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Engebretsen

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[54] **COMPACTOR DRIVE SYSTEM**

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[52] **U.S. Cl.**..... **100/53,** 100/229 A, 100/278, 100/290, 74/242.11

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

[58] **Field of Search** ..... 100/53, 229 A, 278, 290; 74/242.11 R

[56] **References Cited**

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Primary Examiner—Billy J. Wilhite

Attorney, Agent, or Firm—Biebel, French & Bugg

[57] **ABSTRACT**

A compactor has a compacting ram driven by jack screws and cooperating sprockets which are rotated by a drive chain wrapping the sprockets and a drive sprocket. The drive chain is maintained in taut, sprocket engaging relationship to both the drive and driven sprockets by means of a pair of tensioning sprockets pivotally mounted on the ram and urged toward each other into engagement with the drive chain by means of a coil spring. A split-phase start reversible induction motor is connected to rotate the drive sprocket and the slack in the chain, taken up by the spring, is sufficient to allow the motor to start in an essentially unloaded condition, particularly after the ram has compressed a quantity of trash and the motor is starting to withdraw the ram.

6 Claims, 4 Drawing Figures

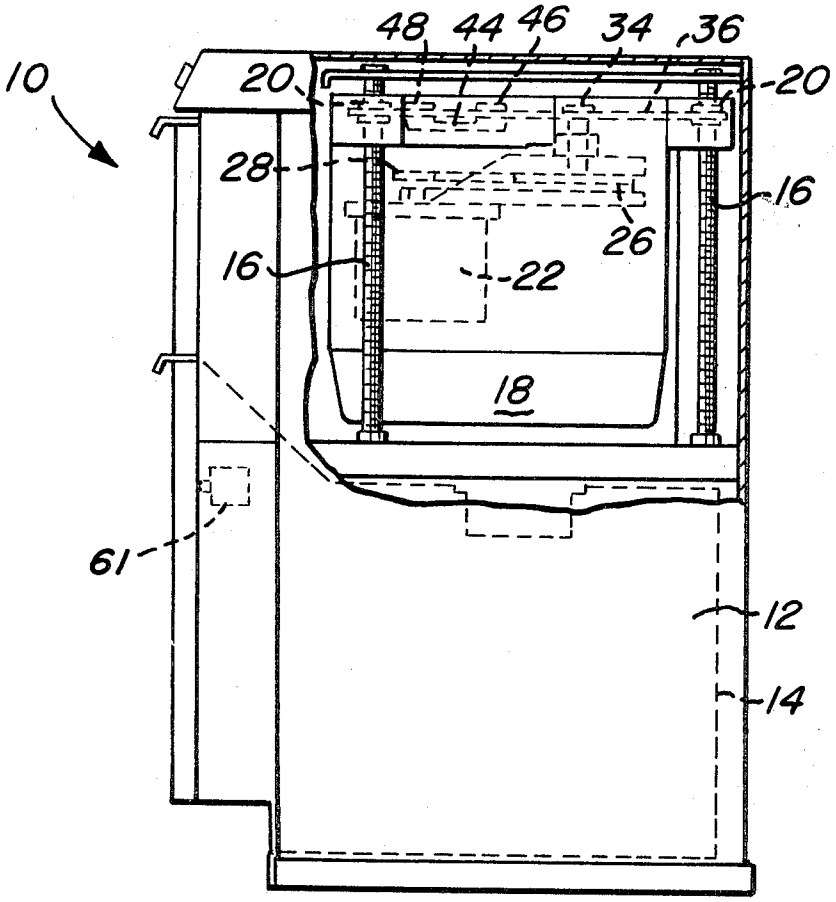


FIG-1

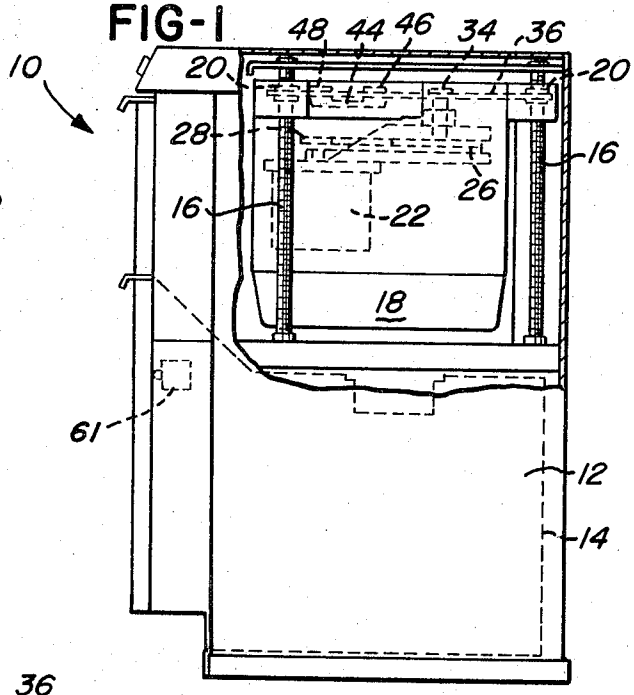


FIG-4

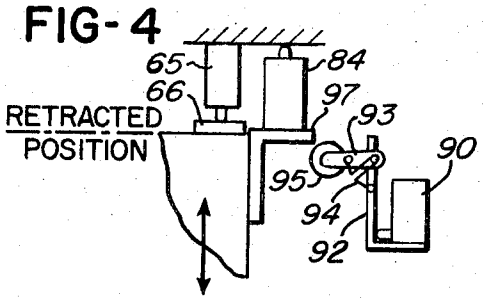


FIG-2

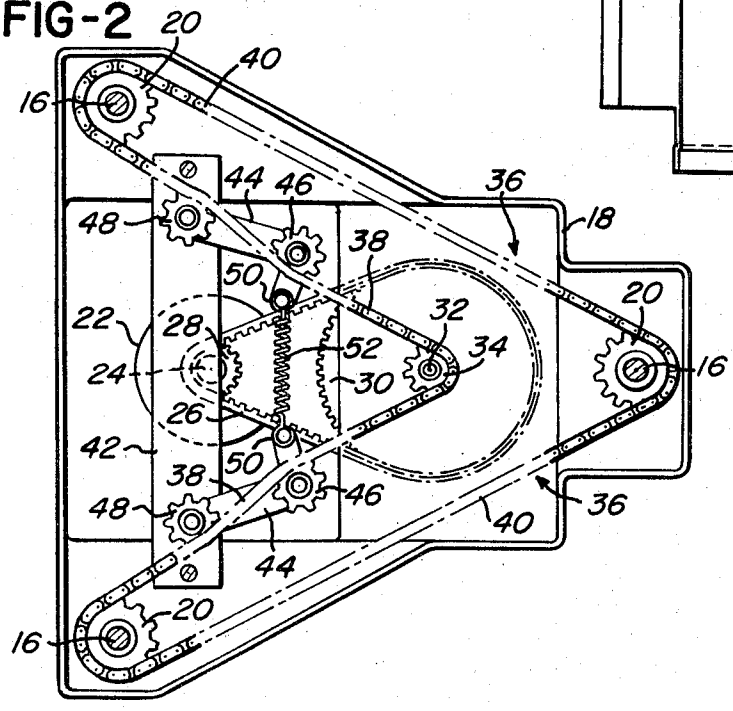
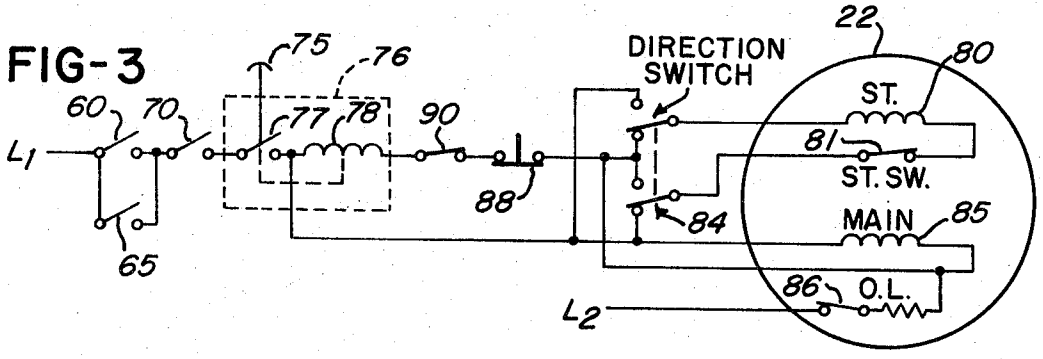


FIG-3



COMPACTOR DRIVE SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

COMPACTOR AND DRIVE ASSEMBLY, Ser. No. 194,891, filed Nov. 2, 1971, now U.S. Pat. No. 3,734,009 and COMPACTOR DRIVE CHAIN TENSIONING APPARATUS, Ser. No. 224,775, filed Feb. 9, 1972, now U.S. Pat. No. 3,757,683.

