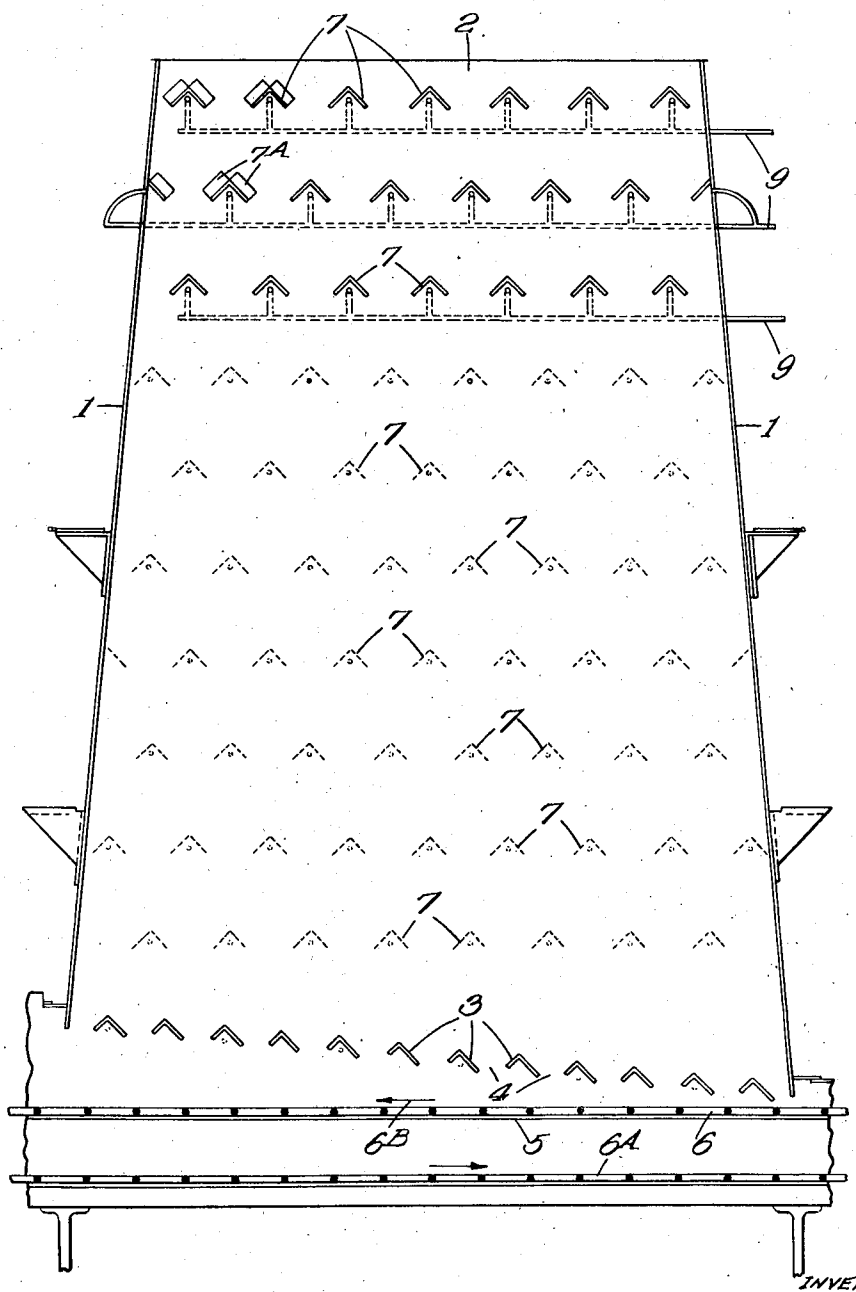
Dec. 12, 1939. F. H. BARNSDALE 2,183,274

