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[56]

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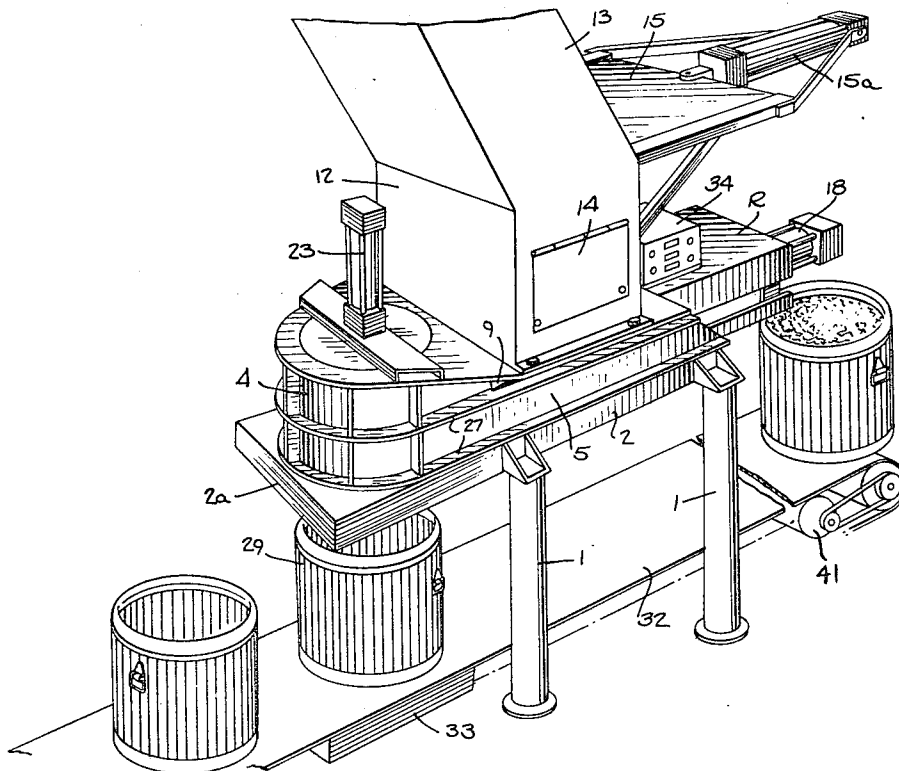
[54] **GARBAGE COMPACTOR**
19 Claims, 20 Drawing Figs.

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21/61, 53/124, 100/49, 100/50, 100/52, 100/53,
100/74, 100/98, 100/99, 100/215, 100/218,
100/251, 100/256, 100/295, 141/12, 141/71

[51] Int. Cl..... **B30b 13/00,**
B30b 15/16

[50] Field of Search..... **53/124;**
141/71, 73; 100/45, 49, 50, 51, 52, 53, 70-75,
215, 218, 99, 295, 269, 229, 41, 256, 251, 35;
21/61; 141/12

ABSTRACT: A garbage compactor has a compacting chamber into which garbage, including refuse is compacted by a ram, after which the garbage is ejected into a portable container. A hydraulic and electrical operating and control system permits the compactor to operate without constant attendance by an operator.



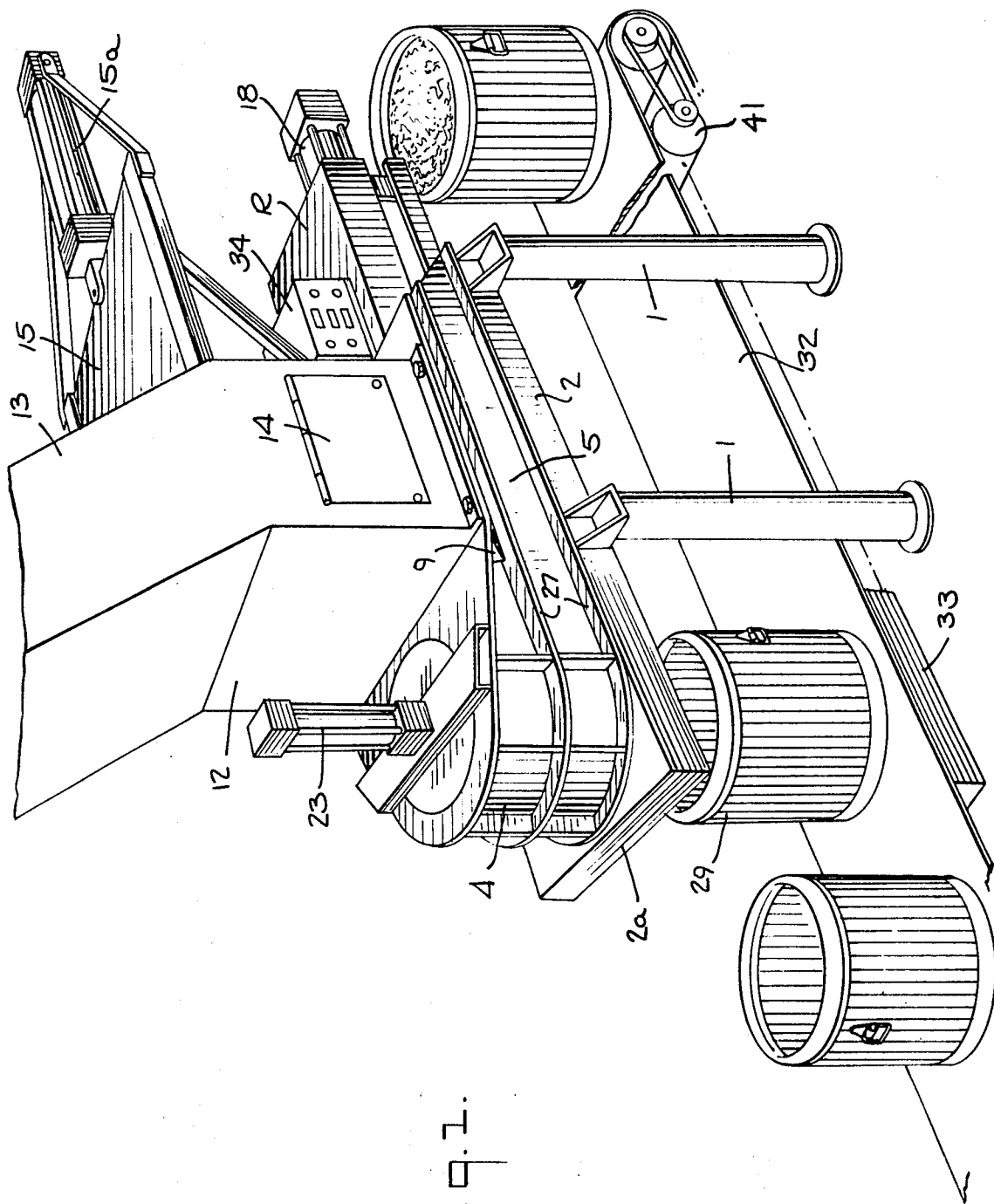
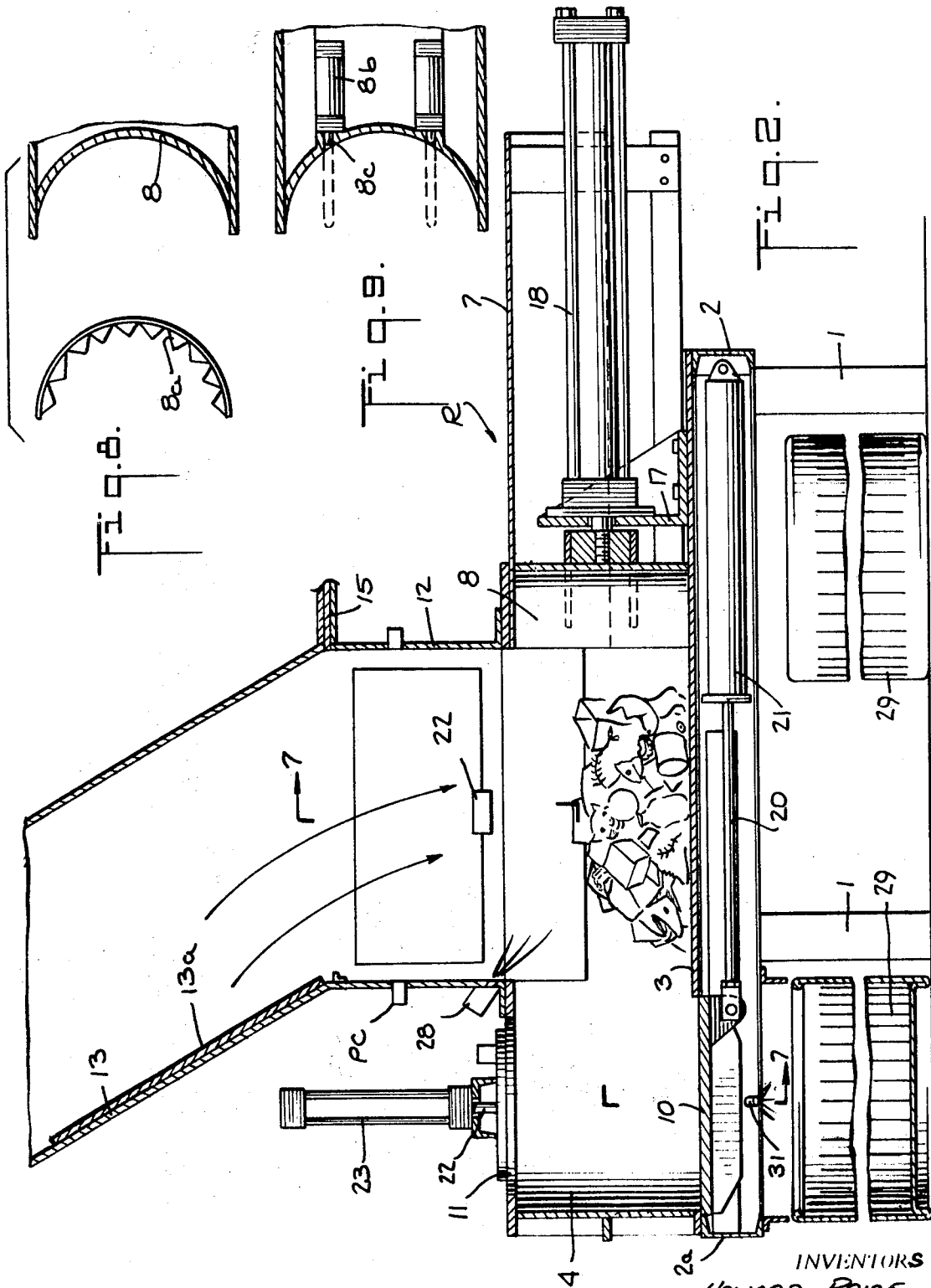
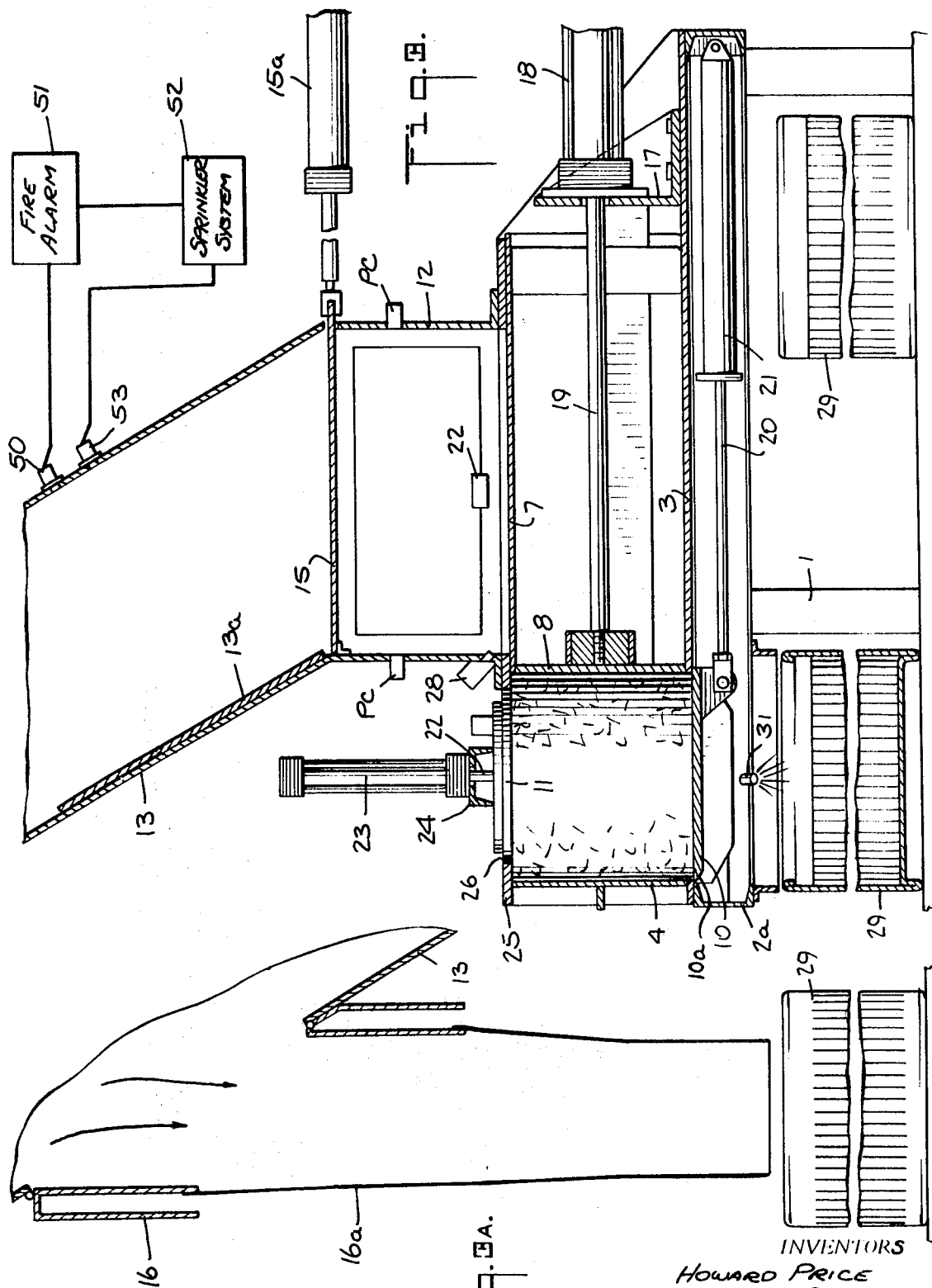


