

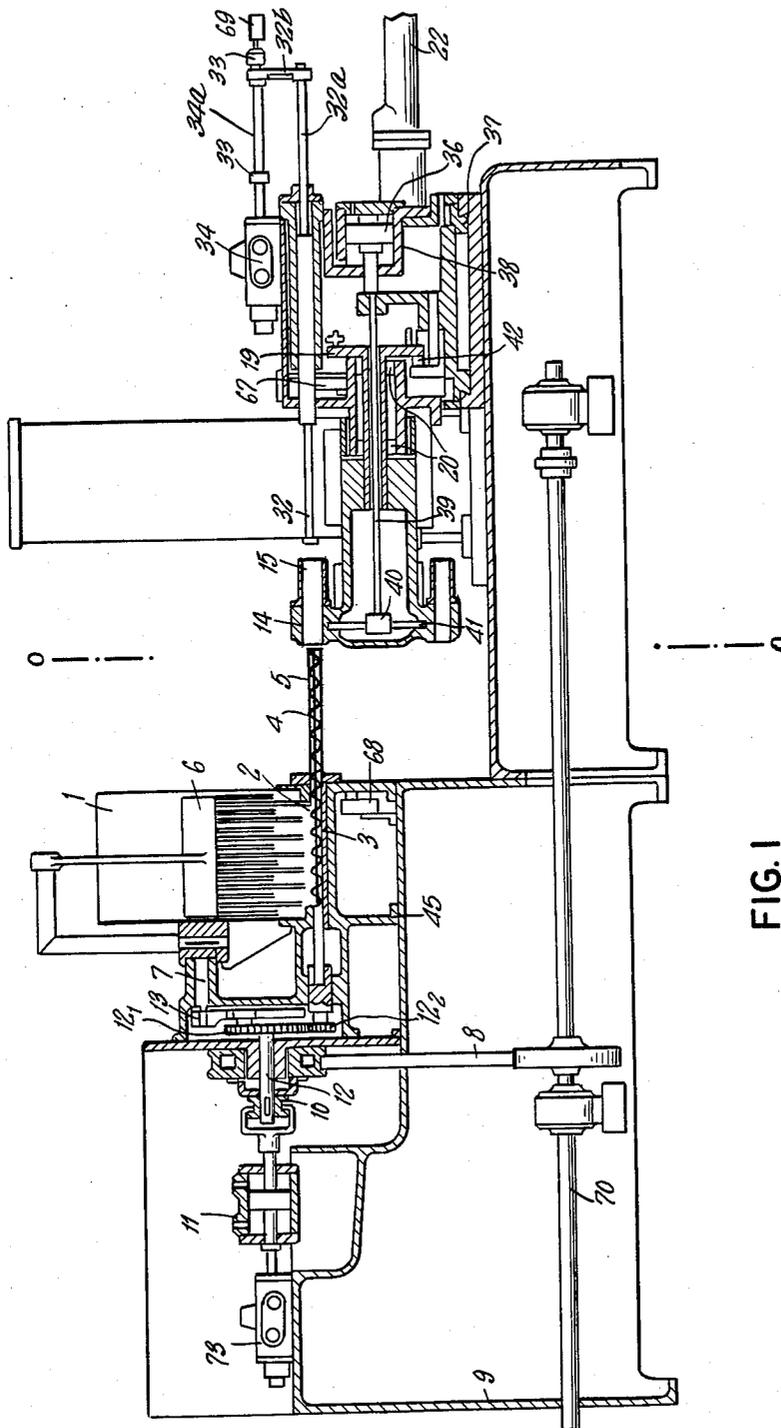
May 1, 1962

F. LAZARI ET AL
AUTOMATIC CARTRIDGE-FILLING MACHINE FOR
POWDERED AND SEMIGELATINOUS EXPLOSIVES

3,031,912

Filed Oct. 3, 1957

5 Sheets—Sheet 1



May 1, 1962

F. LAZARI ET AL
AUTOMATIC CARTRIDGE-FILLING MACHINE FOR
POWDERED AND SEMIGELATINOUS EXPLOSIVES

3,031,912

Filed Oct. 3, 1957

5 Sheets-Sheet 2

