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Garnett

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[45] **Nov. 6, 1973**

[54] **METHOD OF SHAPING AND COMPACTING MATERIAL**

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[73] Assignee: **Mahogany Farms, Inc.,** Williamston, Mich.

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[21] Appl. No.: **211,813**

Related U.S. Application Data

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[52] **U.S. Cl.** **264/294,** 99/107, 99/187, 99/194

[51] **Int. Cl.** **A22c 18/00**

[58] **Field of Search** 99/107, 108, 194, 99/187, 188, 450.1

[56] **References Cited**

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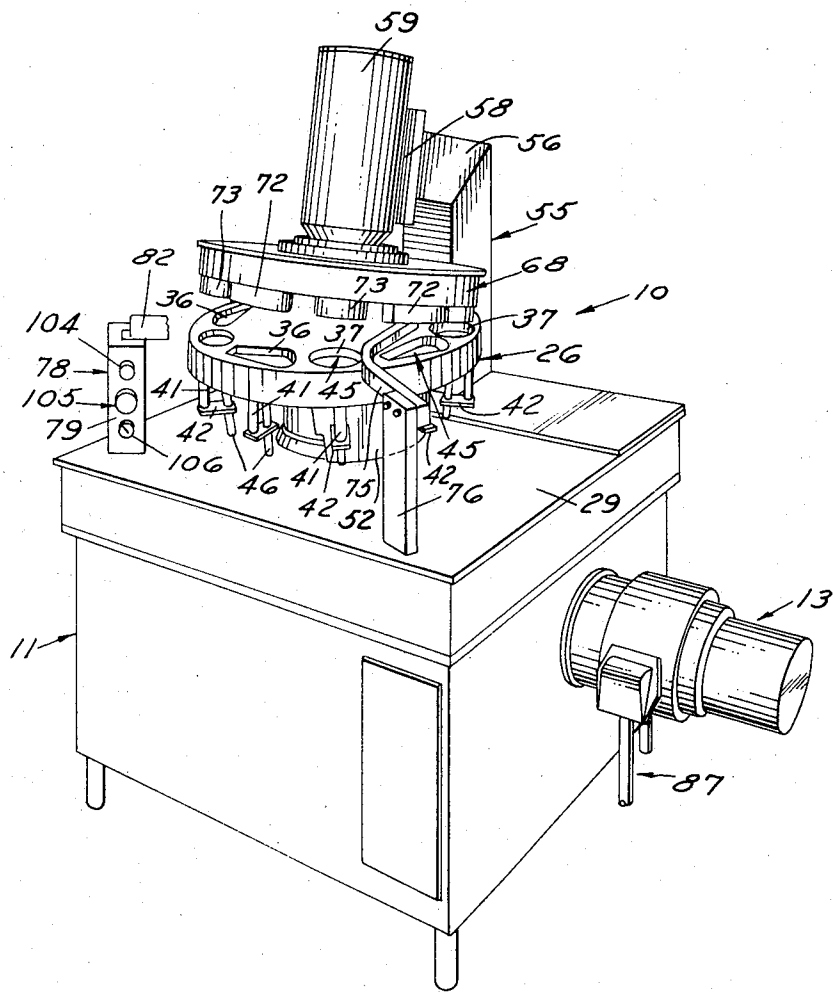
Primary Examiner—Hyman Lord

Attorney—Whittemore, Hulbert & Belknap

[57] **ABSTRACT**

A motor driven rotary compactor table carries a circumferential series of material-receiving pockets, each bottomed by an ejector cam-operated during the table rotation to eject a shaped and compacted product from its pocket. A compactor plate of the same diameter is journaled above the table on an axis at an acute angle to the table axis, and theoretically intersecting the latter at the table surface. The plate carries an annual series of compactor plungers equal in number and circumferential spacing to the table pockets, and the inclination and vertical relationship of table and plate to one another are such that the plungers enter into the respective table pockets at the apex of an acute angle theoretically defined by planes of the convergent, mutually facing plate and table surfaces. Thus, in compacting material in the pockets, the plungers also effect a cog and wheel-like drive of the compactor plate.