Fig. 1.

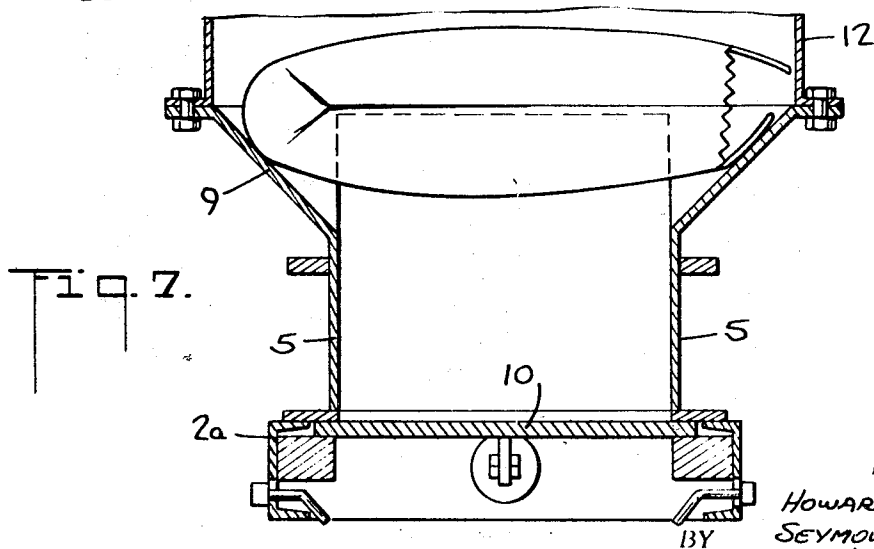
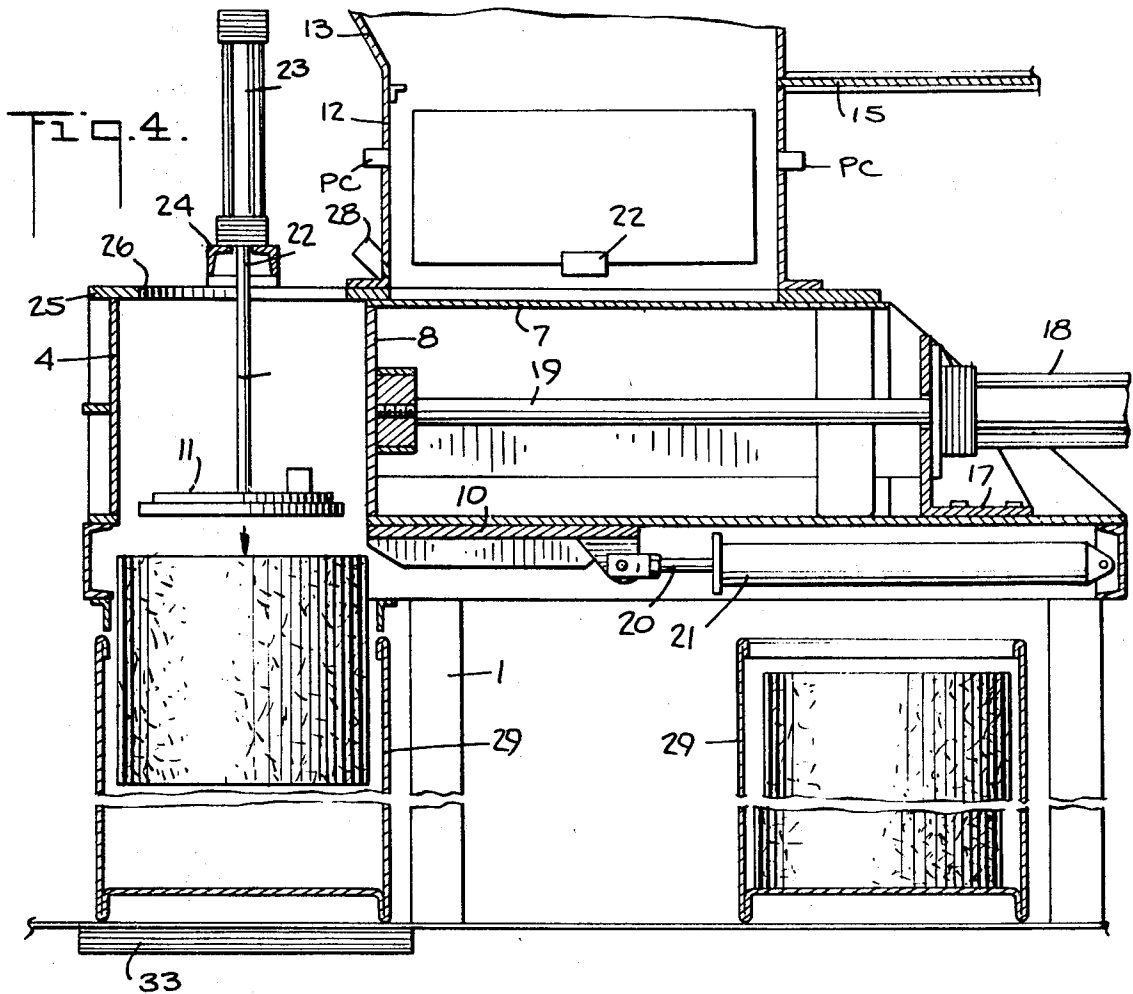
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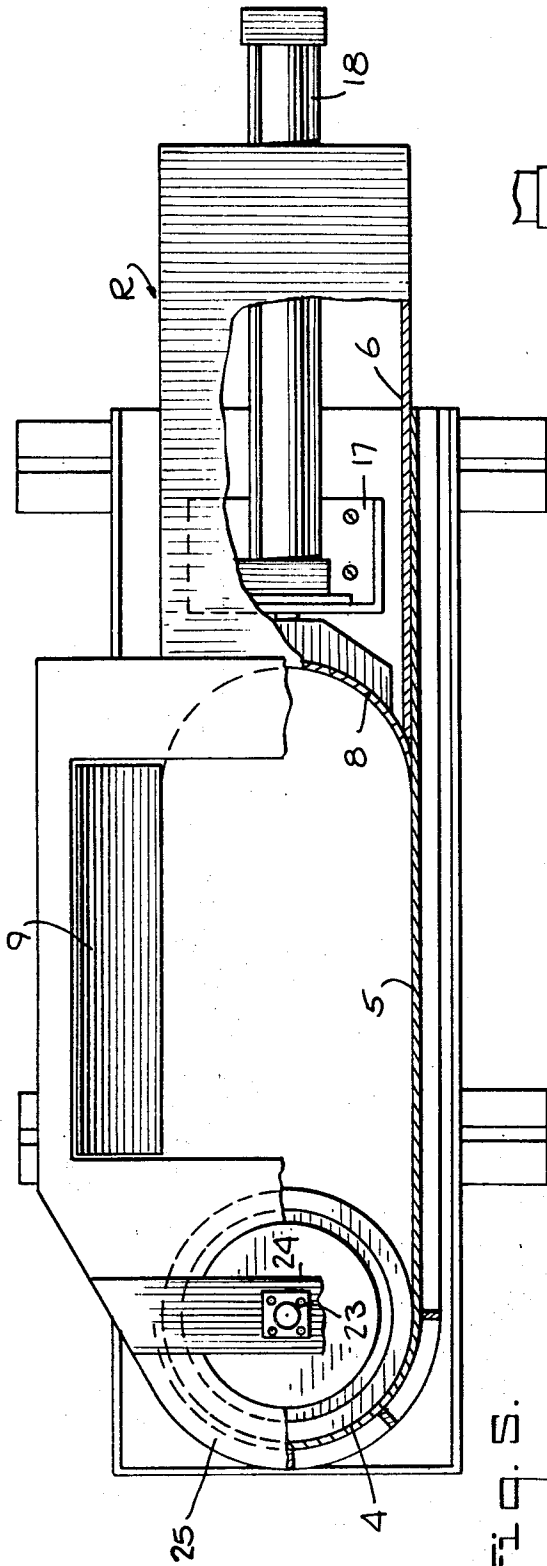


FIG. 5.