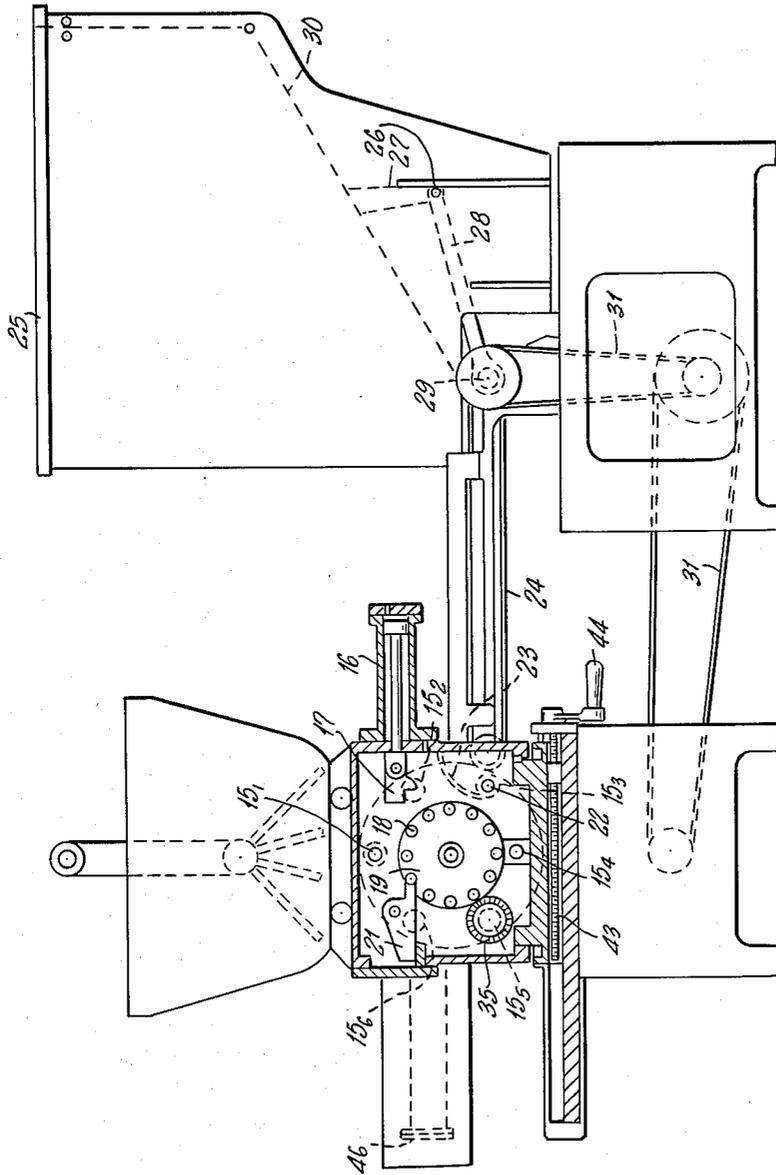


FIG. 2

May 1, 1962

F. LAZARI ET AL
AUTOMATIC CARTRIDGE-FILLING MACHINE FOR
POWDERED AND SEMIGELATINOUS EXPLOSIVES

3,031,912

Filed Oct. 3, 1957

5 Sheets-Sheet 3

FIG. 5

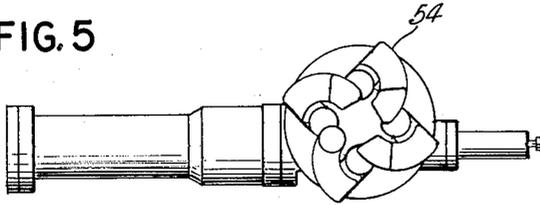


FIG. 4

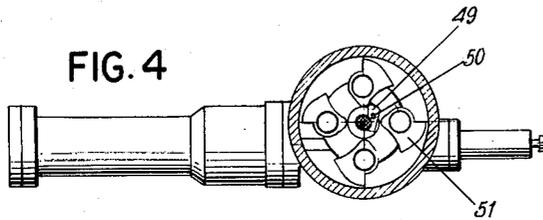
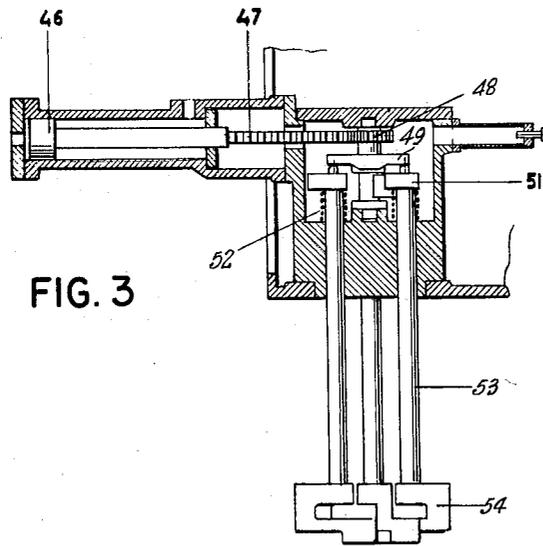


