ABSTRACT

An apparatus for treating garbage and trash so that it may be reduced to compact form in bags, blocks or otherwise. The apparatus is typically placed at the bottom of a garbage chute and the apparatus breaks up the garbage into small pieces by means of a rotatable low speed high-torque motor-driven breaking drum running in cooperation with a matching anvil. The breaking drum has several rows of teeth which mesh with teeth-like anvil elements of the anvil, and the teeth on the breaking drum are so gapped as to provide a nip to trap and crush oversize bottles and the like. There are two torque-overload features. One torque-overload feature is an electrical overload device which can stop the rotation of the breaking drum if there is a jam, and carry out the cycle of reversing the drum, moving it forward again, and repeating the aforesaid predetermined number of times and shutting off the machine after any predetermined number of cycles if the jam has not then been cleared. A second torque-overload feature involves moveable mounting of the anvil such that it can move away from operative position in the event of a jam. The anvil is normally held in operative position by hydraulic means and in the event of an overload the hydraulic means permits the anvil to move away from operative position and restores the anvil to its initial position when the jam is cleared. The apparatus also provides a check means in the form of a series of parallel check plates rigidly mounted on the frame of the apparatus. Each check plate is perforated so that it surrounds the breaking drum. Part of each check plate facing the breaking drum has an abrasive surface. The check means in combination with the other elements of the apparatus carry out the functions of clearing the breaking drum and its associated teeth of material adhering thereto which could cause clogging of the mechanism, which clearing of the drum includes scraping the breaking drum and grinding off tightly adhering material particularly material which may have strong fibers; the check means also prevents processed material from returning “upstream” and directs the flow of processed material into the bin or container so that the breaking drum exerts a “pumping” action on the processed material, so that the processed material may be tightly compacted in the bin or other container.

9 Claims, 23 Drawing Figures
OPERATION SEQUENCE

OPERATION SEQUENCE

APPARATUS OFF

GARBAGE ARRIVES AT BOTTOM OF CHUTE

NEW BIN FILLED, MANUAL SWITCH

CHUTE SWITCH STARTS APPARATUS

MOTOR draws overload current (JAM)

MOTOR draws normal working current

APPARATUS PROCESSES GARBAGE

NO GARBAGE IN CHUTE, CHUTE SWITCH OFF

NORMAL WORKING CURRENT

REVERSE FOR SHORT PERIOD

FORWARD

MOTOR (AGAIN) draws overload current (JAM)

REVERSE AGAIN

FORWARD

IF AFTER REPEATING THIS PROCEDURE 5 OR 6 TIMES IT STILL OVERLOADS

SHUT DOWN AND REMOVE POSSIBLE OBSTRUCTION

FIG. 15

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APPARATUS FOR TREATING WASTE MATERIAL

This application is a continuation-in-part of my copending application Ser. No. 46,700 filed June 16, 1970, now abandoned.

This invention relates to apparatus for treating waste material, particularly garbage and trash of the kind normally collected and disposed of by the city and garbage disposal authorities or processed for re-cycling or reclamation.

One of the very considerable problems relating to garbage disposal is the volume occupied by waste material of this kind. The large volume of course results from the fact that much trash of this nature consists of empty containers such as bottles and cans which occupy much space unless properly broken up. Much other garbage material also has considerable volume and this means that the disposal operation has to contend with very considerable bulk of material.

It is a principal object of this invention to effectively compact waste material such that in its compacted form it may be more economically disposed of whether this be in conventional land fill, incineration or as the main ingredient in building block production.

A further object is to provide means for effectively compacting waste material with a minimum of attention and handling by adaptation of automatic devices suitable for this purpose.

The aforesaid object of achieving the desired result with a minimum of attention is accomplished by providing features which largely prevent serious jams from occurring.

Other objects and advantages will be apparent from the present specification and drawings and from the appended claims.

The preferred embodiment of the invention disclosed herein may be described as a garbage treating apparatus comprising: a rotatable low speed high-torque power driven breaking drum, cooperating anvil and cooperating check means, the rotatable breaking drum being provided with a series of teeth mounted on the drum and spaced along the drum. The anvil is of general crescent shape and downwardly depending so as to extend partly under the breaking drum and is moveably mounted so as to be able to move away from the breaking drum temporarily in order to pass large incompressible objects through the apparatus and then return to the initial anvil position. The check means consist of a number of parallel check plates mounted on the frame of the apparatus and placed in close proximity to the breaking drum between the teeth spaced along the drum. Motive power means is provided for driving the breaking drum and means is connected through the motive power means for detecting a serious overload and to thereupon cause the apparatus to execute a predetermined series of steps such as: stop, reverse, restart, and if a serious overload still remains a repeat of the said stop, reverse and restart cycle; repeat the aforesaid several times; and if the said overload still exists shutting down the machine.