APPARATUS FOR TREATING LOOSE FLOWABLE MATERIAL

Filed July 23, 1937 4 Sheets-Sheet 1

Fig. 1



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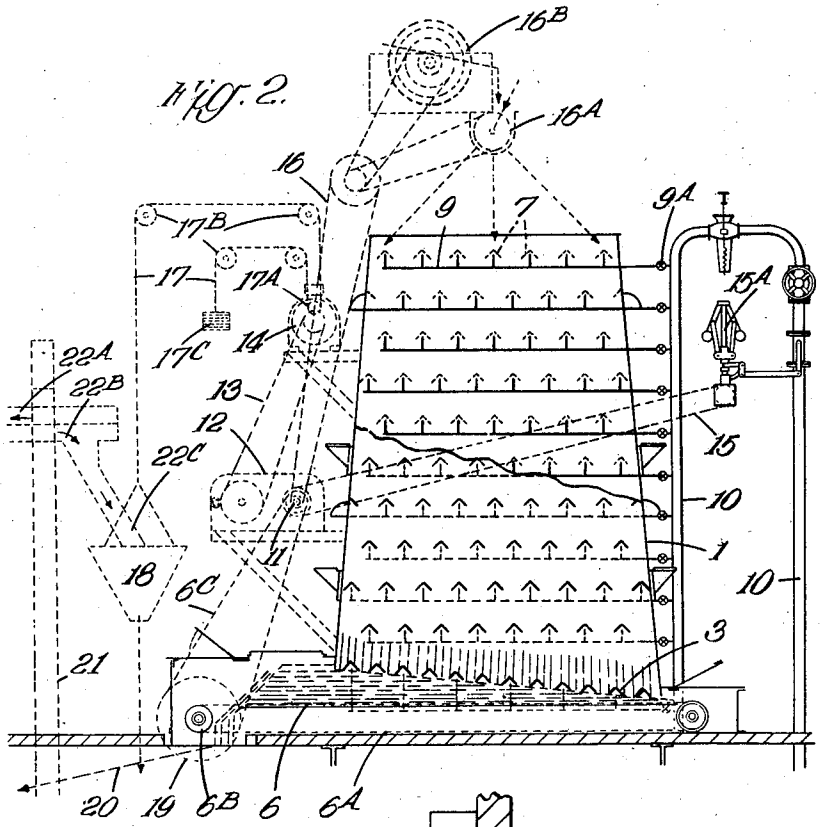


FIG. 2.

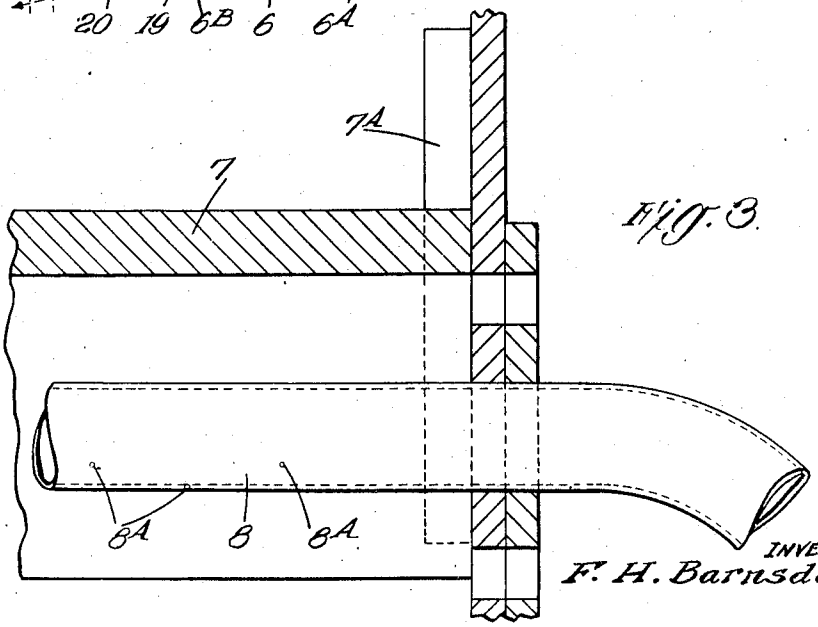


FIG. 3.