FIG. 3



May 1, 1962

F. LAZARI ET AL
AUTOMATIC CARTRIDGE-FILLING MACHINE FOR
POWDERED AND SEMIGELATINOUS EXPLOSIVES

3,031,912

Filed Oct. 3, 1957

5 Sheets-Sheet 4

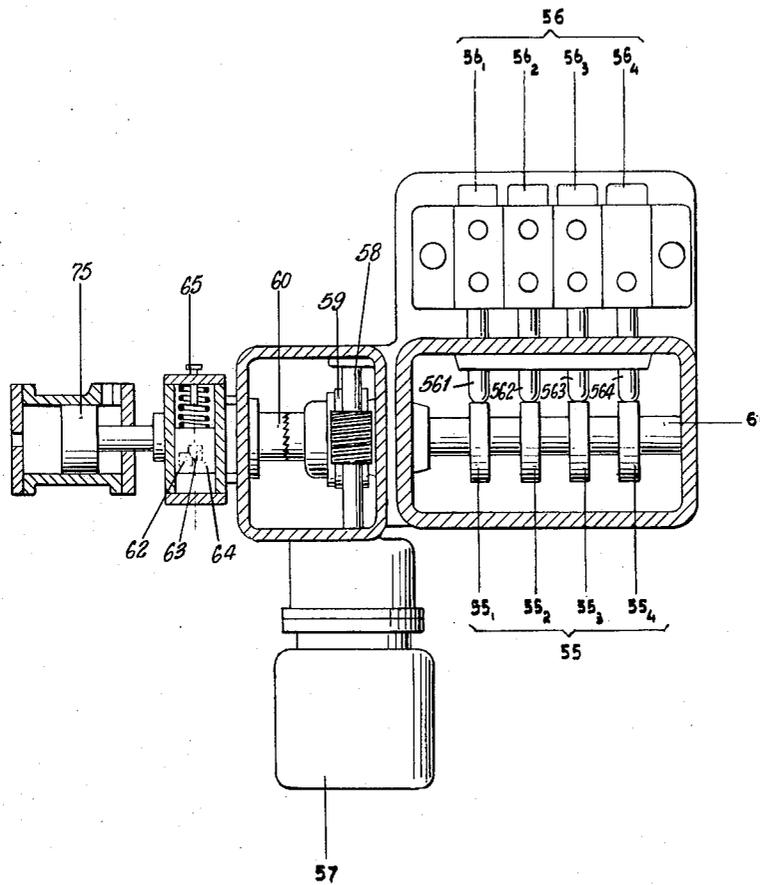


FIG. 6

May 1, 1962

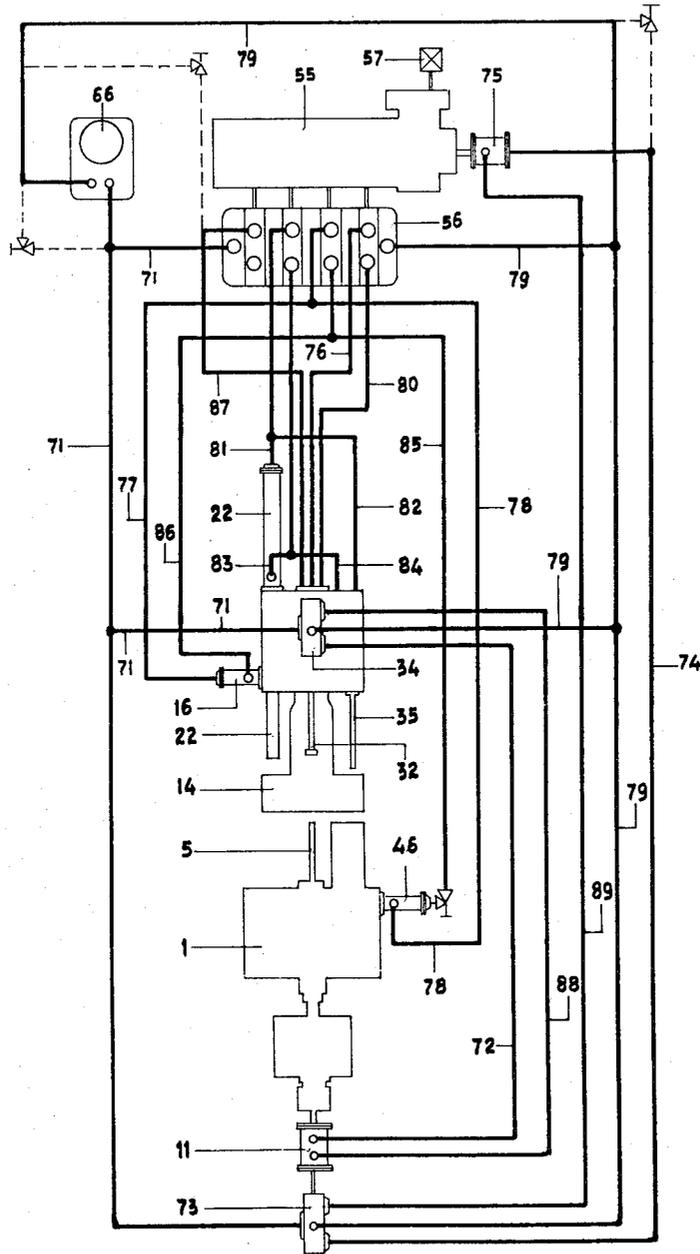
F. LAZARI ET AL
AUTOMATIC CARTRIDGE-FILLING MACHINE FOR
POWDERED AND SEMIGELATINOUS EXPLOSIVES

3,031,912

Filed Oct. 3, 1957

5 Sheets-Sheet 5

FIG. 7



1

3,031,912

AUTOMATIC CARTRIDGE-FILLING MACHINE FOR POWDERED AND SEMIGELATINOUS EXPLOSIVES

Fabrizio Lazari and Angelo Sormani, Milan, Italy, assignors to Montecatini Società Generale per l'Industria Mineraria e Chimica, Milan, Italy, a corporation of Italy

Filed Oct. 3, 1957, Ser. No. 687,885

Claims priority, application Italy June 15, 1956

15 Claims. (Cl. 86-20)

This application is a continuation-in-part of our application Serial No. 663,806, filed June 5, 1957, of the same title, now abandoned.

This invention relates to an automatic apparatus and process for filling cartridge cases with explosives. It especially relates to an apparatus in which friction and impact in the various parts are minimized, as a safety measure.

For this purpose the means employed to control or energize the various parts, that is the operating members, comprises a pneumatic, hydraulic, or oil-flow control system.

The cartridgeing of mine explosives in general, and powdered or semigelatinous explosives in particular, is usually carried out by introducing the explosive material into an envelope having a determined size, called the cartridge case, pressing it to a certain required degree of density and closing the end of this envelope. In its simplest form the cartridge-filling machine comprises a hopper to collect the explosive, and a device which pushes the explosive through a matrix or union member on or in which the envelope or cartridge case is placed or inserted. The steps of placing the empty cases onto the union, closing the full cases, and operating the machine are manual.

Although complex automatic machines can carry out the feeding of the explosives and of the cases, many of such automatic machines comprise mechanisms which are not suitable, because of the sensitivity to impact and friction characteristic of these explosives.

Moreover, if a cartridge is not properly filled, or is deformed or broken, the machine continues its work, unless the attending person intervenes. Makers of these automatic machines have tried, by various means, to reduce the contact of the explosive with machine members, the movement of which could cause dangerous friction or impact, also protecting such members, as far as possible, from dusting by the explosive.

The principal object of the present invention is to provide a cartridge-filling machine for explosives, particularly powdered or semigelatinous explosives, in which machine most of the operating members are actuated by a pneumatic, hydrodynamic, or oil-dynamic system, preferably by the last one, thus permitting the elimination of gears, crank mechanisms and other mechanisms which can be the source of dangerous friction or impact.

When such members are actuated by oil-dynamic systems, they are inherently and automatically lubricated. No jamming of the mechanism can occur while the oil film which permanently covers the piston shafts inactivates or makes inert the traces of explosive powder which, in spite of protective precautions, may eventually deposit on said shafts.

Another outstanding advantage of this system is that the force which can be exerted by the various moving members is always limited by the magnitude of the pressure of the fluid. Therefore, in the case of a phase displacement of the connected movements, or a jamming of one of those members, movement is stopped without any further damage to the machine or danger from explosives.

2

Still another advantage of this system is that the motor group which supplies the fluid under pressure and the distribution system for supplying said fluid to the members of the cartridge-filling machine, can be placed at a distance, in the most convenient place, being connected thereto by a simple pipe network.

