

[54] **ARTIFICIAL FUEL LOG MACHINE**
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[51] Int. Cl. **C10I 5/22, B30b 11/00**
[58] Field of Search **44/2, 11, 13, 12**

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Primary Examiner—C. F. Dees
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[57] **ABSTRACT**

An apparatus for forming compressed fuel logs from shredded waste paper impregnated with oil. The apparatus includes an upwardly open receiving chamber within which a charge of partially compressed material is received, the material being directed to the receiving chamber by an upright chute. A lateral compression ram moves the charged material from the receiving chamber to a compression chamber and reduces the width of the charge. The perpendicular compression ram reduces the length of the charge within the compression chamber. The finished log is discharged through a release door in the compression chamber during retraction of the two rams.

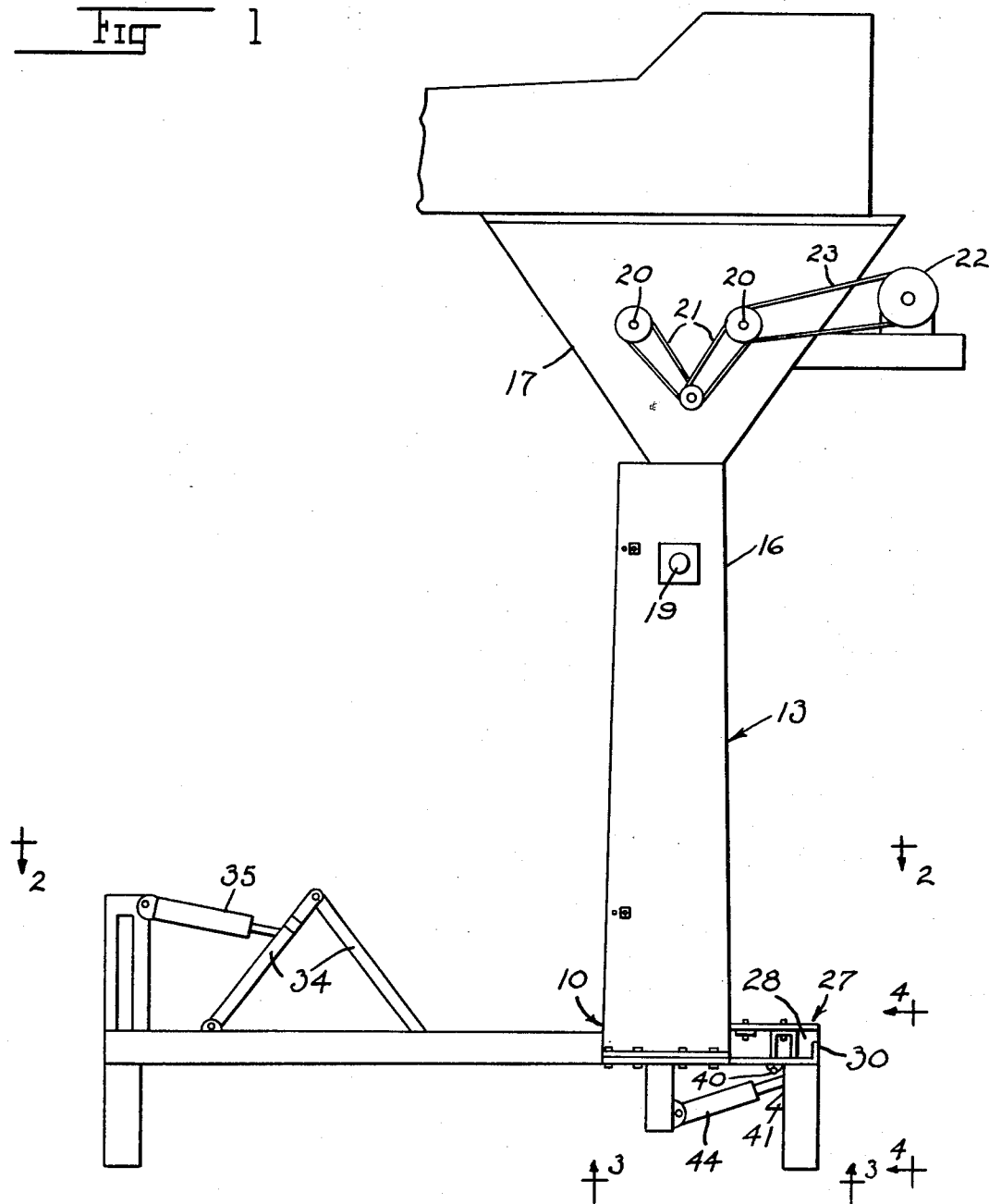
6 Claims, 13 Drawing Figures

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SHEET 1 OF 5

Fig 1



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Fig 2

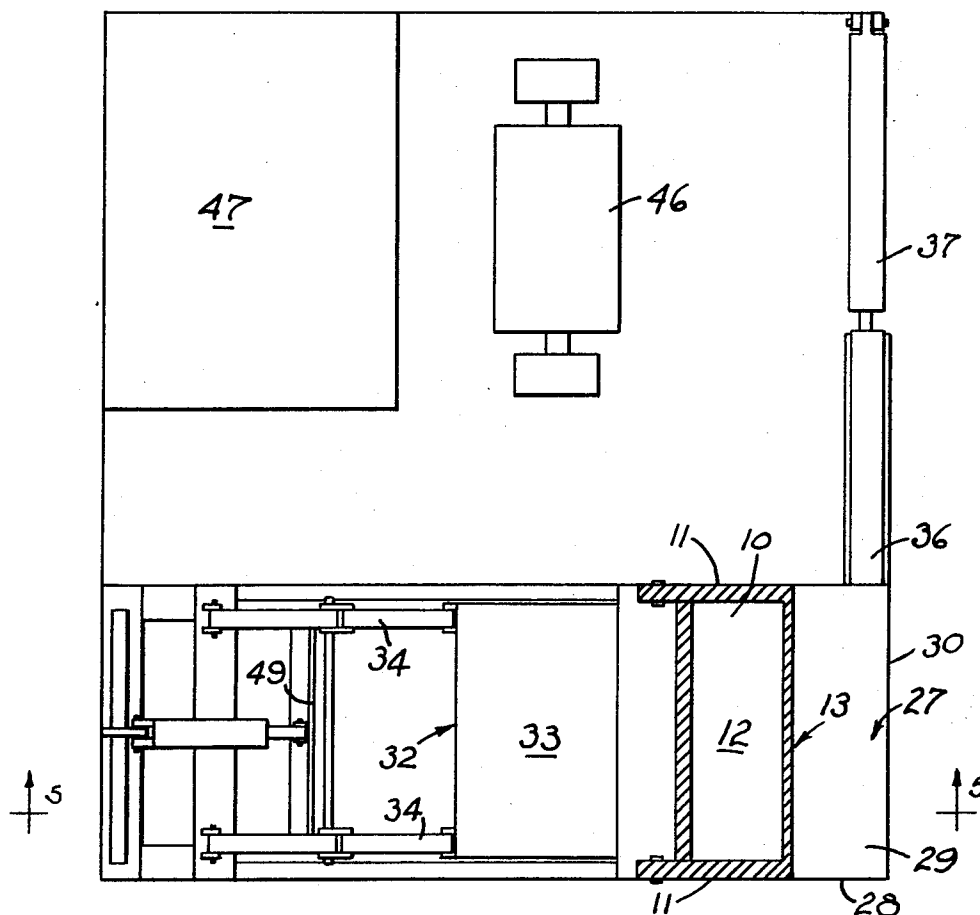


Fig 3

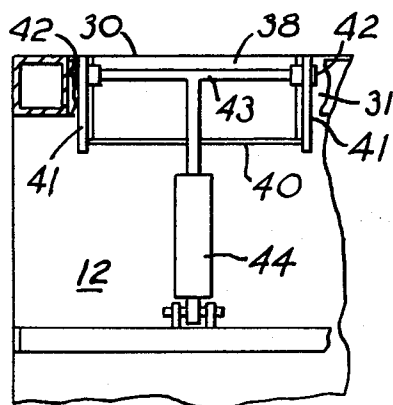
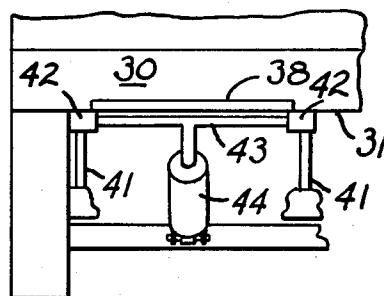


