# United States Patent [19]

**Longo**

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[54] **MOVABLE VERTICAL COMPACTOR**


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[52] **U.S. Cl.**..... **100/100,** 100/52, 100/53, 100/289, 100/229 A, 220/65 R, 308/3 A

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

[58] **Field of Search** ..... 100/52, 53, 100, 229 A, 100/229 R, 289, 290, 295, 223; 220/65 R; 308/3 R, 3 A; 53/124 B



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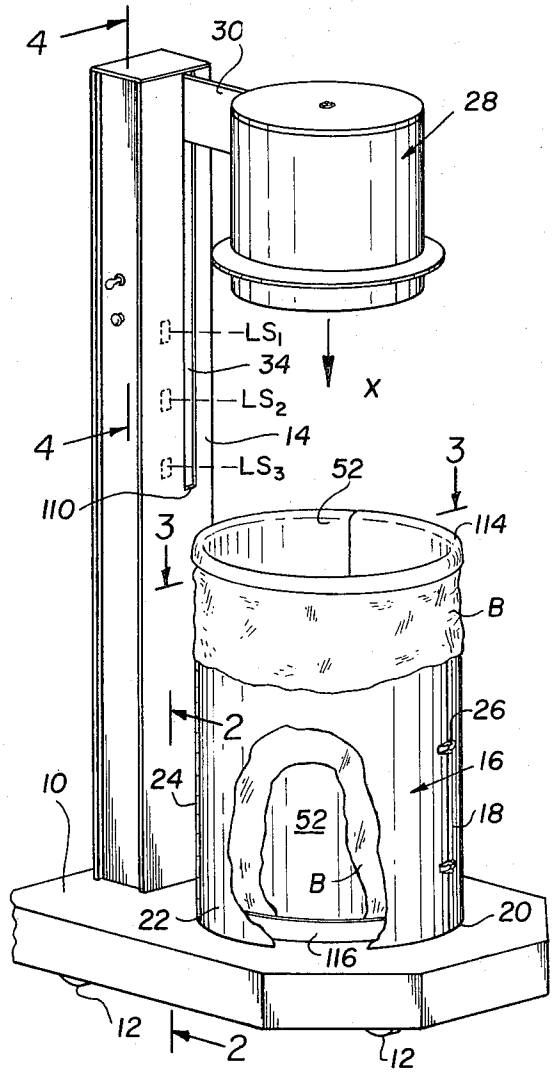
[57] **ABSTRACT**

A compactor comprising a base on which a container is secured. A column is fixed to the base and a ram is located movably in the column. The ram is moved into and out of the container to compact the refuse therein.