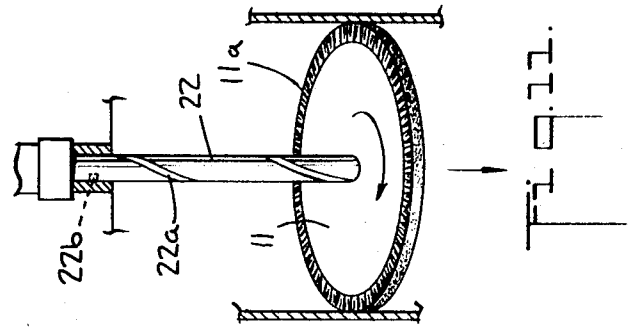


FIG. 11.

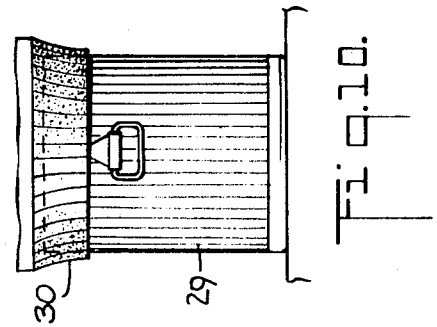


FIG. 10.

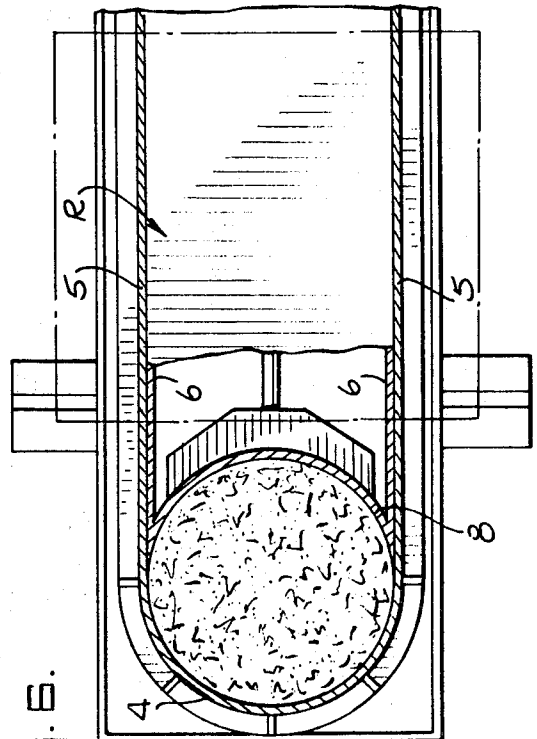


FIG. 6.

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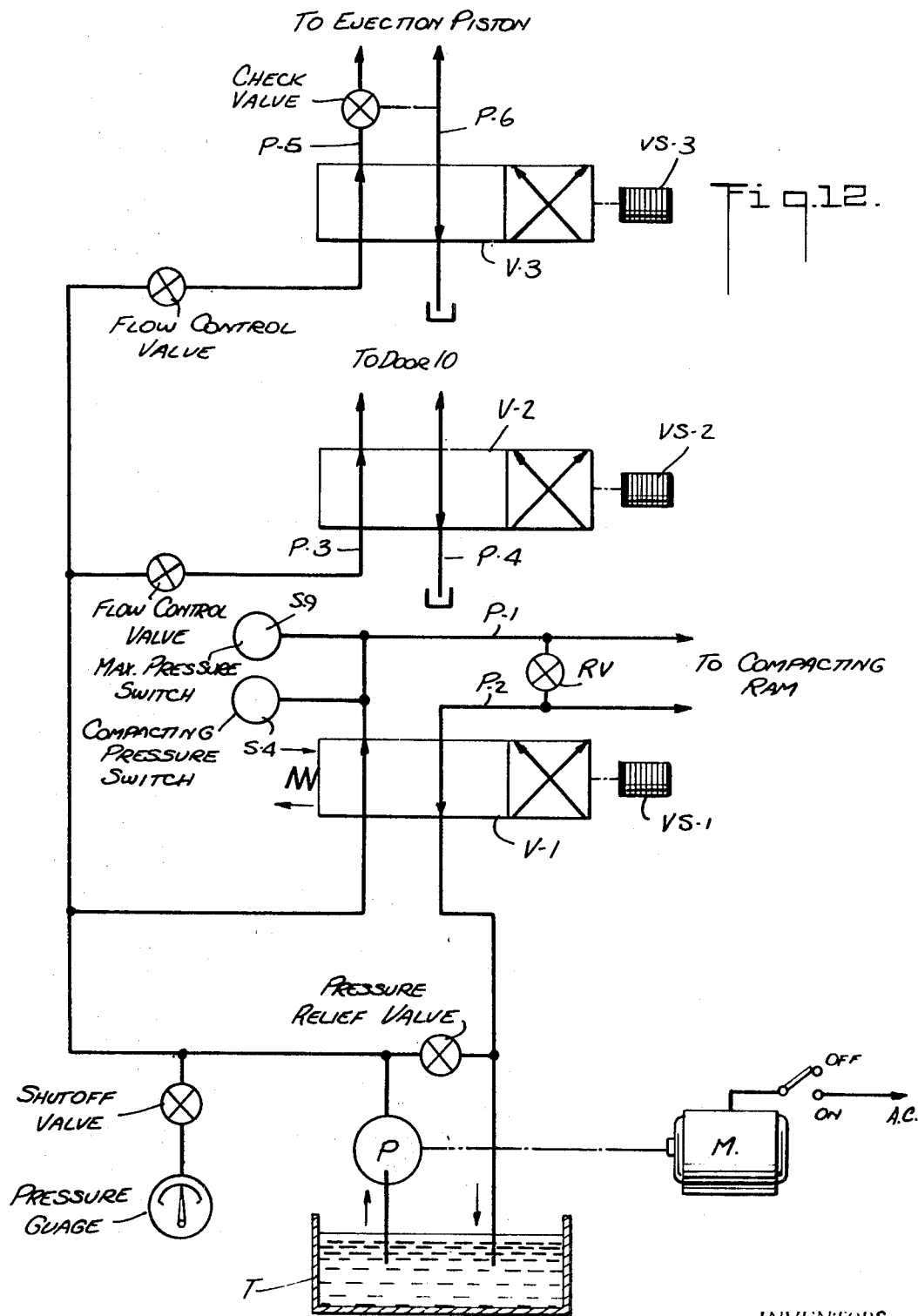


Fig. 12.

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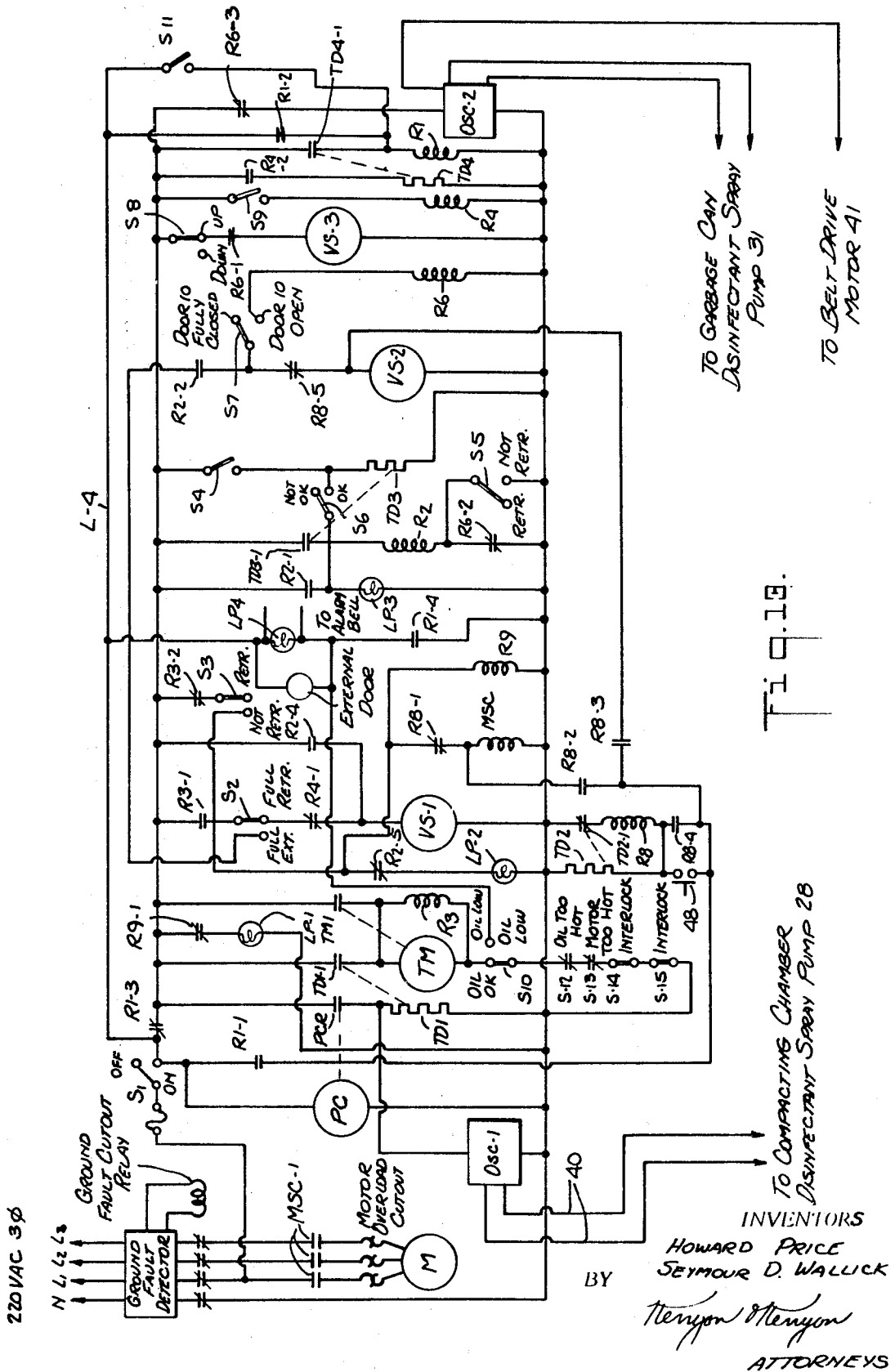


Fig. 14.