BACKGROUND OF THE INVENTION

In the above noted, related applications a trash compactor is disclosed which includes a housing with an open top receptacle and a ram mounted for movement along jack screws into and out of the receptacle to compact waste material therein.

The ram is provided with driven sprockets engaging the jack screws so that upon rotation of the sprockets the ram will move upwardly and downwardly along the jack screws. The ram also carries a reversible electric motor powering a drive sprocket, and a drive chain wraps the drive sprocket and the driven sprockets to move the ram along the jack screws.

For efficient operation, the chain is in positive engagement with each of the drive and driven sprockets. This can be achieved merely by adjusting the sprockets, and/or an idler device to maintain the chain substantially taut, but this in turn requires rather careful adjustment of the drive assembly. The installation and operation of a drive assembly of the type described above is simplified by purposely utilizing a drive chain of a length such that there is appreciable slack therein and providing a pre-loaded but yieldable tensioning device engaging the chain and maintaining it in positive engagement with the drive and driven sprockets.

In a preferred embodiment of the invention the tensioning device comprises a pair of arms pivotally mounted adjacent one of their ends to a supporting member near at least one flight of the chain. Tensioning sprockets are mounted on the bell cranks in a position such that pivoting of the bell cranks brings the tensioning sprockets into engagement with opposed reaches of the drive chain.

A yieldable preloading of the arms is obtained by a coil spring attached to and extending between the arms, urging them toward each other and resiliently pressing the tensioning sprockets into engagement with the opposed drive chain reaches.

SUMMARY OF THE INVENTION

By using such a drive chain and tensioning arrangement, sufficient yield is provided in the slack takeup mechanism to present only a slight load to the drive motor on starting. As the motor begins to rotate and accelerate, initially it pulls the chain against the preload of the takeup mechanism until the chain is taut in the pulling direction of the drive sprocket. The effort and effect of the takeup mechanism is transferred to the opposite or pay-out side of the drive sprocket. Then the chain begins to pull on the driven sprockets.

This arrangement permits the use of a motor having lower starting torque, since the motor is not effectively loaded until it has started to rotate, rather than having to start against a heavy load. Thus, even if the ram be somewhat wedged or jammed after completing its compaction stroke, the motor effort to start the ram in retraction does not begin until after the motor has begun to rotate from its stopped or stalled condition.

The primary object of the invention is thus to provide a novel and efficient drive system for trash compactors and like devices, as outlined above.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevational view of a compactor in accordance with the present invention with portions broken away for clarity;

FIG. **2** is a plan view showing a drive assembly for the compactor incorporating the present invention;

FIG. **3** is a diagram of motor control circuit.

FIG. **4** is a detailed view illustrating the relationship of the compactor ram and certain switches of the control circuit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As seen in FIG. **1** of the drawings, a compactor **10** in accordance with the present invention includes an upright compactor housing **12.** An open receptacle **14,** for example in form of a drawer, is slidable between a compacting position, shown in FIG. **1,** and a loading-unloading position withdrawn from the housing to the left.

Three triangularly arranged, stationary jack screws **16** are mounted in the housing in spaced parallel relationship to each other, with a single jack screw positioned adjacent the rear of the housing **12** and the remaining two jack screws positioned adjacent each of the front corners thereof.

As shown in FIG. **2,** a ram **18** is provided with internally threaded sprockets **20** rotatably mounted thereon and threadably engaging the stationary jack screws **16.** Ram **18** also carries a motor **22** having a drive shaft **24** and a drive belt **26** connects a pulley **28** on the drive shaft **24** to a large pulley **30** fixed to one end of the countershaft **32** which carries a drive sprocket **34** at its opposite end.

A drive chain **36** wraps around the drive sprocket **34** and each of the internally threaded sprockets **20.** The chain path includes inner chain reaches **38** and outer reaches **40.** Thus the chain path is generally in the form of a double V, one within the other. A support bar **42** is also mounted on the upper surface of ram **18** and a pair of opposed arms **44** are pivotally attached to the support bar **42** for movement toward and away from each other.