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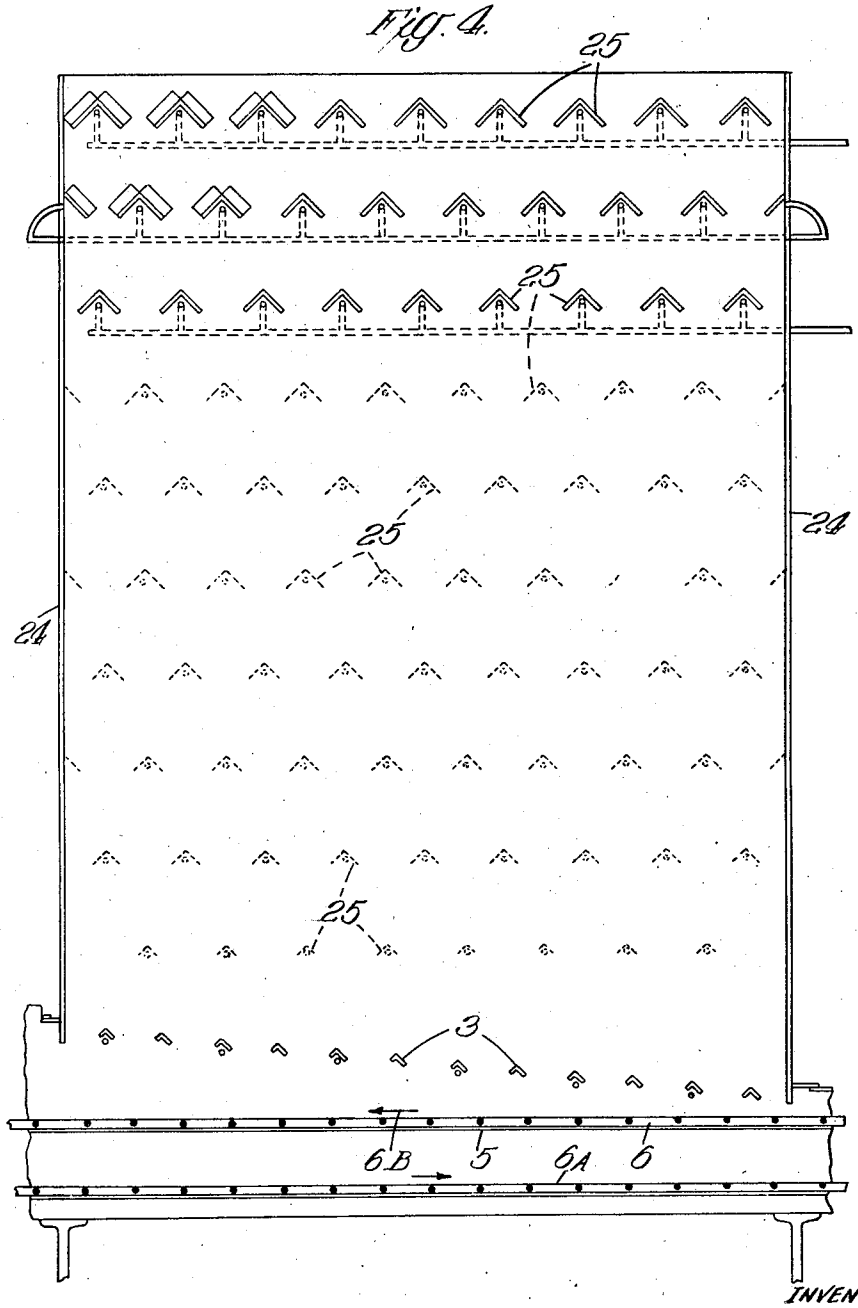
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APPARATUS FOR TREATING LOOSE FLOWABLE MATERIAL

Filed July 23, 1937 4 Sheets-Sheet 3

Fig. 4.