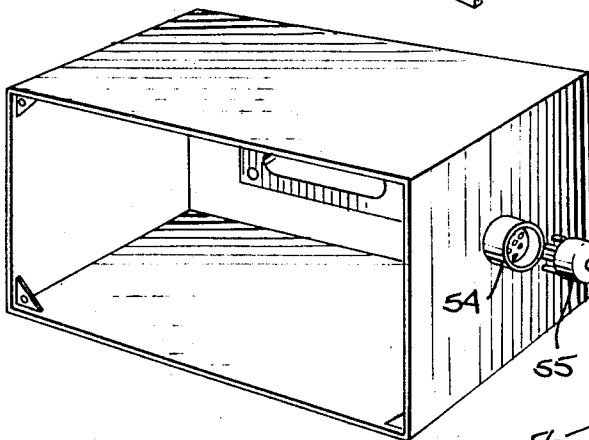
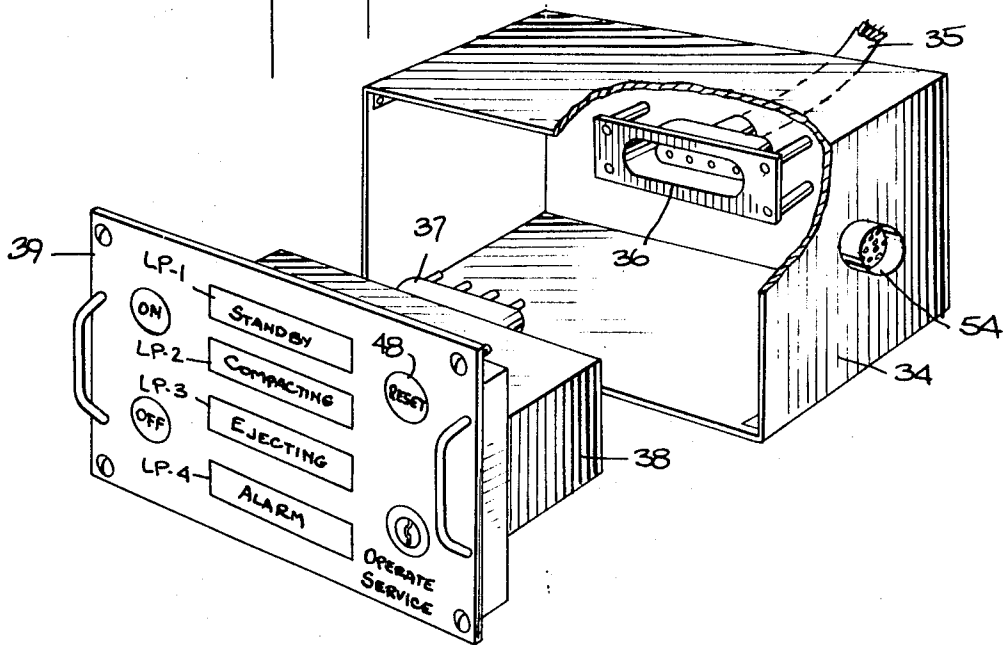


Fig. 15.

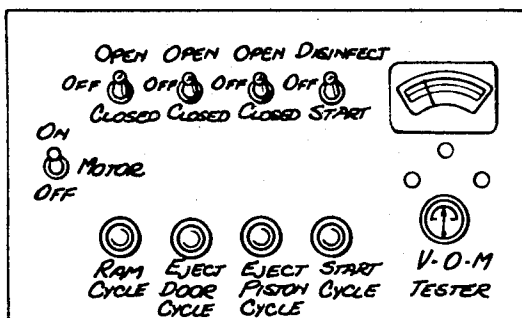
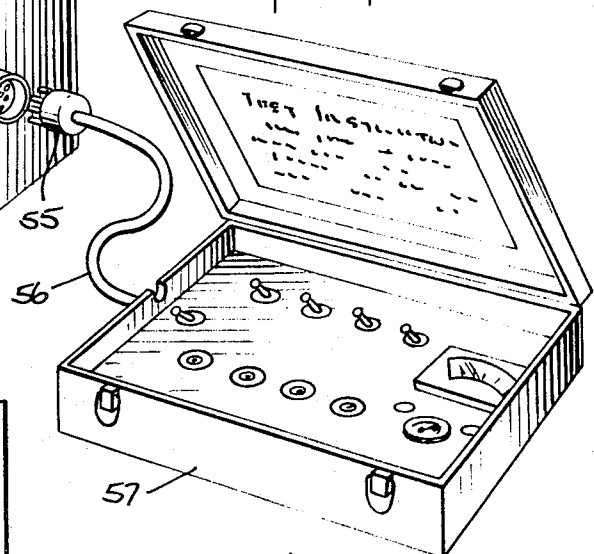


Fig. 16.

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Fig. 17.

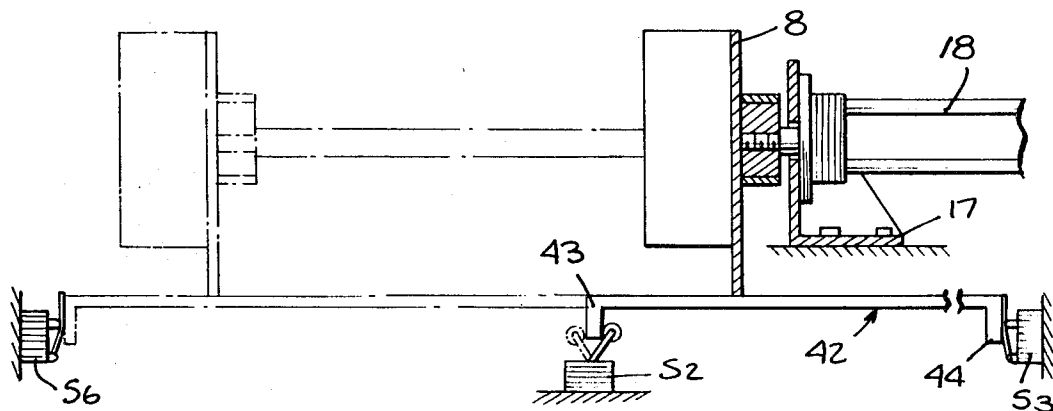


Fig. 18.

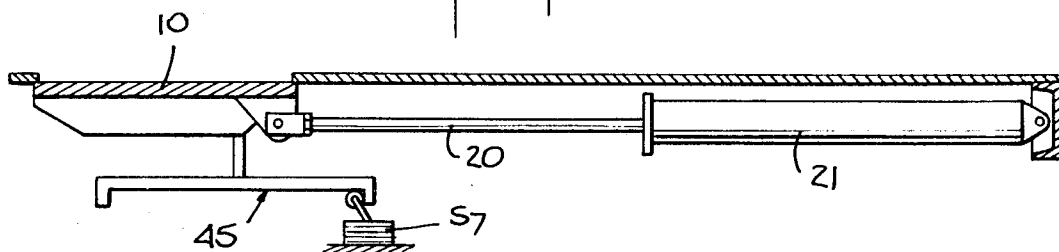
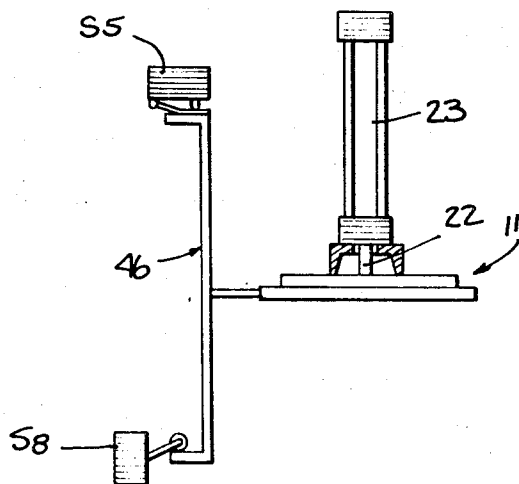


Fig. 19.



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GARBAGE COMPACTOR

This invention relates to garbage compactors having a compacting chamber into which garbage, including refuse, is compressed by a compacting ram after which the compacted material is ejected into a portable container.

BACKGROUND OF THE INVENTION

Industrial and office buildings, as well as apartment houses, often are built with an incinerator chute having access doors on the various floors for use by the occupants, and an incinerator in the basement fed by the chute. Alternately, the garbage disposal mechanism is located in a utility room and may be fed refuse brought to this room by means other than a chute. Air antipollution laws anticipated or now in effect require the use of expensive equipment to treat the incinerator smoke, or the elimination of the incinerator and the disposal of the garbage in portable containers such as garbage cans. Unless a garbage compactor is used, it is necessary to manually pack the garbage in garbage cans for removal to the outside where they are picked up by the city's sanitation personnel and carried to a municipal incinerator. Laws or regulations now going into effect require the compaction of the garbage in the cans so that one can contains what a number of normally packed cans would otherwise contain. The compaction degree is usually expressed as a ratio such as 4 to 1, 6 to 1, etc. Furthermore, the city's sanitation personnel may require that the packed cans should not weigh more than a fixed weight when the cans are handled manually. By controlling the degree of compaction of refuse in a given sized can, it follows that the weight of the filled can will be controlled substantially. Also, excessive garbage compaction must be avoided because municipal incinerator plants cannot handle excessively compacted material.

A garbage compactor intended for use in the basement of an apartment house or industrial building as a replacement for the incinerator encounters many problems. Apartment house tenants and industrial maintenance people include with the garbage refuse of all kinds including bottles, cans, wood articles and the like. A garbage compactor, having a compacting ram powered adequately to crush or break up such refuse when it jams the feed into the machine, inherently must compact the material ultimately to such a high density that it cannot be handled by the normal municipal incinerator. If powered to compact only to the degree specified by the municipal incinerator, refuse of the kind described may jam the compactor so as to put it out of operation. Under such conditions an attendant must be present to manually clear the jam.

An unextinguished cigarette can cause a fire in the garbage compactor. This must be avoided since the smoke would feed up through the incinerator chute to the various floors of the apartment house, or into the compaction room. Fire regulations may require constant protection against this risk.

To avoid the need for the constant presence of an attendant, a garbage compactor used in the basement of an apartment house or industrial building should be capable of being provided with automated garbage can handling equipment. Preferably such equipment should provide for automatically feeding empty cans to the compactor, controlling the degree of compaction and the weight of the compacted garbage ejected into the can, and conveying away the loaded can. Garbage in these cans, and garbage in the compactor itself, should be deodorized. Protection from vermin and decomposition is also necessary.

It is an object of the present invention to provide a garbage compactor which is capable of automated operation on a continuous basis, without requiring the constant presence of an attendant. It is another object to provide a garbage compactor which selectively controls the degree of compaction of the compacted refuse. It is another object to provide a garbage compactor which both selectively controls the degree of compaction of the compacted refuse and also automatically provides a force adequate to break up large solid objects which might otherwise jam the machine. It is a further object to pro-

vide a garbage compactor which substantially controls the weight of the packed garbage cans.