Each of the arms **44** carries a tensioning sprocket **46** rotatably mounted thereon. In addition adjacent the point of pivotal attachment of the arms to the support bar **42** there are rotatably mounted idler sprockets. The sprockets **46** and **48** engage opposite surfaces of the inner chain reaches **38,** as shown in FIG. **2.**

The ends **50** of the arms extend toward each other and are interconnected by a coil spring **52,** which resiliently urges the two pivotally mounted arms toward each other. As a result, the tensioning sprockets **46** are each drawn inwardly against the drive chain, lengthening the path between idler sprockets **48** and the drive sprocket **34,** to maintain the chain in taut relationship to the sprockets regardless of the direction of rotation of the drive sprocket **34.**

A safety interlock switch **60**, the housing for which is shown at **61**, is mounted inside the front of the housing and is engaged by a pin (not shown) when the receptacle **14** is in its compacting position.

A further interlock is provided by the normally closed switch **65** which is wired in parallel with switch **60**. Switch **65** is operated by a bracket **66** (FIG. **4**) carried by ram **18**, and arranged such that the switch is opened when the ram lower surface is slightly below the upper edge of the receptacle, preferably about one inch below this edge. In other words, switch **65** is closed only when the ram has entered, or not yet cleared, the receptacle.

Referring to FIG. **3**, the control system is shown. Interlock switch **60** is closed only when drawer **14** is closed, and it controls all power to the unit together with key switch **70**. Contacts are shown in the position with the drawer open, the ram up, motor stopped, and the key safety switch open. With the key switch **70** operated to close, and the drawer closed, pushing the start button **75** on starting relay **76** will close its contact **77** and energize its coil **78** to seal in the relay. This also applies power from source lines L1–L2 to the starting winding **80** of the ram motor **22**, through the motor's centrifugal starting switch **81**, and through the contacts of a directional switch **84**. The power circuit is completed to main winding **85** through the overload protector **86**.

The holding circuit for relay **76** includes its coil **78**, manual stop switch **88** which is normally closed, a normally closed ram-operated switch **90**, and the overload protector **86**. Switch **90** is arranged to be opened momentarily by the ram only when it is nearing the top of its return stroke. Its operating lever **92** has an outwardly extending arm **93** pivoted thereon, normally held by a spring **94** in the extended position as shown. A roller **95** on the arm is in position to engage an arm **97** extending from the ram **18**. On the downward stroke switch **90** is unaffected and remains closed, but on the upwardly retracting stroke the switch is momentarily opened just as the ram approaches its fully retracted position. Directional switch **84** is carried by the ram and is held in the position shown only when the ram is fully up. When the ram is in any other position, the blades of switch **84** transfer to the contacts shown open.

Thus, as power is first applied the motor **22** starts in a direction to lower the ram in a compacting stroke. The motor immediately comes up to speed, since it is under only a slight load, and switch **81** opens and transferring of the contacts of switch **84** has no effect on motor direction. However this change in the direction switch prepares the circuit for reversing the motor as soon as the compaction stroke is resisted enough to slow the motor to a speed where switch **81** closes. The motor immediately reverses, withdrawing the ram, and near the end of the upward stroke switch **90** momentarily opens, deenergizing coil **78** of the starting relay. The motor coasts to a stop past the actuation position of switch **90**, so that it again closes. Switch **84** is moved to the position shown, such that the circuit is ready for the next compacting stroke, just before switch **90** is actuated.

After a compacting stroke begins switch **65** closes, bypassing interlock switch **60** since the ram is now inside the receptacle. Thereafter, if stop switch **90**, or key switch **70**, is opened, or the motor overload protector **86** opens, the circuit energizing relay **76** will be broken, and the motor will stop. Subsequent operation of the start button **75** will energize the motor to drive the ram upward, provided the appropriate switch contacts are then closed.

When the ram **18** is in its maximum downward position, i.e., compacting a load of trash in the receptacle, all the kinetic energy of the motor is expended through the motor drive into the load resisting ram motion. A relatively high force can thus be exerted between the jack screws and the threaded driven sprockets **20**, and under this condition with the motor stalled, substantial torque is required to rotate the motor even in the reverse direction tending to retract the ram. In the prior art it has been the practice to employ a capacitor start motor, or in some cases a universal motor, or equivalent high starting torque motor to assure that sufficient starting torque is available to release the ram from this maximum force position.