**7 Claims, 8 Drawing Figures**



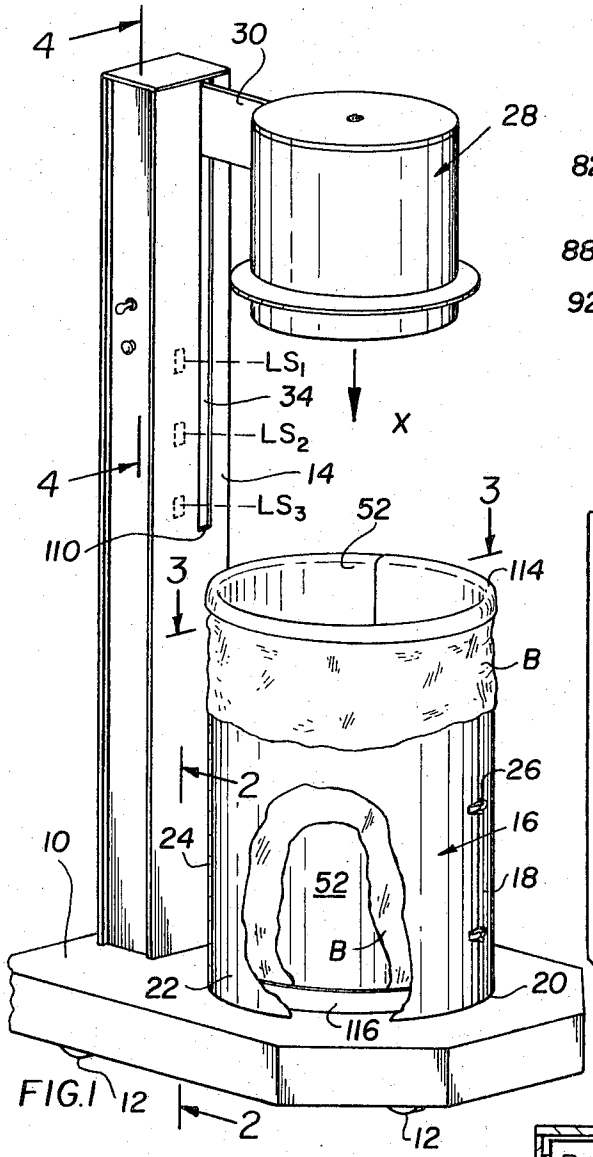



FIG.1

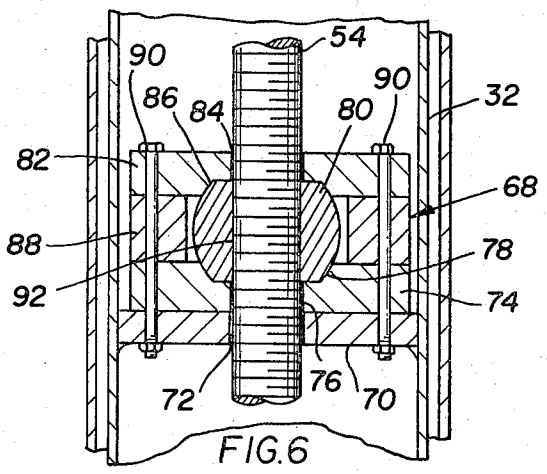



FIG.6

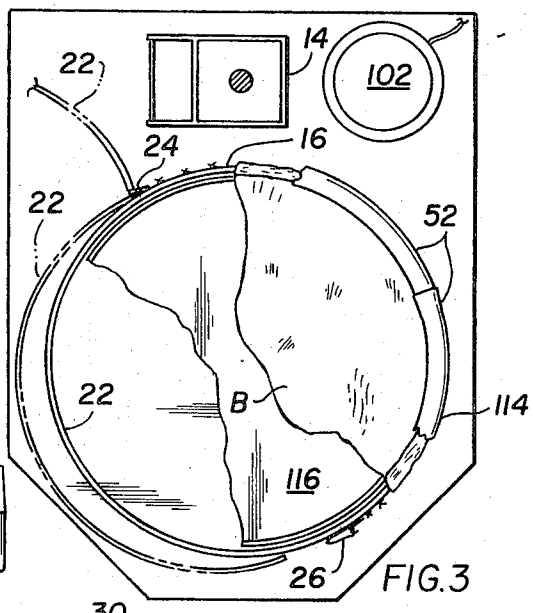



FIG.3

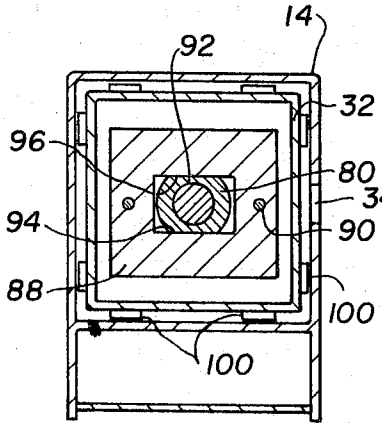



FIG.5

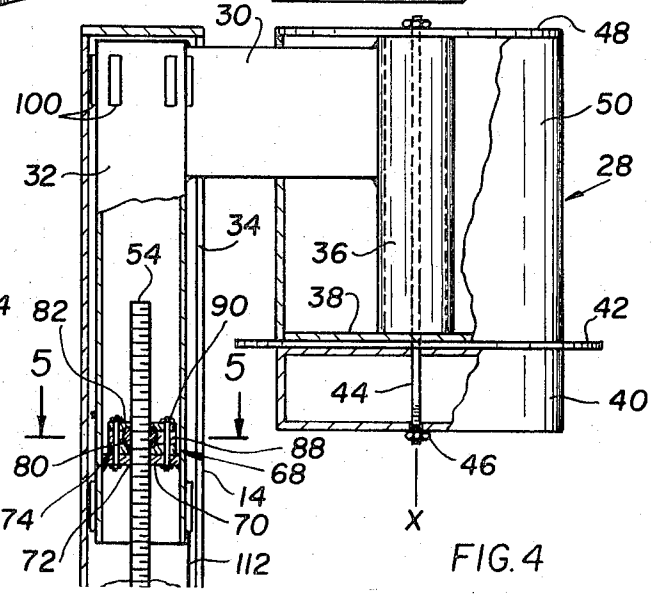



FIG.4

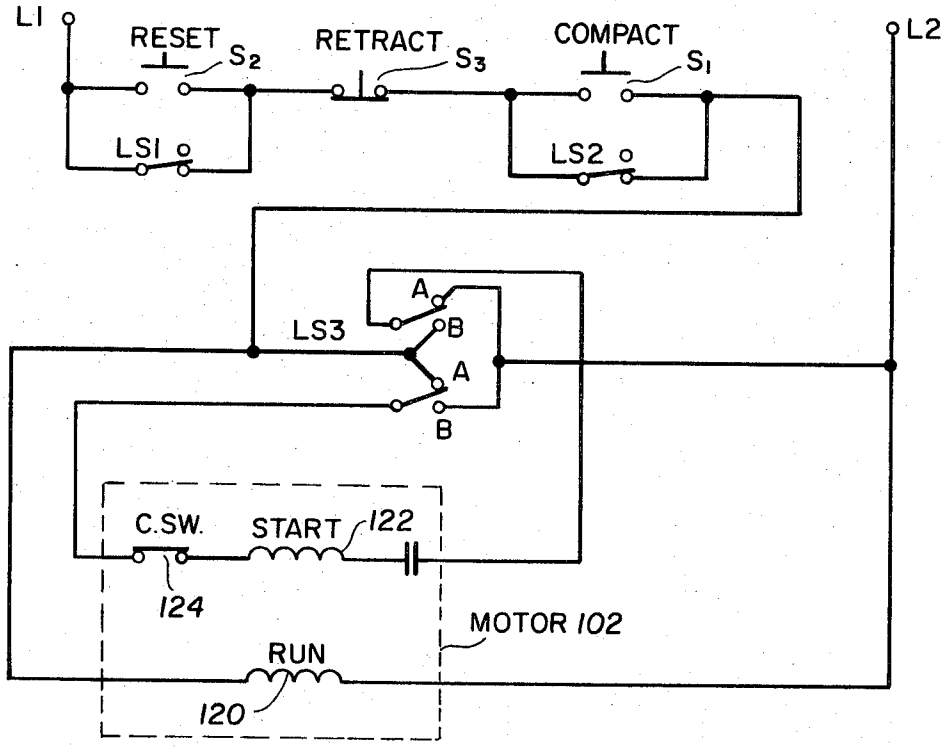



FIG. 7

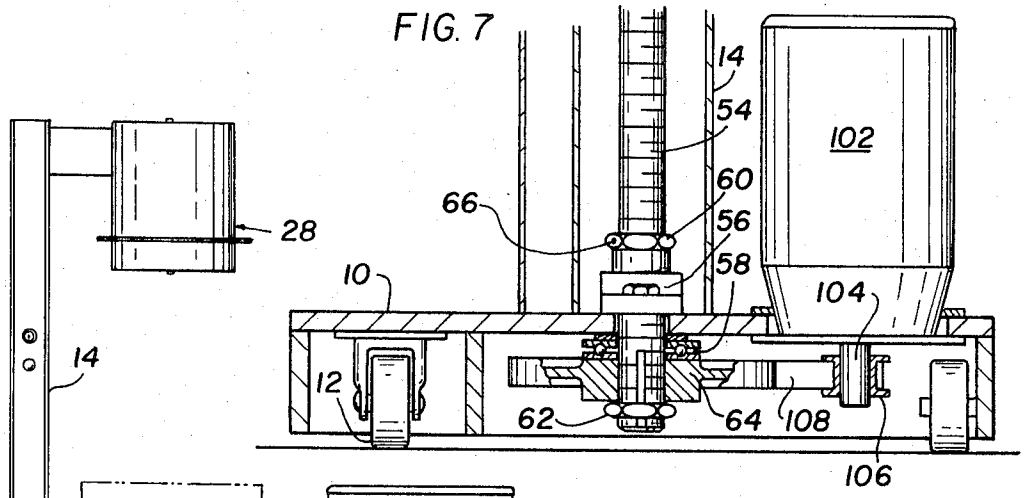



FIG. 2

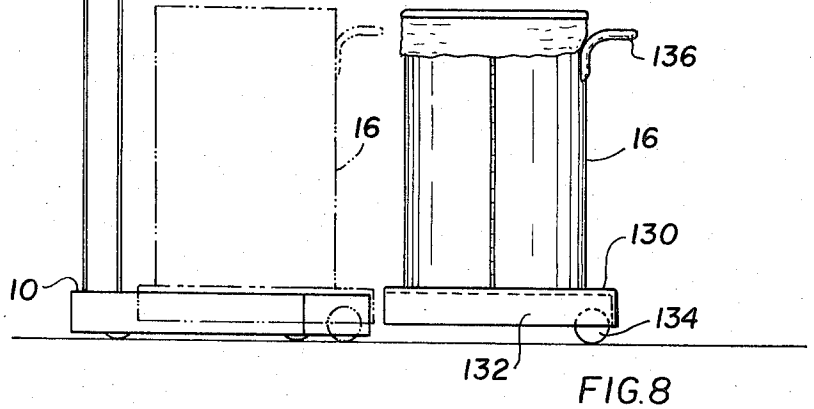



FIG. 8

# MOVABLE VERTICAL COMPACTOR

## BACKGROUND OF INVENTION

The present invention relates to apparatus for compacting refuse and in particular to apparatus for compacting household, restaurant and similar heterogeneous refuse.

Compacting devices are now in common use in large industrial and apartment house settings. Recently smaller home type units have been introduced. However, existing units are either too large or too small for extensive use in those situations where only moderate amounts of refuse are collected, or where refuse must be compacted and disposed of in fairly regular intervals, as for example, in restaurants, diners and the like.

It is the object of the present invention to provide a compacting machine which fills this need.

It is another object of the present invention to provide a compacting device capable of collecting refuse and permitting its easy and swift disposal.

