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PACKING MACHINE FOR MOLTEN MATERIALS

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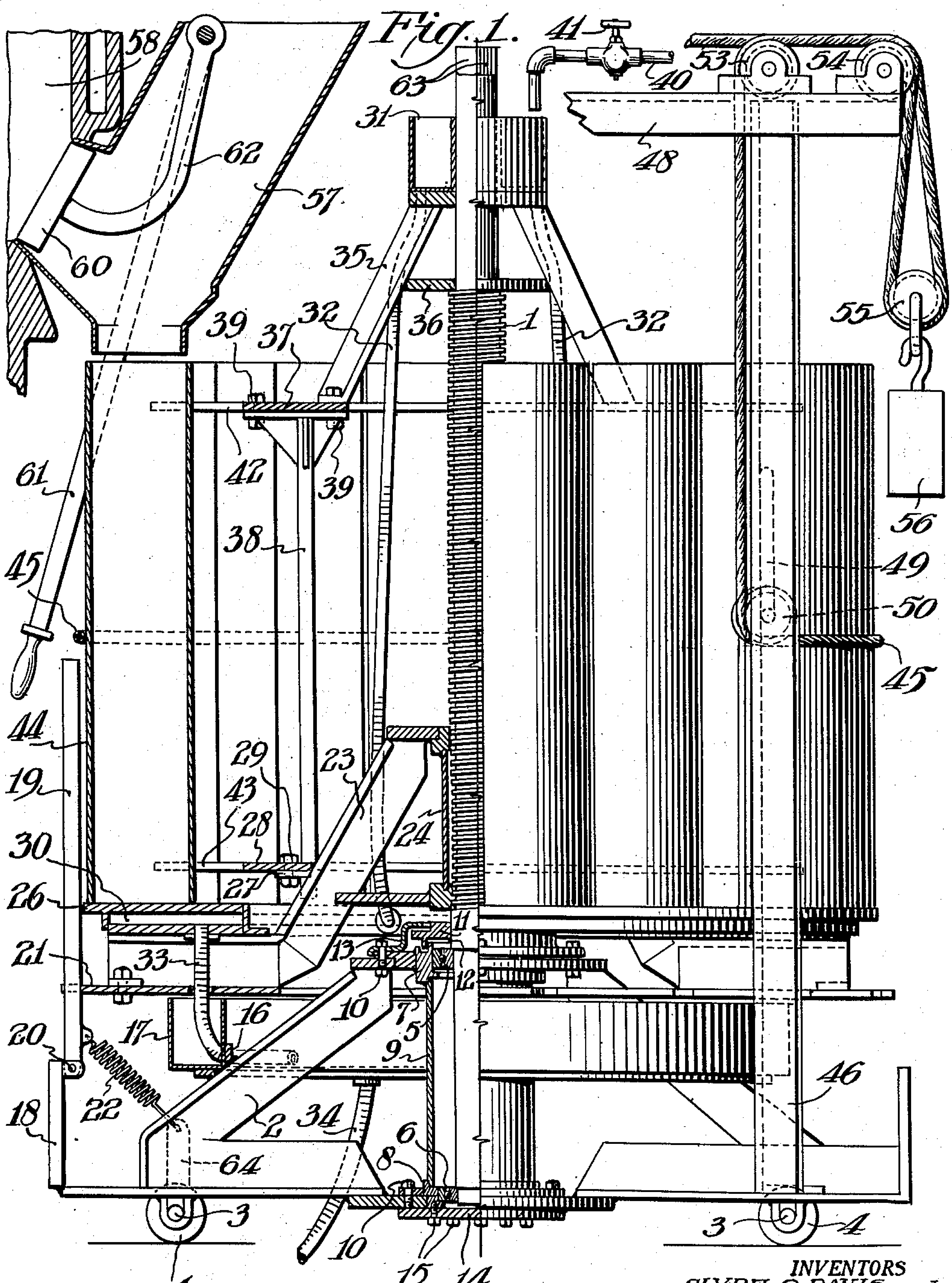

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Fig. 2.