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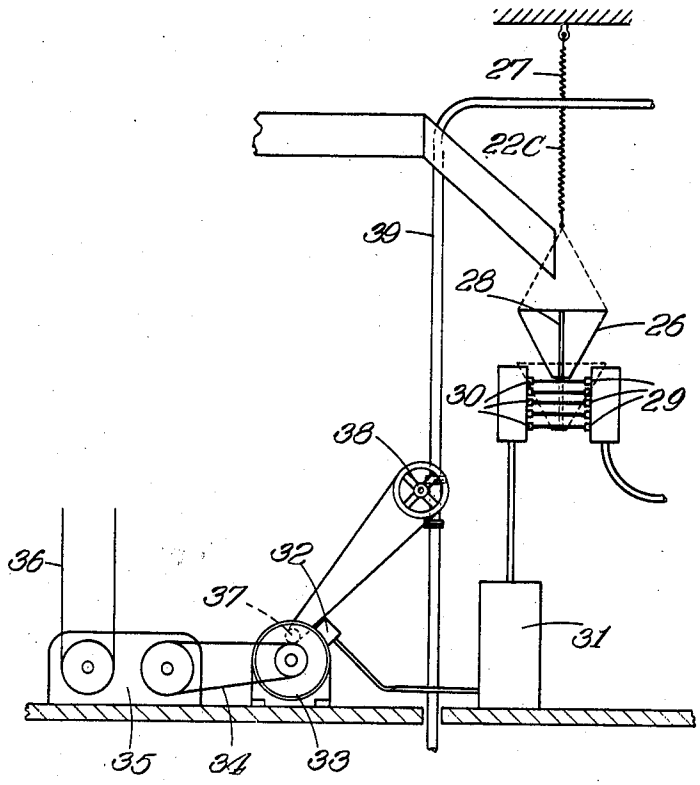
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APPARATUS FOR TREATING LOOSE FLOWABLE MATERIAL

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Fig. 5.



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2,183,274

APPARATUS FOR TREATING LOOSE FLOWABLE MATERIAL

Frederick Herbert Barnsdale, Bristol, England, assignor to Arnold Redler, Stroud, England

Application July 23, 1937, Serial No. 155,352
In Great Britain July 23, 1936

8 Claims. (Cl. 34—34)

This invention relates to improvements in apparatus for treating loose flowable material, such as grain, maize, minerals in somewhat small particles, or the like. For many industrial purposes it is needed to treat such materials by steam, warm air, gases, insecticides, or merely by heat. The control of such treatment, so that the result is uniform and the product is kept loose and not compressed, is of importance. In particular it is often desirable to maintain a proper relationship between time and temperature, and to cook for a long time, say one hour upwards. It is also often of great importance to treat somewhat fragile material, and a particular example with which the invention deals is the cooking of whole maize by steam. The invention seeks to provide apparatus which will supply the above requirements. The invention is concerned with the known type of apparatus for treating loose flowable material, such as grain, maize, minerals in somewhat small particules, or the like, in which the material is allowed to fall under the influence of gravity through a bin or tower and its fall is impeded by transverse members. In some previous proposals the material was allowed to fall in a free state and interruption of delivery resulted in packing or building up of the material at the bottom with resulting absence of uniformity and difficulty in controlling other desired factors. Moreover, the rate of flow was of necessity fairly high. The present invention is concerned with the provision of apparatus in which a considerable quantity of material can be retained in the bin or tower for a desired duration of time, whilst a characteristic feature is that the discharge from the bin or tower ensures uniform movement of the material. With any intermittently operating discharger, or any hopper bottomed discharger (such as have been proposed with filled bins for treatment processes) no uniform flow of material can be ensured as "coring" and avalanching occurs. The invention is based on the idea, familiar in relation to conveyors, that in loose, solid, flowable material, a number of transverse bar-like members spaced uniformly in the mass of material, will retain and support the material uniformly and prevent a head of pressure being transmitted through its depth, and will if provided as bars made movable like a conveyor across the bottom of a mass of material over a wedge-shaped outlet, discharge the material absolutely uniformly and evenly.

