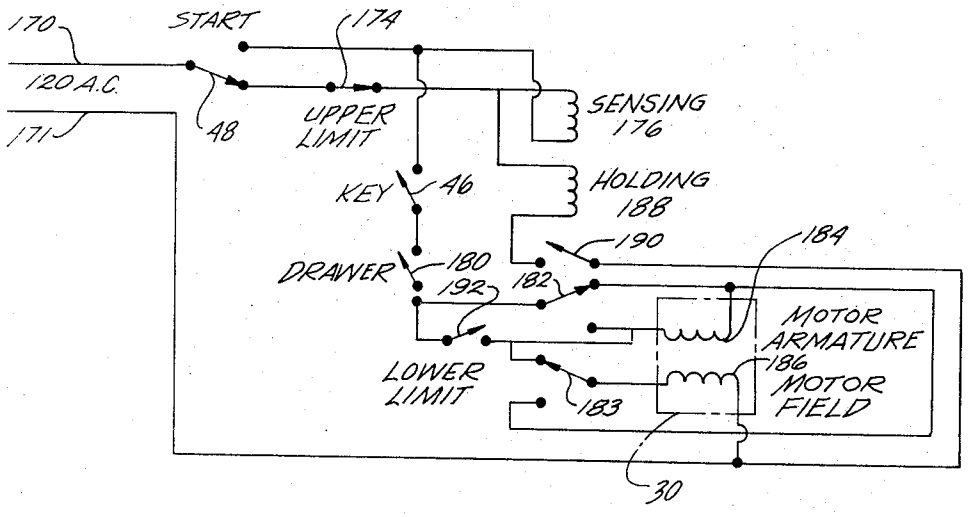

170
START
174
120 A.C.
171
48
UPPER LIMIT
SENSING 176
KEY
46
HOLDING 188
190
184
DRAWER
180
192
182
MOTOR ARMATURE
186
LOWER LIMIT
183
MOTOR FIELD
30