It is also the object of the present invention to provide a compactor for refuse which is self-contained and which may be easily movable for use in selected locations or areas of restaurants, diners etc.

It is a further object to provide a vertical compactor of purely electro-mechanical design which is simple and easy to use and which is economical to purchase.

These objects, as well as other, together with numerous advantages will be seen from the following disclosure.

## SUMMARY OF INVENTION

According to the present invention a refuse compactor is provided comprising a base on which a container or can adequate to receive refuse is located and which has a vertical column extending adjacent thereto. A ram member is mounted on the column to be moved up and down into the container. Motive means are provided to move the ram upwardly and downwardly with sufficient pressure to compact the refuse in the container. Preferably the receiving container is secured to the base, however, it may also be removably mounted on a dolly or similar portable cart.

Preferably, the ram is formed of a heavy pressure plate or a heavy drum or cylindrical member forming the ram face. The ram is preferably cantilevered from the column so as to be freely movable above the container and is actuated by a jack screw connected to a ball and socket assembly secured to the ram. The jack screw is mounted to be freely rotatable on the base and is provided with bearing means to absorb the thrust loads.

The refuse is preferably compacted within a plastic bag which may be disposed with the fully loaded charge. A heavy plastic or sheet metal liner is provided which is distendable to insure that the bag is opened and kept open during use while insuring that the bag will not tear under compaction conditions.

These features, as well as full details, of the invention will be seen in the following description, and in the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a vertical perspective view of the device of the present invention,



FIG. 2 is a sectional view taken along lines 2—2 of FIG. 1,

FIG. 3 is a plan view partially in section taken in the direction of lines 3—3 of FIG. 1,

FIG. 4 is a section taken along line 4—4 of FIG. 1,

FIG. 5 is a sectional view taken along line 5—5 of FIG. 4,

FIG. 6 is an enlarged view of a portion of FIG. 4,

FIG. 7 is a schematic diagram of the control circuitry for operation of the present device, and

FIG. 8 is a view of modified form of base and a cooperating portable container.