The invention will now be described with reference to the accompanying drawings, wherein,

FIG. 1 shows an oblique three-quarters view illustrating a practical form of a preferred embodiment of the present invention;

FIG. 1A shows a fragmentary representation of an alternative form of the top portion of the apparatus shown in FIG. 1 to indicate the difference of construction where hopper feeding rather than chute feeding of the apparatus is used;

FIG. 2 shows a partly cross-sectioned and partly schematic side elevation view of the embodiment of the invention shown in FIG. 1 as seen looking from the right-hand side of center in FIG. 1;

FIG. 3 shows a fragmentary partly cross-sectional view as seen at III—III in FIG. 2 to illustrate the relative position of the breaking drum, anvil and check means to be described in greater detail below;

FIG. 4 shows an enlarged fragmentary view of the central region of FIG. 3 in order to more clearly illustrate the structure shown therein;

FIGS. 5, 6, and 7 show the breaking drum which is an important feature of the present invention, FIG. 5 being a three-quarters oblique view of the breaking drum, FIG. 6 a side elevation view as seen from the right-hand side in FIG. 5, and FIG. 7 a fragmentary enlarged partly cross-sectional view of the central region of FIG. 6 in order to more clearly illustrate the structure;

FIG. 8 shows a "slice" cross-sectional view of a preferred form of the breaking drum particularly illustrated in FIGS. 5, 6 and 7;

FIG. 9 shows a "slice" cross-sectional view of an alternative form of the breaking drum 11;

FIGS. 10 and 11 show oblique three-quarters views of the anvil which is an important feature of the present invention, FIG. 10, showing the working face of the anvil which is positioned adjacent the breaking drum, and FIG. 11 is a similar view, but turned clockwise from the position of FIG. 10 to show the rear face of the anvil;

FIG. 11A is a vertical medial cross-sectional view of the anvil shown in FIGS. 10 and 11 to disclose the design characteristics thereof;

FIG. 12 shows a fragmentary partly cross-sectioned elevation view as seen at XII—XII in FIG. 3, to effectively illustrate the check means which is an important feature of the present invention;

FIG. 12A shows a fragmentary enlarged view of a part of the apparatus illustrated in FIG. 12 to better illustrate its construction;

FIG. 13 shows a fragmentary partly cross-sectional view of certain of the important components shown in the preceding figures to better illustrate the function of the apparatus when handling objects of large size such as large bottles;

FIG. 14 shows in diagrammatic form the components whereby the proper position of the breaking drum and anvil shown in the foregoing figures may be maintained, and indicates the manner of operation in connection therewith;

FIG. 15 shows a function chart indicating the manner in which the apparatus of FIG. 1 typically operates; and,

FIGS. 16 through 20 illustrate specific uses of the embodiment of the invention of the foregoing figures, to indicate more fully the utility of the present invention.

The apparatus shown in the foregoing figures will now be described in further detail with reference to the drawing figures. It will be appreciated that the foregoing figures are given by way of example only, and for
the precise scope of the invention reference should be made to the appended claims.

In the accompanying drawings the same reference numerals denote like parts in all figures.

With particular reference at the outset to FIG. 1, the waste compacting apparatus of the present invention is shown generally at 1. Waste compacting apparatus 1 has an apparatus frame denoted by 2. Garbage may be fed automatically by chute denoted by 5 connected to waste compacting apparatus 1.

The use of a chute 5 will be useful where the waste compacting apparatus is installed in a multi-story building such as an apartment house where the garbage originates on different floors or levels and must be brought down to street level. Where there is a building of one or two floors, or as a supermarket, where the garbage originates on the same general level, a chute is not usually appropriate and a hopper seen at 3 in FIG. 1A into which the garbage may be dumped will generally be preferable.

It is contemplated that the trash will be fed to apparatus 1 and will there be appropriately broken up and will drop into a bin denoted by 7. Bin 7 is shown only in simple form but in practice various kinds of bins could be used. Bin 7 typically extends from under apparatus 1 as shown in FIG. 2. Bin 7 may be provided with casters, shown at 8, and a lid shown at 9, held in place by a locking bar denoted by 10. By means of the construction shown, bin 7 is held rigidly in place but may be easily removed if desired. As will be described below various other forms of ultimate disposal are contemplated by the present invention.

A control box denoted by 120 is provided whereby an operator can control the operation of compacting apparatus 1, and control box 120 is connected to apparatus 1 by a multiple electric cable denoted by 121.

Referring now to FIG. 2, three of the most important features of the present invention are the rotatable breaking drum denoted by 11, the anvil denoted by 21 and the check means denoted by 170.

Breaking drum 11 is rotated by a drive motor denoted by 31 through conventional speed reducers shown diagrammatically at 32, the drive being through a gear box at 33. Breaker drum 11 has a series of projecting teeth denoted as 57 through 76 and the anvil 21 has a series of anvil elements denoted by 83. It is contemplated that trash will be crushed and broken between the teeth 57 through 76 of breaking drum 11 and the anvil elements 83 of anvil 21 as the breaking drum 11 rotates. Check means 170 helps keep the breaking drum 11 free of material likely to impede its operation and controls the direction of pressure applied to material treated in apparatus 1.

The breaking drum 11 is driven at low speed but with high available torque through the speed reducer 32. It has been found desirable that breaking drum 11 turn at such speed that the tips of the teeth 57 through 76 move at a speed of 40 to 50 feet per minute. For a machine of typical size with the tip speed mentioned the corresponding rotational speed of breaking drum 11 will be of the order of 10 rpm.

Drive motor 31 is supplied with electrical energy by a power supply denoted by 35 through a line shown at 37. It is important in the operation of the present device to ascertain when the drive motor 31 is being overloaded as by a trash article in the apparatus which does not break properly and accordingly there is an appropriate electrical overload sensing device denoted by 39 attached to drive motor 31 through a controller denoted by 41 through lines shown at 43 and 45.

The power supply 35, overload sensing device 39 and controller 41 are all perfectly conventional and need not be further described. However, so far as the present inventor is aware it is new to make use of the elements just referred to in the combination illustrated and described herein and to carry out the method disclosed.

The overload sensing device 39 and the controller 41 would normally be housed in the control box 120 along with other apparatus to be referred to below and line 37 would normally be carried in cable 121.