3 Claims, 5 Drawing Figures



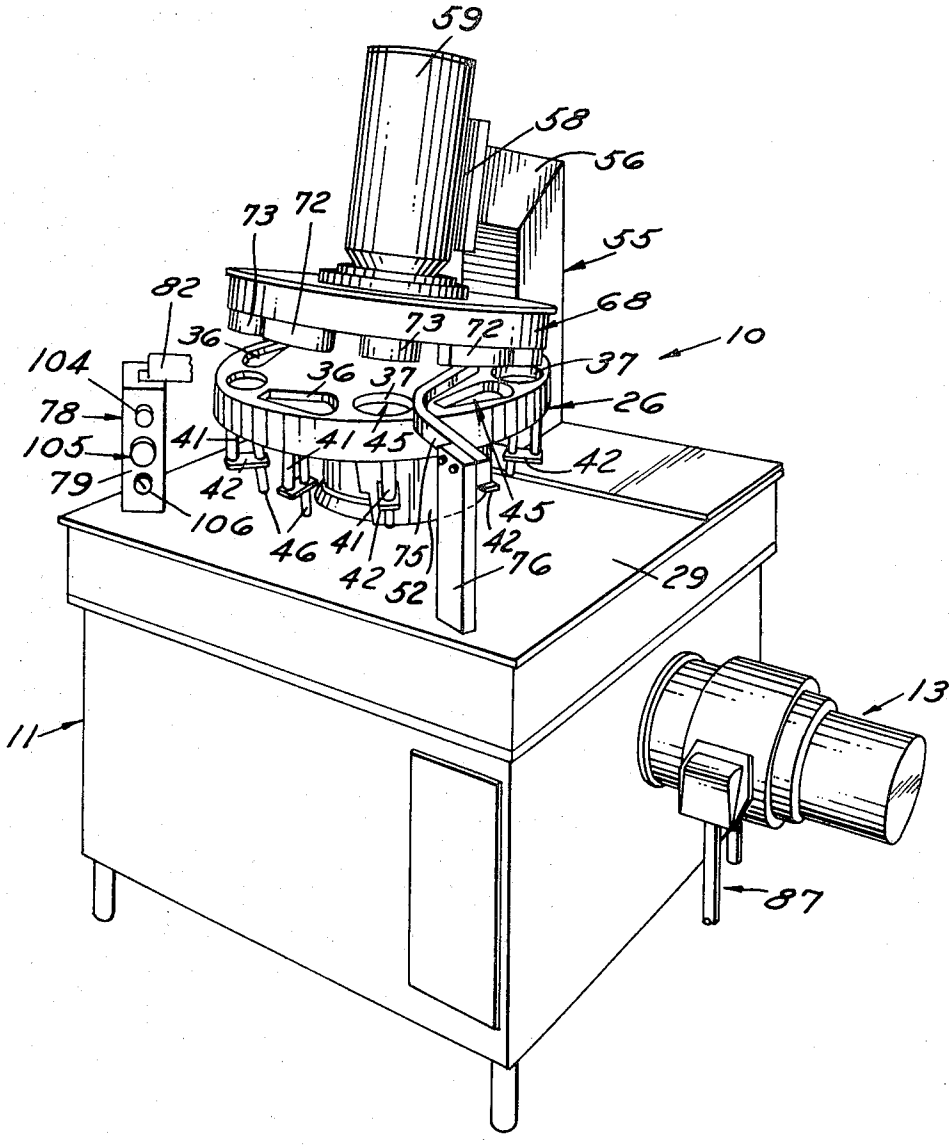

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