Other special advantages of this system will be described below, in the detailed description of the machine.

A preferred embodiment of the invention is illustrated in the drawings, which are in some respects schematic, and in which:

FIG. 1 is a longitudinal section in elevation;

FIG. 2 is a transverse sectional elevation of the machine, taken at and viewed from the right end region of FIG. 1;

FIG. 3 is a horizontal section of the piston-operated hammer mechanism employed to seal the case or cartridge;

FIG. 4 is a vertical section of the mechanism of FIG. 3;

FIG. 5 is an end view of the hammers;

FIG. 6 illustrates the main fluid control distribution group in detail;

FIG. 7 illustrates the fluid control conduits and their connections, schematically.

The system of apparatus may be viewed as comprising two interdependent groups (FIG. 1). On the left of the imaginary center line 0-0 is the charging group, and on the right is the manufacturing group.

Referring to FIG. 1, the hopper 1 contains the explosive, which descends through the slit 2 in ebonite sheath 3 at the bottom of the same hopper onto a helical screw 4. The latter pushes the explosive into the conduit or union member 5.

Regular flow of the explosive from the hopper is ensured by an agitator rake 6 which is given an oscillatory movement. The fulcrum of this movement is at 7 outside the hopper, in order to avoid friction with the explosive powder. The screw 4 and agitator 6 are driven by V-belt 8 which is enclosed by machine bed 9. The drive is through a claw clutch 10, the position of which is controlled by a piston in chamber 11. Clutch 10 engages shaft 12 which turns gear 12₁ carrying eccentric link block 13. The latter oscillates the agitator. Gear 12₁ turns gear 12₂, to rotate the helical screw 4.

The entire toothed gearing system and the link block are enclosed by a sealed box, in an oil bath.

The manufacturing group consists of a pivoted member comprising a rotatable head, magazine or revolver barrel 14 carrying six chambers or sleeves 15 located at the apexes of a regular hexagon inscribed in the face plate thereof. These sleeves can be replaced by others, to accommodate the diameter and length of the cartridge to be manufactured. The rotatable head 14 turns, during each operation, one-sixth of a complete revolution. It is turned by means of piston 16 (FIG. 2), through the action of bolt 17 upon the stakes 18 fixed to the disk 19. The disk is connected with the rotatable head, and rotates therewith on the bearings 20 (FIG. 1).

The pawl or pivoted clamp 21 (FIG. 2) stops the stakes at the end of each fraction of revolution to assure the accuracy of the rotation of a sixth of a revolution.

The double acting piston in chamber 22 (FIG. 2) pushes the new empty cartridge cases, displacing them from collector 23 (FIG. 2) to the sleeve which is in position 15₃. The cartridge cases are carried into the collector by means of conveyor belt 24, which draws them from the hopper 25. The cartridge cases were previously arranged in required position in the hopper. The bottom 30 of the hopper 25 has a lever 27 attached thereto, the lever being pivoted at 26. The lever is connected with connecting rod 28 controlled by the eccentric

29. This impresses an oscillatory movement upon the bottom 30, in order to facilitate constant settlement of the cartridge cases, to ensure continuous feeding of the conveyor belt 24.

The entire feeding system is controlled by track or chain drive 31, which is enclosed by the machine bed.

The empty cartridge case presented in position 15₁ (FIG. 2), by the rotatable head, is pushed upon union member 5 by the single acting longitudinally directed piston 32 (FIG. 1). Piston 32 carries a rod 32a at its right end, the rod being provided with a member 32b. At each end of the run the latter member moves against adjustable clamps 33 mounted on a longitudinally movable piston shaft 34a of a four-way distributor device 34. This device controls the starting of each working cycle. The longitudinally directed double acting piston 35 (FIG. 2) discharges the manufactured cartridge case from sleeve 15₅.

During each operation cycle, the entire manufacturing group recoils for the purpose of inserting or positioning onto the union that initial or end part of the case which is not to be filled and which is needed for the closing of the cartridge case after its filling. The end part is closed by hammers. The recoil operation is actuated by piston 36 (FIG. 1). This piston is connected with the fixed part or base plate part 37 and displaces impulse cylinder 38 and consequently the entire group, upon application of pressure. To the fixed part 37 is connected a rod 39 carrying at its head a fixed cam 40 which operates upon movable pistons 41. The latter hold fast the cartridge cases, in the pre-established position, during rotation of the rotatable head. A pin 42 controls the exact position of the rotatable head or revolver at each rotation.

The entire movable part of the manufacturing group and the fixed part can be displaced laterally by means of screw 43 (FIG. 2) controlled by crank 44, to facilitate the operations necessary for changing the sleeves, cleaning and general maintenance. The manufacturing group is completed by the case sealing group (FIG. 3) fixed on the frame 45 (FIG. 1) in a position corresponding to that of revolver barrel position 15₆ (FIG. 2). This group is controlled by piston 46 (FIGS. 2 and 3) and is provided at its outer end with rack 47 which rotates gear 48. To the shaft of gear 48 is connected the cam 49 (FIG. 4), pivoted at 50. This operates the cams 51, impressing upon them a rotatory movement. After passing the cam 49, the cams are recalled by springs 52, to return to their initial position. The shafts 53, rigidly connected with the cams 51, carry the hammers 54 on their outer ends. Consequently at each rotation of the cams there is a corresponding rotation of the hammers to close the cartridge cases.

The distributor group (FIG. 6) consists of a set 55 of four rotating cams 55₁ to 55₄ which displace the shafts of the distributor boxes shown at 56. An electric motor 57 connected through a flexible coupling rotates a worm screw 58 which, through helical gear 59 and claw coupling 60, rotates the cam shaft 61 at the desired velocity. Cams 55 displace successively in the pre-established order the distributor boxes 56₁ to 56₄. Each operative cycle of the machine corresponds to a complete revolution of the cam shaft 61. Stopping after any revolution is assured by a tooth 62 fixed on the movable part of the coupling 60. At the end of the revolution tooth 62 meets another tooth 63 connected with the piston 64. Piston 64 allows tooth 63 to run until the piston meets a stop 65. Being hindered from continuing its run, tooth 62 forces tooth 63 to slide on the inclined plane, consequently disconnecting the claw coupling to stop the cam shaft.