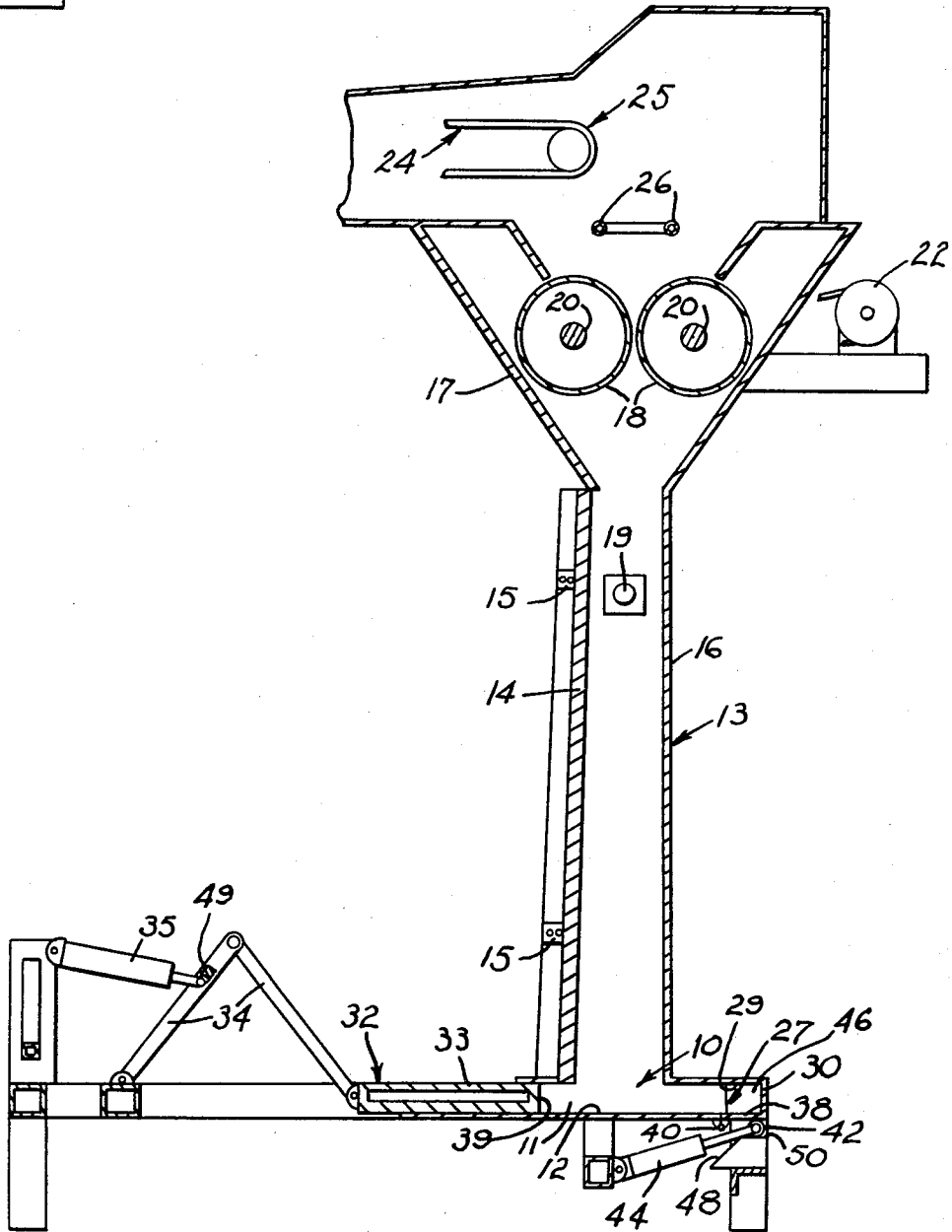
Fig 4



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Fig 5



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Fig 7

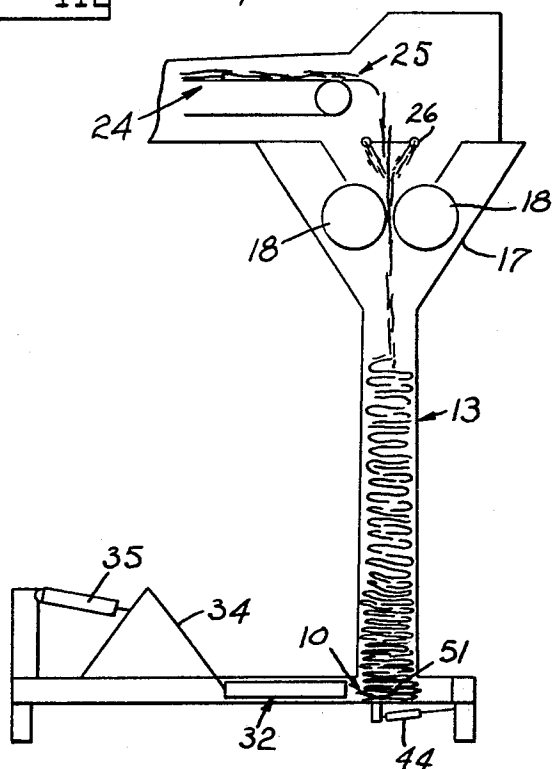


Fig 6

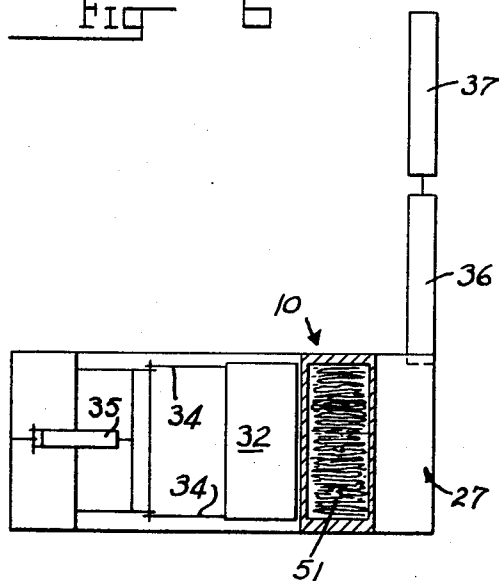


Fig 8

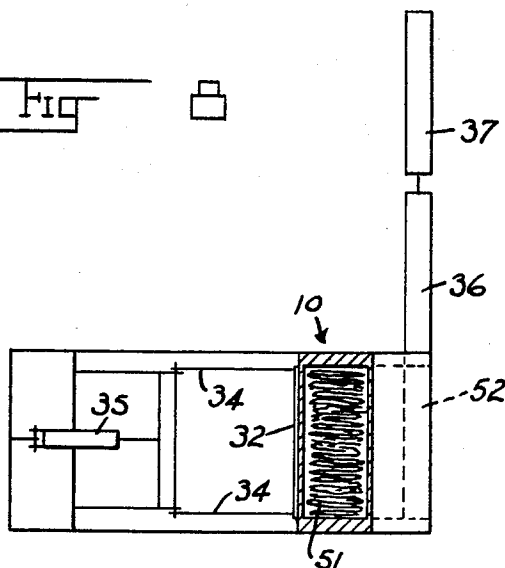