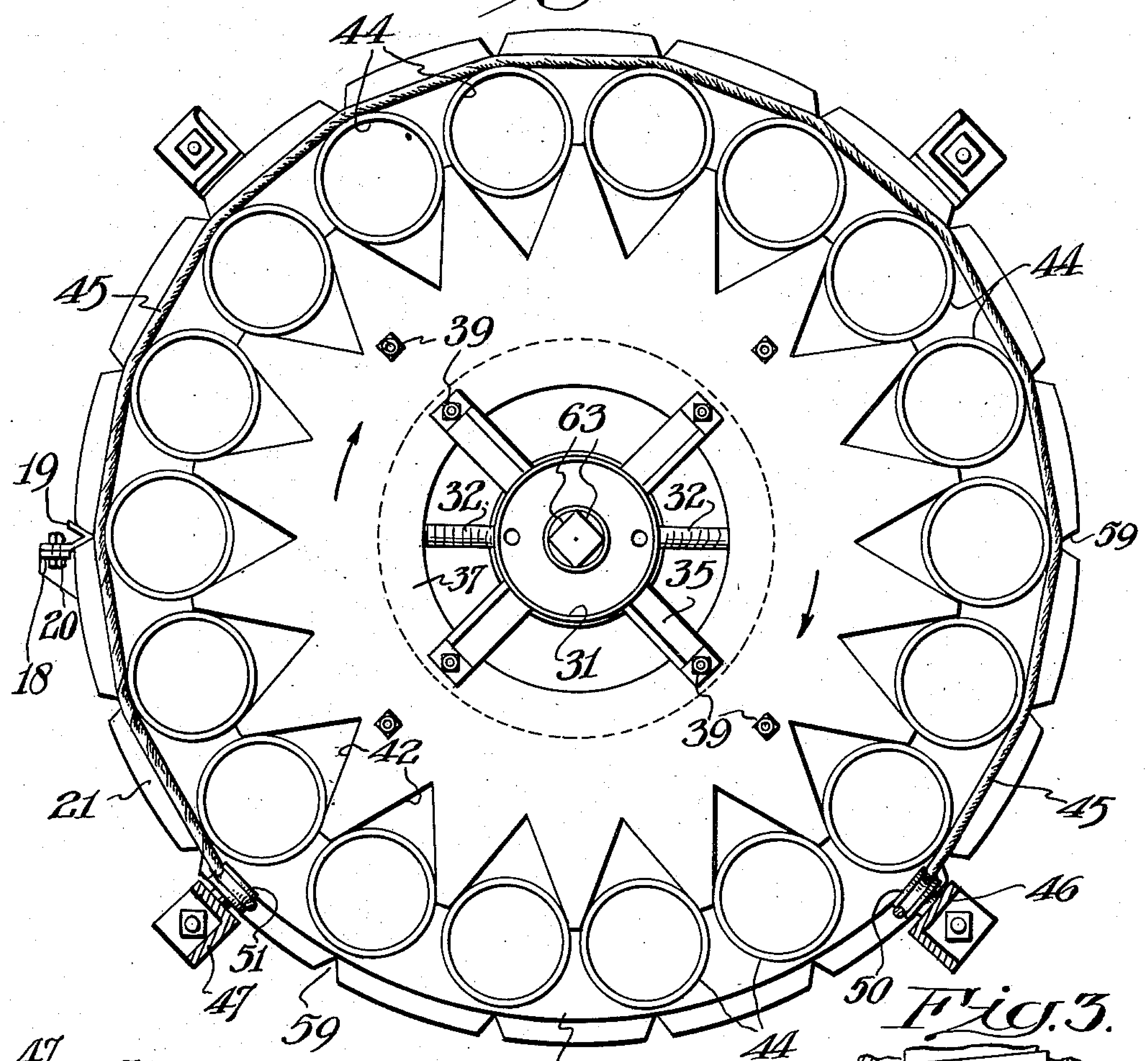


Fig. 3.