The set of distributor boxes 56 consists of three four-way distributor boxes 56₁, 56₂, 56₃, and of a three-way distributor box 56₄; the set is also completed by two heads, one of which corresponds to the delivery and the

other to the discharge. The system is completed by a central station 66 (FIG. 7). Station 66 is conventional, comprising a tank, a pump motor connected with a submerged pump, a maximum pressure valve, a flow regulator and a manometer. These are not individually shown in the drawing.

A light source 67 (FIG. 1) is placed in such a position that its beam of light passes longitudinally to the axis of the union through the sleeve in the position 15₂ (FIG. 2) to photo-electric cell 68 (FIG. 1). The photo-electric cell, by means of a suitable relay, stops the machine when acted upon by the beam of light. This can occur only when, owing to a fault of the cartridge case, or of the case feeding, or to an exhaustion of the supply of cases, the mouth of the empty case has not been correctly inserted into or placed onto the union member 5 or in position 15₃ (FIG. 2).

Device 69 (FIG. 1) is a conventional sealed micro limit-switch which is pressed by the shaft 34a of distribution box 34 (FIG. 7). When said shaft moves, the micro-switch is freed and excites a conventional time relay moving it. The time relay is not shown. If the functioning of the machine is normal, the time relay never has time to complete its cycle. Thus it does not switch off the circuit, because the shaft of the distribution box 34 returns to its starting position, again pressing against the micro-switch. If, on the contrary, the case charging is not regularly carried out, owing to either the insufficient feeding of explosive to the screw, or to breakage of the paper case or to its jamming, caused by deformation, this causes the pre-set time on the relay to be exceeded. The relay then enters into action and stops the helical screw 4 (FIG. 1), which discharges the cases. The control devices may also be connected to conventional visual and sound signals, for the use of the attending persons.

At the beginning of an operative cycle the machine is in the position shown in FIG. 1. After charging the hopper and making certain that the first case is on the union 5 (FIG. 1), the operator starts the oil pump 66 (FIG. 7) and the motor 57 of the distributor group (FIGS. 6 and 7). Then he starts the remote motor (not shown) which controls the drive 70 (FIG. 1). The latter, through claw coupling 10, actuates the agitator 6 and the helical screw 4. This fills the case, previously positioned on the union 5. With this system the case is filled entirely uniformly, because it is opposed by a member, namely piston 32 (FIG. 1), which presents a constant resistance. The cramming of explosive can be regulated by controlling the piston resistance to obtain the desired apparent density of the cartridge charge. This is done by controlling the oil outlet of the piston chamber. The explosive, pushed by the helical screw through the union 5, gradually fills the case, driving it back, together with shaft of piston 32. The shaft, after having reached the outer end of its run, displaces the control element 34a of distributor box 34. The pressure coming from the pipe 71 (FIG. 7) is directed or deviated to the pipe 72, causing displacement of the piston 11 (FIG. 1), and in consequence disengages the coupling 10, thus stopping the motion of the screw 4 and of the agitator 6. The piston 11 in its run displaces also the shaft of distributor box 73 (FIG. 7) which conveys the pressure through pipe 74 to the piston in chamber 75. This piston in its advancement phase moves coupling 60 (FIG. 6) of the distributor group into engaging position, thus rotating the cam shaft 61.

The cam 55₁ (FIG. 6), during its rotation, displaces the shaft 561 of the distributor box 56₁ and conveys the pressure into the pipe 76 (FIG. 7) connected with the cylinder 38 (FIG. 1). Upon receiving the pressure, the cylinder 38 is displaced, thus removing from the union 5 that portion of the empty case which is needed for closing, or hammer-sealing, the cartridge case. The cam 55₂ (FIG. 6) moves the shaft 562 of the distributor box 56₂ and conveys the pressure through pipes 77 to the

5

piston 16 (FIG. 2), which acts upon the stakes 18 situated on the disc 19, and therefore rotates the rotatable head 14 (FIG. 1). The latter presents a new cartridge case to the union 5. Simultaneously with the rotation of the revolver, piston 46, which controls the sealing hammers 54 (FIG. 3), is maintained in a position of rest by means of pressure applied through pipe 78 (FIG. 7). Successively cam 55₁ (FIG. 6) moves or carries back the box 56₁ into the initial position. This shifts the connection of pipe 76 from the discharge pipe 79, conveying the pressure to the pipe 80 which is connected with cylinder 38 (FIG. 1). This actuates the approach movement of the entire manufacturing group, and inserts a new case on the union.

Successively the cam 55₂ displaces the piston or shaft 56₃ of box 56₂ which conveys the pressure through pipe 81 (FIG. 7) to the piston 22; this inserts a new case in the sleeve 15₃ situated on the rotatable head. Contemporaneously the pressure is conveyed through pipe 82 (FIG. 7) to the piston 35 which discharges the manufactured cartridge case from the sleeve. Rotation of the cam 55₃ brings back the shaft of the box 56₃ to initial position and reverses the connection thus conveying the pressure through pipes 83 and 84 and connecting pipes 81 and 82 with the discharge. The increased pressure in pipes 83 and 84 moves the cylinders 22 and 35 back into rest position.

Following its rotation the cam 55₂ (FIG. 6) displaces the piston or shaft of box 56₂ thus conveying pressure through pipe 85 to piston 46, which actuates the hammer 54 to close the filled cartridge case. Simultaneously the pressure through pipe 86 moves piston 16 back to rest position.