Anvil 21 is pivotally mounted on a pivot shaft denoted as 81 so as to be capable of rotation from the position shown, away from breaking drum 11 through an angle of approximately 45°. Anvil 21 is normally in the position shown in FIG. 2, but under certain operating conditions where an incompressible object is received in apparatus 1 to be described below, anvil 21 swings about pivot shaft 81 in a counter-clockwise direction as viewed in FIGS. 2 and FIG. 13.

Other kinds of motion of anvil 21 are contemplated as an alternative such as linear translation motion rather than the pivotal motion referred to, but the pivotal motion will be particularly referred to.

In a typical installation, solid waste is introduced to the apparatus 1 from the bottom of the garbage chute 5 in, say, an apartment building.

It is contemplated that garbage entering the apparatus 1 will automatically start the rotation of a drum 11. This automatic starting of the drum 11 may be accomplished by any suitable detecting method such as the interruption of a light beam directed at a photoelectric cell, or by provision of a pressure-operated switch. By way of example in the embodiment described the starting of drum 11 is accomplished by means of a pressure operated switch denoted as 47 attached near the entrance to apparatus 1. A suitable flap or lever denoted by 49 is moved inwardly when it is contacted by trash fed into the machine and this causes the switch 47 to be operated which turns on drive motor 31 through controller 41 by a line denoted as 51 for this purpose. Line 51 would normally be carried in cable 121.

The drum 11 rotates in cooperation with anvil 21 so that garbage fed into the machine is broken up and drops into bin 7. This breaking up is accomplished by the action of the teeth 57 through 76 of breaking drum 11, which rotate between the anvil elements 83 of anvil 21 and forcefully reduce to small fragments material received between the teeth 57 through 76 and the anvil elements 83.

As bin 7 fills up, the rotating drum 11 acts so as to force the broken-up garbage downwardly into bin 7, and to move the broken up garbage horizontally in the bin. The broken up garbage in the bin 7 initially moves in the direction of motion of teeth 57 through 76 on the lower side of breaking drum 11, that is in a left-hand direction as seen in FIG. 2 but as the bin 7 fills up the broken-up garbage flows to all sides of the bin 7 in the manner of granular material. In this way the pressure
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on the garbage in bin 7 is such as to compact it firmly in the bin 7. The action of drum 11 in compacting the garbage in bin 7 is thus in the nature of a pump in forcing a liquid into a confined space.

As will be seen particularly in FIGS. 2 and 13 the drum 11 is positioned in relation to anvil 21 that a ‘nip’ is formed between the drum 11 and the anvil 21. The teeth 57 through 76 of drum 11 are so designed as to allow glass and metal containers and other material to be drawn into and trapped in the ‘nip’ resulting in the glass breaking and the metal containers being torn or heavily deformed.

It is of particular importance to understand how the apparatus 1 handles incompressible and undeformable articles such as lumps of concrete, large telephone directories, discarded pieces of machinery and the like which cannot be reduced to any smaller volume. Such articles are automatically passed through apparatus 1 without any attempt to break them up. When incompressible and undeformable articles are received in apparatus 1 and caught in the nip, the anvil 21 is caused to move back from the breaking drum 11 for a short interval of time so as to permit such incompressible and undeformable articles to pass immediately to bin 7.

When incompressible and undeformable articles are caught in the nip, the anvil 21 is caused to rotate away from drum 11 if the crushing force exceeds a predetermined value. This means that under normal operating conditions the garbage passes through the region of drum 11 and anvil 21 and the garbage is crushed, broken up and reduced in particle size without anvil 21 being rotated appreciably, but when some unusual object which would be likely to seriously damage the machine if the machine attempted to crush it, such as a chunk of concrete, is received in the region of drum 11 and anvil 21 the predetermined pressure on anvil 21 would be exceeded, and anvil 21 caused to rotate about its pivot shaft 81 allowing the object in question to drop through into bin 7.

It may be mentioned that the fact that an unusual object such as a chunk of concrete is passed through the machine without further breaking up does not mean that the machine is not functioning in a desirable manner in respect of such an object. Rather, the machine is functioning in the best possible manner under these circumstances. An object such as a chunk of concrete not easily further broken up is already compacted to the greatest possible degree and if it were to be further broken up it would actually occupy a larger volume. Thus the passing of a not easily broken object of relatively large size by the partial rotation of anvil 21 about pivot shaft 81 is a normal and expected part of the operation of the apparatus described herein.

The rotation of anvil 21 under the circumstances just referred to may be carried on by holding the anvil 21 in its initial position by means of a hydraulic ram in its extended position and providing for retraction of the hydraulic ram and corresponding rotation of anvil 21 when more than a predetermined pressure is applied to anvil 21. The motion of anvil 21 just referred to will be discussed more fully below.

The breaking drum 11, the anvil 21 and the check means 170 will now be described in a little further detail. As particularly shown in FIGS. 3 through 7, the drum 11 consists of a heavy steel cylinder shown at 53 mounted on a shaft denoted as 55 appropriately held in suitable bearings, such as ball bearings (not shown and which form no part of the present invention). At each end of steel cylinder 53 is a circular end plate denoted by 54, to which shaft 55 is rigidly attached. At each end of breaking drum 11, on end plates 54 are short abrasive strips denoted by 56 the function of which will be discussed below.

As already stated breaking drum 11 has a number of teeth denoted as 57 through 76.

Two manners of tooth positioning will be referred to. The teeth 57 through 76 may be arranged in pairs at diametrically opposite sides of drum 11, or else they may be arranged at an angle other than diametrically opposite as shown in FIG. 8, where non-diametrically arranged teeth are shown at 157 and 158. Whether the teeth are arranged diametrically opposite or otherwise is a matter of convenience: if arranged as shown in FIG. 8, it will be possible to more easily position drum 11 so as to provide a clearance to remove and replace bin 7, but the operation is equally good in either case.