According to the present invention, apparatus of the type specified has the transverse elements so spaced and numbered as to result in a substantially equal distribution of pressure of the material during its downward passage by retaining or supporting the material at a large number of localities, and is provided at the bottom of the bin or tower with a discharger arranged to withdraw material evenly and continuously over the whole area of the bottom. Preferably the transverse elements are of inverted V-section and shelter within and below themselves pipes perforated for the flow of gas, steam, or the like for the treatment of the material, whilst the supply of gas, steam, or the like may be automatically controlled in accordance with the rate of the flow of material through the apparatus.

It may be arranged that the supply of material to the top of the bin or tower and discharge from the bottom is controlled by a speed control which is responsive to the ultimate demand or consumption, by virtue of conveying apparatus which returns unconsumed material, this unconsumed material being measured by means which alter the speed control. In constructing apparatus for use with materials which expand during treatment, in order to ensure uniform rate of travel through the bin it may be arranged that the latter has downwardly uniformly diverging walls. Alternatively to ensure uniformity of flow and of pressure within the bin the latter may be formed with parallel sides, with the transverse elements uniformly diminishing in width from the top to bottom of the bin.

Conveying apparatus for effecting the uniform and continuous discharge of material from the bottom of a bin and operating on the "en masse" principle has been known for many years, in which there is a discharging device for flour or other substances of a flowable nature, which device comprises chain-like elements adapted to be continuously driven. A preferred form of the apparatus for the cooking of whole maize by steam is illustrated diagrammatically in the accompanying drawings together with modifications of its parts.

In the drawings—

Figure 1 is a vertical section across the treatment bin;

Figure 2 shows the general arrangement schematically;

Figure 3 on enlarged scale and in partial section shows a treatment (steam or gas) pipe in relation to a transverse element;

Figure 4 is a vertical section across an alternative treatment bin; and

Figure 5 shows diagrammatically a speed control system employing a photo-electric relay.

Referring to the apparatus shown in Figures 1–3 the bin, which is preferably of square cross-section, has side walls 1 which diverge downwardly to allow for swelling of the material and thereby to ensure a uniform rate of travel. It is open at its upper end 2 and across its bottom end has a sloping series of transverse members 3 spaced apart and forming a uniform escape, through openings 4, of material. The openings 4 allow flow of material on to a conveyor floor 5, across which moves an "en masse" conveyor chain represented at 6 which is an endless chain with its return run at 6A. The direction of conveyance is shown by the arrow 6B, and it is seen that this corresponds with the slope of the series of members 3. Across the bin are fixed a large number of spaced members 7 each of which is an angle-iron arranged with inverted V-section, secured to the walls 1 by lugs 7A formed at their ends. Each member 7 shelters within and below itself a steam or gas pipe 8 with holes 8A for emission. The pipes 8 are mutually connected by supply pipes 9 having if desired, hand control valves 9A. All pipes 8, 9, are supplied by a distribution main pipe 10 from a boiler or other source.

The chosen form of the members 7, and their spacing, in particular their arrangement in transverse planes which are vertically spaced and so that the gap between any two nearly always had one other symmetrically above and one other symmetrically below, is such as to give the effect that, if maize or like flowable solid be filled into the bin, it will be at substantially uniform pressure throughout, and will descend uniformly if some be withdrawn from the bottom, being thoroughly rotated and mingled on its way downwards. Moreover the even distribution of the pipes 8 ensures uniform treatment throughout the mass of material. Escape of material through the spaces 4 depends on the material being moved away by the conveyor 6; if no material were removed, none could flow down the bin, even though there might be a channel of escape along the direction of the conveyor such as a liquid could take.