## DESCRIPTION OF THE INVENTION

Turning to FIG. 1, the compactor comprises a base 10 of substantially flat heavy metal plate, to the bottom of which a plurality of wheels 12 are affixed. Rising form the rear of the base 10 is a vertical column 14, of rectangular cross section, formed of a heavy metal stock material. The column 14 has a generally hollow interior. In the embodiment seen in FIG. 1, a steel or heavily constructed container generally depicted by numeral 16 is affixed to the base 10. The container comprises a partial circular first wall 18, welded along its bottom edge to the base as seen at 20, and a second partially circular swingable wall 22 affixed to the first portion by a vertical piano hinge 24 or other hinge fastener. The wall sections 18 and 22 form a cylindrical container open at its upper end to receive a bag B, into which refuse can be dumped. The second section swings as seen in FIG. 3, as a door, so that it may be opened to remove the bag once filled. Suitable latch means 26 are provided so that the two sections may be closed together when the machine is in operation.

A cylindrical ram, generally depicted by the numeral 28, mounted on the end of a solid metal arm 30, is adapted to move up and down into and out of the container 16 so as to compact the refuse delivered to it. The arm 30 is mounted on carriage 32 which fits within the column 14 and rides through a slot 34 in the face of the column. The center of the cylindrical ram 28 is positioned along the vertical center line of the container 16, depicted by this arrow X, the various parts of the apparatus being so dimensioned as to provide this particular arrangement.

The ram 28 comprises, as is seen in FIG. 4, an inner tubular member 36 of heavy gauge metal, lying along the vertical central axis X; a pressure plate 38 welded to it, also of heavy gauge; a steel drum 40 closed at both ends forming the ram face and a circular flange-like shield member 42 of enlarged diameter. The flange 42 is made of flexible rubber or plastic material and is interposed between the drum 42 and the pressure plate 38. These parts are held securely together by an axial bolt 44 extending through their centers, closed on both ends by nuts 46. To complete the ram assembly for generally esthetic purposes a top cover 48 is secured to the tube 36 and an encircling shroud 50 is interposed between it and the pressure plate 38. The lower edge of the shroud 50 rests on the flexible shield 42 and is supported by the edge of the drum 40, so that as seen in FIG. 4, a smooth continuous exterior is formed.

The diameter of the drum 40 is smaller than that of the container 16 so that it may freely move into and out of the bag B when inserted within the container. The flexible shield 42 extends radially from the drum periphery and has a diameter just slightly smaller than the

container **16** so that it seals the annular space between the drum **40** and the bag B, thus preventing refuse from spilling out of the bag during compaction. As will be seen later a liner **52** may be placed within the bag to protect the bag. If so, the shield **50** will ride on it.

As seen in FIG. **4**, the tubular center post **36** of the ram is welded to the arm **30**. The arm itself is welded to the carriage **32**, which is of a cross section smaller than, but conforming to the column **14**, so that it is freely movable within it. Rising upward within the column from beneath the base **10** is an elongated threaded jack screw **54**. As seen in FIG. **2**, the jack screw **54** is held between a radial-thrust bearing **56** located on the top of the base **10** and an axial thrust bearing **58** located below the base. The bearings **54** and **56** are secured by a nut **60** threaded on the jack screw from below. A drive pulley **64** the purpose of which is to be later described, is sandwiched between the lower nut **62** and the thrust bearing **58**. By tightening the two nuts **60** and **62** the jack screw is secured to the base in a true vertical position, without limiting its ability to rotate. Set screws or pins **66** are provided in the nuts **60** and **62** to securely fix them in position on the jack screw once the desired or pre-elected compress between the bearing is attained. The radial thrust bearing **56**, of course, absorbs radial flexing, and vibratory forces sustained by the column while simultaneously absorbing the gravitational and downward axial thrust loads. The lower thrust bearing **58** absorbs the upward thrust or load created by the compaction cycle itself (i.e. the upward reaction thrust of the refuse against the downwardly driven ram). Thus, it will be seen that together the bearing **56** and **58** absorb all of the load of the compactor cycle, while permitting the jack screw to rotate although as the jack screw rotates it does not move upwardly or downwardly because of the fixed position of the bearings about the base.

The carriage **32** is secured to the jack screw **54** by a universal ball and socket assembly generally depicted by the numeral **68**, seen in greater detail in FIG. **4** and **6**. The assembly **68** comprises a flat horizontal supporting plate **70** welded to the inner walls of the carriage **32**. The support **70** has a central bore **72** through which the jack screw **54** extends. Resting on the support **70** is a first race member **74** having a central annular hole **76** concave bevelled at its upper inner edge **78**. The bevelled edge **78** receives a ball **80** having a generally spherical exterior, although flattened at its poles. A second race member **82** also having a central annular bore **84** bevelled as at **86** to conform to the ball **80** is arranged to seat on the ball in a position opposite to that of the first race member. A spacer **88** is arranged between the race members to maintain the upper race **82** parallel to the lower race **74**. The upper and lower races together with the spacer are clamped together by a plurality of bolts and nuts **90**. The ball **80** itself is provided with a central bore **92** having an internal thread conforming to the thread of the jack screw **54** which is obviously mated.