Whether diametrically opposed teeth are used or not, the teeth 57 through 76 should be spaced along the length of the drum 11 so as to cooperate with the structure of anvil 21. Reference is made to FIGS. 5 and 6 where there are shown ten pairs of teeth as follows: tooth 57 and its opposite pair 58 (not visible in FIG. 6), tooth 59 and its opposite pair 60 (not visible in FIG. 6). Pair of teeth 59 and 60 are spaced along drum 11 from teeth 57 and 58 and staggered away from the direction of rotation of drum 11 angularly with relation to pair of teeth 57 and 58 an angle of approximately 22½°. The direction of rotation is clockwise as seen in FIG. 5 and appropriately marked on the drawings.

The ten pairs of teeth shown are merely a typical number. There could be more or less than 10 pairs depending on the material being handled. In general with coarser material, fewer teeth would be desirable, and vice versa.

Pair of teeth 61 and 62 are similarly spaced along the drum from pair of teeth 59 and 60, and similarly staggered angularly backward in relation to the rotation of drum 11.

Pairs of teeth 63 and 64 and 65 and 66 are similarly spaced along the drum 11 and angularly staggered backwardly progressively in the same manner as described in connection with pairs of teeth 57, 58, 59, 60 and 61, 62.

Because of the progressive angular staggering of the pairs of teeth with an angle of approximately 22½° between each pair, pair of teeth 65, 66 is displaced 90° in relation to pair of teeth 57, 58.

The remainder of the pairs of teeth 67, 68 (tooth 68 is not visible in FIG. 6) 68, 69 (tooth 69 is not visible in FIG. 6) 73, 74 and 75, 76 are arranged in a similar way to the arrangement of teeth 57 through 66 except that they are progressively staggered backwardly from tooth 67, such that teeth 67 through 76 are a “mirror image” of teeth 57 through 66.

The teeth 57 through 76 thus present a sort of “prow” configuration whereby teeth 57 and 67 are at the leading edges and the remaining teeth are arranged along rearwardly inclined side lines.

As particularly seen in FIG. 7, the teeth 57 through 76 are inclined at a small angle to the direction of rota-
tion of the breaking drum 11. The teeth of each half of the drum are inclined toward the nearest side of drum 11. The effect of the inclination of the teeth is to exert an outward thrust toward the ends of breaking drum 11 and also aid to prevent jamming when the teeth 57 through 76 pass between the anvil elements 23 of anvil 21 with garbge material adhering to the teeth. The angle of inclination of the teeth 57 through 76 denoted by a in the drawings, is preferably of the order of about 15°.

An arrangement of the “pairing” of opposite teeth 57 through 76 in a non-diametrically arranged fashion has already been referred to with reference to FIG. 8 where only teeth 157 and 158 are shown for simplicity. Teeth 157 and 158 are similar to any of teeth 57 through 76, apart from their angular positioning. It is contemplated that there will be a series of pairs of teeth like teeth 157 and 158, arranged in a staggered row in relation to teeth 157 arranged in a staggered row in relation to tooth 158 similar to the arrangement shown in FIGS. 5, 6 and 7. In other words tooth 157 may be one of a series of teeth such as teeth 57, 59, 61, 63, 65, 67, 69, 71, 73, and 75 in FIGS. 5 and 6 and tooth 158 one of a series of teeth such as teeth 58, 60, 62, 64, 66, 68, 70, 72, 74, and 76 in FIGS. 5 and 6. The arrangement of FIG. 8 may be found advantageous where it is desirable to position drum 11 so as to be able to leave a clear space below drum 11 as for the removal of bin 7. A guide mark on the end of shaft 55 (not shown) will indicate the shaft position where the drum 11 is in position to leave a clear space as aforesaid.

The arrangements of teeth shown and described have been found satisfactory in practice, but these arrangements are only examples. The pairs of teeth 57 through 76 or 157 and 158 are intended to pass between the slots between anvil elements 23 of anvil 21, to be described more fully below.

Reference will now be made to the construction of teeth 57 through 76. With particular reference to FIG. 7, each of teeth 57 through 76 is in the form of a generally rectangular plate.

The teeth 57 through 76 are typically blocks of steel welded to shell 53 of drum 11. If a tooth should become broken it can ordinarily be repaired or replaced by welding. FIGS. 5, 6, and 7 show the construction of the teeth 57 through 76 and the manner in which they are positioned. Typical dimensions of any one of teeth 57 through 76 may be length: 5 inches, width: 3 inches, thickness: three-fourths inch. All of the sides of teeth 57 through 76 may be linear except for the peripheral edges denoted for example in relation to tooth 59 as peripheral edge 59a in FIGS. 5 and 7. Tooth 59 is referred to by way of example, but all the teeth will have similar characteristics.

It will be noted that each leading edge as viewed in relation to the direction of motion of drum 11 of each of teeth 57 through 76, a leading edge denoted by 59b being given as an example is along a radius of drum 11 whereas each of the trailing edges is parallel to its companion leading edge, and is thus not along a radius of drum 11. An example of a trailing edge is shown at 59c, which is desirably tangential to drum 11.

The peripheral edge 59a of tooth 59 by way of example, has the same curve as a circle with its center at the center of drum 11.