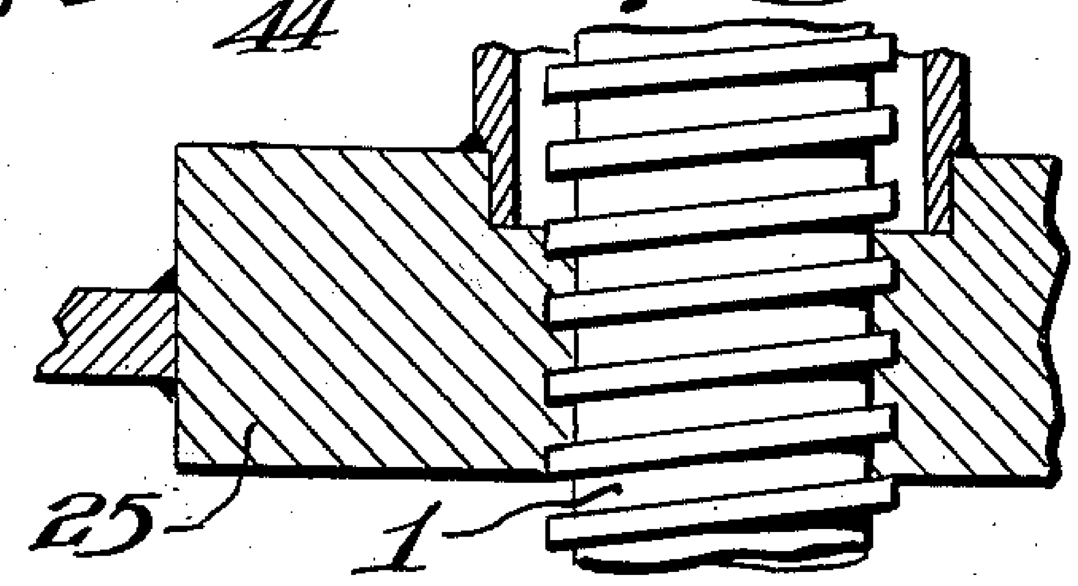
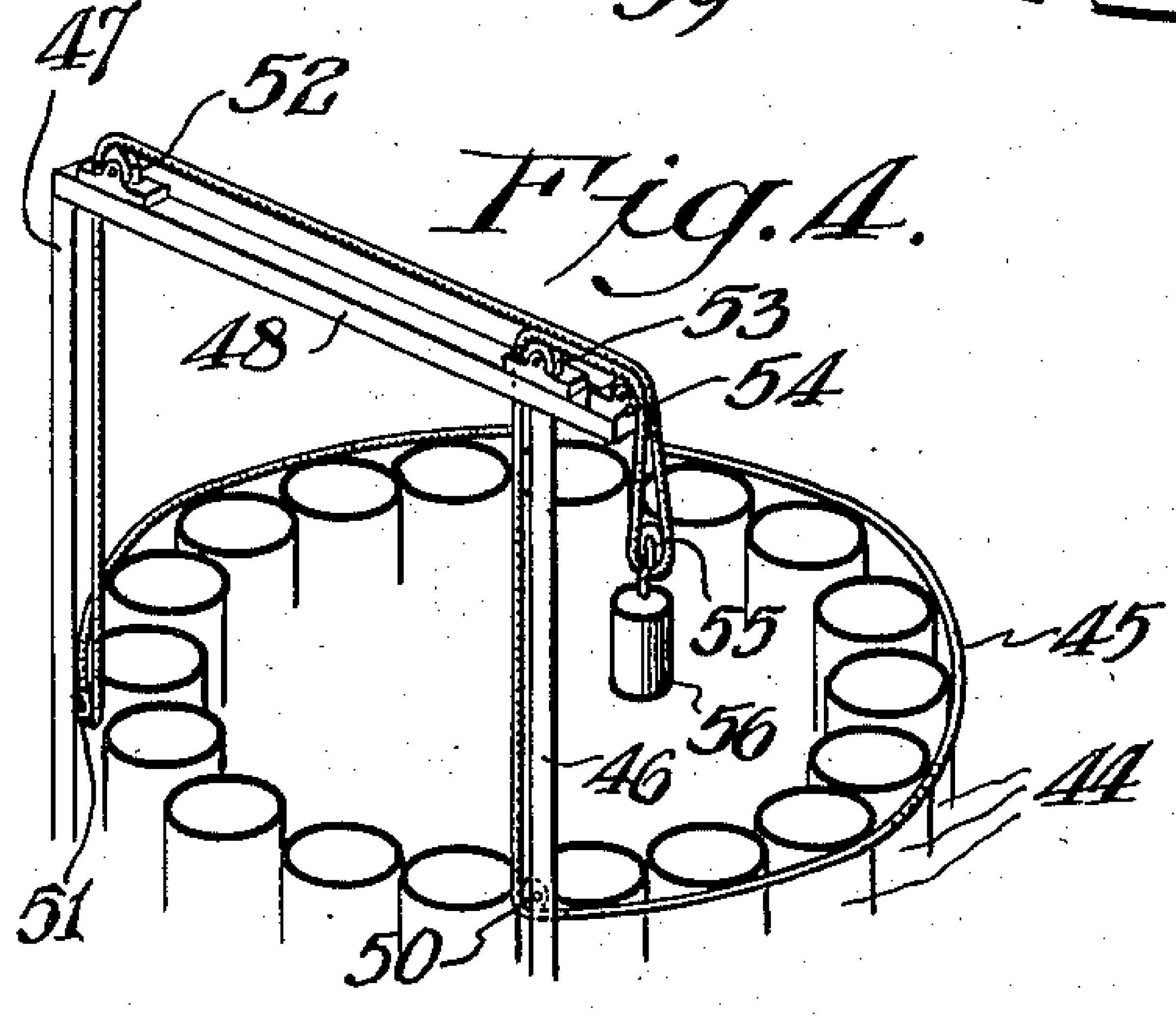