FIG. 1

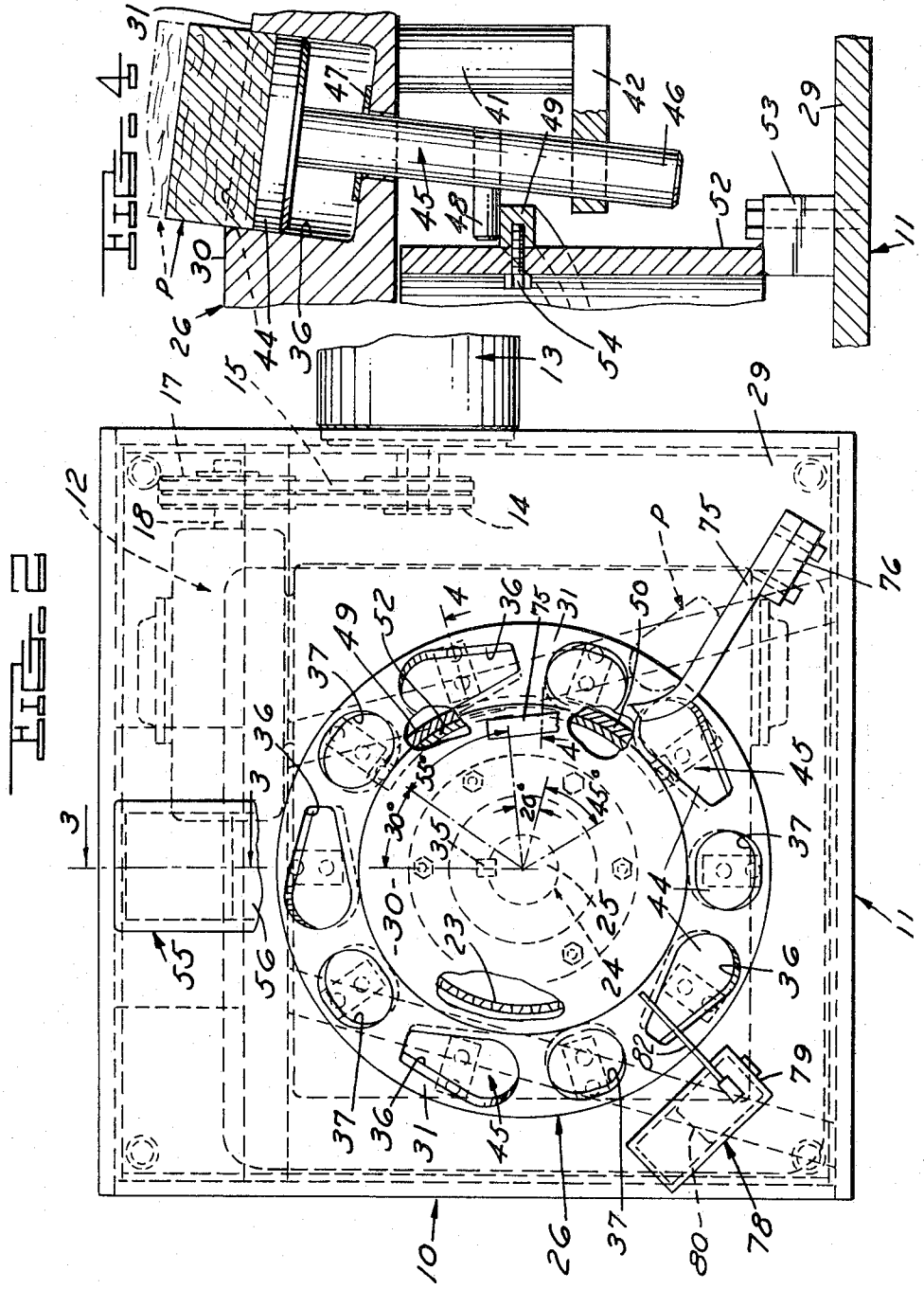
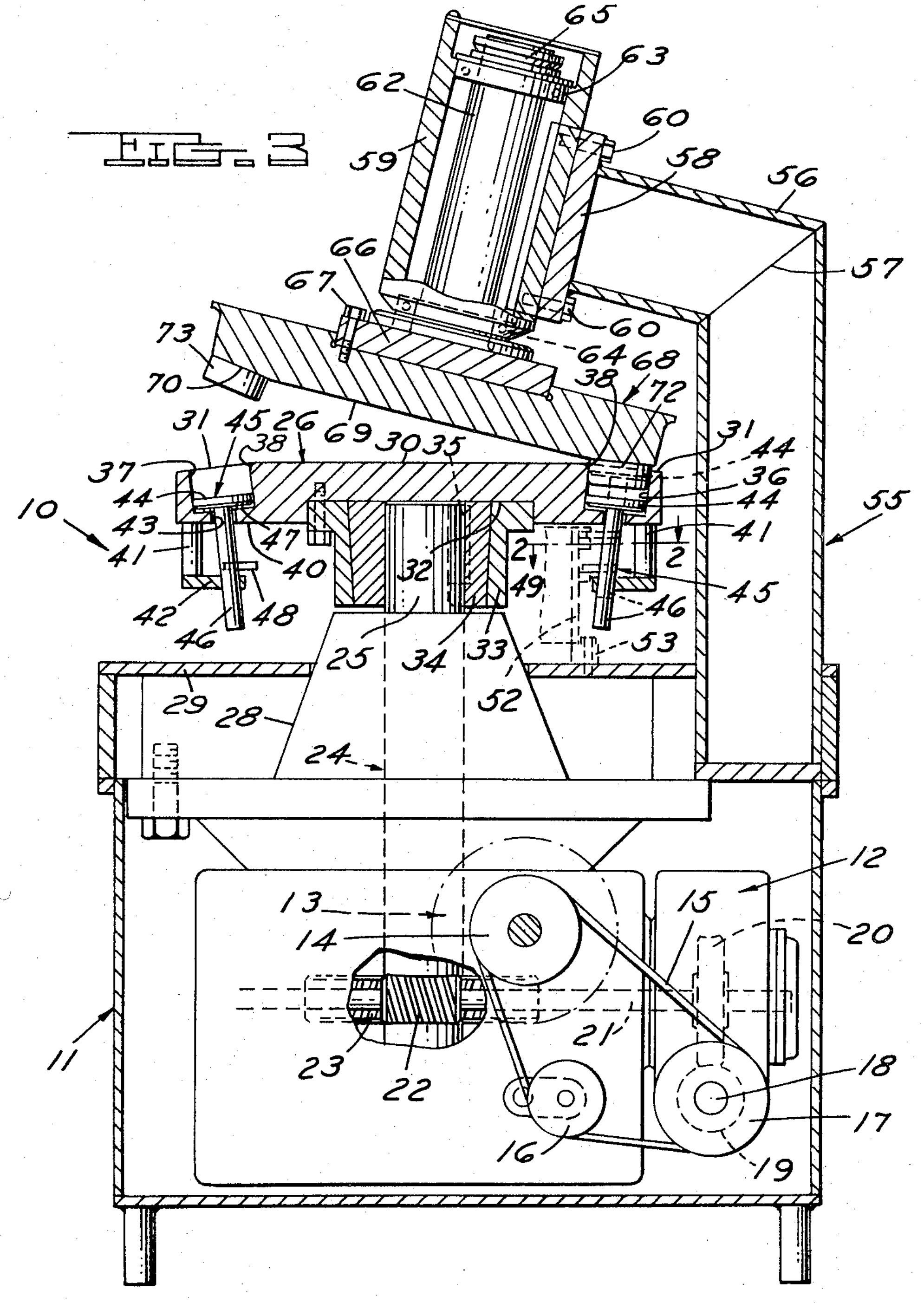