It is contemplated that both leading edges such as 59a and trailing edges such as 59c will be straight and flat. There might in some circumstances be a slight advantage in providing leading edge 59b with a triangular or sharpened cross-section, or a rounded cross-section, but the present inventor considers that the danger of tooth breakage is increased if the leading edges such as edge 59b are other than flat. The description of the shape and construction of tooth 59 applies to all of teeth 57 through 76.

As particularly indicated in FIG. 8, teeth 57 through 76 may be attached to the steel cylinder 53 of breaking drum 11 by simply welding the teeth 57 through 76 to the surface of cylinder 53. If desired, steel cylinder 53 may be thick as seen in FIG. 9 at 53a and the teeth 57 through 76 attached in the manner exemplified by teeth 57 and 58 shown in FIG. 9 by way of example, with the tooth faces 57a, 58a, and 57b, 58b, being similar to those of tooth 59 already referred to. In the alternative construction of FIG. 9, teeth 57 and 58 are set in rectangular sockets denoted by 77 and welded in place as shown. In spite of the apparently rugged alternative construction of FIG. 9, the construction as shown in FIG. 8 provides adequate strength.

It is also contemplated by the present invention that the breaking drum 11 with its teeth 57 through 76 may be made by casting as an integral whole. It is also contemplated that the breaking drum 11 and teeth 57 through 76 could be of laminar construction such as by assembling a stack of laminae corresponding to teeth and spaces therebetween on a central shaft.

Teeth 57 through 76 and anvil 21 (to be described in greater detail below) obviously are subject to considerable stress, shocks and abrasion, and it has been found desirable to use a steel for these members which provides high strength, easy weldability, good wear resistance and a good work-hardness characteristic such that the impact of hard objects give the surface a specially hard exterior. Such a steel is that sold under the trade name “WEL-TEN 80 C” a low-carbon steel alloy with magnesium, copper and molybdenum. However, the material of teeth 57 through 76 and anvil 21 is not critical so long as reasonably good steel is available, in view of the fact that the overload features of the apparatus are such that it passes incompressible objects without necessarily breaking such objects further and has the stop-reversal cycle of operation as an overload protection feature.

Referring now to the anvil 21, as particularly shown in FIGS. 10, 11, and 13 the anvil 21 in its elevation view has a crescent-shaped appearance resembling a portion of a scoop associated with certain kinds of earth moving machinery. Anvil 21 is pivotally mounted on shaft 81 so that it can swing toward and away from drum 11. It is also contemplated by the present invention that anvil 21 could move horizontally in a motion of translation instead of moving pivotally.

As already described, anvil 21 is capable of rotating about shaft 81 so as to temporarily provide a large clearance between anvil 21 and the drum 11 when a relatively large solid object is received in the apparatus 1. The rotated position of anvil 21 may be referred to as the retracted anvil position.

It is believed that the shape of anvil 21 contributes materially to the operation of machine 1, as discussed
elsewhere in the present application, and certain typical dimensions can be seen in FIG. 11A.

Typical dimensions of anvil element 21 can be appreciated with reference to FIG. 11A as follows:

- (length of anvil 21): 13¾ inches
- (length of backing plate 27): 8 inches
- (thickness of backing plate 27): one-half inch
- (radius of lower main length of anvil element): 13¾ inches
- (width of toe 26): 1¼ inches
- (under angle of toe): 30°
- (upper angle of toe): 125°
- (radius of curvature of part of anvil element 83): 12 inches
- (ordinate of center of radius h): 1¾ inches
- (absissa of center of radius h): 1¼ inches

The anvil 21 is pivoted mounted so as to depend downwardly and is normally held firmly in place close to drum 11 as seen in FIG. 2.

As already noted anvil 21 has a number of parallel anvil elements or anvil teeth denoted by 83. Anvil elements 83 are of generally triangular shape made up of an upper curved portion denoted by 83a, and a lower curved portion denoted by 83b connected by a toe portion denoted as 83c.

The anvil elements 83 may be of substantially the same thickness as the teeth 57 through 76, and the anvil elements 83 are adapted to lie between the spaces left between the rows of teeth 57 through 76.

Anvil 21 has anvil elements 83 mounted on and preferably integrally connected to a backing plate denoted by 27. Backing plate has two side members denoted as 29 which act as guides and also act as reinforcing ribs.

As already indicated there are two limiting positions of the pivotal motion of anvil 21. As seen in FIG. 2 the usual operative position of drum 11 and anvil 21 is such that a small clearance is left therebetween so that garbage material broken up by the teeth 57 through 76 and anvil 21 can pass through the region of the rotating teeth 57 through 76 and into bin 7. With a machine having an anvil with the dimensions of FIG. 11A, in the position shown in FIG. 2, there will normally be only a small gap between toe 83c and the check means 171, of the order of three-sixteenths inch. The position of anvil 21 shown in FIG. 2 may be referred to as the forward anvil position.

As will be discussed below, the position of anvil 21 is controlled by hydraulic means, and a hydraulic ram denoted by 95 is attached to anvil 21 by means of a lug denoted by 88.

The manner in which the anvil 21 is moved in response to the pressure applied to anvil 21 can best be seen with reference to FIGS. 2 and 14. Anvil 21 is held in its initial or forward position by means of a hydraulic ram denoted by 95 connected to anvil 21 by means of lug 88 on anvil 21 and it is contemplated that when a pressure in excess of a predetermined pressure is applied to anvil 21, hydraulic ram 95 will retract, and the details thereof will now be discussed.

The normal operating position of the anvil 21 as seen in FIG. 2 will preferably correspond to the fully extended position of hydraulic ram 95. Such fully extended position may be called the “bottomed” position, and indicates that the piston (not shown) inside ram 95 has moved as far outward as possible.