As seen in FIG. **5** the central spacer **88** has a rectangular inner edge **94** while the exterior equatorial surface of ball **80** is provided with hands **96**. The flats of the inner edge **94** match with the sides **96** of the ball **80**, forming a key way and key respectively which prevents rotation of the ball **80** about the axis of rotation of the jack screw **54**. Thus as the jack screw **54** is rotated only the linear axial components of its screw thread is transmitted to the ball **80** causing the ball to ride upwardly or downwardly on the screw. As the ball **80** rides in the described manner, it carries the assembly of races **74** and **82** and consequently the carriage **32** with it. The bolts and nuts **90** are pre-set to a desired compression to provide for the conjoint vertical movement of the ball and races without any undue play or vibration while permitting sufficient slidability to allow the ball to rotate within the socket should a sudden shock, torque or other unwanted pressure applied to the ram be transmitted to the carriage **32**. For additional stability, glide members **100** are secured to the upper and lower extremities of the carriage **32**. The glides **100** may be brass, nylon or any suitable low friction material and fit between the walls of the carriage and the inner walls of the column in sliding frictional engagement. It will be noted that the upper end of the jack screw **54** is free and is borne against radial flexure only by the bearing means affixed to the base and by the combination of ball socket assembly and the carriage at its upper end.

Mounted on top of the base to provide additional weight and to provide a unitary machine is the drive motor **102**. A conventional reversible electric motor of about 1½ horsepower preferred in order to provide the necessary compaction forces. As seen in FIG. **2**, there is extending from the motor beneath the base **10** is drive shaft **104** to which a pulley **106** is secured. Connecting the pulley **106** with the previously mentioned pulley **64**, is an endless timing belt **108** with molded teeth. The pulley **106** and **64** have mating teeth. The timing belt arrangement is preferred because it does not slip and maintains a low noise level. It may, however, be replaced with a chain, or suitable gear transmission by which a direct transmission may be obtained.

The elongated slot **34** in the face of the column **32** terminates at its lower end in a fixed stop **110** against which the arm **30** abuts. This limits the downward movement of the ram **28**. A shield **112** may be used to fixed to carriage **32** or arm **30** to the slot **34** during the up ward movement of the ram.

If desired the wheels **12** may be retractable so that while the entire unit can be moved from one location to another, the base may be made to rest squarely on the ground. Alternatively, stop members may fix the wheels in non-rotatable position when operating the machine.

In operation, a bag B preferably light plastic material is inserted into the closed and latched container **16**. To maintain the bag in open position and to prevent it from abrading or tearing on the movement of refuse within it, a liner **52** is provided. The liner **52** is preferably of a heavy grade plastic material such as ⅛ inch thick P.V.C. or low density polyetheline. The liner generally is in a cylindrical form split along its length, in a direction parallel to its axis. The liner **52** is open at its bottom and has a curved lip **114** at its upper end adapted to overlie the upper edge of the container. The split in the liner **52** permits it to be inserted in the empty bag with ease and also enables the refuse to be dislodged from it when it is removed. The lip **114** maintains the liner in position during operation. A tray **116**, also of plastic, may be inserted in the container beneath the bag B in order to capture any loose refuse or water.

Once the bag and liner **52** are inserted, refuse can be delivered to the container at will. At periodic intervals

an attendant will actuate the motor **102,** turning the jack screw **54** causing the ram **28** to descend and compact the refuse therein. When a sufficient load of refuse has been compacted, or when the arm **30** abuts against the slot stop **110** the motor reverses itself to lift the ram. When a full load has been compacted the liner **52** is removed, the swingable wall **22** is opened revealing the full bag which can then be removed laterally from the container.

It is intended to provide this apparatus as a single cycle-single bag compactor. That is, the activation of the motor at any one time causes movement of ram downwardly and upwardly in a single cycle. Depending on the nature of the refuse, a fully loaded bag may be obtained by operation of the ram only once or by multiple cycling of the ram. As a feature of the present invention there is provided a novel method and circuit for controlling this operation.