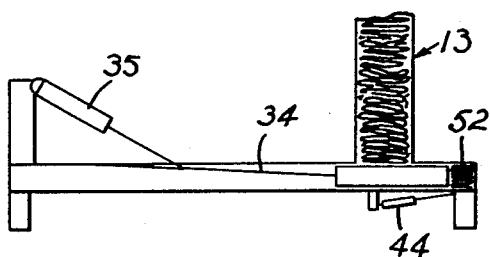


Fig 9



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Fig 11

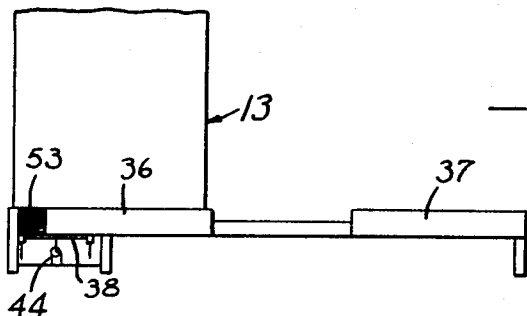


Fig 10

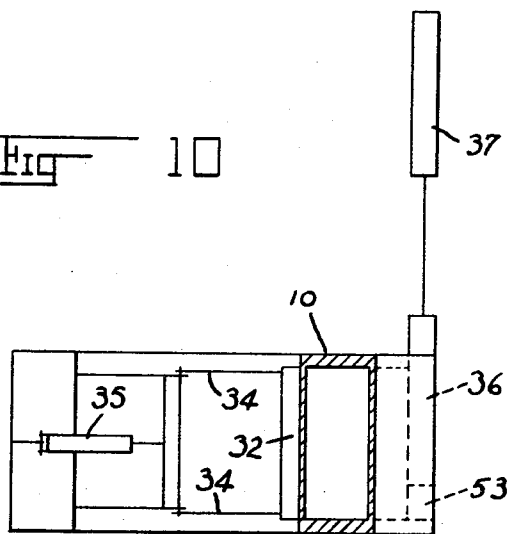


Fig 13

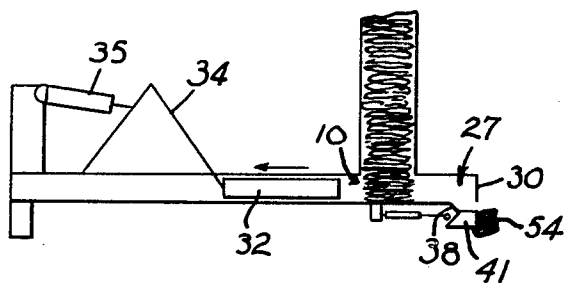
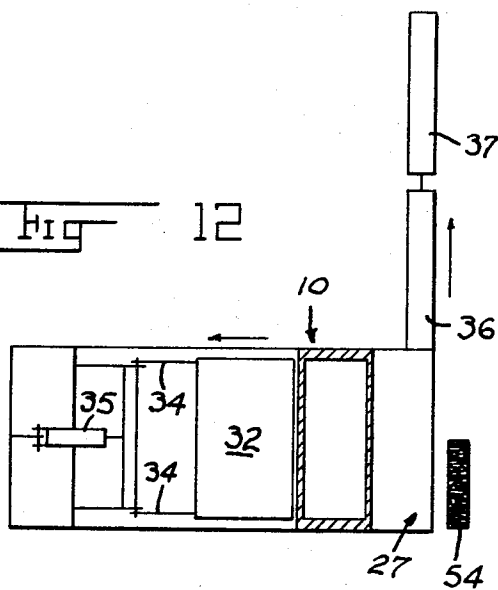