The retracted position of anvil 21 may but need not correspond to the completely non-extended piston position of ram 95.

In FIG. 14 the cylinder 95 is the same cylinder 95 shown in FIG. 2, although it will be seen that cylinder 95 in FIG. 14 is shown in the opposite direction with respect to FIGS. 2 and 13. It is contemplated that there will be fluid such as water provided for cylinder 95 in the space denoted by 97. If predetermined pressure is applied to anvil 21 the piston denoted as 99 in cylinder 95 attempts to move in a left-hand direction as seen in FIG. 14, (it will be realized that “left” and “right” are only in relation to the direction of view in FIG. 14) thereby exerting increased pressure on the liquid in space 97 which, in turn, forces liquid out through the relief valve denoted by 101 and permits the piston 99 to move to the left as seen in FIG. 14. This decreases the volume of water in space 97 and permits anvil 21 to move to the right as seen in FIG. 2. When the object creating the pressure on anvil 21 has been cleared from the machine, liquid under pressure from a supply through a pipe denoted by 103 flows back into the space 97 through a check valve denoted as 100 thus restoring pressure in the space 97 and causing the anvil 21 to rotate back to its initial position.

In view of the fact that water is generally available in the area where equipment of the kind described would be used it has been found convenient to use water from ordinary supply mains as the liquid in the space 97 and in hydraulic cylinder 95. In such a case, the restoring or water mains pressure which is generally from 70 to 110 psi will normally be less than the pressure necessary to actuate relief valve 101. This is not a problem because the overload conditions when relief valve 101 is released usually correspond to a much higher pressure in the system than when the overload has passed and the anvil 21 is being restored to its initial position.

It may be mentioned that although making use of water from regular supply mains is desirable, the invention is in no way restricted to the use of water. For example, air pressure could be used.

As stated above, when there is high pressure on anvil 21, the effect may be to discharge liquid through relief valve 101. If the liquid is water, the water is discharged through relief valve 101 may be applied to the interior of chute 5 to dampen the garbage being treated, or otherwise applied to the intake side of the machine to dampen the trash as a fire preventative and to make the trash easier to treat. Separate, alternative or additional spraying apparatus may be provided in chute 5 if desired.

It may also be desirable to periodically apply sanitizing or deodorizing chemicals to the garbage being treated, and such substances may be mixed with water spray or applied separately.

Referring further to FIG. 14, it has been found advantageous to provide an injector, denoted by 106 as part of the hydraulic system associated with valve 101 and pipe 103. Injector 106 may be charged with any desired sanitizing or deodorizing chemical, denoted by 107 and an escape tube denoted by 108 with an escape nozzle denoted by 109 of known construction may be provided. Each time the pressure on anvil 21 causes water to escape through relief valve 101, a small quantity of chemical substance 107 is withdrawn from injector 106 and applied to the incoming garbage in chute 5.
The present invention has been described with particular reference to the anvil 21 rotating away from breaking drum 11 when a predetermined force exists between anvil 21 and drum 11. It is possible and within the scope of the present invention to have the anvil 21 rigidly mounted and provide for the drum 11 to move away from anvil 21 when the predetermined force exists. In such a case the shaft 55 carrying drum 11 would be mounted in bearings in turn mounted on a moveable structure capable of moving drum 11 away from anvil 21 and restoring drum 11 to its initial position in a similar manner to that discussed above in relation to anvil 21.

Another important feature of the apparatus of the present invention is the check means denoted by 170 now to be described, particularly illustrated in FIGS. 3, 4, 12 and 12A. The check means 170 are important because they remove material if it does adhere to the breaking drum 11 and the teeth 57 through 76 and they determine the direction of flow of material within the apparatus. That is, the check means 170, in addition to keeping breaking drum 11 free of entangling material further act so as to block the return of treated garbage on the side of breaking drum 11 where the teeth are going upwardly while at the same time garbage is subjected to pressure below from the teeth going downwardly, causing the apparatus of the present invention to function as a sort of pump or compressor which not only breaks up the garbage but compresses it, guides it in the apparatus and compacts it tightly in a bin or other suitable means.

Referring further to the check means, it may be pointed out that some items which are disposed of as garbage do not require any particular breaking up but they must be treated along with other material which does require such breaking up, and there are certain materials which tend to collect on and adhere to the moving parts of apparatus 1. Lengths of cord, discarded garments and the like tend to become im- paled on the teeth 57 through 64 and to bind upon the drum 11. Such discarded garments as nylon stockings and nylon pantyhose having quite tough and resilient fibers tend to become impaled on various parts of the apparatus and are rather difficult to dislodgment.

As will be seen the check means 170 consists of a series of parallel check plates each denoted as 171. Each check plate 171 is perforated by a circular opening denoted by 172 just large enough to receive breaking drum 11. The circular opening 172 is so close to the edge of plate 171 that check plate 171 has the appearance of a ring held in a concave cut in a plate. As a matter of fact, for ease of assembly it has been found desirable to make check plates 171 in two parts consisting of a flat plate with a semi-circular cut out portion, and welding the aforesaid components together to provide the shape of check plate 171 seen in FIG. 12. Whichever construction of check plate 171 is used, the size of the circular opening is such that a clearance of approximately three-sixteenths inch may be left all around the breaking drum 11.

Check plate 171 is securely attached to the frame of apparatus 1 as by welding to a bracket denoted by 176 rigidly attached to the apparatus 1, the weld is shown 78.