SUMMARY OF THE INVENTION

These and other objects, which will become apparent from the detailed disclosure and claims to follow, are achieved by the present invention which provides a refuse compactor apparatus comprising (a) a support frame, (b) a receiving chamber within the support frame and having an inlet and an outlet, (c) a compaction chamber having an inlet coincident with the outlet of the receiving chamber and an outlet, and a semicylindrical wall spaced apart from the inlet of the compaction chamber, (d) a ram having a generally semicylindrical front plate adapted to reciprocate within the receiving chamber between an extended position in which the front plate cooperates with the semicylindrical chamber wall to form a substantially cylindrical compaction chamber, and a retracted position, (e) power means to reciprocate the ram between its fully extended and retracted positions, (f) a top plate positioned to block the receiving chamber inlet when the ram assumes its extended position, and to leave the inlet unobstructed when the ram is in its retracted position, (g) a disc-shaped ejection piston mounted for reciprocatory movement within the compaction chamber, (h) power means for effecting the movement of the ejection piston to selectively force the compacted refuse through the outlet of the compacting chamber, and (i) control means to selectively actuate the power means of said ram to force refuse from the receiving chamber to the compacting chamber, and to then actuate the ejection piston power means. The ram is adapted to apply a given pressure against the refuse which selectively controls the degree of compaction of the compacted refuse, and also, such ram selectively applies a greater pressure adequate to break up large solid objects which might otherwise jam the machine.

THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a perspective view of the compactor, illustrative of the invention;

FIG. 2 is a vertical longitudinal section of the compactor of FIG. 1;

FIG. 3 is the same as FIG. 2 but showing the compaction action;

FIG. 3a is a detail from FIG. 3 showing an emergency operating phase of the compactor;

FIG. 4 is similar to FIG. 3 but shows the compacted garbage ejection operation;

FIG. 5 is a plan view of FIG. 1 partially broken away to give a horizontal longitudinally sectioned view of the internal parts; FIG. 6 is a cross section taken on the line 6-6 in FIG. 5;

FIG. 7 is a horizontal cross section and is similar to FIG. 5 but shows the compacting action;

FIG. 8 is an exploded view of a detail showing a modification of FIG. 7;

FIG. 9 shows a further modification of this detail of FIG. 7;

FIG. 10 is an elevation view showing a garbage can positioned at the ejecting opening of the compactor;

FIG. 11 is a perspective view showing a modification of the garbage ejector mechanism shown by FIGS. 2 through 4;

FIG. 12 is a schematic of the hydraulic circuitry;

FIG. 13 is a schematic of the electrical control system, which with the hydraulic circuitry operates the machine;

FIG. 14 is an exploded perspective view showing the external physical appearance of the control system;

FIG. 15 is a perspective view showing test equipment which may be associated with the assembly of FIG. 14;

FIG. 16 is a plan view of the operating panel of the equipment of FIG. 15;

FIG. 17 is a diagrammatic view of the actuator and switch control arrangement for the compacting ram;

FIG. 18 is a diagrammatic view of the actuator and switch control arrangement for the bottom door of the compacting chamber; and

FIG. 19 is a diagrammatic view of the actuator and switch control arrangement for the ejection piston.

This illustrated compactor has four rectangularly interspaced legs 1 which extend vertically and support a rectangular framework 2 which is horizontal and has a portion 2a which extends well beyond two of the legs in an overhanging or cantilever manner. A horizontal plate 3 closes the top of this frame work 2 throughout its portion encompassed by the legs 1, the bottom of the framework portion 2a being open. A U-shaped plate extends upwardly from the framework so as to form a semicylindrical end portion 4 located above the framework portion 2a and straight parallel sidewalls 5 which extend throughout the length of the horizontal plate 3.

These walls 5 and the plate 3 define both a garbage-receiving receptacle and a linear guideway for a reciprocatory ram R in the form of a box section made of suitable materials defining interspaced vertical walls 6 having bottom edges riding on the plate 3, a flat top wall 7 and a semicylindrical front plate 8. When this ram R is pushed forwardly, its front plate 8 cooperates with the end 4 of the previously described U-shaped plate, to form a cylindrical compacting chamber.

The walls 5 are flared outwardly in an upward direction to form a hopper or funnel 9 for receiving the garbage and guiding it into the receptacle formed by the bottom wall 3 and the two parallel upstanding sidewalls 5. This is possible when the ram R is in its retracted position, the top plate 7 of this ram preventing garbage from falling behind the ram when the ram is in its advanced or full extended position where its front face 8 cooperates with the wall 4 to define the cylindrical compacting chamber. A sliding door 10 closes the bottom of this compacting chamber, its top being closed by a vertically reciprocative ejecting disk 11. The door 10 may have a hard metal cutting front edge 10a as shown in FIG. 3.

The previously described funnel or hopper 9 permits the use of a compactor having overall dimensions smaller than would normally be required to fit with the incinerator chute of some apartment houses or industrial buildings. This actual chute is not shown by the drawings but connection therewith is made by the upstanding conduit 12 of rectangular horizontal cross section and the upwardly angular extension 13 thereof which avoids a direct drop from the apartment house incinerator chute into the compactor.

All of the parts of the compactor are where possible made from materials having a strength sufficient to permit the compactor to withstand rough usage. The angular extension 13 receives the initial impact of having objects dropped down the incinerator chute, and absorbs much of the shock of the object before it falls into the compactor. A suitably designed plate 13a shown in FIG. 2, may be positioned to receive the initial shock of such an object.

The conduit 12 has a door 14 in one or both of its sides which may be opened in the event garbage or refuse must be cleared because of jamming the compactor. In the event of such a jam the conduit 12 above the door 14 has a sliding door 15 which may be slid into place, as shown in FIG. 3, and which is made strong enough to hold up the garbage and refuse coming down the incinerator chute and thus permit clearing of the jammed material. This door is shown as being powered by a double-acting reciprocatory hydraulic motor 15a which may be manually controlled. While clearing is occurring, more garbage and refuse may come down the chute which would undesirably pile upwardly. One method of overcoming pile up in the chute is to provide the declining wall of the angular extension 13 with hollow door sections 16 which house a collapsible flexible chute 16a made in the fashion of an airplane passenger escape chute. The door 16 may be opened, as illustrated by FIG. 3a, with the chute 16a automatically extending so that the garbage and refuse may be charged into garbage cans during any period the compactor might be out of operation because of clearing a jam. This chute arrangement would also be used in the event the compactor's powering system became inoperative.

The ram R operates successfully in the guideway formed by the flat surfaces of the plate 3 and walls 5, but additional guid-

ing means (not shown) can be provided if considered desirable.

As shown by FIG. 8, the upper edge of the curved plate 8 may be provided with cutting teeth 8a which may be removably connected to the top edge of the curved plate 8 so that other sets of teeth of different configurations or a straight cutting edge can be used as conditions may require. The use of such teeth or such a cutting edge is not always necessary. Another modification is shown by FIG. 9 wherein a pair of hydraulic cylinders 8b power piston rods 8c which can project forwardly through holes formed in the curved plate 8 to assist in the dislodgment of material clinging to the curved plate. Here again, the use of this arrangement is not mandatory. Both modifications may be useful under some circumstances.

The plate 3 on framework 2 supports a transversely extending angular plate 17 which mounts a motor-driven, horizontal hydraulic cylinder 18 of the double-acting type, having a reciprocatory piston rod 19 which connects with the back of the compacting ram R. In this way the ram is powered to reciprocate between forward or full extended and backward or full retracted positions. The bottom door 10 of the compacting chamber is powered to slide between shut and open positions by being connected to the piston rod 20 of a motor-driven hydraulic cylinder 21 of the double-acting reciprocatory type.

The disk 11 which closes the top of the compacting chamber and ejects the material when the door 10 is opened, is vertically reciprocated by being attached to the piston rod 22 of a motor-driven, vertical hydraulic cylinder 23 of the double-acting reciprocatory type and having its cylinder mounted by a horizontal channel bar 24 connected to the top of a horizontal plate 25 having a hole 26 in which the disk 11 fits. This horizontal plate 25 forms what is in effect a flange around the previously described vertical wall portions of the compactor while also acting as cross bracing for these walls. The vertical walls are further strengthened by having reinforcing bars 27 welded on their outside in a manner best calculated to increase their inherent structural strength.

The plain nonrotative compaction chamber ejection disk 11 operates satisfactorily. It may in some instances leave material clinging to the walls of the compaction chamber and in such instances the disk may be replaced by one having a peripheral annular brush 11a, shown as a modification by FIG. 11, with the piston rod 22 provided with a helical groove 22a cooperating with a fixed pin 22b and with the piston rod 22 rotative relative to the nonrotative parts of the hydraulic cylinder 23. With this arrangement during the ejection operation the disk is caused to rotate to reduce the possibility of material clinging to its bottom surface while at the same time exerting a cleaning action on the compaction chamber defined by the wall 4 and the face plate 8 of the ram R.

This garbage compactor is automatically controlled as described hereinafter, so that it operates as follows:

Once connected to a suitable electric power source, the machine is constantly protected against electric shock hazard with respect to both its attendant and others who might be in the apartment house basement or industrial compaction room. It may be equipped with a ground fault detector which in the event of any unnatural ground connection or fault will cut out all incoming electric power lines completely isolating the entire machine from these lines and preventing it from operating or presenting any shock hazard.

With the machine in operating condition a garbage sensor is operated by garbage and refuse falling down the conduit 12. Even when the material passes this sensor momentarily, a small amount of rodent repellent and disinfectant compound is sprayed into the garbage on the horizontal plate 3 between the straight parallel walls 5, this being done through a liquid ejector 28 in the front or left-hand wall of conduit 12. This discharge is momentary, such as in the order of 5 seconds, but it occurs each time anything falls through the conduit 12.

When garbage piles to a level extending above the wall 5 to a predetermined level in the conduit 12, the garbage sensor

becomes actuated continuously and when this occurs the hydraulic cylinder 18 is actuated to reciprocate the ram R between a full retracted position as shown in FIGS. 2 and 5 and fully advanced position as shown in FIGS. 3 and 7, the ram's semicylindrical face 8 forming a complete cylinder with the curved wall 4 each time the ram reaches its fully advanced position. This reciprocation continues either for a predetermined time or until the compacting pressure on the garbage reaches a predetermined value giving the desired compacting ratio.

If when the reciprocating time period times out the garbage and refuse is still above the predetermined level in the conduit 12, a new timed reciprocating period is started. It is to be kept in mind that the volume of the garbage and refuse is not necessarily a determining factor in its compactability.

Eventually the ram's resistance to further compaction indicates that the desired compaction ratio has been reached. If this occurs before the ram's curved face has fully closed to form the compacted garbage cylinder, it continues to advance. This may result in a slightly greater compaction than desired but is within any reasonable tolerance range. If the predetermined compaction resistance is felt just as the ram reaches its fully advanced position, substantially the exact desired compaction ratio is obtained.

Under the above circumstances the ram remains at its fully advanced position, the door 10 slides open and the ejection disk 11 descends to eject the compacted material into a garbage can 29. As shown by FIG. 10, a flexible skirt 30 may depend from the bottom of the framework end 2a as a precaution. Means are provided for preventing reclosing of the door 10 while the ejection disk 11 is at its lowermost position. The ejector disk 11 almost immediately lifts to its full-up position after ejecting the garbage slug into the garbage can.