Fig. 3

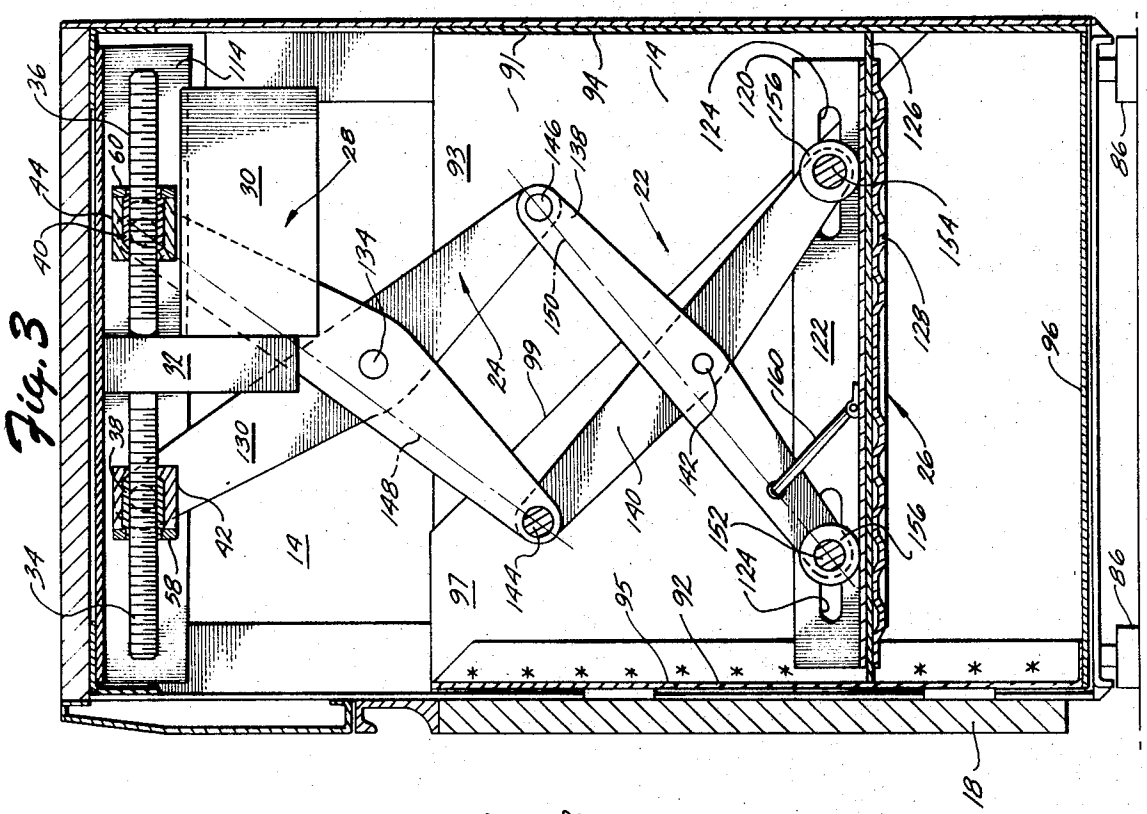


Fig. 2

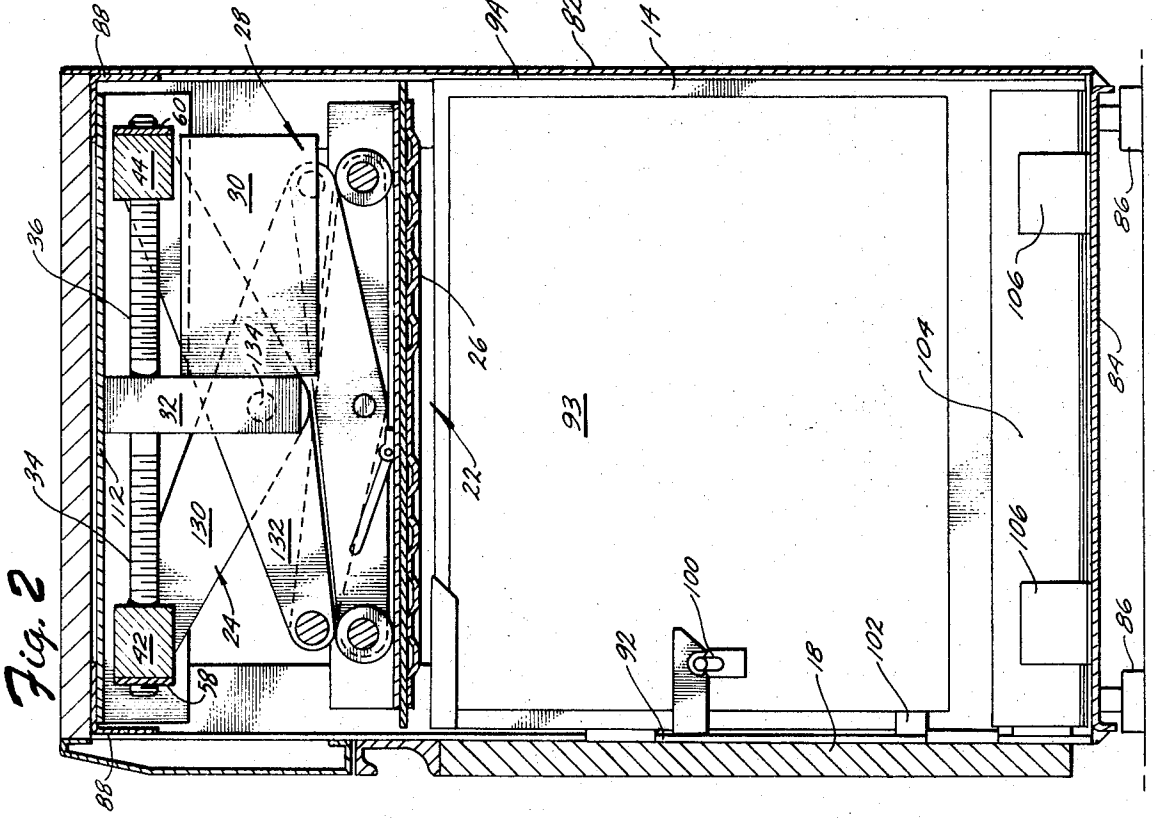


Fig. 4

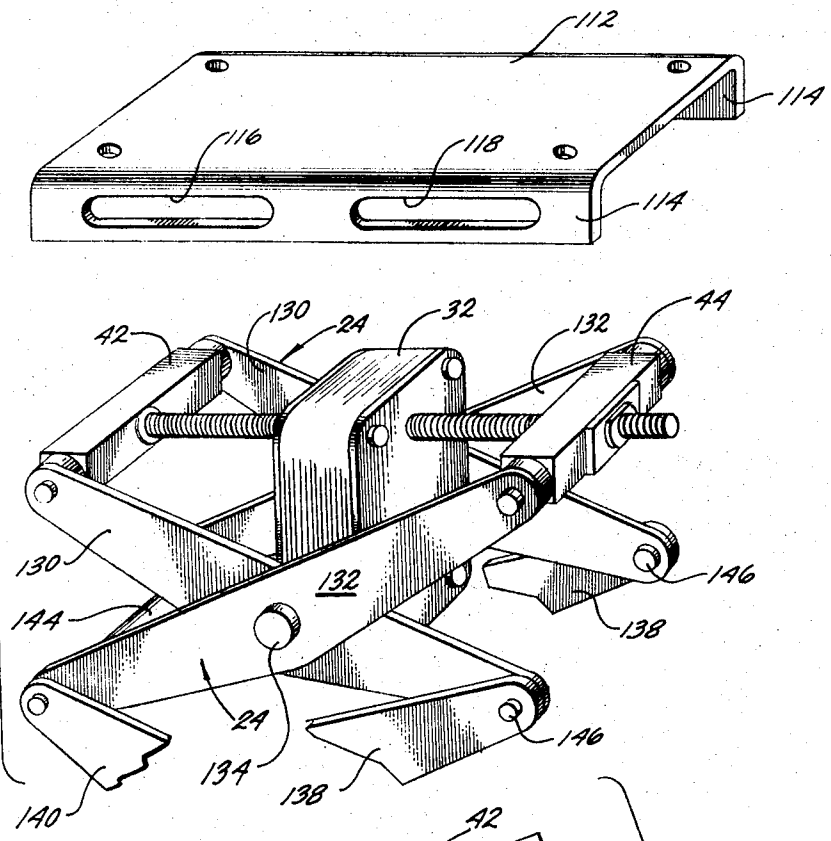


Fig. 5

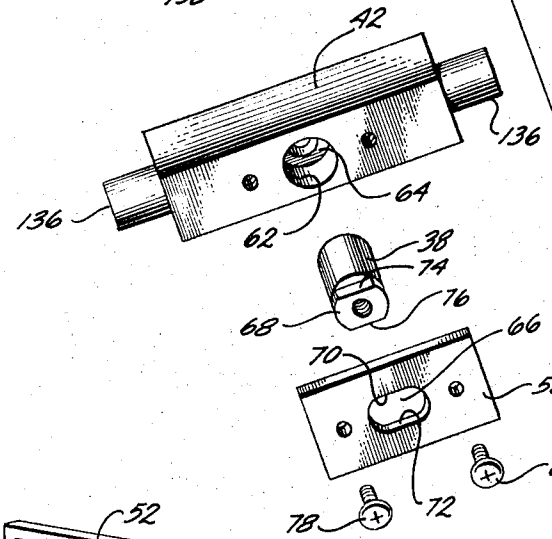
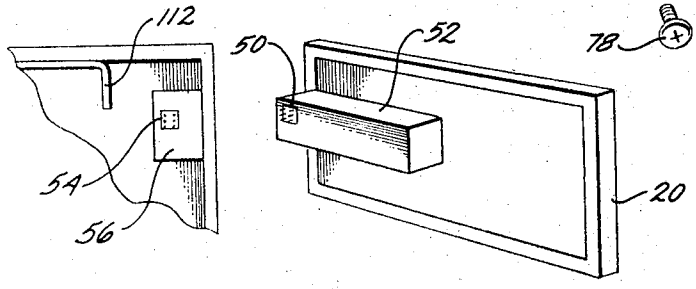


Fig. 6



REFUSE COMPACTOR

BACKGROUND OF THE INVENTION

The present invention relates to refuse compactors in general and, more in particular, to an improvement in refuse compactors which makes them readily serviceable in the field.

A refuse compactor is an appliance which applies force to trash, such as cans and bottles, to reduce the bulk of the trash. Accordingly, the space required for storing trash is reduced and trash handling is more convenient.

A refuse compactor employs a ram which is driven by some power means, typically an electric motor, to apply a crushing force on trash contained in a trash compartment, say a drawer.

One of the more attractive rams for refuse compactors employs a scissor jack or pantographic linkages for movement of a compaction head. A pair of oppositely threaded drive screws extend and retract the linkages.

As in most appliances, the operator control electrical circuit elements are conveniently disposed in a front panel and are electrically connected to various circuit elements within the balance of the compactor.