FIG. 4
FIG. 2

FIG. 3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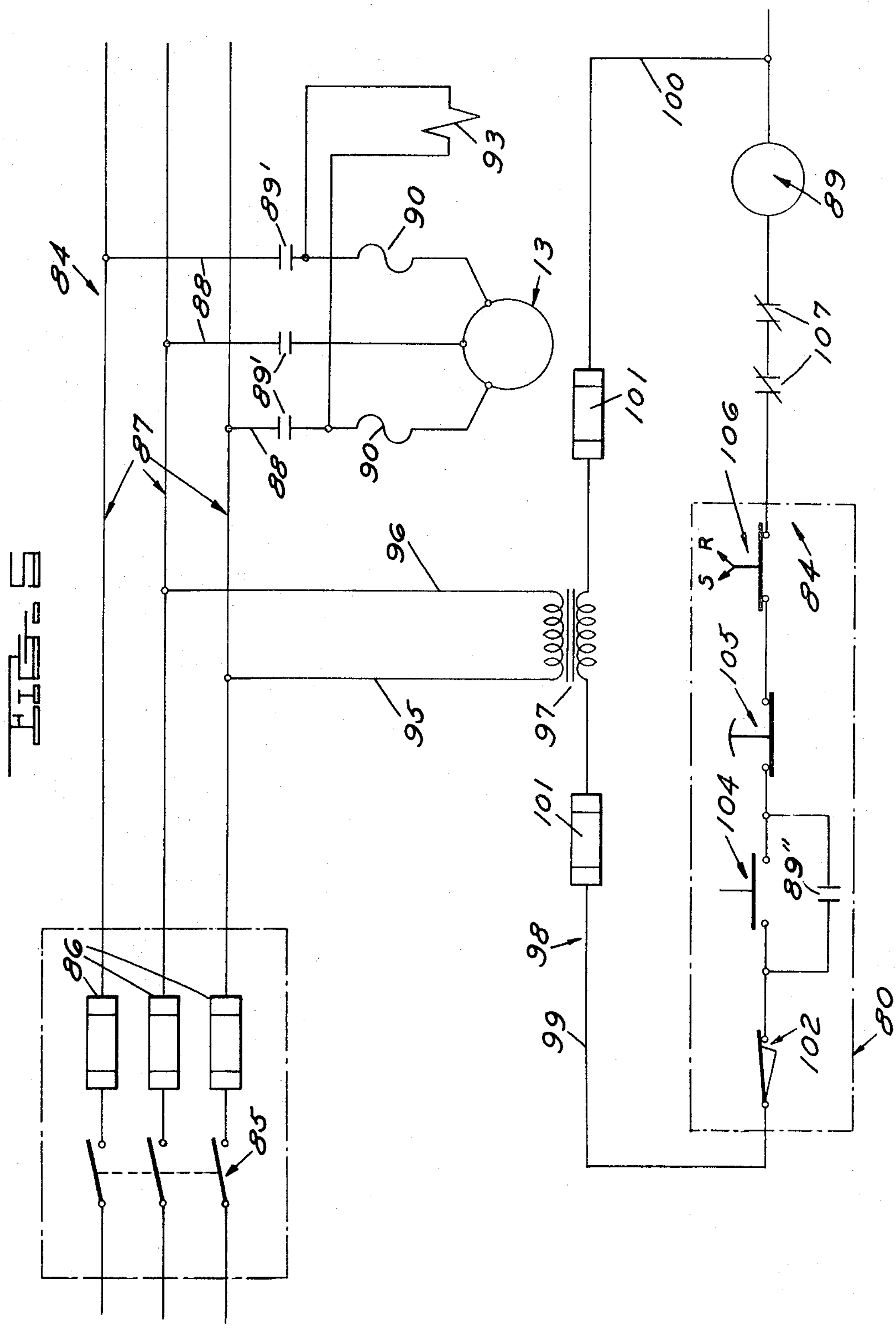
FIG. 5
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88
89'
90
93
13
100
89
107
101
87
96
97
95
106
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S
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105
104
89"
98
99
86
85
102
80

METHOD OF SHAPING AND COMPACTING MATERIAL

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a division, of application Ser. No. 875,267, filed Nov. 10, 1969, now U.S. Pat. No. 3,647,343 issued Mar. 7, 1972.

My co-pending U.S. Pat. application, Ser. No. 847,297, filed Aug. 4, 1969, now Letters Patent No. 3,683,793 of Aug. 15, 1972, illustrates and describes a method and apparatus for blending and portioning meat products, which products are fed to the present equipment for final compacting into desired sizes and shapes, with their weight, as determined volumetrically by the earlier equipment, augmented if necessary, by small make-up portions. However, the nature of the method and equipment of my co-pending application and the method and equipment herein disclosed have no other structural and functional relationship to one another than in the above respect.

BACKGROUND OF THE INVENTION — FIELD

As appears from the above, the method and apparatus of the present invention were evolved for the purpose of shaping and compacting volumetrically weighed charges of meat, sometimes as augmented in weight, but more especially to simulate recognized shapes of meat product, such as steak, filet, or the like. As thus re-shaped, a less-than-highest-quality meat product, will find sale at a meat counter at a price very much lower than the price of a conventional meat cut of a better grade, but comparable to the latter, as to appearance, taste, texture, etc.