Fig 12



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ARTIFICIAL FUEL LOG MACHINE

BACKGROUND OF THE INVENTION

The disclosed invention is concerned with the production of fuel logs from shredded waste paper. To provide a cohesive log with improved burning capability, the shredded paper is impregnated with a flammable liquid, such as waste oil.

Prior attempts have been made to produce useful fuel logs from waste paper, but most have failed because of the economics of the processes chosen. Considerable pressure is required for compressing such logs and the apparatus must be automated so as to be operable with a minimum of human supervision. Furthermore, it is necessary to provide a mechanism that is capable of rather fine adjustment so as to maintain uniform product quality regardless of the particular grades of waste paper fed into the machine.

According to the disclosed invention, mechanical compressing of logs is achieved on an individual basis, with adjustment being provided to accommodate the properties of the paper. The apparatus is readily cycled for automatic operation and does not require human supervision when operating properly. The log formed can be readily wrapped by conventional machinery and produces a suitable fuel log for fireplaces, stoves, and other burning purposes.

SUMMARY OF THE INVENTION

The invention comprises a partially enclosed receiving chamber adjacent to a partially enclosed compression chamber. The lateral ram is movable in a straight path between a first position at the side of the receiving chamber opposite to the compression chamber and a second position wherein it serves as one side wall of the compression chamber. One end wall of the compression chamber is movable in a straight path from a level position at one end of the compression chamber toward the remaining end wall thereof. One wall of the compression chamber is releasable to permit removal of the compressed log from the chamber.

A special chute is provided above the receiving chamber for supplying partially compressed shredded paper impregnated with oil and for maintaining a height of such material above the receiving chamber so as to ensure the desired quantity of material within the open chamber prior to movement of the lateral compression ram.

It is a first object of this invention to provide relatively simple mechanisms with the strength necessary to produce a highly compressed finished log from shredded waste paper.

Another object of this invention is to insure the quality production of the machine by careful control of pre-compression, spraying of oil, and the volume of material directed into the initial receiving chamber.

Another object of this invention is to provide such an apparatus which is capable of relatively high speed production with a minimum of human supervision.

These and further objects will be evident from the following disclosure, taken together with the accompanying drawings which illustrate a preferred form of the invention. The concepts of the invention are not to be limited except as set out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of the apparatus;

FIG. 2 is a sectional plan view of the apparatus as seen along line 2—2 in FIG. 1;

FIG. 3 is an enlarged bottom view of the release door as seen substantially along line 3—3 in FIG. 1;

FIG. 4 is an end view of the lower portion of the apparatus as seen along line 4—4 in FIG. 1;

FIG. 5 is an elevational sectional view of the apparatus substantially along the plane designated at 5—5 in FIG. 2;

FIGS. 6—13 are paired plan and elevational schematic views illustrating the basic operational steps of the machine;

FIG. 6 is a plan view showing receipt of a charge of material;

FIG. 7 is an elevation view corresponding to FIG. 6;

FIG. 8 is a plan view showing the lateral ram moved to its compression position;

FIG. 9 is an elevation view corresponding to FIG. 8;

FIG. 10 is a plan view showing the end ram moved to its compression position;

FIG. 11 is an elevation view corresponding to FIG. 10;

FIG. 12 is a plan view illustrating initial retraction of the rams and release of the compressed log; and

FIG. 13 is an elevation view corresponding to FIG. 12.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The construction of the apparatus is illustrated in FIGS. 1—5. The operational sequences of the various moving parts of the machinery are illustrated in FIGS. 6—13.

The disclosed apparatus has been specifically designed for producing a rectangular compressed log suitable for fuel purposes, beginning with shredded waste paper impregnated with a flammable oily substance such as waste crank case oil available for salvage purposes from automobile service stations. The log is preferably formed in a rectangular shape generally corresponding to the size of a loaf of bread, although it can be made in any desired size or configuration within the practical limitations of machinery design. By producing a log having the general shape and size of a loaf of bread, one can conveniently package each log by use of conventional wrapping machinery available in the baking industry, whereby the log is enveloped in a sealed wrapper of waxed paper. This wrapper, not illustrated herein, facilitates lighting of the log and presents a clean package for storage and handling purposes.