Unfortunately, when maintenance is required on this type of compactor it is necessary to remove the pantographic linkages and the compaction head from the drive. This requires removal of the face panel, unwiring the connections between the control and the operating circuit elements, and arduously dismantling the linkage from the drive.

Thus there is a need for an improved refuse compactor which lends itself to easy dismantling and reassembly for maintenance.

SUMMARY OF THE INVENTION

The present invention provides an improved refuse compactor of the type which employs parallel sets of pantographic linkages in its ram to extend and withdraw a compaction head from a refuse compartment. A pair of oppositely threaded coaxial drive screws are driven by power means such as an electric drive. Each screw is coupled, preferably, to the pantographic linkage through one of a pair of floating nuts captured in one of a pair of trunnions. The trunnions track on guides for movement along the axes of the screws. The nuts, being floating, are capable of limited angular displacement with respect to the axis of its screw to avoid thread seizure and damage to the threads. To prevent rotation of the nuts, each nut has a key received in a key slot of a member removably attached to the trunnion. The key is preferably defined by two parallel flats disposed on either side of the axes of screws and parallel to the axes of the screws.

When it is necessary to remove the pantographic linkages and compactor head from the drive, all that it is necessary to do is to remove the members having key slots from the trunnions, loosen the floating nuts by applying a wrench to the key flats, and then unthreading the nuts completely off the screws. This enables the trunnions to be slid off the screw and frees the interior of the compactor for maintenance or repair.

Preferably control electrical components are contained in a face panel wired to operating electrical components through a plug and plug receptacle between the interface of the face panel and the cabinet of the compactor such that upon removal of the face panel the control and operating circuits are electrically uncoupled without unwiring.

The compactor of the present invention, then, provides for rapid and facile removal of the ram from its drive to facilitate maintenance and repair. The uncoupling of the operator control circuitry from the operating circuitry further enhances the facility of the compactor for service.

These and other features, aspects and advantages of the present invention will become more apparent from the following description, appended claims and drawings.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a perspective view of the exterior of the refuse compactor of the present invention;

FIG. **2** is a cross-sectional, elevational view taken along lines **2—2** of FIG. **1** showing the ram assembly in its retracted position;

FIG. **3** is a cross-sectional, elevational view similar to that of FIG. **2** showing the ram assembly in an extended position;

FIG. **4** is an exploded perspective view of a portion of the ram assembly illustrating in particular the improved trunnion and floating nut construction of the present invention;

FIG. **5** is an exploded perspective view illustrating in even more particular the improved trunnion and floating nut of the present invention;

FIG. **6** is a perspective, fragmentary view of the front panel of the refuse compactor of the present invention to illustrate the plug and plug receptacle coupling of the control electrical components and the operatinng electrical components; and

FIG. **7** is a line schematic illustrating an electrical circuit suitable for operation of the refuse compactor of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With very brief reference to FIG. **1** a refuse compactor **10** has a cabinet with a top **12,** sides **14** and a front **16.** The front includes the face of a drawer **18** and a control panel **20.** The drawer is for refuse.

With reference to FIGS. **2** and **3** the interior of the refuse compactor includes a ram **22** which in general is comprised of parallel sets of pantographic linkages **24,** a compactor head **26** and a drive **28.**

The drive includes an electric motor **30** which drives a gear reducer **32** which in turn drives a pair of oppositely threaded, coaxial screws **34** and **36.** The screws are preferably of a common shaft. Screws **34** and **36** drive floating nuts **38** and **40,** respectively. Floating nuts **38** and **40** are connected to the pantographic linkages through trunnions **42** and **44,** respectively. The floating nuts and trunnions are in the upper portion of the cabinet behind front panel **20.**

Operation of motor **30** in a directional sense causing floating nuts **38** and **40** to travel down screws **34** and **36** towards each other extends the pantographic linkages and lowers compactor head **26** into drawer **18** for the compaction of trash or refuse (see FIG. **3**). Alternatively, when the rotational sense of motor **30** is opposite, the floating nuts will travel on their screws outwardly from each other to return the pantographic link-

ages and compactor head to the position shown in FIG. 2.

As shown in FIGS. 1 and 6, front control panel 20 is removable and includes the controls for the electrical circuit of the refuse compactor, such controls including a key lock 46 and a switch 48. These controls are in electrical circuit with operating electrical circuitry within the cabinet of the refuse compactor.

If it is necessary to repair the refuse compactor, it typically will be necessary to remove the ram assembly. This requires removal of the pantographic linkages from the drive screws. Access to the drive screws, however, is limited.