The control means can now be understood (see Figure 2 in particular). The conveyor chain 6, 6A, is driven by a terminal sprocket 6B on a shaft which is driven by a belt 6C from a main shaft 11 of a gear box 12 (for varying the driving ratio) which is powered through belt 13 by electric motor 14.

The shaft 11 also drives, through belt 15, a centrifugal governor 15A which regulates the delivery of steam through the pipe 10. Shaft 11 also drives, through belt 16, a worm or Archimedean helix feeding device 16A (and a wheel 16B for feeding water to the material just before it is fed into the bin by device 16A if some humidity be required).

The speed of the motor 14 is controlled electrically in accordance with the rotation of a pulley 17A by a rope or chain 17. This rope 17 suspends a counterpoise weight 17C, and passes over as many idle pulleys 17B as are necessary to guide it. Its other end supports a frusto-conical hopper 18 with open large and small ends.

The conveyor 6 delivers material from the bin down a chute at 19 and a suitable sloped channel indicated schematically at 20 to the feeding foot of a chain elevator indicated by 21 which lifts the material "en masse" in known manner to a conveyor of the same type as 6, 6A, running as shown by the arrows 22A, 22B; this conveyor delivers the material for consumption, but brings back (arrow 22B) any unconsumed material not discharged and this flows down the chute 22C into the hopper 18. The hopper 18 sinks according to the weight of material in it; material escapes from its lower, smaller, end back to the chute 20. The hopper thus, in effect, responds to the demand and causes the whole flow of material to accelerate or slow down in accordance with the demand for material. Simultaneously it opens up or throttles down the cooking steam in pipe 10.

This hopper is normally kept empty, and so the rate of flow down the bin is critically controlled together with the rate of admission of steam and initial wetting (if any) of the material. In Figure 4 an alternative bin arrangement is shown; this comprises straight parallel sides 24, with transverse elements 25 arranged therein. The breadths of these diminish uniformly from the top to the bottom of the bin to accommodate for the increased velocity of flow due to the expansion of the material, and thereby to maintain uniformity of flow and pressure throughout the material. It is believed that by use of bins with diverging walls as shown in Figure 1 or such as shown in Figure 4, restarting of the apparatus after a period of rest with the apparatus full may be facilitated. The conveyor and other parts shown in the figure correspond to those shown in Figure 1 and are designated by like numerals. Referring now to Figure 5, which shows diagrammatically a speed control employing a photo-electric relay system, the unconsumed material from the discharger is returned as described with reference to Figure 2 down a chute 22C into a frusto-conical hopper 26. The hopper 26, which has open large and small ends, is resiliently mounted by a suitable means as diagrammatically shown by a spring 27. The hopper carries a vane 28 shown in endwise elevation which is arranged to block the passage of light from sources 29 to light-sensitive cells 30. The current output from the cells is led to an amplifier or relay 31 of any known or convenient kind and the output current therefrom is used to operate electro-magnetic means at 32 for regulating the speed of a motor 33, which drives, through a belt 34 a gear-box 35 and a belt 36, the input conveyor and the discharger. The electro-magnetic means 32 operates to turn a wheel 37 which turns a steam-regulating cock 38 in the steam pipe 39. It will be appreciated that the rate of flow of material from the hopper will depend on the head of and therefore on the weight of material in the hopper, and when the hopper yields on its suport it successively blocks the passage of light from the sources to cells, thereby reducing the current to the amplifier. It is arranged that with the reduced output from the amplifier the speed of the motor is reduced. The apparatus described is designed for the cooking of whole maize by steam; it may be varied for different treatments and materials. In all cases, however, the bin will be kept full and the internal arrangements thereof will consist of as many transverse elements as will, considering their nature and spacing, cause the material to descend uniformly without substantial pressure and to be submitted uniformly to the treatment admitted.