Cam 55₄ displaces the shaft 56₄ of box 56₄ which, through pipe 87, conveys pressure to piston 32. The latter inserts a new case on the union member 5. As soon as the end of the run is reached the pressure in pipe 87 is directed or shifted to discharge pipe 79. At the end of its run piston 32 displaces the shaft of the box 34, which, by reversing the circuit, discharges pipe 72 and conveys pressure into the pipe 88. The pressure displaces the piston in 11, thus causing the engaging of coupling 10, which again starts the helical screw and the agitator, and displaces the shaft of the box 73. This, by reversing the circuit, discharges pipe 74 and conveys pressure through pipe 89 to cylinder 75. This last, by displacement of its piston, releases tooth 63 (FIG. 6), which causes stopping of the cams 55 and prepares coupling 60 for a new operation cycle.

In summary:

Under control of the cam profiles of main distributor group 55, which operates, as mentioned above, when the cartridge case is filled and the charging screw is filled, the following operations are performed in predetermined sequence:

(a) the whole revolver group recoils, removing the case mouth from the end of the union member 5;

(b) successively the revolver head 14 rotates 60°, offering a new case to or before union member 5, and the whole group advances thus returning in normal position, and then inserts the new case onto the union;

(c) contemporaneously, an empty case is introduced into the sleeve in position 15₃ by piston 22, the charged case contained by the sleeve in position 15₆ is closed by the set of hammers actuated by piston 46, the charged and closed case contained in the sleeve in position 15₅ is expelled by piston 35 and is collected in a suitable box or on a belt conveyor;

(d) finally in the last stage, piston 32 pushes against the end of the empty case contained in the sleeve in top position 15₁, inserting the empty case onto the outside of union member 5; the cycle is thus started again.

We claim:

1. An automatic apparatus for filling cartridge cases with explosive, comprising an axially movable pivoted

6

member having a plurality of axially directed chambers each adapted to receive a cartridge case, means for introducing an empty cartridge case into one of said chambers, means for stepwise turning said pivoted member to present said empty cartridge in said one chamber in position for filling with explosive, means for filling said cartridge with explosive from one end, said means for filling comprising a tubular member and a helical screw conveyor means therein, means for moving the pivoted member axially toward the tubular member, means for pushing an empty cartridge case toward the tubular member for connection therewith, whereby the helical screw extends within the said case, means for closing said end, means for removing the pivoted member axially away from the tubular member to remove the closed, filled cartridge case from the pivoted member, all of said means being fluid-pressure operated and being automatic and being operatively interconnected for cyclic operation, automatic control devices to carry out said automatic and cyclic operation, said automatic control devices comprising fluid pressure control conduits operatively connected to said means, fluid pressure distributor means controlling distribution of fluid pressure to the conduits, pump means to supply said conduits with actuating fluid under pressure, prime mover power means for driving said means for filling the case with explosive and for operating said pump and distributor means, said power means being isolated from the cartridge introducing, presenting, filling, closing, and removing means.

2. The apparatus of claim 1 in which the fluid is lubricating oil.

3. An automatic apparatus for filling cartridge cases with explosive, comprising a revolver member having a plurality of chambers each adapted to receive an empty cartridge case, means for introducing a cartridge case into one of said chambers, means for turning and stationing said revolver member to present said empty cartridge in said one chamber in position for filling with explosive, conduit and rotary helical screw conveyor means for filling said cartridge with explosive from one end, piston means pressing said cartridge case toward said conveyor and into connection with said conduit while the case is being filled, the helical screw extending within said case to press the explosive thereinto, means for closing said end, means for removing the closed, filled cartridge case from the pivoted member, all of said means being automatic and cyclic in operation, automatic control devices to carry out said automatic and cyclic operation, said automatic control devices comprising control conduits operatively connected to said means, pump means to supply said conduits with liquid actuating fluid under predetermined maximum pressure, the maximum force exerted by said devices on each other and on the cartridge case and explosive being limited by the said predetermining of the maximum pressure.

4. An automatic apparatus for filling shells with explosive, comprising a hopper for the explosive, a generally horizontal tubular member communicating therewith, a generally horizontal helical rotary screw means in said tubular member to push the explosive outwardly of the hopper, a magazine mounted for rotation about a generally horizontal axis, said magazine having a plurality of circumferentially distributed horizontally extending through passageways for reception of an empty shell in each one thereof, means for stepwise turning of the magazine to position each passageway in turn, and the empty shell therein, opposite the said tubular member for filling, means to push a replacement empty shell into one of the passageways not at the time being so positioned, horizontally movable piston means entering a passageway of the magazine to push the empty shell that is positioned opposite said tubular member onto the tubular member whereby the screw means extends within the shell, fluid pressure operated means connected to actuate the piston means to so push said empty shell and to thereafter apply

a regulable opposing resisting force to said piston during the filling of that shell, the explosive pushed by the helical screw through the tubular member gradually filling the shell and driving it back together with the piston means, motive means for turning the rotary screw, the motive means being energized separately of the fluid pressure means exerting said resisting force, said fluid pressure operated means including an hydraulic pressure distributor means to govern movement of said piston means and stopping of said screw, a control means for the distributor means, said control means being operated by said piston means, when the latter is driven back, to stop the helical screw, said magazine being also mounted for horizontal displacement, means controlled by the hydraulic pressure distributor means to horizontally displace the magazine, said control means being operated by said piston means, when the latter is driven back, to actuate the distributor means to displace the magazine away from the tubular member, thereby carrying the explosive containing shell away therefrom, means actuated by the hydraulic pressure distributor to thereafter rotate said magazine stepwise to position another empty cartridge, carried therein, opposite the tubular member and to move the magazine back horizontally, toward the tubular member.