However, the method and apparatus as herein disclosed are of far wider utility and applicability than the limited usage just mentioned. That is, the equipment is well adapted to compact, shape and/or size many types of material, edible and otherwise. An instance that suggests itself is in the compression and simutaneous shaping of sintered metals, such as the sponge-like oil-impregnated bronze material widely marketed under the designation "Oilite." The sizing and shaping of blocks of cinder and other objects comstituted by particulate material offers another possibility; pills are a further one, and still others will occur to those having particular requirements in mind in reference to a particle-constituted, shaped and solidly compacted product.

SUMMARY OF THE INVENTION

The invention affords an extremely simple but very rugged and heavy-duty type of apparatus for the purposes and method referred to above. The only direct-driven component is a vertically journaled, motor-reducer driven compacting table, plural mold-like compacting pockets of which individually receive product ejecting plungers. These parts are cam-reciprocated up, as an incident to the rotation of the table, to discharge the shaped products from pockets.

The table and its pockets in turn serve as a source of power, in the manner of a cog wheel, to rotate a unitary type of circular compactor plate, which is very simply, ruggedly and inexpensively journaled for rotation at a circumferential and lineal speed equaling that of the compactor table. That is, there is no need for any additional power transmitting means than the engagement of compactor members on the plate in the compactor

mold cavities or pockets of the table, in the manner of cogs engaging and driven by a cog wheel.

To this end, mutually facing surfaces of the plate and table, both circular and equal in diameter, respectively rotate about vertical and acutely angled upright axes which theoretically intersect at the center of the table, the compacting plunger members of the plate entering into the compacting die-like or mold pockets of the table during a predetermined arcuate segment to the plate and table rotative travel. Fullest entry takes place at a point in a radial plane including the axes of the plate and table, which point represents the theoretical apex of convergence of the horizontal and inclined planes of the facing table and plate surfaces, respectively.

The equipment of the invention is also characterized by the extreme ease and simplicity of supervision thereof and attendance thereon. As the compacted and shaped products are discharged upwardly from the respective mold pockets by vertically acting ejectors mated in and bottoming the latter, the products are plow-swept off the surface of the pocket-carrying table, and may be disposed of further, as for packaging, by conveyor and other means, not herein shown. The only attendant necessary is an individual to place the previously volumetrically weighed charges, which in the case of meat charges are frozen so-called "chubs" (augmented as to weight or not), into the pockets. This can be done safely and efficiently by reason of the relatively slow speed of rotation of the pocket carrying table, the fact that the feeding of the charges to the pockets is at a radial zone of maximum spacing of the table and plate relative to one another, and the fact that the apparatus in addition has safety limit switch means at this zone to prevent any possibility of injury to the attendant arising from carelessness.

In the preparation of meat products the latter resemble high priced steaks and/or filets, have comparable taste qualities, and maintain these qualities sealed therein as the result of pressure compacting and shaping the material, with no incidental loss of liquid content.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view generally depicting the apparatus of the invention, including a vertically journalled pocket-carrying table, the latter's motor drive unit, an inclined-axis rotary compactor plate, a product sweep-off plow and a control switch unit;

FIG. 2 is a fragmentary top view showing base and rotary compactor table structure of the equipment, being partially broken away and in horizontal section along line 2—2 of FIG. 3, as well as partially broken locally to show a portion of a worm and worm gear table drive arrangement;

FIG. 3 is a view, partially broken away, in radial and vertical section along the line 3—3 of FIG. 2, certain ejector controlling cam provisions being indicated in a dotted line position other than the position at which they are actually located (as properly and accurately depicted in FIG. 2), certain worm type drive means being also shown;

FIG. 4 is a fragmentary enlarged scale view in vertical section along broken line 4—4 of FIG. 2, indicating in solid and dotted line the action of a product ejector in discharging a shaped and compacted object from a compactor pocket; and

FIG. 5 is a schematically shown diagram of the electrical equipment.

DESCRIPTION OF A PREFERRED EMBODIMENT

As shown best in FIGS. 1 and 3, the apparatus of the invention, generally designated by the reference numeral 10, comprises a rugged, cabinet-like base 11 enclosing a massive, heavy-duty speed reducer 12 powered by a 2 h.p. electrical motor 13, which is disposed externally of but suitably supported on base 11. An output double pulley or sheave 14 on the shaft of motor 13 drives belts 15 trained about an adjustable idler 16 and a double sheave 17 secured to the input shaft 18 of reducer 12. These sheave means are appropriately journalled on base 11 by means not shown.