At this time the door 10 reshuts. As soon as the door 10 is fully closed, a liquid ejector 31, for a brief time period, which again may be in the nature of 5 seconds, sprays a disinfectant and rodent repellent liquid into the garbage can containing the compacted material. This liquid may also include a quick-hardening adhesive or plastic to form a film over the garbage in the garbage can.

At the termination of the above application of liquid the system described hereinafter provides a signal which may be used to activate a garbage can conveyor 32 which is shown in FIG. 1 as extending beneath the compactor between its upstanding legs 1. Although not shown, this conveyor may be made to be actuated by a motor 41 so that it moves an empty garbage can into registration with the door 10 to receive the next load of compacted material. As shown in FIG. 1, it is possible to provide a weighing station 33 on which each garbage can is carried to receive the compacted material. This weighing station may be a suitable scale with the conveyor 32 comprising, as is shown, a flexible belt permitting the can's weight to be felt by the weighing mechanism. If such a weighing mechanism 33 is used, it may be wired into the controlled circuitry of the machines and to a controlling circuit for the motor 41 powering the belt 32 so that each can is moved away with an empty can replacing it only when the can receiving the compacted material has received a predetermined weight of this material suitable for manual handling of the garbage can.

Extensive protection is provided against abnormal operation of the compactor. If either the motor pumping the hydraulic oil or the hydraulic oil itself gets too hot, or any of the various interlocks which safeguard the machine are open, the machine stops and will not move until the fault is corrected. When the fault corrects itself by cooling or by resetting of the open interlock, the machine returns to automatic operation.

However, if the level of the hydraulic oil used to operate the machine gets too low, the whole machine stops and a visual and audible signal is actuated. Now, and this is a point of substantial importance, if during the advancement of the ram, refuse in the nature of a piece of wood or other noncompressi-

ble object interferes with the advancement of the ram as it attempts to reach its fully advanced position, substantially all the available force of the hydraulic system is applied to the ram to shear or crush or break loose the obstacle. This high degree of force is substantially greater than that required for the desired garbage compaction ratio and once the obstacle is overcome the powering hydraulic system returns under control so that it can provide only the force required for proper garbage compaction.

In other words, this compactor has a two-pressure system. When obstacles are encountered, a very high force is available but when the obstacle is overcome or broken, the compacting pressure is controlled to that desired for proper garbage compaction.

If, when the ram is being driven by the full system pressure available, during attempted breakage of an obstacle, and this pressure in the hydraulic system is maintained for a predetermined length of time, the ram automatically reverses and moves forward again. The maximum available pressure, even in the "high" range, is thus controlled so that it is never so high as to damage the operating elements of the compactor. After reversal the ram goes forward again and reciprocates for a predetermined time as it endeavors to break the obstacle. If it cannot do this within the set time, the entire machine stops and operates an alarm which may be visual, audible, or both. Alternately, the machine may be designed without this reciprocating feature. In this instance when the maximum available pressure is applied for a predetermined amount of time, the entire machine stops and operates the alarm.

When the machine stops because of such an abnormal condition, the ram stops dead. Circuitry is provided for the attendant to then cause the ram to retract fully and door 10 to open. Then by using the door 14 or the opening permitted by door 10, an attendant can clear the obstacle that caused the stoppage, the door 14 being preferably interlocked so that the machine cannot actuate. During this time, the door 15 is, of course, slid shut and the chute 16a placed into use by opening the door 15a, provided a stoppage occurs during a period when substantial quantities of garbage and refuse are being dropped down the incinerator chute by the attendants.

The foregoing operation may be understood by reference to the schematic drawings of FIGS. 12 to 16 to which reference is made below.

In this instance the electric power mains are assumed to be 208 volt AC, three-phase, 60 Hz. electric power which the lines L-1, L-2, and L-3 connect to an electric motor M which, as shown by FIG. 12, powers a hydraulic displacement pump P drawing hydraulic liquid from a tank T. This connection is through normally open relay contacts MSC-1. Power for the control circuitry is drawn from the line L-1 and the neutral line N, and all four of the lines are under the control of a commercially available ground fault detector, through the normally closed contacts of the cutout relay controlled by this detector. A commercial detector of this type with correct sensitivity can detect any unnatural ground or fault in the system or in the machine elements and its relay will immediately cut off all electrical power.

The neutral line N is used as a ground for the electrical circuitry powered by it and the line L-1.

All of the control circuitry of FIG. 13 is enclosed by a box or cabinet 34 shown by FIG. 14 which, as shown by FIG. 1, may be mounted conveniently on the machine or, when provided with a long flexible multiconductor cable 35, at some remote location if desired. This cable 35 connects with the female socket 36 of a separable multiple contact connector, the plug 37 of which is mounted by an internal box 38 secured to the cabinet 39 which is releasably fastened to the cabinet 34 so that it may be removed and pulled out for servicing when necessary.

The compactor is placed in operating condition by manually controlled switch S-1 having the on and off buttons shown in FIG. 14 and which when closed connects a standby lamp or visual indicator LP-1, also shown on FIG. 14, through nor-

mally closed relay contacts R1-3 and R9-1, with the ground line N.

The garbage level sensor for the conduit 12 may be a sensing means, such as a photocell control device PC of commercially available type having its photocell receiving light from a light beam source and arranged at the appropriate level in the conduit 12. The light beam is interrupted and the photocell control activated to close relay contacts PCR by any material falling through the conduit 12. If the amount of this material is small so it causes only a momentary interruption of the light beam, the normally open relay contacts PCR are momentarily closed. These contacts connect the electric power lines L-1 and N with a one-shot control circuit OSC-1 which is momentarily activated and through lines 40 powers the liquid ejector 28 to give one shot of disinfectant spray or other liquid into the chamber of the compactor.

One-shot control circuit devices are commercially available which when momentarily energized close a switch for a predeterminable time. Thus OSC-1 provides power through lines 40 so that one shot of disinfectant or the like is applied to the liquid ejector 28 which for example may be an electric pump unit drawing liquid from a suitable reservoir (not shown). A 5-second shot of spray should suffice.

The photocell control contacts PCR also connect time delay relay TD-1 to the lines L-1 and N, this relay having normally open contacts TD1-1 which close only after current flows for a predeterminable time. Therefore, with momentary interruptions of the light beam the contacts TD1-1 do not close but if the light beam is interrupted for longer than a predetermined time, which would be due to the garbage piling up to the light beam and photocell control level in the conduit 12, then TD-1 times out and its contacts TD1-1 close. Closing of these contacts powers a timer motor TM closing its normally open contacts TM-1 for a predetermined length of time. With these contacts TM-1 closed, a relay solenoid R-3 is powered to close its normally open contacts R3-1 which, through limit switch S-2 closed when the ram is fully retracted, and through normally closed contacts R4-1, powers the solenoid VS-1 of compacting valve V-1. Closing the contacts R3-1 through normally closed relay contacts R8-1 energizes a motor-starting contactor relay solenoid MSC which closes the normally open motor-starting contacts MSC-1 which have kept the motor M from being powered by the lines L-1, L-2 and L-3.

Referring now to FIG. 12, it can be seen that with the motor M running the pump P provides hydraulic pressure through the spring-returned, solenoid-shifted, four-part, valve V-1 through a pipe P-1 to the back end of the hydraulic cylinder 18 so that the ram R moves forwardly with its face 8 pushing the garbage towards the compacting chamber. The valve V-1 is solenoid operated so that it is pulled to the position shown by FIG. 12 but spring shifts to the left when its solenoid VS-1 is deenergized. The line P-2 from the front of the cylinder 18 is now connected to the tank T.

When the switch S-1 was first turned on, the standby lamp LP-1 was lighted through the normally closed relay contacts R9-1 but when relay solenoid R-9 is energized, simultaneously with energization of the motor starting relay solenoid MSC, contacts R9-1 open and the standby lamp LP-1 goes out. Closing of the relay contacts R3-1, through normally closed relay contacts R2-5, lights a compacting lamp LP-2 to light the compacting indicator shown by FIG. 14.

As the ram R reaches its fully extended position where its face 8 forms a cylinder with the semicylindrical wall 4, an arm 43 of an actuator 42, shown in FIG. 17, moving with the ram, moves the switch S-2 to the fully extended switch position so that the circuit through the compacting valve solenoid is opened, with the result that the valve V-1 spring shifts to the left so that the pump P is connected with the pipe P-2 at the front of cylinder 18 while the pipe P-1 is connected to the tank T. The ram now returns to its fully retracted position where another arm 44 of the ram switch actuator 42, shown in FIG. 17, throws the switch S-2 to its fully retracted position. This results in reenergization of the compacting valve solenoid VS-1 so that the ram may start forward again.

The ram, under normal conditions, continues to reciprocate back and forth until either the timer motor TM times out so as to open its contacts TM-1 and thus the circuit through the solenoid of the relay R-3 so that its contacts R3-1 open, or the garbage is compacted to the desired degree.

It is possible for timer motor TM to time out while the ram is in a position other than its fully retracted position. With this in mind, a normally closed compacting ram sensing switch S-3 is positioned to be opened only when the ram is fully retracted in the positions shown by FIGS. 2 and 17. If the ram is moving forward when the timer motor TM times out and opens its contacts TM-1, causing deenergization of the solenoid of relay R-3 and its contacts R3-1 to open, the limit switch S-2 will still be in its full retracted position. However, the circuit through the compacting valve solenoid VS-1 is maintained by the compacting ram sensing switch S-3 until the ram advances fully and throws the switch S-2 to its fully extended position. Thereafter, the ram retracts until the switch S-2 is thrown to its fully retracted position, at which time the ram comes to rest, both the compacting ram sensing switch S-3 and relay contacts R3-1 now being open. If the timer motor TM times out while the ram R is retracting, the compacting ram's sensing switch S-3 holds the circuit closed through the motor starting contactor relay MSC until switch S-3 is opened by full retraction of the ram. Opening of the compacting ram sensing switch S-3 ultimately deactivates the motor-starting contactor relay solenoid MSC if the timer motor TM has timed out so that its contacts TM-1 are open, but only when the ram R is fully retracted.

This ram reciprocation action continues under normal conditions for the timed period whenever the level of garbage is high enough in the conduit 12 to be sensed by the photocell control PC and until the desired degree of garbage compaction is obtained.

Eventually the garbage is compacted into a cylindrical slug to the desired degree, and this is sensed by a compacting pressure switch S-4 connected in the pipeline from the pump P to the pipe P-1. This pressure-responsive switch S-4 has a variable actuation pressure, and is set as required to provide the degree of garbage compaction desired and when it closes it connects time delay relay TD-3 in circuit between the lines L-1 and N. This time delay is to prevent momentary ram pressure increases from initiating an operating sequence. When the time delay relay TD-3 times out, its normally open contacts TD3-1 close and energize the solenoid of relay R-2 so that its contacts R2-1 close.