Fig. 4.



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PACKING MACHINE FOR MOLTEN MATERIALS

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5 Claims. (Cl. 86—20)

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This invention relates to packing machines for molten or partially molten materials, and particularly to packing machines for partially molten explosives, such as amatol (mixtures of ammonium nitrate and trinitrotoluene) and the like.

In the manufacture of amatol explosive it is necessary to secure an intimate mixture of the ammonium nitrate and trinitrotoluene components, and this is conveniently accomplished by incorporating molten trinitrotoluene with a suitable amount of crystalline ammonium nitrate in a jacketed mixer customarily referred to as a "grainer." Stirring of the solid ammonium nitrate and the molten trinitrotoluene is continued for a sufficient time to insure that a homogeneous mixture of trinitrotoluene-coated solids is produced, whereupon the mixture is discharged into suitable containers and the mass is allowed to cool to the solid state. Compositions within the range of 30–50% trinitrotoluene, the balance being ammonium nitrate, are sufficiently fluid to permit ready pouring and casting into blocks and are therefore employed as blasting materials in the form of cylindrically shaped masses solidified within open-ended paper shells. The device of this invention comprises a machine for packing the partially molten explosive into these cylindrical retaining shells.

An object of this invention is to provide a machine for efficiently packing molten or partially molten explosive material into containers wherein the mass is cooled to the solid state.

Another object of this invention is to provide a machine for packing partially molten amatol explosive with safety and dispatch.

Another object of this invention is to provide a portable packing machine for partially molten amatol explosive which may be rapidly shifted from one loading area in the plant to another.

Other objects of this invention will become apparent from the detailed description and the following illustrative drawings in which:

Figure 1 is a side elevation view in partial section of one embodiment,

Figure 2 is a top plan view of the device shown in Figure 1, the overhead portion of the rope retaining system being omitted for clarity of representation,

Figure 3 is a detailed view of the elevating nut,

Figure 4 is a perspective view showing one arrangement of the retaining rope and its guiding pulleys.

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Referring to Figure 1, the packing machine of this invention comprises a main rotatable screw member 1 mounted on a four-legged base 2 which is provided with axles 3 and truck wheels 4 so that the device may be easily transported from one loading location to another.