As seen particularly in FIGS. 2 and 5, a pre-compressed charge of shredded paper impregnated with oil is received within a rectangular receiving chamber designated generally at 10. The receiving chamber 10 is partially enclosed, being open at both sides and at its top. Fixed end walls 11 on the supporting machine framework define the end limits of chamber 10. The horizontal smooth bottom wall 12 defines its lower limits.

An upright rectangular chute 13 is located immediately above receiving chamber 10 and is in open communication therewith. The chute 13 includes two

side walls, 14 and 16. The walls 14, 16 diverge slightly from top to bottom, providing a slightly tapering enlargement of the cross-sectional area within chute 13 from its upper end to the receiving chamber 10. This provides negative clearance to insure gravitational movement of material within chute 13. As shown, the side wall 14 is laterally adjustable relative to wall 16 by selective positioning along brackets 15. The adjustment of position of side wall 14 permits one to change the interior cross-sectional area of chute 13 as dictated by the density requirements of the finished log and the types of shredded waste paper being fed to the machine for processing.

At the upper end of chute 13 is an enlarged hopper 17 that initially receives the shredded paper. The material is received from an elevating sheet conveyor 24 of conventional belt conveyor design. The upper or exit end 25 of the conveyor 24 discharges material by dropping it between horizontal spray pipes 26 which direct a suitable flammable material such as waste oil onto the loosely shredded waste paper.

Immediately below the exit end 25 and feed conveyor 24 are a pair of smooth rollers 18 rotatably mounted on hopper 17 by parallel shafts 20. Rollers 18 are powered in opposite rotational directions by conventional pulleys through belts or chains 21 or other suitable conventional driving connections. A motor 22, mounted at the exterior of hopper 17, is operatively connected to one of the shafts 20 through a conventional chain or pulley connection illustrated at 23. Rollers 18 are spaced so to press the incoming loose shredded paper into a mat, reducing the bulk of the material, eliminating entrapped air, and further distributing the oil previously applied to the material.

The continuous mat of compressed shredded waste paper is received within the chute 13 and is maintained in a solid mass therein extending to a selected height to insure a desired minimum weight of material above the receiving chamber 10 at all times during which the apparatus is operating. As an example, the chute 13 has been constructed to a height of 13 feet, and a normal operating height of material within chute 13 has been maintained at ten feet. This height of precompressed material itself exerts compression forces at the top of chute 13 to insure desired density of material as charged within the receiving chamber 10. As illustrated, suitable sensors 19, such as a light source and opposed photoelectric cell, can be mounted on or within chute 13 for detecting the height of material therein, according to conventional sensing and control techniques.

Laterally adjacent to the receiving chamber 10 is a compression chamber generally designated by the numeral 27. It comprises a fixed end wall 28 coincident and integral with one end wall of the receiving chamber 10 and a fixed side wall 30 at the side of compression chamber 27 opposite to receiving chamber 10. It is completed by a bottom wall 31 which is a continuation of the previously described bottom wall 12 and a parallel upper wall 29 which is coplanar with the upper edges of receiving chamber 10.

The remaining end of the compression chamber 27 is defined by an end compression ram 36 having a cross-sectional configuration that complements the operative compression chamber. It is movable toward wall 28

from the position shown in FIG. 2, where it is recessed slightly beyond the corresponding end wall 11 of the receiving chamber 10.

The lateral compression ram 32 is slidably mounted on the framework of the apparatus for movement through the receiving chamber end in a straight path. The ram 32 includes an outer upright wall 39, that is parallel to the side wall 30 of compression chamber 37. Extending back from the upper edge of wall 39 is a top wall 33. The upper surface of the top wall 33 is coplanar with the upper edge of the receiving chamber 10 and serves to block the lower end of chute 13 when ram 32 has been moved to its compression position. Ram 32 as illustrated is constructed in the form of a hollow rectangular enclosure including walls 39 and 43. It is movably guided by the framework and inner surfaces of receiving chamber 10. At its outer end the ram 32 is operatively connected to a pair of toggle arms 34 at the respective sides of ram 32. Cams 34 are jointed at their centers and are movable by force applied to the pivoted double-acting cylinder assembly 35 operatively connected between the machinery framework and a transverse bar 49 fixed across the respective toggle arms 34. The cylinder assembly 35 is operable to retract ram 32 so as to clear the receiving chamber 10, in the manner shown in FIG. 7, and to move ram 32 to a position wherein it defines one wall of the compression chamber with the toggle arms 34 in a straight line condition, as shown in FIG. 9.