A normally open limit switch S-6 is positioned so that its contacts are closed by the arm 43 of the actuator 42, shown in FIG. 17, only when the compacting ram is fully advanced and the compacting chamber's cylindrical shape is fully formed, and if switch S-6 is closed it shunts out the relay TD-3 so that closing of the pressure switch S-4 immediately energizes the solenoid of relay R-2 so that the contacts R2-1 immediately close. The normally open contacts R2-4 close when the solenoid of relay R-2 is energized, so the valve V-1 is held to keep pressure on the ram R. Under these circumstances, the garbage in the compacting chamber is under the desired degree of compaction and ready for ejection.

However, if the switch S-6 is open, this is because the ram R is not at its fully extended position. In this event, the relay TD-3 is effective so that momentary pressure increases do not affect the operation of the compactor. This protection is not needed when the ram is fully advanced. The ram R continues to advance under these circumstances even when the pressure switch S-4 remains actuated, until the ram is fully extended and throws switch S-2 to its fully extended position but is limited by the closed relay contacts R2-4. This results in a slightly higher compaction degree than the predetermined degree, but not to an objectionable amount.

Note that at this time the pressure in the line P-1 continues to increase because the relay contacts R2-4 shunt around the limit switch S-2, but this has no effect on the garbage because the ram R is at its full extended position and cannot apply further pressure. A relief valve RV, shown in FIG. 12, blows

off at a pressure just safely under that which might cause the pump P to be damaged.

Energization of the relay solenoid R-2 opens its normally closed contacts R2-5 so that the compacting lamp LP-2 on the panel 39 is extinguished, while at the same time, an ejecting lamp LP-3 on the panel lights since it is in parallel with relay solenoid R-2. Also, normally opened contacts R2-2 close and through limit switch S-2, in its full ram extended position and the now-closed contacts R3-1 energizes the solenoid VS-2 of the door valve V-2, shown in FIG. 12. Valve V-2, before energization of solenoid VS-2, has been spring biased to its left-hand position where it was sending hydraulic pressure through the pipe P-4 to the back of the hydraulic cylinder 21 to positively hold the door 10 shut in its normal position. When shifted, it now sends pressure through the pipe P-3 to actuate the hydraulic cylinder 21 to slide open the door 10, the pipe P-4 exhausting to the tank T. This manipulation of V-2 also serves to provide a relief path to keep hydraulic pressure in the lines associated with ram motion within tolerable limits.

When the door 10 is fully opened, a switch actuator 45, shown in FIG. 18, closes a normally open, door limit switch S-7 which energizes the solenoid of relay R-6 whose contacts R6-1 then energize the actuating solenoid VS-3 of valve V-3 to send hydraulic pressure through pipe P-5 to the top of the ejector cylinder 23, the latter's pipe P-6 being connected to the tank T. This pushes the ejection disk 11 down to eject the compacted slug of garbage into the garbage can beneath the compacting chamber. When the ejection disk 11 is at any other position than fully retracted, a normally closed limit switch S-5, shown in FIG. 19, held open by an actuator arm 46 when the ejector piston rod 22 is fully retracted, closes so as to positively maintain the circuit through the relay solenoid R-2, and positively keep this relay's contacts R2-2 closed and sealed through closed contacts R2-1 and assure that the door 10 remains open. The door 10 cannot close while the ejecting disk 11 is at any position other than fully retracted or up.

It is to be pointed out that suitable switch and actuator arrangements, other than those shown and described with reference to FIGS. 17-19, may be employed to perform the same functions.

When the hydraulic cylinder 23 moves the ejection disk 11 to its fully extended or down position, switch actuator 46 opens a normally closed limit switch S-8 so that the solenoid VS-3 of the valve V-3 is deenergized and its valve spring shifts to the left so that the ejection disk 11 rises and at its top position opens ejection piston limit switch S-5 through switch actuator 46. At this time the solenoid of relay R-6 is energized because the door is open so its normally closed contacts R6-2 are open. It follows that the solenoid of relay R-2 is deenergized by opening of both the limit switch S-5 and the contacts R6-1. The ejecting lamp now is extinguished and the relay contacts R2-2 return to their normally opened position so that the door valve solenoid VS-2 is deenergized, this resulting in spring shifting of valve V-2 and reclosing of the door 10.

Closing of the door 10 opens the limit switch S-7 via actuator 45 so that the solenoid of relay R-6 is deenergized. While energized, its normally closed contacts R6-3 were held open, but now these contacts close so that a one-shot control circuit OSC-2 is activated so that for a short time it activates the liquid ejector 31 spraying a disinfectant, deodorant, rodent repellent on the garbage slug deposited in the can 29. This ejector may also be used to spray a very quick-drying adhesive also plastic on top of the garbage. One-shot control circuit OSC-2 also serves to energize the belt drive motor 41 so that the can-moving conveyor 32 places an empty garbage can in position. As previously indicated, this may be placed under the control of the weighing mechanism 33 so that a can is advanced only when the can receiving the compacted garbage has reached a predetermined weight.

It can be seen from the foregoing that whenever the ram R is advancing and the compacting pressure switch S-4 is actuated longer than the time fixed by the time delay relay TD-3, the machine goes through its ejecting cycle. This assures the

proper degree of compaction. Compaction pressure switch S-4 can be provided with an adjustment governing the degree of pressure necessary for actuation. This enables adjustment of the compaction volume ratio, to comply with varying ratio requirements and to adapt to various types of refuse.

However, if while the ram is advancing it is required to break through a heavy solid object, as suggested by FIG. 6, the full hydraulic pressure provided by the pump P up to the limit permitted by the pressure relief valve RV protecting this pump is available to break through the obstacle. Furthermore, if during the time interval allowed by the time relay TD-3 the hydraulic pressure in the line P-1 continues to increase beyond the pressure for which the compacting pressure switch S-4 is set, a second or maximum pressure switch S-9 is actuated so that it closes and energizes the solenoid of a slow fallout relay R-4 which closes its normal open contacts R4-2 so as to energize a time delay relay solenoid TD-4. At the same time the normally closed contacts R4-1 of this relay are opened so as to deenergize the compacting valve solenoid VS-1 of the valve V-1. This valve V-1 spring shifts to its left-hand position so that the ram retracts or moves to the right. The time of this backward motion of the ram is set by the timing of the fallout of the relay R-4. During this time, the relay contacts R4-2 remain closed while the contacts R4-1 remain open, after the maximum pressure switch S-9 has been opened by the resulting drop in hydraulic pressure. When the relay R-4 times out, the ram starts forward again and will continue to advance again under the controls previously described unless the maximum pressure switch S-9 is again actuated. It is possible for the ram to reciprocate with relatively short strokes with each forward reciprocation powered by the full safely available pump pressure until the obstacle is broken or cleared, which occurs in most instances. Maximum pressure switch S-9 can be provided with an adjustment governing actuation pressure, to adapt to varying tolerances of equipment to high pressure.

During these attempts to clear the obstacle, the time delay relay TD-4 is repeatedly placed in circuit by closing of the normally open contacts R4-2 of the relay R-4. This relay TD-4 is of the heat-actuated type and eventually with repeated energizations it finally closes its contacts TD4-1 so as to energize the solenoid of relay R-1 which seals through its contacts R1-2 and remains energized through the line L-4. This opens and holds open this relay's normally closed contacts R1-3, disconnecting all the circuitry of the machine from power with the exception that current flows through the line L-4 shunting around the open contacts R1-3 and also actuating an alarm lamp LP-4 on the panel 39 through the now closed normally opened contacts R1-4 of the relay R-1. The solenoid of relay R-1 remains energized by the line L-4 through its now closed normally open contacts R1-2. Thus the entire machine shuts down with a visible or audible alarm signal actuated.

It is to be pointed out that if this reciprocatory feature of the ram is not desired, when clearing an obstacle, then the circuit described can be simply modified by placing a jumper across the contacts R4-1 of slow fallout relay R4 to prevent ram retraction.

It is only under the above conditions that the presence of an attendant is required.

With the machine jammed the attendant presses the reset push button switch 48 on the panel 39. This connects line L-5, which shunts around the open contacts R1-3 through now-closed normally open contacts R1-1, of the relay R-1, so as to energize the solenoid of a relay R-8 through normally closed contacts TD-1 to the line N. This relay's normally open contacts R8-4 close so that this relay solenoid R-8 stays energized. This relay's normally open contacts R8-2 close so that the motor starting contactor solenoid MSC is energized to close the motor's starting contacts MSC-1 and actuate the pump motor M with the result that the ram R moves to its full retracted position because the solenoid VS-1 of the valve V-1 is not energized at this time. The relay's normally open contacts R8-3 also close so that the door valve solenoid VS-2 of

the valve V-2 is actuated to open the door 10. With the normally open contacts R8-4 closed, a time delay relay TD-2 is actuated and when it times out after giving time for the described operations, it opens its normally closed contacts TD2-1 so that the solenoid of the relay R-8 is deenergized. Normally opened contacts R8-4 and R8-2 and R8-3 all open at this time so that the entire machine is again rendered inoperative. The attendant can now clear the jam of the machine.

To restart the machine after correction of the trouble, the attendant after opening the switch S-1 recloses this switch. Opening of the switch S-1 unseals the solenoid of the relay R-1 so that its contacts R1—R1-3 close, closing of the switch S-1 then restarting the machine in the manner explained before.

Can conveyor 32 can, if desired, be provided with limit switch S-11, normally open. Switch S-11 is adapted to close when the last can on can conveyor 32 is filled with sufficient refuse. When S-11 is closed, power is allowed to flow to R-1, which in turn opens R1-3 contact, halting the machine until S-11 is opened by the placement of additional cans on can conveyor 32. This feature prevents operation in absence of a properly positioned can.

Fire protection is provided by the use of a sensor 50 located in the declining extension 13 of the conduit 12, shown in FIG. 3. This sensor 50 may be one of the commercial types that detects either smoke or heat or both, and when activated it may activate a fire alarm 51 and sprinkler system 52 which ejects either water or fire-extinguishing liquid through a nozzle 53 into the conduit 12 and on any garbage or refuse that might be resting below the conduit. This avoids the fire hazard such as might be created by someone dropping a lighted cigarette down the incinerator chute.

Furthermore, in the event the hydraulic liquid or the motor M overheats, thermally responsive normally closed switches S-12 and S-13 may be placed in circuit with the timer motor TM and solenoid of the relay R-3, as indicated by FIG. 13. An oil level switch S-10 is also in circuit with the solenoid of the relay R-3 so that if the oil is too low for safe operation of the pump the solenoid of the relay R-3 is deenergized and the alarm lamp, or external audible signal is activated. Two interlock switches S-14 and S-15 are also shown in the circuit of the relay solenoid R-3 and these may be used, for example, as switches on the door 14 and the door 15 in the interest of safety.

As shown by FIGS. 14 and 15, it is contemplated that the instrument box 34 that houses the control circuitry may be provided with a multicontactor socket 54 which by sliding contacts can be placed in circuit with the various functions of the machine, in a manner not illustrated. Then a serviceman provided with a service control box, such as shown by FIGS. 15 and 16, may through a suitable plug 55 and flexible cable 56 connected with a service box 57, place the various functions of the machine under manual control. The panel of this box 57 may appear as shown by FIG. 16. In this manner a serviceman can test the various functions as well as circuitry of the machine without disassembly.