Screw 1 is provided at its lower end with shoulders for the accommodation of bearings 5 and 6 which rotatably support 1 and carry the full weight of the screw and all of its appurtenances hereinafter described. The outer races of bearings 5 and 6 are housed within the flanges 7 and 8 of bearing housing 9 which is secured to base 2 by bolts 10. Screw 1 is provided with a circular collar 11 fixedly secured thereto and machined with a downwardly disposed flange 12 which recesses within a peripheral groove in flange 7, sealing bearing housing 9 against the entrance of foreign material from the top end. Screw 1 is retained in position in base 2 by one or more individual bracket members 13 which extend over the outer edge of collar 11 but which are normally out of contact therewith so that the brackets do not interfere with free rotation of the screw. The lower end of housing 9 is closed off by plate 14 secured by bolts 15 so that the full interior space may be packed with lubricant.

The four legs of base 2 are each provided with welded brackets 16 which support open annular drain tank 17 for the collection of water draining off from the cooling table later described. Two adjacent legs of 2 support an upstanding extension 18 to which restraining lever 19 is pivotally secured at its lower end by pin 20. The upper end of lever 19 is continually retained against the edge or serrations of indexing plate 21 by tension spring 22 (refer Figure 1), the inner end of which is connected to member 64 carried by a cross member of base 2, not shown.

Support spider 23 may conveniently comprise four angle shapes fixedly secured at 90 degree intervals around the upper and lower flanges of unitary elevating nut 24. As shown in detail in Figure 3, the lower flange 25 of the nut is internally threaded so that it is freely movable up or down on screw 1 when the screw is retained against rotation. If desired the upper flange may be similarly threaded; however, in the construction disclosed this has not been done since the lower flange has been designed sufficiently thick to provide enough thread area to carry the full weight load. Enough clearance is allowed between the upper flange of nut 24 and the outside surface of the threads of screw 1 to prevent binding therebetween and to permit nut 24 to pass freely up and down the shaft as vertical adjustments require.

Spider 23 carries cooling table 26 which may be securely welded thereto and is also provided with brackets 27 for the support of lower shell spacer 28 secured thereto by bolts 29.

Cooling table 26 is annular in shape and completely enclosed, the top and bottom plates defining it being separated a sufficient distance to form a hollow chamber 30 for the circulation of cooling water through its interior. This cooling water is continuously introduced from annular supply reservoir 31 through two flexible hose lengths 32, while warm water from chamber 30 drains off into tank 17 through a number of short flexible hose lengths 33, only one of which is shown. Water collecting in tank 17 is led off to any conveniently located waste water building drain through hose 34.

Supply reservoir 31 is supported on four-legged spider 35 to which it is fixedly joined by welding or in any other convenient manner. Spider 35 is supported loosely on a shoulder of screw 1 just above the threaded portion, the full weight of spider 35 and its appurtenances being carried by bearing plate 36 which is integrally joined to the spider legs, so that, with hoses 32 disconnected, the entire upper assembly may be lifted off if removal ever becomes necessary.

Upper spacer plate 37 and the four shell spacer guides 38 are secured to the lower arms of spider 35 by bolts 39. The lower ends of guides 38 engage with companion holes or slots (not shown) near the inner edge of lower spacer 28, so that the upper and lower spacers are always retained in the same relative positions with respect to one another regardless of the various positions taken by spider 23 in the course of its rotation. As shown in Figure 1 the cooling-water for the apparatus is supplied by a plant water line or extension 40 which is fitted with a valve 41 for adjusting the delivery rate.

As shown most clearly in Figure 2, upper shell spacer 37 is provided with a series of V-shaped serrations 42 around its periphery, eighteen in number being depicted, although it will be understood that a greater or lesser number may be provided, depending upon the degree of cooling required by the material which is being solidified and also upon the dimensions of the machine. Lower shell spacer 28 is provided with serrations 43 which are identical in size and number to the serrations of spacer 37 and are also always maintained in precise alignment therewith by guides 38.

Cylindrical paper shells 44, which are to be loaded with explosive, are retained in position by contact with the edges of serrations 42 and 43 and are restrained against outward displacement by endless rope 45.

Referring to Figures 1, 2 and 4, rope 45 is threaded around a series of guiding pulleys which maintains proper placement during loading operations and at the same time keeps the rope taut. In Figure 4 the containers are represented as being cut off at the plane of rope contact to show more clearly the encircling relationship of rope 45, although in practice the rope is preferably positioned at about the midpoint between the spacer plates, as shown in Figure 1, for best stability.