As seen in FIG. **7,** a single phase capacitor-start motor is used connected to commonly available AC or DC current through leads L1 and L2. It is provided with a running winding **120** and a start winding **122.** The start winding **122** is controlled by a centrifugal switch **124.** In series with the centrifugal switch **124** and the start winding **122** is a limit switch $LS_3$ which is connected to a parallel arrangement of second limit switch $LS_2$ and an operating compact switch $S_1$. A reset switch $S_2$ and a parallel limit switch $LS_1$ are provided as an emergency switch system. A retract switch $S_3$ is interposed in the line to permit the emergency retracting of the ram.

The limit switches are mounted within the column to contact the carriage **32** as seen in FIG. **1.** Limit switch $LS_1$ is normally closed and arranged to contact the carriage **32** only when it is at a position above its normal upper rest position. Thus, should the motor or any extraneous factor cause the ram to move upward to a higher position than normal, and tend to ride off the jack screw **54,** $LS_1$ will open, cutting out all power to the apparatus. The ram may be lowered by operating the reset switch $S_2$. Located below the $LS_1$ switch and in a position to contact the carriage when the ram is in its normal upward rest position is the switch $LS_2$. Switch $LS_2$ is normally closed, but is opened by the contact with the carriage in the up position. The switch $LS_2$ is bridged by the compact switch $S_2$ which must be closed in order to start operation. The third limit switch $LS_3$ is located below $LS_2$. In the rest position the switch $LS_3$ does not contact the carriage. $LS_3$ comprises a pair of double throw switches, each having terminal contacts A and B; the contacts A are normally closed when $LS_3$ is out of contact with the upward resting carriage and open (simultaneously closing contacts B) on the downward movement. $LS_3$ moves between contacts positions A and B on the alternate upward and downward movement of the carriage.

In the normal rest position, the ram is up, opening $LS_2$ to prevent operation of the motor and thus maintain the device stationary. On depressing both the compact switch S2 current is supplied via the A contacts of $LS_3$ to actuate the motor via the start winding **122.** The motor **102** starts immediately and the ram moves downwardly. As the ram moves downwardly $LS_2$ closes and $LS_3$ changes over to the contacts B.

As the motor reaches its full speed the centrifugal switch **124** opens cutting out the start winding **122.** Simultaneously the descent of the carriage has caused reversal of the limit switch $LS_3$, switching current from the contacts through the contacts B. This switching action causes a change in current phase between the start and running windings of the motor. (If DC power is used the change is in current polarity). When the ram reaches its full down position, (arm **30** abutting against stop **110**), or when the refuse being compacted exerts a strong enough back pressure on the ram the drag on the motor causes its armature to slow down. When the armature slows sufficiently, the centrifugal switch **124** cuts back in placing current through the start winding **122.** Since the current is out of phase with the running current (or of different plurality), the running winding of the motor is caused to reverse its direction, driving the ram upwardly.

As the ram moves up, the motor picks up speed and the centrifugal switch opens again, permitting the motor to run solely on current through the running winding. As the ram rises further it passes the limit switch $LS_3$ causing it to again reverse contacts A and B to its original position. The ram continues upward until $LS_2$ is opened, shutting off power to running motor winding so that the armature stops and the centrifugal switch again closes. Should the ram exceed its normal upward position the limit switch $LS_1$ opens insuring complete shut-off of power.

In the normal rest position current is, when the compact switch $S_1$ is closed, supplied via $LS_1$ and $LS_3$ to both the start and running winding of the motor. Once the ram begins to descent, switch $LS_2$ closes and the compact switch $S_1$ need not be kept closed. The windings are arranged so that in this condition the motor acts to maintain the ram in its full up position. If the ram is not in its full rest position, the switch $LS_2$ remains closed, thus permitting the ram to move upwardly to it. Descent and ascent of the ram is obtained by reversal of the leads to the start winding. As a safety measure, the compact switch $S_1$ is preferably a key switch, so that only authorized attendants may operate the compact cycle.

It is to be noted that the switch $LS_2$ and $LS_3$ are opened or closed only when (i.e. at the time) a very small back EMF or inductive load is placed on the motor windings and not when the full load is exerted in the full down position. The switches are located so that they are triggered before the ram gets full down or full up. The reset $S_2$ and contact switch $S_2$ are spring load, they open on release and need only be depressed sufficiently to permit the ram to move. The retract switch $S_3$ is an emergency switch which is normally closed. When opened, it completely stops the operation of the ram and the drive apparatus stopping the machine in whatever position it is found.