Access to the drive screws must be had by removal of the front panel. The front panel, however, carries the control circuit elements, and its removal might require the unwiring of the connections between the front panel and the balance of the compactor. In accordance with the present invention and with reference to FIG. 6, the front panel is readily removable without disconnecting the wiring between the control circuit elements in the front panel and the balance of the circuitry in the cabinet by providing a male plug 50 in a control box 52, in which box the control circuit elements are housed. A cooperating female plug receptacle 54 is mounted in a box 56, in which many of the operating circuit elements are housed. Upon pulling the front panel from the balance of the compactor, plug 50 withdraws from plug receptacle 54 and unwiring is unnecessary.

As previously mentioned, it is often necessary in making repairs to the compactor to remove the ram assembly from its drive. This is done after the front panel is removed to expose trunnions 42 and 44. The trunnions mount floating nuts 38 and 40 which are threadably received on drive screws 34 and 36, respectively. The floating nuts are captured within bores in each of the trunnions by a pair of plates 58 and 60. With the removal of the plates and the floating nuts from screws 34 and 36, the ram is freed from its drive.

The construction of the trunnions and floating nuts is best seen in FIG. 5. In the Figure, trunnion 42 and nut 38 are illustrated and their construction and relationship is the same as that of trunnion 44 and nut 40. Trunnion 42 has a bore 62 for receiving nut 38. Bore 62 ends at a shoulder 64 against which nut 38 bottoms. The bore and diameter of the nut allow angular misalignment between them to prevent the threads of the nut from binding on the threads of its screw when, for example, the trash in the compactor is not evenly distributed and therefore causes uneven loading on head 26 of ram 22 which, in turn, will cause drive screws 34 and 36 to rotate slightly from their true axes. Plate 58 has a key slot 66 for receiving a key 68 of the floating nut. The key slot has parallel edges 70 and 72 for engaging mating parallel flats 74 and 76 of the key 68. Plate 58 is readily removable from trunnion 42 as by screws 78 and 80. The register of the key of the floating nut in the key slot of the plate prevents the floating nut from rotating with its screw and consequently causes the nut to travel up aand down the screw, depending on the direction of the rotation of the screw. When the plate is removed, the key of the nut is exposed and the nut can be removed. If the nut is tight, key 68 can be wrenched by using flats 74 and 76 as wrenching flats. After loosening, the nut can be manually removed.

Referring again to FIG. 2, the cabinet further includes a back wall 82 and a reinforced bottom wall 84 having support legs 86. The cabinet is framed with four upright corner channels welded at the top to four angles 88 arranged in a rectangle and welded at the bottom directly to bottom wall 84 and short upstanding side walls formed integral with the bottom wall.

Referring to both FIGS. 2 and 3, a drawer 18 for receiving refuse is positioned within the lower portion of the cabinet. The drawer has an open top and it is formed by a U-shaped rear portion 91 and a front portion 92. The rear portion has a pair of reinforced side walls 93 formed integral with a back wall 94. Front panel 92 includes a front wall 95 and two integral side walls 97 which have tapered rear portions 99. Front portion 92 is mounted on rear portion 91 to be pivoted forward a limited amount. Frontwall 95 is attached to the exterior panel of drawer 18. A bottom wall 96 closes the bottom of the drawer.

The front wall of the drawer is held in an upright position by means of a suitable latch 100. With latch 100 released, the front wall of the drawer may be pivoted outwardly about lower pivotal connections between the front wall and the balance of the drawer. A stop 102 attached to side wall 93 extends in front of front wall 95 to limit pivotal movement of the front wall.

Drawer 18 is mounted within the cabinet to be easily withdrawn on a conventional track and roller arrangement 104. A pair of angular brackets 106 are mounted to bottom wall 84 of the cabinet. Attached to each bracket is an outer channel of the track. It is preferred to have compaction loads transferred from the drawer to the bottom of the cabinet without loading the rollers of the track and rollers.

With reference to FIGS. 2, 3 and 4, ram 22 and its drive will be described. The ram includes an upper ram carrier channel 112 which is attached to upper framing angles 88. Rdm carrier channel 112 has two depending side walls 114, each of which is formed with a pair of elongated, horizontally extending slots 116 and 118.

With reference to FIG. 3, compactor head 26 also has a channel 120 supported parallel to channel 112 by pantographic linkages 24. The compactor head channel has a pair of upwardly extending short side walls 122, each of which is formed with a pair of elongated horizontal slots 124. A flexible sealing plate 126 is secured to the lower side of the compactor head channel by a corrugated clamp plate 128.