The rope pulley system is supported on a guide frame comprising upright angle shapes 46 and 47 which may be secured at their lower ends to adjacent legs of base 2 by welding or by suitable bolts. Cross piece 48 joined to the upper ends of the uprights provides additional strength and stiffness to the frame. Uprights 46 and 47 are slotted as shown at 49 in Figure 1 to permit vertical adjustment of single sheaves 50 and 51 to vary the level of rope contact with shells 44. The rope length is next threaded around single sheaves 52 and 53 and the two ends passed over double sheave 54, the free loop carrying block 55 provided with weight 56 which tensions rope 45 sufficiently so that the rope maintains shells 44 in firm engagement with serrations 42 and 43.

In operation, the machine is kept loaded with shells within the approximately 270 degree angle included by the lower reach of rope 45. Assuming that rotation of table 26 is in a clockwise direction as viewed from the top, the shells are successively positioned beneath the discharge funnel 57 of grainer kettle 58 as restraining lever 19 is manually engaged with the successive serrations 59 on the periphery of indexing plate 21. The vertices of serrations 59 lie in the same radial plane as the vertices of serrations 42 and 43, so that engagement of lever 19 brings each of the several shells into precise location beneath the discharge funnel. In the embodiment described the friction of the threads of elevating nut 24 with screw 1 is sufficient so that there is no relative motion therebetween as table 26 is indexed to successive positions, and screw 1 therefore rotates with nut 24 without any slippage. With constructions of lower weight it may be necessary to provide flange 25 and screw 1 with a mating key and keyway to prevent unwanted vertical displacement between these elements during the course of table rotation.

As each of the shells 44 is presented to funnel 57, the machine operator opens discharge gate 60 by depressing lever 61 connected to bell crank 62, and fills the shells to the top level with the fluid explosive. The material at the bottom of the shells is thus brought into direct contact with the cold surface of table 26, whereupon it instantly freezes into a solidified mass which prevents any molten material from leaking around the bottom edges of the container. This solidification process is continued as succeeding shells are filled during the following indexings so that, when the shell finally reaches the point where rope 45 passes around pulley 50, the filling is sufficiently hardened so that the loaded shells may be removed without danger of leakage of molten material. When large volume shells are being filled it is sometimes desirable to store them on a separate cooling platform, not shown, subsequent to their removal from the loading machine, to continue the cooling process to complete solidification prior to further processing.

Filled shells are removed by a loading assistant at the point between uprights 46 and 47 where the filled shells escape the restraint of rope 45, and empty shells are loaded into the machine prior to the reimposition of rope restraint. During the rotation of table 26, drain hoses 33 are free to trail around the full length of tank 17, thereby continuously removing the water from chamber 30, which is concurrently replaced by cooler water supplied from tank 31.

Amatol explosive is required in packages of a number of different sizes to suit the particular requirements of the trade. The loading machine of this invention is adapted to accommodate shells varying in outside diameter from about 2'' to about 8'' and in length from about 6'' to about 30'' when spacer plate serrations of 5½'' radial depth are utilized. Vertical adjustment for varying lengths is accomplished by restraining screw 1 against rotation while turning elevating nut 24 up or down the requisite distance to position the upper ends of the shells closely adjacent to the loading opening of funnel 57. This adjustment is facilitated by providing the top end of screw 1 with flats 63 for the engagement of a box wrench to prevent the rotation of 1 as elevating nut 24 is screwed up or down the threaded length by manual rotation of table 26.

In explosives use all parts of the machine are preferably fabricated from non-ferrous metals, such as aluminum, brass or bronze, to safeguard against sparking hazards. Aluminum is particularly preferred for the cooling table, because the amatol will not stick to aluminum, and the danger of reaction of copper and ammonium nitrate is eliminated.