5. An automatic apparatus for filling shells with explosive, comprising a hopper for the explosive, a tubular member communicating therewith, a screw means in said tubular member to push the explosive outwardly of the hopper, a magazine mounted for rotation about an axis extending longitudinally of said tubular member, said magazine having a plurality of circumferentially distributed axially extending through passageways for reception of an empty shell in each one thereof, means for stepwise turning of the magazine to position each passageway in turn, and the empty shell therein, opposite the said tubular member for filling, means to push a replacement empty shell into one of the passageways not at the time being so positioned, longitudinally movable piston means entering a passageway of the magazine to push the empty shell that is positioned opposite said tubular member onto the tubular member whereby the screw means extends within the shell, fluid pressure operated means connected to actuate said piston means to so push said empty shell and to thereafter apply a regulable opposing resisting fluid-pressure force to said piston during the filling of that shell, the explosive pushed by the screw through the tubular member gradually filling the shell and driving it back together with the piston means, said fluid pressure operated means including an hydraulic pressure distributor means to govern movement of said piston means and said screw, a control means for the distributor means, said control means being operated by said piston means, when the latter is driven back, to stop the screw, said magazine being also mounted for axial displacement, means controlled by the hydraulic pressure distributor means to axially displace the magazine, said control means being operated by said piston means, when the latter is driven back, to actuate the distributor means to displace the magazine away from the tubular member, thereby carrying the explosive containing shell away therefrom, means actuated by the hydraulic pressure distributor to thereafter rotate said magazine stepwise to position another empty shell, carried therein, opposite the tubular member and to move the magazine back axially, toward the tubular member.

6. An automatic apparatus for filling cases with explosive, comprising a hopper for the explosive, a generally horizontal tubular member communicating therewith, pusher means in said tubular member to push the explosive outwardly of the hopper, a magazine mounted for rotation about a generally horizontal axis, said magazine having a plurality of circumferentially distributed horizontally extending through passageways for reception of an empty case in each one thereof, means for stepwise turning of the magazine to position each passageway in

turn, and the empty case therein, opposite the said tubular member for filling, means to push a replacement empty case into one of the passageways not at the time being so positioned, horizontally movable piston means entering a passageway of the magazine to push the empty case that is positioned opposite said tubular member onto the tubular member, fluid pressure operated means connected to actuate said piston means to so push the empty case and to thereafter apply a regulable resisting force during the filling of that case, the explosive pushed by the pusher means through the tubular member gradually filling the case and driving it back together with the piston means, said fluid pressure operated means including an hydraulic pressure distributor means to govern movement of said piston means and said pusher means, a control means for the distributor means, said control means being operated by said piston means, when the latter is driven back, to stop the pusher means, said magazine being also mounted for horizontal displacement, means controlled by the hydraulic pressure distributor means to horizontally displace the magazine, said control means being operated by said piston means, when the latter is driven back, to actuate the distributor means to displace the magazine away from the tubular member, thereby withdrawing the explosive containing case therefrom, means actuated by the hydraulic pressure distributor to thereafter rotate said magazine stepwise to position another empty cartridge, carried therein, opposite the tubular member and to move the magazine back horizontally, toward the tubular member.

7. An apparatus for filling a shell with powdered or semigelatinous explosive, comprising a tubular member having an explosive outlet end, means for supplying explosive to the member, pusher means to push the explosive through the tubular member, rotary support means for a series of empty shells to be filled, liquid fluid pressure actuated piston means to push each empty shell in turn into overlapping relation with the tubular means, the explosive pushed by the pusher means through the tubular member gradually filling the shell and driving the shell back together with the piston means, the fluid pressure means applying a regulable resisting force during the filling of the shell in opposition to the driving back of the shell, means for stepwise turning of the rotary support means about an axis longitudinal to the tubular member to position each empty shell in turn opposite the tubular member for filling, means operable subsequently to the filling of each shell to move the rotary support means longitudinally away from the tubular member to withdraw the shell, that has been filled, from the tubular member, liquid fluid pressure distributor means operatively connected for energizing the stepwise turning and the piston means and said longitudinal movement, automatically, and separate motor means for driving the pusher means.

8. In a automatic apparatus for filling cartridge cases with explosive, comprising devices to place the empty cases in position for filling, and to fill the cases, and to remove them after filling, the improvement comprising a control system for operating the devices in predetermined automatic cyclic operating sequence, the control system including an actuating liquid fluid distributor and means connecting the distributor to the said devices, means for supplying actuating liquid fluid under pressure to said system to control said devices, the device to fill the cases comprising a conduit for explosive and a screw conveyor therein, an open end of the empty case being juxtapositionable in overlapping relation with respect to the conduit to receive the explosive, the screw conveyor extending within the case being filled, and a liquid fluid pressure piston operated means comprising part of said control system and operatively positioned to push said empty case into said overlapping relation and to push against the opposite closed end of the case as it is being filled by the screw conveyor, the piston operating

9

in a piston chamber having a pressure fluid outlet, the pressure of said piston operated means being controlled by the control of liquid fluid egress through said outlet.

9. An apparatus for filling cases with powdered or semi-gelatinous explosive, comprising a tubular member having an explosive outlet end, means for supplying explosive to the member, a rotary screw means in said tubular member, rotary support means having a series of circumferentially distributed axially directed passageways for reception of empty cases, liquid fluid pressure actuated means, the latter including a device for automatic stepwise rotation of the rotary support means to juxtaposition each empty case in turn opposite said tubular member, said liquid fluid pressure actuated means including piston means for thereafter automatically pushing the so juxtapositioned empty case into overlapping relation with respect to the tubular means, whereby the screw means extends within the case, the explosive pushed by the screw through the tubular member gradually filling the case and driving the case back together with the piston means, the liquid fluid-pressure piston means applying a regulable, resisting force during the filling of the case in opposition to the driving back of the case, the liquid fluid-pressure piston means comprising a piston chamber having a pressure fluid outlet, the resisting force being controlled by control of fluid egress through said outlet, motive means for turning the rotary screw, means for energizing the motive means separately of the fluid pressure means exerting said resisting force.