In the embodiment seen in FIG. **8,** the container is formed as a movable dolly. The cylindrical hollow can **16** is mounted on a base **130** having depending side skirts **132** to which a pair of wheels **134** are rotatably fixed at their rear ends. A handle **136** is fixed to the stationary segment of the can **16.** The can **16** is otherwise formed as described in connection with FIG. **1.** The compactor itself is otherwise formed as in the embodiment previously described, except that the base **10** is flat and not provided with a can **16.** The dimensions of the base **130** and skirts **132** are such that they are slightly larger than the base **10** of the compactor so that the dolly may be wheeled up to the compactor and the base **130** allowed to fit over and rest on the compactor

base as seen in the dotted outline of FIG. **8.** Thus, the base **130** of the dolly need not be made of sheet metal or other heavy material, although it may be so if desired. The base **130** merely rests on the compactor base **10** and thus does not absorb shocks or stress. It's purpose merely is to carry the container **16.**

The portable dolly has a unique advantage, in that a single compactor may be used with multiple containers. Thus, in a large restaurant such as quick food establishments, a number of dollies may be scattered over the dining room, which, when full can be wheeled to the compactor for compaction of refuse. The container **16** may be provided with bag, liner, etc., and the compactor operated in the same manner as previously described.

Various changes, modifications, and improvements may be made on the embodiment shown. It is intended, therefore, that the present description be taken as illustrative only and not as limiting of the present invention.

What is claimed is:

**1.** A refuse compactor comprising a base adapted to receive a container for refuse, a vertical column rising above said base, a carriage mounted within said column to be freely movable therein, an arm extending outward of said column cantilevered above said base from said carriage, a ram mounted at the end of said arm in line with said container, an elongated jack screw rotatably mounted on said base and extending vertically within said column, interconnecting said jack screw and said carriage comprising a ball threaded about said jack screw and a socket assembly slidably mounted about said ball and secured to said carriage, providing a universal joint permitting said carriage to move vertically on rotation of said jack screw and to move angularly relative to the axis of the jack screw and means for selectively rotating said jack screw to move said ram into and out of said container.

**2.** The compactor according to claim **1** wherein at least one of said carriage and column are provided with slide members adapted to limit the relative movement of said carriage.

**3.** A refuse compactor comprising a base adapted to receive a container for refuse, a vertical column rising above said base, a carriage mounted within said column to be freely movable therein, an arm extending outward of said column cantilevered above said base from said carriage, a ram mounted at the end of said arm in line with said container, an elongated jack screw rotatably mounted on said base and extending vertically within said column, a ball and socket assembly interconnecting said jack screw and said carriage, said ball and socket assembly comprising a ball located between a pair of race members, a spacer separating said race members, said spacer and said ball being provided with engaging key and key way means to prevent rotation about the central axis providing a univeral joint permitting said carriage to move vertically on rotation of said jack screw and to move angularly relative to the axis of the jack screw and means for selectively rotating said jack screw to move said ram into and out of said container.

**4.** The compactor according to claim **3** including means for securing said race members and spacer about said ball, said means being adjustable to vary the pressure of said race members against said ball.

**5.** A refuse compactor comprising a base adapted to receive a container for refuse, a vertical column rising above said base, a carriage mounted within said column to be freely movable thereon, an arm extending outwardly of said column cantilevered from said carriage, a ram mounted at the end of said arm in line with said container, an elongated jack screw rotatably mounted on said base and extending vertically freely within said column, and means interconnecting said jack screw and said carriage, to cause said carriage to move on rotation of said jack screw, said jack screw being supported at its lower end by a radial axial thrust bearing secured to said base rotatably journalling said jack screw above said base and an axial thrust bearing secured to said base rotatably journalling said jack screw below said base and means for rotating said jack screw.

**6.** The compactor according to claim **5** wherein said means for rotating said jack screw includes a reversible motor, means connecting said motor to said jack screw and means for controlling said motor to rotate said screw in selected directions.

**7.** The compactor according to claim **4** including wheels mounted on said base to permit said compactor to be movable.

* * * * *