Reducer 12 includes a double worm and gear arrangement, including a worm 19 fixed on shaft 18 and meshing with a worm gear 20 on a shaft 21, which shaft is suitably journaled on the base at 90° to shaft 18. Shaft 21 carries a worm 22 mating with a worm gear or wheel 23 of large diameter. The last named worm wheel is fixed to an upright drive shaft or spindle 24 of the machine 10; and a top extension end 25 of shaft 24 drives the rotary horizontal compactor table 26 of the apparatus 10. Appropriate heavy-duty bearing means (not shown) are provided to journal the drive shaft 24 on its vertical axis; and the motor speed reducer 12 transmits power through the double worm and gear arrangement to rotate the table 26 at a speed of, for example, 8 r.p.m. The bearing means for journaling the shaft 24 are contained at least in part within a frusto-conical housing member 28 projecting upwardly through an opening in a base superstructure platform 29; and the shaft drive extremity or extension 25 is at a sufficient elevation above this platform to accommodate the action of certain ejector provisions of table 26, to be described.

The compactor table 26 is circular in outline and, as best shown in FIG. 3, is characterized by a horizontally flat, circular center surface 30 of substantial area disposed concentric of the axis of drive shaft 24, the surface 30 being rimmed by the inclined circular land 31. The bottom area of table 26 is centrally recessed at 32 to receive a flanged, sleeve-like adapter 33, which is upwardly bolted to the table. Adapter 33 concentrically carries a nested, downwardly extending hub bushing 34 to which the shaft extension 25 is keyed at 35.

As appears in FIG. 2, the inclined annular land surface 31 of compactor table 26 is recessed to provide a number of circumferentially spaced, charge shaping and compacting mold cavities or pockets, shown as being ten in number, the centers of which are equally spaced from one another at 36° angles. Of these pockets or cavities, half thereof, as specially designated 36, are in an outline generally simulating a steak or other type of meat cut; while the remaining five pockets, as specially designated 37, resemble the shape of a meat filet or other cut. The pockets 36, 37 alternate with one another about the periphery of the land 31, and are of substantial depth in the material of table 26. Each thereof is shaped at its radially inner wall surface to afford a clearance relief portion at 38, thus to accommodate the entry of the punch-like compactor forming members of the apparatus, to be described, into the die-like pockets 36 and 37.

The bottom surface 40 of rotary compactor table 26 has a circumferential series of depending post elements 41 fixedly secured thereto, as by welding, each in a vertical radial plane through a pocket center; and each such post carries a small horizontal guide bracket 42. Each of the shaping pockets 36, 37 is centrally apertured through the bottom thereof at 43; and each pocket is in effect bottomed by the flat, enlarged head 44 of an ejector plunger 45. These plungers are shaped in conformity with the outlines of the respective several mold pockets 36, 37, and are received in the latter with a relatively free sliding fit. An elongated cylindrical stem 46 of each plunger 45 extends through the pocket bottom opening 43, being slidably guided in a guide opening of the guide bracket 42 for action in a back-and-forth manner at 90° to table land 31.

In order to enable the volumetric capacities of the compacting and shaping pockets 36, 37 to be varied from time to time as desired, a replaceable spacer, washer-or shim 47 is placed in the pocket beneath the ejector head 44, which rests on the spacer in a fully retracted position (FIG. 3), a removal and substitution of spacers making possibility the desired pocket volume adjustability.

Each of the plunger stems 46 carries, beneath table 26, a radially inwardly extending cam follower dowel 48, which dowel is respectively engaged from beneath and from above by one of two segmented vertically spaced cams 49, 50. These are curved bars having the outline, in plan, of segments of a circle of approximately 75° arcuate extent, as shown in FIG. 2, overlapping one another a bit in the circumferential sense at adjacent ends thereof. Cams 49, 50 are fixedly secured against the outer surface of an upright segmental mounting plate 52, which is fixedly sustained appropriately at its bottom, as by blocks 53 bolted to the top surface of base platform 29 (FIG. 4). The mounting plate is welded to the tops of the blocks, and the cams 49, 50 are fixedly secured in turn to the outer side of the mount 52, as by a series of bolts 54.

As indicated above, FIG. 3 is distorted somewhat in its dotted line showing of the mount 52, position-wise, the true relationship of the latter and the cams 49, 50 appearing in the plan view of FIG. 2, and as sectioned at 4—4 for FIG. 4. The cam 49 acts beneath the dowels 48 to elevate the ejectors 45. The latter will normally descend by their own weight after circumferentially leaving the cam 49; however, the cam 50 insures their full descent in the event of any frictional tendency to stick. It may also be desirable to provide an additional stop segment on the mounting plate 52 onto which the ejector stems 46 may come to rest without unduly impacting the spacer shims 47 to their damage.

The ejector heads 44 are shaped to have a relatively close but substantially friction-free fit, as to shape, in the respective compactor pockets 36, 37; and it is evident that in the rotation of the compactor table 26 the cams 49, 50 will successively act on the follower dowels 48 on ejector plunger stems 46 to elevate the ejectors 45 from a retracted, solid line position, as appears at the right of FIG. 3, to an operative, elevated ejecting position appearing in dotted line, then a gradual downward return for another rotative cycle. The angular sequencing of this action will be hereinafter described by reference to FIG. 2.

The base structure 29 has welded or otherwise appropriately secured rigidly thereto a rugged upright tubular column 55, which column extends vertically a substantial height; and a column extension 56 is welded to

the top of column 55 along a mildly angled joint at 57. The angularity of members 56 and 57 is an upwardly and radially inward obtuse one, and a vertical plane through their centers includes the axes of compactor table 26 and a compactor plate, presently described.