The end compression ram 36 is also preferably a sealed rectangular enclosure. It is powered by a second double acting cylinder assembly 37. Its piston rod is operatively connected between the machinery framework and the ram 36 for direct straight line movement to the compression chamber 27 between the position shown in FIGS. 7 and 9 and the position illustrated in FIG. 11.

The finished logs are removed from compression chamber 27 through a hinged release door 38 which forms part of the bottom wall 31 previously described. Release door 38 has a length substantially corresponding to the length of the finished log, which is greater than the minimum separation between the end compression ram 36 and the end wall 28 of compression chamber 27. This increased length is due to the expansion of the log in an endwise direction which results from final release of ram 32.

As seen more specifically in FIGS. 3 and 4, the release door 38 is connected to the fixed apparatus by hinges 40 which pivot door 38 about an axis parallel to the side wall 30 in the compression chamber 37. Immediately below the normally horizontal door 38 are fixed cams 41 located outwardly adjacent to the pivotal path of door 38 about the axis of hinges 40. The cams 41, in elevation, each includes an inclined surface 48 and a top horizontal surface 50 generally parallel to the bottom wall 31. A T-shaped frame 43, having rollers 42 at the respective ends of its transverse rigid arm, is fixed to the outer end of a piston rod comprising the movable portion of a double-acting hydraulic cylinder assembly 44. Rollers 42 overlap the surfaces 48 and 50 of cams 41 and the lower edges of release door 38, thereby locating door 38 about the axis of hinges 40. When the cylinder assembly 44 is fully extended, rollers 42 rest on the horizontal surfaces 50, providing a

substantially rigid support for the door 38 in its closed or horizontal position. This position is coextensive with the remainder of bottom wall 31 within compression chamber 27. This substantially rigid connection is capable of withstanding a considerable interior pressure exerted on door 28 during production of a log. Upon retraction of the cylinder assembly 41, door 38 is permitted to drop about the hinges 40 due to gravitational forces and thereby releases the compressed fuel logs in the manner shown in FIG. 13.

The apparatus is completed by a motor and pump unit 46 and hydraulic reservoir 47 used to supply fluid under pressure to the cylinder assemblies 35, 37, and 44. Suitable valves and switches can be utilized in the conventional manner to automate the sequence of automation of the various components described above.

It is believed that the general operation of the apparatus is clear from the above description of the components. However, the compression of a fuel log is schematically illustrated in FIGS. 6-13 and will be related herein to a specific apparatus for forming finished logs having a cross-sectional area of approximately three and one half inches square and a length of approximately eleven to twelve inches.

To produce such a log, I have found it best to apply a spray of waste crank case oil as the shredded particles of paper fall from conveyor 24 in the upper end of hopper 17. The amount of oil applied should be the minimum volume necessary for proper ignition of the material in the finished form. As an example, approximately one-quarter to one-half pound of filtered crank case oil has been sprayed onto 2 pounds of paper as received in hopper 17. As described above, a minimum height of approximately 10 feet of this oil-impregnated paper is maintained above receiving chamber 10 after pre-compression through the rollers 18.

In the example given, the dimensions of the receiving chamber are approximately 32 inches from end to end (between walls 11) by 3½ inches high and approximately 12 inches in width. The width of a charge of material received within the chamber 10 can be varied up to 4 inches by adjustment of wall 14 on chute 13 as previously discussed. FIGS. 6 and 7 illustrate the positions of the various movable components at the beginning of an operating cycle, there being shown an initial charge of material 51 indicated within the receiving chamber 10.

The first operation comprises movement of compression ram 32 through the receiving chamber 10 from left to right as shown in FIGS. 8 and 9. During such movement, the charge of material 51 is sheared from the remaining material within chute 13 and is laterally compressed to the desired cross-sectional shape of the finished fuel log. In this example, the charge, now designated as 52, has a dimension of 32 inches in length and a cross-sectional area of 3½ inches square. The laterally compressed end position is illustrated in FIGS. 8 and 9.

After ram 32 has completed its movement and the toggle arms 34 are straight so as to mechanically support ram 32 against the resulting high pressures, the end compressing ram 36 is moved from the position shown in FIG. 8 to the position shown in FIG. 10.

After complete compression of the fuel log, indicated in its minimum configuration by the numeral

53 in FIGS. 10 and 11, the end compression ram 36 is retracted. As it clears the release door 38, the cylinder assembly 34 is operated to permit door 38 to swing downwardly about hinges 40 and hydraulic cylinder assembly 35 is simultaneously actuated to retract compression ram 32. Because of the degree of end compression, the log expands to the elongated form at 54 in FIGS. 12 and 13. Whereas it was compressed to a length of about 3½ inches, it will expand to a final length of between 11 and 12 inches. As release door 38 drops, the log 54 is discharged by gravity and can be received by a conventional conveyor belt (not shown) or other receiving apparatus.