Compactor head 26 is supported for vertical movement by means of force transmitting scissors-jack or pantographic linkages 24 formed by a series of pivotally connected arms and trunnions. More specifically, two upper arm pairs 130 and 132 on either side of gear box 32 are each pivotally connected by pivot pins 134. The upper ends of arm pairs 130 and 132 are pivotally connected to trunnions 42 and 44. The ends of the trunnions extend through arms 130 and 132 and are sized to fit within and be guided by elongated slots 116 and 118, respectively. As seen in FIG. 5, ends 136 of the trunnions are cylindrical for tracking in the slots of the carrier channel.

Speed reducing gear box 32 is mounted directly on the central portion of screws 34 and 36 to drive the screws in either direction of rotation. Electric motor 30 in turn drives gear box 32. The gear box extends downwardly from the screws and both the box and the motor are completely positioned within the space between the right- and left-hand upper pantograph arms.

The heads of pivot pins **134** are confined within a pair of vertically oriented guide channels mounted on opposite sides of two opposed flanges extending downwardly from each side of carrier channel **112.**

Two lower pairs of arms **138** and **140** are pivotally connected near their midpoints by a pivot pin **142.** A trunnion **144** extends between and through the lower ends of arms **132** and the upper ends of arms **140.** Pins **146** extend through the lower ends of arms **130** and the upper ends of arms **138.** Using pins **146** at this location instead of a trunnion provides additional space for motor **30,** as seen in FIG. **2.** Thus the arms are properly spaced and pivotally connected.

It should be noted that pivot pins **134** are closer to the lower ends of arms **130** and **132** than to the upper ends. This provides increased leverage from the drive by increasing the mechanical advantage over a central disposition of the pins. Also, pivot pins **134** are offset on the lower side of a line **148** between the center of upper trunnion **44** and trunnion **144.** Pins **134** are similarly located with respect to arm **130.** Likewise, pivot pins **142** are offset below a line **150** on arms **138** between pins **146** and a lower trunnion **152.** Pins **142** are similarly located with respect to arms **140.** These features provide a greater force output from the ram during the initial downward movement of the ram from the fully retracted position.

The lower ends of arms **138** are joined by trunnion **152** and the lower ends of arms **140** are joined by a trunnion **154.** The outer ends of the lower trunnions extend through elongated slots **124.**

Pairs of rollers **156** are mounted on opposite ends of the trunnions **152** and **154** immediately within the side walls of the cabinet. These rollers engage channel **120** of the compactor head to facilitate movement of the arms and trunnions with respect thereto.

It will be appreciated that as drive screws **34** and **36** are rotated, force is transmitted through the arms and trunnions to drive the compactor head upwardly or downwardly depending upon the direction of rotation of the screws. During this movement, lower trunnions **152** and **154** move within elongated slots **124** and thereby guide the ram compactor head. To provide additional stability, a guide crank **160,** seen in FIG. **3,** is pivotally mounted at its midsection to channel **120.** Guide crank **160** includes upwardly and outwardly extending end portions which extend through openings in arms **138.** The guide crank is located and dimensioned such that it smoothly pivots with respect to arms **138** as the lower ends of the arms move within slots **124.**

With reference to FIG. **7** the control and operating circuitry for the compactor will be described. Motor **30** may be energized by a conventional source of 120 volt AC indicated by leads **170** and **171.** The circuitry includes start switch **48,** either of the push button or toggle variety, which normally remains in the position indicated in the drawing but which can be held manually in the alternate position. Serially connected to switch **48** is a normally closed ram upper limit switch **174,** a relay sensing coil **176,** key switch **46,** a drawer interlock switch **180,** relay switches **182** and **183,** armature winding **184** of motor and motor field **186,** which in turn is connected to the other power lead **171.** Connected across sensing coil **176** and motor windings **184** and **186** is a relay holding coil **188** and a normally open relay switch **190.** Relay switches **182, 183** and **190** together with relay sensing coil **176** and holding coil **188** are available in a single relay component. The relay switches are shown in their normal position, when the relay coils are not energized. A normally open ram lower limit switch **192** is connected across motor armature **184.** The second position of start switch **48** is connected across upper limit switch **174** and sensing coil **176.**

Ram upper limit switch **174** is not physically shown in the drawings, but it should be understood that it may be conveniently mounted on the ram assembly to be opened when the ram is in its uppermost position. Similarly, normally open ram lower limit switch **192** may be conveniently mounted on the ram assembly to be closed when the ram reaches a lower limit position. Key switch **46** is accessible on front panel **20** of the cabinet as shown in FIG. **1.** This switch is provided as a safety measure to prevent use of the appliance by those not authorized to have the key. Start switch **48** is also in the front panel. The male plug and female receptacle are not shown in FIG. **7.** Drawer interlock switch **180** is normally open and is depressed by the drawer when it is completely closed. Thus operation of the ram assembly is prevented if the drawer is in any position other than completely closed.