In the present invention, a less expensive and longer life type of motor can be employed, such as a simple induction motor, since the tensioning mechanism above described permits the motor to commence rotation in a direction to retract the ram, at least for a fraction of a motor revolution, before the heavy load is encountered. In an actual embodiment, about one-half of a motor revolution is provided. This fraction of a revolution is sufficient to build up a substantial amount of kinetic energy in the motor rotor, and this in turn is sufficient energy to break any jammed condition and allow the drive to proceed in a direction retracting the ram. For example in an actual embodiment, using a 0.5 H.P. induction motor, tests have shown the motor to be rotating at approximately 600 to 700 rpm within the one-half revolution of the motor.

Referring to FIG. **2**, it will be seen that if for example the ram has been driven to its compacting position, the drive system will have halted with the pullies **28** and **30**, and the drive sprocket **34**, rotating in a counterclockwise direction. The lower reach **38** of the drive chain will be under tension, and the chain tensioning or slack adjusting mechanism will be shifted slightly in the direction of the upper chain reach **38**.

As the motor starts in the opposite direction, the drive sprocket **34** will first draw against the slack upper chain reach **38**, which is being held under sufficient operating tension by the action of the spring **52** and the wrap of the chain between sprockets **46** and **48**. In the meantime the sprocket **34** and pulley **30** will have rotated through a fraction of revolution, e.g., about 37.5° in the previously mentioned embodiment, and due to the reduction provided by the belt drive, the drive pulley **28** and the motor rotor will have made about one-half of a revolution. Thus the motor rotor will be moving at an appreciable velocity and will be in an accelerating mode by the time the full load required to break loose the driven sprockets is encountered by the drive mechanism. The kinetic energy available from this intial lightly loaded start of the motor is sufficient to continue the retracting motion even though there may be substantial initial resistence as the ram is moved away from the position where it stalled at the end of the compacting stroke.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be

made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a trash compactor having a housing with an open trash receptacle, a reciprocable compacting ram movable into and out of said receptacle, and a reversible electric motor for driving said ram; the improvement comprising

a driving connection between said motor and said ram including a yieldable force transmitting member connecting said motor to said ram and constructed and arranged to permit said motor to commence rotation before exerting a moving effort against said ram at least in the direction of retracting said ram from said receptacle after compacting trash therein.

2. In a trash compactor as defined in claim **1**, said driving connection including a drive sprocket rotatably driven by said motor, at least one driven sprocket connected to move said ram, a drive chain connecting said sprockets, said chain having greater length than the shortest path for connecting said sprockets to leave some slack in said chain, said yieldable member engaging said chain and taking up the slack in that portion of said chain passing from said drive sprocket when the ram is being driven into said receptacle whereby at the end of a compacting stroke of said ram and reversing of said motor the initial rotation of said motor is resisted primarily by said yieldable member until the slack is taken up in said portion of said chain.

3. In a trash compactor as defined in claim **1**, said motor being a split-phase start reversible induction motor, and said driving connection including a speed reducing connection between said motor and said yieldable force transmitting member.

4. In a compacting machine having a receptacle for trash material, a ram mounted for compacting movement in a compacting stroke entering said receptacle and an opposite retracting stroke to a retracted starting position, a power supply, a reversible motor connected to drive said ram, a directional switch connected to control the forward and reverse operation of said motor corresponding to the compacting and retracting strokes of said ram, means urging said directional switch into its reverse position, means moving said directional switch to its forward position only when said ram is at its starting position, a plurality of jack screws mounted adjacent said receptacle in spaced parallel relationship to each other and extending in the direction of movement of the receptacle, drive means for causing said ram to move along said jack screws, said drive means including a drive sprocket rotatable by said motor, a driven sprocket connected to each of said jack screws, a drive chain wrapping said drive sprocket and said driven sprockets with some slack in said chain, tensioning means engaging said chain on opposite sides of said drive sprocket, means mounting said tensioning means for movement in a direction normal to the axis of rotation of said sprockets, and means resiliently urging said tensioning means in said direction normal to the axes of rotation of said sprockets to take up the slack in said chain producing a taut driving relationship of said sprockets while permitting some relative movement between said drive and driven sprockets during starting of said motor.

5. The compactor of claim **4** wherein said chain tensioning means includes a pair of movable arms each carrying an idler sprocket, and means mounting said arms for pivotal movement toward and away from said chain with the axes of pivotal movement of said arms and the axes of said idler sprockets, drive sprocket and driven sprockets extending in parallel relationship to each other.

6. A compactor as defined in claim **4** wherein said resilient means is a spring connected at its opposite ends to said arms such that tension in the chain on one side of said drive sprocket will reflect through said spring and said arm to take up slack in the chain on the other side of said drive sprocket.

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