An arcuate adapter or saddle plate 58 is welded at 90° to the outer end of column extension 56, this adapter seating a rugged tubular bearing housing 59, which is rigidly secured to the adapter by bolts 60.

A compactor plate shaft 62 is rotatively jounraled coaxially within housing 59, as by upper and lower bearings 63, 64, being axially sustained from above by a retainer nut 65 on the shaft. The latter carries a bottom adapter block 66 which is secured by bolts 67 in a central recess of the rotary compactor plate of the apparatus 10, the plate being generally designated 68. Like the rotary compactor table 26, the plate 68 has a central flat, circular surface 69 of substantial area peripherally bounded by a leveled land 70; and the land carries an annular, circumferentially spaced series of solid punch-like compactor elements or plungers. These depend at 90° to the land 70, and are shaped to correspond with and nestingly fit into the respective shaping and compacting pockets 36, 37 on table land 31. Thus, compactor members which fit into the steak-shaped pockets 36 are designated 72, while those fitting into the filet-shaped pocekts 37 are designated 73.

As an essential feature of the invention, the angularity of the compactor plate shaft 62, as journaled at the end of the obtuse column extension 56, in such that (a) the axes of shaft 62 and table drive shaft 24 lie in a vertical plane diametral of both the plate 68 and the table 26; (b) the axes theoretically intersect at the midpoint of the top flat surface 30 of table 26; and (c) the vertical positioning of the table 26 and plate 68 relative to one another, and the angularity of the convergent planes of surfaces 30 and 69, are such that the peripheral land 70 of plate 68 and the peripheral land 31 of table 30 come very closely adjacent one another just radially inwardly of the column 55, and are parallel.

A sweep-off plow 75 of arcuate contour extends parallel to and slightly above the article compactor plate 26, being supported and positioned by an upright post 76 on platform 29 just forwardly in the direction of table rotation (clockwise as viewed in FIG. 2) of a point at which a shaped and compacted product P is upwardly discharged from one or the other set of five each, of the molding pockets 36, 37 of the compactor table 26. As thus discharged radially from the surface of the table, the product P may be transferred, as by a conveyor, not shown, for instance, to suitable packaging equipment.

An electrical control switch unit, generally designated by the reference numeral 78, is also fixably mounted atop the machine base platform 29, this unit including a small box 79 within which a switch assembly, generally designated 80, (FIGS. 2 and 5) is disposed. An angularly displaceable limit switch actuator arm 82 extends radially inwardly from the switch unit 78 into the path of circumferential travel of the compacting pockets 36, 37, the arm 82 being operatively connected to a limit switch of the electrical circuit depicted in FIG. 5. Thus, in the unlikely event of an attendant's arm remaining unduly long and low in the loading zone of the apparatus, i.e., directly opposite the column 55, its impingement against the limit switch arm 82 will cause an immediate stoppage of the drive of the equipment, through circuit provisions illustrated in FIG. 5, and now described.

The electrical system 84 of FIG. 5 is electrically supplied with 220 volt, three phase current through a ganged master switch 85 aapropriately fused at 86, from which the phase line conductors 87 extend. Leads 88 connect from those conductors through motor starter relay contacts 89' and suitable overload relays 90 to the terminals of the 2 h.p. prime mover motor 13 of the apparatus 10. A spring-set motor brake (otherwise not shown in FIG. 5) has its release solenoid 93 wired to two of the motor leads 88.

Positive and negative conductors 95, 96 supply the primary winding of a control circuit transformer 97, the secondary of which supplies a control circuit 98 of the equipment, including supply and return leads or conductors 99, 100, and each equipped with a protective fuse 101.

Conductor 99 is connected to the terminal of a safety limit switch 102, the normally closed contactor of which is physically operated by arm 82 (FIGS. 1 and 2) to open the control circuit 98 in the event that the attendant inadvertently or carelessly leaves her arm too far clockwise of the direction of rotation of the product compacting table 26. The safety factor is obvious, considering the relatively slow linear rate of travel of the table 26. A push-button "start" switch 104 of the system or circuit 84 is adapted to be shunted through a normally open armature contact 89'' of the motor starter relay 89 across the terminals of a "start" switch 104 of control circuit 98; and switch 104 is series-connected to a push button "stop" switch 105 and a 2-position "safe"-"run" switch 106, all of the switches 102, 104, 105, 106 being components of the switch assembly 80 mounted in control box 79. "Safe" and "Run" settings of switch 106 are respectively indicated by the letters S and R in FIG. 5. A terminal of switch 106 is connected through overload contacts 107 with a coil terminal of a motor starter relay 89 whose above-described contacts 89' are in the circuit of drive motor 13. Relay 89 is connected at its opposite terminal to the control circuit's return conductor 100. The operation of the circuitry 98 of FIG. 5 will be apparent to those of ordinary electrical skill.