During the discharge of the fuel log, the rams 32 and 36 continue movement back to their initial positions as seen in FIGS. 6 and 7. After the discharge of the fuel log, movement of cylinder assembly 44 is reversed to again support the release door 38 in a horizontal position as part of the floor within the compression chamber 27. The discharge of the fuel log can be detected by conventional control devices (not shown).

In actual practice, the above apparatus has been found to produce an economical and acceptable fuel log from waste paper with otherwise little salvage value. The apparatus is capable of producing a very compressed log which will burn over a substantial period of time for fireplace use, use in camping situations, or for heating or other fuel purposes. It can be conveniently wrapped and is readily lighted due to the flammable nature of the liquid spray used to adhere the particles to one another. Various additives might be added in the fuel log to reduce the amount of smoke due to combustion or to produce colored flames or other desired burning properties.

Various modifications might be made with respect to the exact structure as illustrated, while remaining within the general scope of the disclosure as suggested by the summary of the invention and general discussion above. Therefore, the invention is not to be restricted by the exact details illustrated, except as it is defined in the following claims.

The application of the present disclosure is not limited to production of logs for fuel or to any size logs. Bricks of fertilizer might be produced by it, or other loose materials compressed for storage or end use applications. In addition, other suitable loose combustion materials might be used to produce an artificial fuel log by the operations described, with or without spraying of oil or other combustible liquids.

Having thus described my invention, I claim:

1. In an apparatus for forming compressed fuel logs from shredded waste paper impregnated with oil:

a partially enclosed receiving chamber having fixed end walls and a bottom wall;

a partially enclosed compression chamber adjacent to said receiving chamber having bottom and end walls normally coincident with the bottom and end walls of the receiving chamber, together with a side wall opposite to said receiving chamber and a top wall coincident with the top edges of the receiving chamber;

a lateral ram movable in a first straight path between a first position at the side of the receiving chamber opposite to said compression chamber and a second position spaced parallel to the side wall of

the compression chamber by a distance less than the width of the receiving chamber;
 one end wall of the compression chamber being selectively movable inward from its normal position toward the remaining end wall thereof in a second straight path perpendicular to said first straight path; and
 one wall of the compression chamber being releasable to permit removal of a compressed log from within the chamber;
 an elevated vertical chute extending upwardly from the receiving chamber in open communication therewith;
 feed means at the top of said chute for directing partially compressed shredded waste paper impregnated with oil into the chute;
 And means for selectively actuating said lateral ram conditioned upon the existence of a predetermined height of material being within the chute prior to movement of the ram from said first position to said second position.

2. The apparatus as set out in claim 1 wherein one side wall of said chute is transversely adjustable relative to the other, whereby the interior volume of the chute may be changed dependent upon the density of material received therein.

3. The apparatus as set out in claim 1 wherein said lateral ram comprises:
 an upright wall extending the full width and height of said receiving chamber;
 and a top wall extending outwardly from the upper edge of said upright wall oppositely to the compression chamber, the length of said top wall being such as to close the lower end of the chute when the lateral ram is in its second position;
 guide means fixed relative to said receiving chamber for guiding said upright wall and top wall along a transverse path parallel to the end walls of the receiving chamber;

and a toggle mechanism operatively connected between the upright wall and the framework of said receiving chamber for selectively moving the walls along said guide means relative to said receiving chamber, said toggle mechanism having a straight configuration when the lateral ram is in its second position.

4. The apparatus as set out in claim 1 wherein the bottom wall of said compression chamber is movable between a position coincident with the bottom wall of the receiving chamber and a position permitting removal of a compressed log.

5. The apparatus as set out in claim 4 wherein the bottom wall is hinged along one edge of the compression chamber;

and cooperating cam and roller means for selectively locating said wall relative to the hinge pivot in response to gravitational forces.

6. In an apparatus for compressing shredded waste paper impregnated with oil:

a vertical hopper comprising an upright chute having a horizontal cross-sectional configuration corresponding to the desired configuration of a charge of shredded waste paper;

an open sided enclosure at the lower end of the chute in open communication therewith for receiving a charge of shredded waste paper from within the chute;

lateral compression means for shifting a charge of shredded waste paper within the enclosure transversely relative to the chute against a stationary end wall to thereby reduce the width of the charge; perpendicular compression means for reducing the length of the charge while engaged by said lateral compression means; and

a movable wall within the enclosure permitting removal of a compressed charge upon release of said lateral and perpendicular compression means.

* * * * *