10. An automatic apparatus for filling cases with explosive, comprising a hopper for the explosive, a generally horizontal tubular member communicating therewith, a generally horizontal motor driven rotary, helical screw means in said tubular member to push the explosive outwardly of the hopper, a magazine mounted for rotation about a generally horizontal axis, said magazine having a plurality of circumferentially distributed horizontally extending through passageways for reception of an empty case in each one thereof in turn, automatically operated means for stepwise turning of the magazine to position each passageway in turn, and the empty case therein, opposite the said tubular member for filling, automatically operated means to push a replacement empty case into one of the passageways not at the time being so positioned, horizontally movable piston means entering a passageway of the magazine to push the empty case that is positioned opposite said tubular member onto the tubular member whereby the screw means extends within the case, automatic liquid fluid pressure operated means connected to actuate the piston means to so push said empty case and to thereafter apply a regulable opposing resisting force to said piston during the filling of that case by the motor driven screw, the explosive pushed by the helical screw through the tubular member gradually filling the case and driving it back together with the piston means, automatically operated means to close the filled case after it is driven back and while the means for stepwise turning of the magazine is non-operational, and to thereafter remove the filled case from the magazine, all of said automatically operated means being cyclic in action, and automatic control devices to carry out said automatic and cyclic operation.

11. The apparatus defined in claim 10, said automatic control devices including means actuated by the piston means, upon being pushed back, to stop the screw means.

12. An automatic apparatus for filling cartridge cases with explosive, comprising an axially movable pivoted member having a plurality of axially directed chambers each adapted to receive a cartridge case, means for introducing an empty cartridge case into one of said chambers, means for filling said cartridge with explosive from one end, said means for filling comprising a tubular member and means for pushing the explosive therethrough, means for stepwise turning said pivoted member to present said empty cartridge in said one chamber in posi-

10

tion opposite said tubular member for filling with explosive, means for moving the pivoted member axially, the latter means being actuatable to move the pivoted member toward the tubular member for connection of said cartridge to said tubular member, means for pushing said empty cartridge case toward the tubular member for operative connection therewith for filling thereof, the means for moving the pivoted member axially being actuatable after said filling to move the pivoted member away from the tubular member to remove the filled cartridge case from the tubular member, means for closing said end after the filled case is so removed and while the means for stepwise turning of the pivoted member is non-operational, means to thereafter remove the closed cartridge case from the pivoted member, all of said means being automatic and being operatively interconnected for cyclic operation, and automatic control devices to carry out said automatic and cyclic operation.

13. An automatic apparatus for filling cartridge cases with explosive, comprising an axially movable pivoted member having a plurality of axially directed chambers each adapted to receive a cartridge case, means for introducing an empty cartridge case into one of said chambers, means for filling said cartridge with explosive from one end, said means for filling comprising a tubular member and means for pushing the explosive therethrough, means for stepwise turning said pivoted member to present said empty cartridge in said one chamber in position opposite said tubular member for filling with explosive, means for moving the pivoted member axially, the latter means being actuatable to move the pivoted member toward the tubular member for connection of said cartridge to said tubular member, means for pushing said empty cartridge case toward the tubular member for operative connection therewith for filling thereof, the means for moving the pivoted member axially being actuatable after said filling to move the pivoted member away from the tubular member to remove the filled cartridge case from the tubular member, means for closing said end after the filled case is so removed and while the means for stepwise turning of the pivoted member is non-operational, means to thereafter remove the closed cartridge case from the pivoted member, all of said means being automatic and being operatively interconnected for cyclic operation, and automatic control devices to carry out said automatic and cyclic operation, the means for pushing the empty cartridge case toward the tubular member comprising a piston means and fluid pressure means for applying controlled pressure on said piston means during the filling, the piston means being pushed back by the case as the case is filled, said control devices including means actuated by the piston means, when it is pushed back, to stop the means for pushing the explosive and to operate the means for moving the pivoted member away from the tubular member.

14. An automatic apparatus for filling cartridge cases with explosive, comprising an axially movable pivoted member having a plurality of axially directed chambers each adapted to receive a cartridge case, means for introducing an empty cartridge case into one of said chambers, means for filling said cartridge with explosive from one end, said means for filling comprising a tubular member and means for pushing the explosive therethrough, means for stepwise turning said pivoted member to present said empty cartridge in said one chamber in position opposite said tubular member for filling with explosive, means for moving the pivoted member axially, the latter means being actuatable to move the pivoted member toward the tubular member for connection of said cartridge to said tubular member, means for pushing said empty cartridge case toward the tubular member for operative connection therewith for filling thereof by said means for pushing the explosive, the means for moving the pivoted member axially being actuatable after said filling to move the pivoted member away from the tubular mem-

ber to remove the filled cartridge case from the tubular member, means for closing said end after the filled case is so removed and while the means for stepwise turning of the pivoted member is non-operational, means to thereafter remove the closed cartridge case from the pivoted member, all of said means being liquid fluid pressure operated and being automatic and being operatively interconnected for cyclic operation, automatic control devices to carry out said automatic and cyclic operation, said automatic control devices comprising liquid fluid-pressure control conduits operatively connected to said means, liquid fluid-pressure distributor means controlling distribution of fluid pressure to the conduits, pump means to supply said conduits with liquid actuating fluid, prime mover power means for driving said means for filling the case with explosive and for operating said pump and distributor means, said power means being isolated from the cartridge introducing, presenting, filling, closing and removing means.

5

10

15

15. The apparatus defined in claim 14, the fluid being lubricating oil.

References Cited in the file of this patent

UNITED STATES PATENTS

622,711	Render	Apr. 11, 1899
1,346,064	Remmen	July 6, 1920
1,372,009	Davidson	Mar. 22, 1921
1,681,181	Fulton	Aug. 21, 1928
2,355,848	Clark	Aug. 15, 1944
2,356,266	Ogilvie et al.	Aug. 22, 1944
2,381,505	Lindholm	Aug. 7, 1945
2,515,323	Stuart	July 18, 1950
2,601,454	Peone	June 24, 1952
2,811,126	Ford	Oct. 29, 1957
2,822,718	Niepmann	Feb. 11, 1958