The operation of the machine 10 is best adapted in FIG. 2, in reference to certain indicia of angular travel of the compactor table unit 26 (and corresponding angular travel of the compactor plate unit 68). The attendant places pre-frozen charges of meat (for the instanced usage) into either the steak forming pockets 36 or the filet forming pockets 37, or both sets, as they emerge empty beneath the sweep-off plow 75. At this time the ejector heads 44 of the pockets are in a fully lowered position, resting on the spacer shims 47. As indicated above, should the operator accidentally or intentionally trip the limit switch arm 82 in performing her duty, the control circuit 98 of FIG. 5 is broken and the machine motor brakes to an immediate halt.

With the clockwise travel (FIG. 2) of table unit 26 and the corresponding movement of the compactor plate co-ordinated as described above in regard to the convergent angularity of their respective surface planes and their vertical spacing relative to one another, the male compactor members 72, 73 will commence to enter the respective compactor pockets 36, 37 as the pockets approach an apex zone or position on a radius of the table and plate through the center of the column

55. That radial position will, then, represent a point of maximum entry of the plunger members **72, 73** into the pockets **36, 37,** for a maximum compression of the material to form the meat products P. Considering this as a base point, the products become progressively less compressed as their travel continues clockwise and the compactor plungers progressively depart from the pockets in the separating inclination of the compactor table and plate planes.

At a radial zone approximately 30° clockwise from the zero or base point (FIG. 2) the follower dowels **48** of the successive ejectors **45** come under the lifting effect of the inclined arcuate cam length **49**; and as they continue under this influence the ejectors are progressively elevated through about 55° table travel to their full-up position. In this state, the plunger heads **44** are lifted from an intermediate, solid line position, as shown in FIG. **4,** to a fully elevated position, indicated in dotted line, in which the top of the head **44** is a small fraction of an inch above the surface of the inclined circular table land **31.** At this elevation, the rotatively traveling steak or filet product P comes into engagement with the fixed sweep-off plow **75,** and is diverted by it radially off the compactor table **26,** whence it may be forwarded by a conveyor, chute or like means, (not shown) for further disposition.

Continued travel of table **26** brings the ejector **45** of the just-emptied pocket **36** or **37** under the influence, at its follower dowel **48,** of the second, ejector lowering cam **50,** if indeed, as is usually the case, the ejector **45** has not dropped of its own weight onto its spacer shim **47,** since the arcuate zone lifting portion of the elevating cam **49** has been passed. It happens that there is a terminal portion of elevator cam **49,** of about 20° extent, at which the cam is horizontal, exerting no lifting effect on the ejector; and the lowering action by the other cam **50,** if exerted at all, takes place after cam **49** has been passed, continuing through a final segment of arcuate travel of the follower dowel **48** under cam **50** amounting to about 45°, leaving the ejectors **45** in fully lowered condition and the pockets **36, 37** ready for loading in a new cycle.

Typically the steak products P will be 6 ounces each in weight and the filet products three and one-half ounces in weight; however the sizes and weights, as well as the number of pieces treated in each rotative cycle, are naturally subject to wide variation.

The equipment is structurally very simple and inexpensively fabricated, by reason of the cog-and cog wheel-type coupling of the table **26** and plate through their compacting means. Gearing, other than for necessary speed reduction from the prime mover, is eliminated. It is of a nature such as to be readily dismantled for the indispensable frequent and thorough scouring of its parts. The compacting force, in addition to shaping the charges as desired, has the effect of integrating possible make-up portions with the basic frozen portion, by an effect of regelation, with the result that the discharged product P is an entirely uniform and substantially homogeneous one, pressure sealed about its side and edge surfaces to retain meat juices, and in a condition for efficient packaging, and transportation and maintenance in a refrigerated environment.

I claim:

1. A method of shaping and compacting materials, comprising placing charges of the material in at least some of a series of molding pockets traveling in a longitudinal path in one plane, causing a series of compactors to travel in a longitudinal path in another plane at an acute angle to the travel path plane of the pockets, causing the compactors and pockets to have a telescopingly engaged relation to one another in a compacting zone of their travel adjacent the apex of said angle at which said series converge and substantially meet, thus to compact the material in the pockets, and driving one of said pocket or compactor series for its travel, the other series being driven solely through the agency of the telescoped engagement of at least some of the respective compactors and pockets.

2. A method of shaping and compacting materials, comprising placing charges of the material in at least some of a series of molding pockets traveling in a longitudinal path, causing a series of compactors to travel in a longitudinal path converging at an acute angle relative to the travel path of the molding pockets such that the compactors and pockets meet in a compacting zone adjacent the apex of their travel at which the compactors and pockets have a telescopingly engaged relation to one another, thus to compact the material in the pockets, and driving at least one of said pocket or compactor series for its travel.

3. A method of shaping and compacting materials, comprising placing charges of the material in at least some of a series of molding pockets traveling rotatively in a circular path, causing a series of compactors to travel rotatively in a circular path, which compactor travel path is at an acute angle to the travel path of the molding pockets such that the paths converge in a compacting zone of their travel adjacent the apex of said angle at which the compactors and pockets meet and have a telescopingly engaged relation to one another without departing from the respective travel paths thereof, thus to compact the material in the pockets, and driving one of said pocket or compactor series for its travel, the other series being driven solely through the agency of the telescoped engagement of at least some of the respective compactors and pockets.

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