This arrangement thus enables a serviceman to test the various components of the compactor at a central station. The testing is easily accomplished, and is a very brief procedure, making possible rapid diagnosis of trouble and repair of defective elements. Downtime of the compactor is kept at a minimum.

It is noteworthy that, in normal operation, the machine attendant need not be a skilled workman, but can be an unskilled building employee, such as a porter or maintenance man. The only circumstance in which a skilled serviceman is needed is when the machine suffers an actual physical breakdown of mechanical or electrical parts.

What is claimed is:

1. A method of compacting refuse comprising the steps of:

- a. introducing refuse into a receiving chamber having an inlet and an outlet coincident with the inlet of an adjacently positioned compaction chamber, said compaction chamber equipped with ejection means to eject said

compacted refuse from said compaction chamber, said receiving chamber positioned between said inlet to said compaction chamber and the rest position of a ram adapted for reciprocal motion within said receiving chamber from said rest position to a position adjacent said outlet of said receiving chamber;

- b. actuating said ram by means of a sensor responsive to refuse entering said receiving chamber to move said ram reciprocally between said rest position and said outlet of said receiving chamber to compact said refuse into said compaction chamber;

- c. stopping said reciprocal motion and positioning said ram in said rest position upon the expiration of a first predetermined time; and

- d. actuating said ejection means when a predetermined pressure is exerted on said refuse by said ram for a second predetermined time period said second time period being less than said first time period.

2. In a refuse compactor having a compacting chamber having an inlet thereto, a reciprocable ram adapted to compact said refuse into said compacting chamber, power means to reciprocate said ram, means to actuate said power means, a refuse conduit for guiding refuse to a location in said compactor at which said refuse is susceptible of compaction by said ram, means for treating said refuse preparatory to compaction and means for actuating said means for treating, a control system comprising photocell refuse-sensing means responsive to momentary actuation of said photocell means caused by passage of refuse through said conduit to actuate said means for actuating said treatment means and responsive to continuous actuation of said photocell means caused by accumulation of refuse in said conduit to actuate said means for actuating said power means to reciprocate said ram.

3. In a refuse compactor having a support frame, a receiving chamber having an inlet and outlet, a compaction chamber having an inlet and an outlet, the inlet of said compaction chamber being in communication with the outlet of said receiving chamber, a ram adapted for reciprocal motion with said receiving chamber for compacting refuse entering the inlet of said receiving chamber into said compaction chamber, reversible power means for driving said ram reciprocally between an extended and retracted position, means for ejecting said compacted refuse from said compaction chamber, and means for actuating said ejection means, a control system comprising:

- a. sensing means responsive to refuse entering said receiving chamber for actuating said reversible power means;

- b. means responsive to the arrival of said ram at its extreme extended and extreme retracted positions for reversing the direction of drive of said power means when said ram reaches either of said extended or retracted positions;

- c. means responsive to the continuous pressure exerted by said ram in compacting said refuse for constantly applying a predetermined compacting force from said reversible power means when the ram pressure on said refuse is below a predetermined level; and

- d. means, responsive to the time period during which said ram pressure on said refuse is above said predetermined level, for applying a force from said reversible power means which is greater than said predetermined compacting force, for only a predetermined time period, when said ram is situated away from said extreme extended position.

4. The apparatus of claim 3, further comprising:

- a. timing means responsive to both said pressure-responsive means and said time-responsive means for actuating said ejection-actuating means; and

- b. switch means actuated in response to the full extension of said ram for bypassing said timing means when said ram is in said extended position and for actuating said ejection-actuating means when said ram pressure on said refuse is at said predetermined pressure level.

5. The apparatus of claim 4 in which said ejecting means comprises an ejector piston adapted for reciprocatory motion between an extended and a retracted position within said compacting chamber to selectively force refuse out through the outlet of said compaction chamber; power means for achieving said reciprocatory motion; said means for actuating said ejecting means comprising first relay means connected between said pressure-responsive means and said ejection piston power means for actuating said ejection power means on actuation of said ejection actuation means.

6. The apparatus of claim 5, further comprising:

- a. a slidable door interposed across said outlet of said compaction chamber, said slidable door having door power means to selectively open and close said door;
- b. second relay means connected between said pressure-responsive means and said door power means for opening said door upon actuation of said ejection actuation means; and
- c. switch means connected between said pressure-responsive means and said ejection power means and being responsive to said door reaching its extreme open position for preventing actuation of said ejection power means unless said door is in said extreme open position.

7. The apparatus of claim 6, further comprising switch and relay means responsive to said ejection piston reaching an extended position for maintaining said door open at all times when said ejection piston is not fully retracted.

8. The apparatus of claim 6, further comprising:

- a. a reset push button;
- b. relay means connected between said push button and said door power means; and
- c. said ram drive power means being responsive to actuation of said push button for opening said door and retracting said ram.

9. The apparatus of claim 6, further comprising:

- a. limit switch means responsive to full extension of said ejection piston for causing said ejection power means to retract said ejection piston upon full extension of said ejection piston; and
- b. switch and relay means responsive to full retraction of said ejection piston for causing said door power means to close said door on said full retraction of said piston.

10. The apparatus of claim 9, further comprising:

- a. spray means for providing sanitary treatment of said ejected refuse; and
- b. means responsive to movement of said door to said closed position to actuate said spray treating means.

11. The apparatus of claim 9, further comprising:

- a. means disposed outside said compactor for consecutively advancing a succession of refuse receptacles to a position in alignment with said outlet of said compaction chamber; and

- b. means responsive to movement of said door to said closed position for actuating said receptacle-advancing means.

12. The apparatus of claim 11, further comprising:

- a. means connected to said advancing means for weighing the one of said receptacles positioned adjacent said outlet of said compaction chamber and for actuating said advancing means when the weight of the weighed receptacle exceeds a predetermined quantity.

13. The apparatus of claim 4, in which said power means for driving said ram includes a hydraulic system including a hydraulic cylinder and in which said apparatus further comprises:

- a. a maximum pressure switch actuated when the pressure in said hydraulic system exceeds a predetermined value;
- b. a slow-fallout relay means interposed between said maximum pressure switch and said power means for driving said ram for retracting said ram when said maximum pressure switch is actuated; and
- c. a heat-actuated time delay means actuated by actuation of said maximum pressure switch, said heat-actuated time delay means being adapted to deactivate all operative

power means of said compactor when said heat-actuated time delay means reaches a predetermined temperature.

14. The apparatus of claim 4, further comprising a sprinkler system adapted upon actuation to spray fire-inhibiting material into said receiving chamber, said system having heat sensor means adapted for actuating said system when the temperature of said receiving chamber exceeds a predetermined level.

15. A refuse compactor apparatus, comprising:

- a. a support frame;
- b. a conduit within said support frame for receiving refuse, said conduit being defined by at least one nonvertical sloping wall upon which said refuse passes;
- c. a compaction chamber in communication with said conduit for receiving refuse from said conduit;
- d. compacting means;
- e. auxiliary receiving means in communication with said conduit for receiving refuse when said compacting means is inoperative; and
- f. door means providing an opening in said wall for communicating with said auxiliary receiving means.

16. A refuse compactor as recited in claim 15, wherein said auxiliary receiving means comprises a collapsible flexible chute stored behind said door means and adapted to open with the opening of said door means.

17. A refuse compactor apparatus, comprising:

- a. a support frame;
- b. a receiving chamber within said support frame for receiving refuse;
- c. a compaction chamber having an inlet and an outlet;
- d. compacting means;
- e. means for ejecting said refuse through said outlet of said compaction chamber;
- f. positioning means for consecutively advancing a succession of refuse receptacles to a position in alignment with said outlet of said compaction chamber; and
- g. weighing means for weighing the receptacle that is positioned in alignment with said outlet of said compaction chamber, and for actuating said positioning means when the weighed receptacle exceeds a predetermined quantity.

18. A refuse compactor apparatus comprising:

- a. a support frame;
- b. a receiving chamber having an inlet and an outlet;
- c. a compaction chamber having an inlet coincident with the said outlet of said receiving chamber, and an outlet, said compaction chamber having a semicylindrical wall spaced apart from said inlet thereof;
- d. a ram having a generally semicylindrical front plate adapted to slide within said receiving chamber between a first position in which said front plate is between said inlet of said compaction chamber and said semicylindrical wall, and a second position in which said inlet of said receiving chamber is between said front plate and said semicylindrical wall, said front plate and said semicylindrical wall cooperating to form a substantially cylindrical compaction chamber when said ram is in said first position;
- e. power means to reciprocate said ram between said first and second positions;
- f. a top plate positioned to block said inlet to said receiving chamber when said ram assumes said first position, and to leave said inlet unobstructed when said ram is in said second position;
- g. a disc-shaped ejection piston mounted for reciprocatory movement parallel to the longitudinal axis of said substantially cylindrical compaction chamber and within said compaction chamber;
- h. power means for effecting said reciprocatory movement of said ejection piston to selectively force said refuse out through said outlet of said compacting chamber;
- i. control means to selectively actuate said power means of said ram to force refuse from said receiving chamber to said compacting chamber, and to then actuate said ejection piston power means; and

- j. a brush mounted on the periphery of said disc-shaped ejection piston and extending radially therefrom, and means to rotate said ejection piston when said piston is in reciprocal motion.
- 19. A refuse compactor apparatus comprising:
 - a. a support frame;
 - b. a receiving chamber having an inlet and an outlet, said inlet being disposed in the top portion of said receiving chamber;
 - c. a partially inclined conduit extending upwardly from said inlet of said receiving chamber to guide refuse into said receiving chamber;
 - d. a door in the bottom said of said inclined conduit intermediate along its length;
 - e. a compaction chamber having an inlet coincident with the said outlet of said receiving chamber, and an outlet, said compaction chamber having a semicylindrical wall spaced apart from said inlet thereof;
 - f. a ram having a generally semicylindrical front plate adapted to slide within said receiving chamber between a first position in which said front plate is between said inlet of said compaction chamber and said semicylindrical wall, and a second position in which said inlet of said

- receiving chamber is between said front plate and said semicylindrical wall, said front plate and said semicylindrical wall cooperating to form a substantially cylindrical compaction chamber when said ram is in said first position.
- g. power means to reciprocate said ram between said first and second positions;
 - h. a top plate positioned to block said inlet to said receiving chamber when said ram assumes said first position, and to leave said inlet unobstructed when said ram is in said second position;
 - i. a disc-shaped ejection piston mounted for reciprocatory movement parallel to the longitudinal axis of said substantially cylindrical compaction chamber and within said compaction chamber;
 - j. power means for effecting said reciprocatory movement of said ejection piston to selectively force said refuse out through said outlet of said compacting chamber; and
 - k. control means to selectively actuate said power means of said ram to force refuse from said receiving chamber to said compacting chamber, and to then actuate said ejection piston power means.

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