As particularly seen in FIG. 12A check plate 171 is provided with an abrasive strip denoted by 175. Abrasive strip 175 is provided on the inside of the circular opening 172 of check plate 171, of length of 2 or 3 inches. The purpose of abrasive strip 175 is to grind off tightly adhering tough fibers which may have become wound on the breaking drum 11. Such as strips of discarded nylon garments. Abrasive strip 175 is preferably made by welding in to the inside of the circular opening 172 a short strip of abrasive material made up, for example, of particles of tungsten-carbide nickel steel. Such material is available under the trade name "GRITALLOY - 1100."

The effect of abrasive strip 173 is to wear down and disintegrate material stubbornly adhering to breaking drum 11 and cause it to be loosened and be dropped from the drum.

Similar abrasive strips 56 already referred to are provided on the end plates 54 of breaking drum 11 and the purpose is similar to the abrasive strip 175 just discussed.

Further reference to abrasive strips 56 has been delayed until they have been described in relation to the check means 170. Abrasive strips 56 in breaking drum 11 similarly applied to those in check plates 171 wear down and disintegrate material stubbornly adhering to the end plates 54 of breaking drum 11 and likely to cause the breaking drum 11 to bind against the frame of apparatus 1.

The structure and operation of the described embodiment of the invention in relation to the handling of large relatively incompressible objects has been described above. In the event of a blockage or jam which is too serious to be handled by the motion of the anvil 21 described above, the controller 41 may be actuated through overload device 39.

The controller 41 may be programmed merely to stop the apparatus 1 in the event of a serious overload. It is generally more useful if the controller 41 is programmed to attempt to first clear the jam by going through the cycle of: stopping the apparatus 1, reversing the drum 11 for a half revolution and restarting the drum 11 in its original direction and carrying out this cycle several times. If the jam persists, controller 41 should be programmed so as to then shut down the machine and to signal an alarm such as by a visible and audible signal simultaneously.

It would be convenient at this point to refer again to the speed of rotation of drum 11. As already stated, the drum preferably rotates at relatively slow speed, so that the tip speed of teeth 57-64 is of the order of 40-50 fpm. The ideal speed is that speed which smoothly opens anvil 21 as required when a relatively incompressible mass is applied between drum 11 and anvil 21. The anvil 21 and its associated components is quite massive and has considerable inertia and running the drum 11 at a high speed would impose serious strains on the components. The speed at which the anvil opens depends primarily on the speed of drum 11 as modified by the shape of the anvil and the material being treated and keeping the drum speed to a low level causes the anvil to be pushed open rather than being subjected to a sharp blow slamming it open with consequent stresses.
The apparatus of the present invention in its operation can be more fully understood with reference to FIG. 15 which is adequately labelled and self-explanatory.

The function of the apparatus in the present invention is to carry out the following specific steps, that is to say to smash glass containers, collapse and flatten metal containers, burst and rip plastic containers, squeeze and flatten other weak containers such as milk cartons, allow incompressible objects of a common size to pass through the apparatus without performing shredding or pulverizing operations.

The function of the opposed-pair positioning of the teeth 57–76 on breaking drum 11 already referred to will now be discussed in greater detail.

As can best be seen with reference to FIGS. 8, 9 and 13, each row of teeth 57–76 are arranged non-continuously in each row, and in the present embodiment the pairs of teeth are oppositely arranged so as to provide gaps in order to ensure that large glass bottles and other containers will be drawn into the nip formed by such gaps. Large containers shown at 90 in FIG. 13 which would otherwise fail to gain purchase on the teeth for geometric reasons, will fall to the drum diameter, when the space left between teeth comes round. Having made this downward movement into the nip, the following tooth such as 57 is able to trap and deform the container. In this way, very large bottles such as up to 10-inch diameter as shown at 90 can be smashed.

By having each row of teeth progressively staggered in an angular sense as seen in FIGS. 5, 6 and 7, the nip referred to is created over a sufficient length of the length of drum 11 to trap some part of a large container like bottle 90, and even if it is not totally shattered at once it will be reduced to small pieces in a short time. Random arrangement of teeth on drum 11 do not appear to be effective in breaking large containers and appear to act rather as a large brush.

The process of mass flow through the described apparatus is further utilized to obtain compacting pressure as a garbage "pump" (in a manner roughly analogous to the paddle wheel of an old stern wheel or river boat) when the solid wastes are fed out of the drum area and into a closed volume bin at 7. This downstream pumping pressure serves to compact the already high density waste coming from the drum. When the bin 7 is full and under compacting pressure, the apparatus is automatically stopped and the high density waste material is removed to the next stage of processing.

In practical operation of the device high density solid wastes coming from the drum 11 are driven downward by the drum action to collect in a bin 7 securely attached to the base of the apparatus. After loosely filling the bin, the apparatus is allowed to continue working so that the drum action will further compress the garbage up to a predetermined compaction pressure. At this point, the above mentioned switch operates, and the bin may then be removed.

The present inventor would like to supply further details of practical embodiment of the invention. Referring to the drive motor 31 and the drive shaft shown diagrammatically at 33 it may be stated that transmission from the drive motor 31 which may be a 3 H.P. three ph. a.c. motor is by a 4:1 (approx.) Vee belt reduction to a 60:1, 6-inch centers, worm gear reducer with torque-limiter, which is directly coupled to the shaft of brake drum 11. The Vee belt reduction can be varied to adjust the drum speed around the 10 r.p.m. mark, to give the desired tip speed of 40–50 fpm.