What I claim is:

1. Apparatus for the cooking of cereal in gran-

ular or like form by steam, comprising a bin, inverted channel section transverse elements therein, perforated pipes housed in and below said elements, a source of steam preferably connected to said pipes, means for controllably supplying material to the top of said bin, means for controllably, evenly and continuously withdrawing material over the whole transverse area of the bottom of said bin, means for conveying away material so withdrawn and for delivering the same, means for returning undelivered material, means for measuring such undelivered material, means operated by said measuring means for controlling the rate of supply to said bin, the rate of discharge from said bin, the operational rate of said conveyor and the admission of steam, substantially as described.

2. Apparatus for treating material, comprising, a material treating device, means for passing material through said device for treatment therein including means for discharging said material from said device, delivery means for carrying discharged material away from said discharging means and delivering at least a portion of the same from said apparatus, means for returning undelivered material to said delivery means, measuring means for measuring said undelivered material, and means operated by said measuring means for controlling the amount of material passed through said treating device.

3. Apparatus for treating material, comprising, a material treating chamber through which said material is passed, charging means for introducing material into said chamber, discharging means for discharging material from said chamber, delivery means for carrying material away from said discharging means and delivering at least a portion of the same from said apparatus, means for returning undelivered material to said delivery means, means for measuring the material returned to said delivery means, and means operated by said measuring means for controlling said charging and discharging means to control the rate of charging material to said chamber and the rate of discharging material from said chamber.

4. Apparatus comprising a bin, transverse elements therein so spaced and numbered as to result in a substantially equal distribution of pressure of downwardly moving material in said bin, and a discharger at the bottom of the bin capable of withdrawing the material from within the bin evenly and continuously over substantially the whole transverse area of the bottom of said bin, means for controllably supplying the material to the top of the bin, means for controlling the rate of operation of the discharging means, and means responsive to the rate of flow of material at a predetermined point, which responsive means controls said supplying and discharging means.

5. Apparatus comprising a bin, transverse elements therein so spaced and numbered as to result in a substantially equal distribution of pressure of downwardly moving material in said bin, and a discharger at the bottom of the bin capable of withdrawing the material from within the bin evenly and continuously over substantially the whole transverse area of the bottom of said bin, and means for controllably supplying material to the top of the bin, means for controlling the operative rate of said discharger, apparatus for returning unconsumed material towards the bin, means for measuring said returned material and means whereby said measuring means controls the supply and discharge of material to and from the bin.

6. Apparatus comprising a bin, transverse elements therein so spaced and numbered as to result in a substantially equal distribution of pressure of downwardly moving material in said bin, and a discharger at the bottom of the bin capable of withdrawing the material from within the bin evenly and continuously over substantially the whole transverse area of the bottom of said bin, and means for controllably supplying material to the top of the bin, means for controlling the operational rate of said discharging means, and a weighing device adapted to be deflected by the passage of material therethrough to control said supplying and discharging means.

7. Apparatus comprising a bin, transverse elements therein so spaced and numbered as to result in a substantially equal distribution of pressure of downwardly moving material in said bin, and a discharger at the bottom of the bin capable of withdrawing the material from within the bin evenly and continuously over substantially the whole transverse area of the bottom of said bin, and means for controllably supplying material to the top of the bin, means for controlling the operational rate of said discharging means, and photoelectric controlling means whereby said supplying and discharging means are controlled as to their operational rate.

8. Apparatus comprising a bin, transverse elements therein so spaced and numbered as to result in a substantially equal distribution of pressure of downwardly moving material in said bin, and a discharger at the bottom of the bin capable of withdrawing the material from within the bin evenly and continuously over substantially the whole transverse area of the bottom of said bin, said transverse elements being arranged to diminish in breadth progressively down said bin.

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