In operation of the compactor the drawer is withdrawn and an open top bag of suitable construction is positioned in the drawer with the top of the bag folded over the sides of the drawer. Refuse is then placed within the drawer and the drawer is returned to its fully closed position, as shown in FIG. **2.** The ram is in its completely retracted position as shown in FIG. **2.** With this condition, normally open drawer switch **180** is closed by the drawer, and the normally closed upper limit switch **174** is opened by the ram assembly.

If it is desirable to compact the refuse that has been placed in the drawer, key switch **46** is manually closed and the manual switch **48** is momentarily moved to its start position. This bypasses open upper limit switch **174** and energizes motor windings **184** and **186** through relay switches **182** and **183** which are positioned as shown in FIG. **7.** This is the position for rotating the motor in the direction to drive the compactor head downwardly. Once the compactor head begins to move downward, upper limit switch **174** is released so that it is once more closed and thus the start switch **48** can be released so that the motor is energized through limit switch **174** and sensing coil **176.**

The compactor head is driven into the open upper end of the drawer to compact the refuse in the drawer. As mentioned above, the elongated slots in the ram carrier and compactor head together with guide crank **160** guide the compactor head in its downward movement so that it remains essentially parallel to the ram carrier (horizontal).

As the refuse becomes more compressed making the force required for further compression greater, the motor draws more current. This additional current load is sensed by relay sensing coil **176.** When the amperage load reaches a certain predetermined level, such as approximately 8 ½ amps, which corresponds to a predetermined load force by the ram, such as about 2,000 lbs., relay coil **176** will cause relay switches **182** and **183** to move to their lower or second positions and cause relay switch **190** to close. It will be seen that moving switches **182** and **183** to their lower positions will cause the current flow through motor armature **184** to be reversed from that before the relay was oper-

ated. This current reversal causes the motor to reverse direction causing the ram to start to be retracted.

Reversing the motor direction eliminates the high current draw through the motor, with result that the amperage through the sensing coil is no longer sufficient to hold relay switches **182** and **183** in their lower position. However, they are held in their lower positions by holding coil **188** which remains energized by the closing of relay switch **190.** Thus the motor continues to run in a reverse direction and the ram is retracted. When it is fully retracted upper limit switch **174** is opened, thus deenergizing the circuit. This causes the relay switches to return to their original condition, and the compactor is once more set to be operated.

In the event the motor is energized when there is no refuse in the drawer, it is possible that the ram assembly may damage the drawer structure before a sufficient load is developed that would cause the sensing coil to reverse operation of the motor. Thus as a safety measure, normally open lower limit switch **192** is closed by the ram assembly when it reaches a predetermined lower or extended position. Closing this switch causes motor armature **184** to be bypassed with the result that the motor field draws a high amount of current. This increased amperage is sensed by relay coil **176** causing it to actuate relay switches **190, 182** and **183** in the manner previously described to reverse direction of the motor. Note that lower limit switch **192** will still be momentarily closed when the relay switches **182** and **183** are moved into their lower position, but that armature **184** is no longer bypassed with the relay switches in their lower position. Once the ram is retracted a small amount, lower limit switch **192** will of course automatically open.

What is claimed is:

1. An improved refuse compactor comprising:

a. a cabinet;

b. receptacle means in the cabinet for receiving refuse;

c. means for access to the receptacle means for placing refuse therein and for removing compacted refuse therefrom;

d. a ram in the cabinet for compacting refuse having:

i. a compactor head for engaging and compacting refuse in the receptacle means;

ii. first and second sets of parallel and spaced apart pantographic linkages, each of the linkage sets having upper arms and lower arms, the lower arms of the linkage sets carrying the compactor head such that the lower arms of each linkage set can travel towards and away from each other;

iii. means for mounting the upper arms of the linkage sets to the cabinet including first and second trunnions pivotally carrying the upper arms of the first and second sets of pantographic linkages, each of the trunnions having a bore ending in a shoulder on the interior end thereof;

iv. first and second nuts for the first and second trunnions, respectively, each of the nuts being received in the bore of its associated trunnion; and

v. first and second means for mounting the nuts on the respective trunnions for the transmission of a drive force in either direction along the axes of the nuts, for selective removal of the nuts from the trunnions, and to prevent rotation of the nuts, each of the mounting means including a plate removably secured to its associated trunnion and cooperating with the interior shoulder of the bore of such trunnion to keep the nut associated with such trunnion in such bore; and

e. drive means for extending and retracting the pantographic linkage sets and to thereby extend and retract the compactor head into and out of the receptacle means, the drive including first and second oppositely threaded drive screws threadably receiving the first and second nuts such that with rotation of the screws in one direction the nuts travel towards each other to extend the pantographic linkage sets and rotation of the screws in the opposite direction of the screws in the opposite direction the nuts travel away from each other to retract the pantographic linkage sets.

2. The improved refuse compactor claimed in claim **1** wherein,

the first and second nuts each has a key at the outer end thereof; and

each of the plates includes a key slot receiving the key of its associated nut to prevent rotation thereof.

3. The improved refuse compactor claimed in claim **2** wherein each of the trunnion bores and its received nut define a clearance between them for limited angular movement of the nut with respect to the bore.

4. An improved refuse compactor comprising:

a. a cabinet;

b. receptacle means in the cabinet for receiving refuse;

c. means for access to the receptacle means for placing refuse therein and for removing compacted refuse therefrom;

d. a ram in the cabinet for compacting refuse having:

i. a compactor head for engaging and compacting refuse in the receptacle means;

ii. first and second sets of parallel and spaced apart, extendible and retractable pantographic linkages carrying the compactor head;

iii. first and second trunnions pivotally carrying the upper arms of the first and second sets of pantographic linkages, the trunnions being mounted to the cabinet;

iv. first and second nuts for the first and second trunnions, respectively; and

v. first and second means for mounting the nuts on the respective trunnions for the transmission of a drive force in either direction along the axes of the nuts, for selective removal of the nuts from the trunnions, and to prevent rotation of the nuts; and

e. drive means for extending and retracting the pantographic linkage sets and to thereby extend and retract the compactor head into and out of the receptacle means, the drive including first and second oppositely threaded drive screws threadably receiving the first and second nuts such that with rotation of the screws in one direction the nuts travel towards each other to extend the pantographic linkage sets and with rotation of the screws in the opposite direction the nuts travel away from each other to retract the pantographic linkage sets,

the drive means also including a control circuit for manual operation and an operation circuit for the drive means proper, the control circuit being in a removable panel on the cabinet, the two circuits being electrically connected by a plug and plug receptacle at the interface between the removable panel and the balance of the cabinet for disconnecting and connecting the two circuits upon removal and installation of the removable panel, respectively.

5. An improved refuse compactor comprising:

a. a cabinet;

b. receptacle means in the cabinet for receiving refuse;

c. access means to the receptacle means for placing refuse therein and for removing compacted refuse therefrom;

d. a ram in the cabinet for compacting refuse having:

i. a compactor head for engaging and compacting refuse in the receptacle means;

ii. first and second sets of parallel and spaced apart pantographic linkages, each of the linkage sets having upper arms and lower arms;

iii. means for carrying the compactor head by the lower arms of the linkage sets while permitting the lower arms of each linkage set to travel towards and away from each other;

iv. means for mounting the upper arms of the linkage sets to the cabinet including at least one trunnion pivotally carrying corresponding of the upper arms of the linkage sets;

v. a nut associated with each trunnion; and

vi. means for mounting each nut on its associated trunnion for the transmission of a drive force in either direction along the axis of the nut, for selective removal of the nut from the trunnion, and to prevent rotation of the nut, the mounting means including a bore in each trunnion receiving the nut associated with such trunnion, each of the trunnion bores and its received nut defining a clearance between them for limited angular movement of the nut with respect to the bore in orthogonal planes containing the longitudinal axis of the bore; and

e. drive means for extending and retracting the linkage sets and to thereby extend and retract the compactor head into and out of the receptacle means, the drive means including a threaded drive screw threadably receiving the nut such that with rotation of the screw in one direction the nut travels to extend the linkage sets and with rotation of the screw in the opposite direction the nut travels to retract the linkage sets.

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