Referring to the chute switch 47, switch 47 is actuated from off to working conditions when garbage entering from the bottom of the chute operates the chute switch 47. The mechanism utilizes side pressure from the garbage to flatten a hinged plate 49 against the heavier armor plate of the upper wall of the apparatus. This hinged plate is spring-loaded against the switch 47 which is typically a micro-switch.

In order to achieve the maximum practical value from the present invention, the present inventor desires to discuss in a little further detail the ultimate disposal of the waste material treated by the apparatus just referred to.

Referring now to FIG. 16, there is shown an economical and hygienic method of transportation to sanitary landfill sites.

The apparatus, as described above, produces high density odorless bags of waste that can be loaded onto inexpensive trucks, shown at 132 for transportation only. These trucks need not be fitted with elaborate compacting equipment as at present.

In FIG. 17 there is shown a method of further processing of solid waste. Trucks 131 as mentioned above would transport the waste to a strategically located municipal plant equipped with a high pressure compacting mill, designed to compress each bag of waste into very dense cubes shown at 133 and render them both biologically and structurally stable. These cubes 133 could be impregnated with concrete, resin, or bitumen, where necessary, and either sold or given to projects able to utilize them. Land fill sites, using these cubes, would be capable of overbuilding with heavy (and more useful) construction.

A large bulk carrier operation in connection with the invention is shown in FIG. 18. There the reducing mill part of the apparatus can be used to feed into and compact waste in a large truck size bin shown at 141 which would be wheeled out and hitched to the vehicle when full.

Referring to FIG. 19 where there is shown an application of the invention to suburban house collection the apparatus is interfaced to an upward inclined feeding conveyor shown at 151 and perhaps alternatively with a screw conveyor downstream from the reducing mill. This assembly is self-contained and transportable, but remains always in the suburb work district and couples up to inexpensive hauling trucks for loading and compacting. When the truck is full, it uncouples and removes the waste to the next stage of processing. An empty, waiting truck shown at 153 immediately couples to the apparatus. The inclined feeding conveyor allows waists high manual loading. At the end of a working period, the apparatus is hitched to one of the hauling trucks for removal.

As seen in FIG. 20 the invention is adaptable to a waste pumping system for slurries.

The apparatus of this invention feeds into a separating device shown at 161 which channels glass and metal parts to a bag packaging facility shown at 163. Softer materials are directed through a sizer before reaching
the slurry pump at 167 in water suspension to be pumped to more distant disposal.

As will be seen the present invention has very great adaptability to various circumstances and provides a greatly improved apparatus for compacting garbage.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Garbage treating apparatus comprising a hopper having a discharge opening through its bottom, a breaking drum means rotatably mounted within said opening and comprising a central cylindrical member with a plurality of teeth fixed thereto and extending outwardly therefrom, the opposite ends of said drum means being disposed closely adjacent the opposite ends of said opening; anvil means disposed at and defining one side of said opening, said anvil means including a plurality of anvil elements extending between adjacent teeth of said breaking drum means, check means rigidly supported from the side of said opening opposite said first-mentioned side and including check plates disposed between the respective teeth of said breaking drum means and encircling said cylindrical member, and power means for rotating said breaking drum means at a low peripheral speed in a direction such that its said teeth rotate downwardly between said anvil elements to force the treated garbage downwardly through said opening, while said check plates occupying the spaces between adjoining teeth prevent the upward return of garbage into the said hopper.

2. Garbage treating apparatus as defined in claim 1, in which said check plates are respectively formed with circular openings rotatably receiving said breaking drum means, including radially inwardly directed abrasive means carried by the respective check plates at the inner peripheries of their said openings in close proximity to the outer periphery of said central cylindrical member for the removal of foreign material therefrom.

3. Garbage treating apparatus as defined in claim 1, further including abrasive means carried on the opposite axial ends of said breaking drum means and directed toward those portions of the said hopper defining the opposite ends of said opening, whereby to maintain said ends of the opening free of foreign material.

4. Garbage treating apparatus as defined in claim 3, including abrasive means carried by the respective check plates closely adjacent to the outer periphery of said cylindrical member.

5. Garbage treating apparatus as defined in claim 1, wherein said breaking drum means projects downwardly through said opening for reception in a bin disposed therebeneath to distribute the treated garbage horizontally within said bin.

6. Garbage treating apparatus as defined in claim 1, comprising an enclosed elongated bin beneath said hopper and in communication with the opening thereof to receive treated garbage therefrom, said opening and breaking drum means being adjacent one end of the said elongated bin and remote from the opposite end thereof, the said rotating drum means having a lower peripheral portion projecting downwardly through said opening into the bin and rotating in a direction toward the said opposite remote end of the bin to urge the treated garbage within the bin toward said opposite remote end.

7. Garbage treating apparatus comprising a rotatable breaking drum, a cooperating anvil, the rotatable breaking drum being provided with a series of pairs of teeth mounted at spaced intervals along the length of the breaking drum, the anvil being of general crescent shape, pivotally mounted in the region of its upper end and depending downwardly, the anvil extending substantially perpendicularly to the downwardly depending direction so as to extend inside the periphery of rotation of said teeth, motive power means for driving said breaking drum at low speed, check means provided in close proximity to said breaking drum to clear material adhering to said breaking drum, to prevent the processed material from flowing back upwardly past said rotatable breaking drum, said check means including a scraper block having a concave portion of approximately the same circumference as said drum and provided with a grinding surface facing said drum.

8. Garbage treating apparatus as defined in claim 7, in which said power means rotates the said breaking drum at a speed of the order of 10 r.p.m.

9. Garbage treating apparatus as defined in claim 7, in which said power means rotates the breaking drum at a peripheral speed of the order of 20 to 30 ft/min.

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