The device of this invention has proved highly practical in use. With two operators, it has been found that a production rate of 125 shells 4¾'' in diameter and 12'' long can be readily maintained per hour without appreciable spilling of the fluid charge. Using the eighteen position machine described, approximately 1500 lbs. of explosive per hour may thus be loaded, the cooling time per shell being about 2½ minutes in the course of the travel circuit from the filling funnel to the discharge point.

It will be apparent to persons skilled in the mechanical arts that this invention may be modified in a number of ways without departure from principle. Thus, in some cases, only one spacer plate, located near the mid line of the containers, may be entirely satisfactory. Also, an elastic cord pinned to the uprights described may be substituted for the retaining rope, in which case the pulley system may be greatly simplified or even entirely eliminated.

It will be also understood that the machine of this invention may be widely varied in arrangement and construction, wherefore we desire to be limited only within the scope of the appended claims.

We claim:

1. A packing machine for loading molten and partially molten explosive materials into containing shells comprising a base member, an upright rotatable screw supported within said base member, an annular cooling table threadedly engaged with said screw and normally rotatable therewith, a first locating means rotatable with said table for retaining the lower portions of said shells against radial inward movement with respect to said table, a second locating means rotatable with said table and in vertical alignment with said first locating means for retaining the upper portions of said shells against radial inward movement with respect to said table, flexible means integral with said machine for retaining said shells in contact with both of said locating means, and means for passing a coolant through said cooling table to thereby solidify the filling at the bottom of said shells and prevent any substantial leakage therefrom.

2. A packing machine for loading molten and partially molten explosive materials into containing shells comprising a base member, an upright rotatable screw supported within said base member, an annular cooling table threadedly engaged with said screw and normally rotatable therewith, said cooling table being provided with an interior channel for the circulation of coolant therethrough and means for the supply of coolant to and the withdrawal of coolant from said table, a first locating means rotatable with said table for retaining the lower portions of said shells against radial inward movement with respect to said table, a second locating means rotatable with said table and in vertical alignment with said first locating means for retaining the upper portions of said shells against radial inward movement with respect to said table, and flexible means integral with said machine for retaining said shells in contact with both of said locating means.

3. A packing machine for loading molten and partially molten explosive materials into containing shells according to claim 2 wherein said flexible retaining means comprises a continuous tightly drawn rope the shell restraining reach of which is supported by vertically adjustable pulleys while the remaining length is led away from contact with said shells by other pulleys so that, during at least a portion of said cooling table's rotation, said shells will be released from inward radial restraint.

4. A packing machine for loading molten and partially molten explosive materials into containing shells comprising a base member, an upright rotatable screw supported within said base member, an annular cooling table threadedly engaged with said screw in such a manner that rotation of said table turns said screw without substantial relative movement therebetween when said screw is free from extraneous restraint, said cooling table being provided with an interior channel for the circulation of coolant therethrough and means for the supply of coolant to and the withdrawal of coolant from said table, a first locating means rotatable with said table for retaining the lower portions of said shells against radial inward movement with respect to said table, a second locating means rotatable with said table for retaining the upper portions of said shells against radial inward movement with respect to said table, guiding means maintaining said first locating means in vertical alignment with said second locating means, and flexible means integral with said machine for retaining said shells in contact with both of said locating means.

5. A packing machine for loading molten and partially molten explosive materials into containing shells comprising a base member, an upright rotatable screw supported within said base member, an annular cooling table threadedly engaged with said screw in such a manner that rotation of said table turns said screw without substantial relative movement therebetween when said screw is free from extraneous restraint, said cooling table being provided with an interior channel for the circulation of cooling liquid therethrough, a supply tank at a higher level than said cooling table and rotatable therewith for supplying cooling water to said table, an annular open drain tank fixedly supported by said base member at a lower level than said cooling table for the temporary collection of liquid draining from said table, flow conduits connecting said supply tank with said cooling table and said cooling table with said drain tank, a first

locating means rotatable with said table for retaining the lower portions of said shells against radial inward movement with respect to said table, a second locating means rotatable with said table for retaining the upper portions of said shells against radial inward movement with respect to said table, guiding means maintaining said first locating means in vertical alignment with said second locating means, and flexible means supported from said base member for retaining said shells in contact with both of said locating means.

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