Nov. 29, 1949 N. E. MARINER 2,489,428

MAGAZINE FOR MACHINE GUNS

Filed Feb. 21, 1944 5 Sheets-Sheet 1

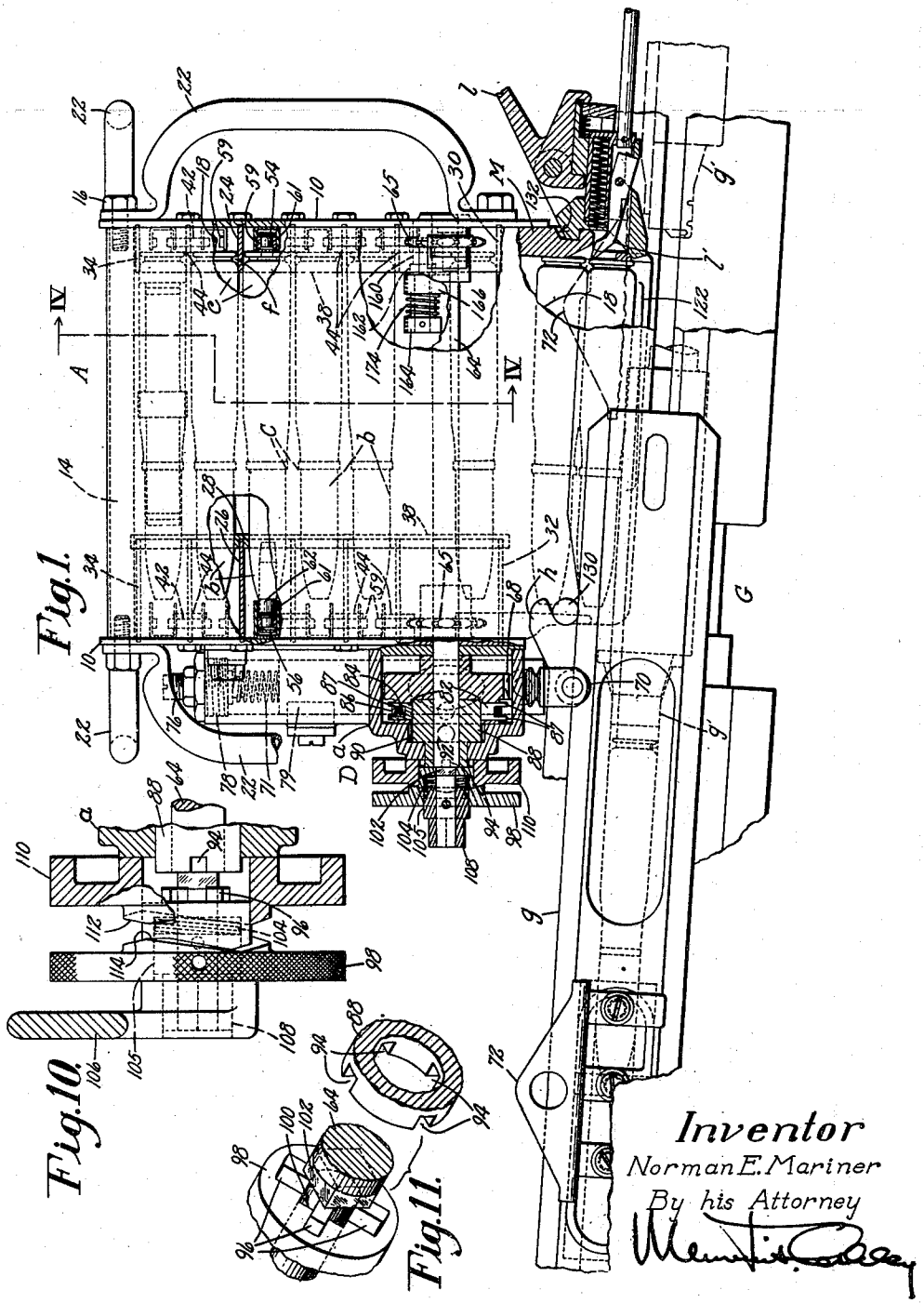


Fig. 1.

Fig. 10.

Fig. 11.

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By his Attorney

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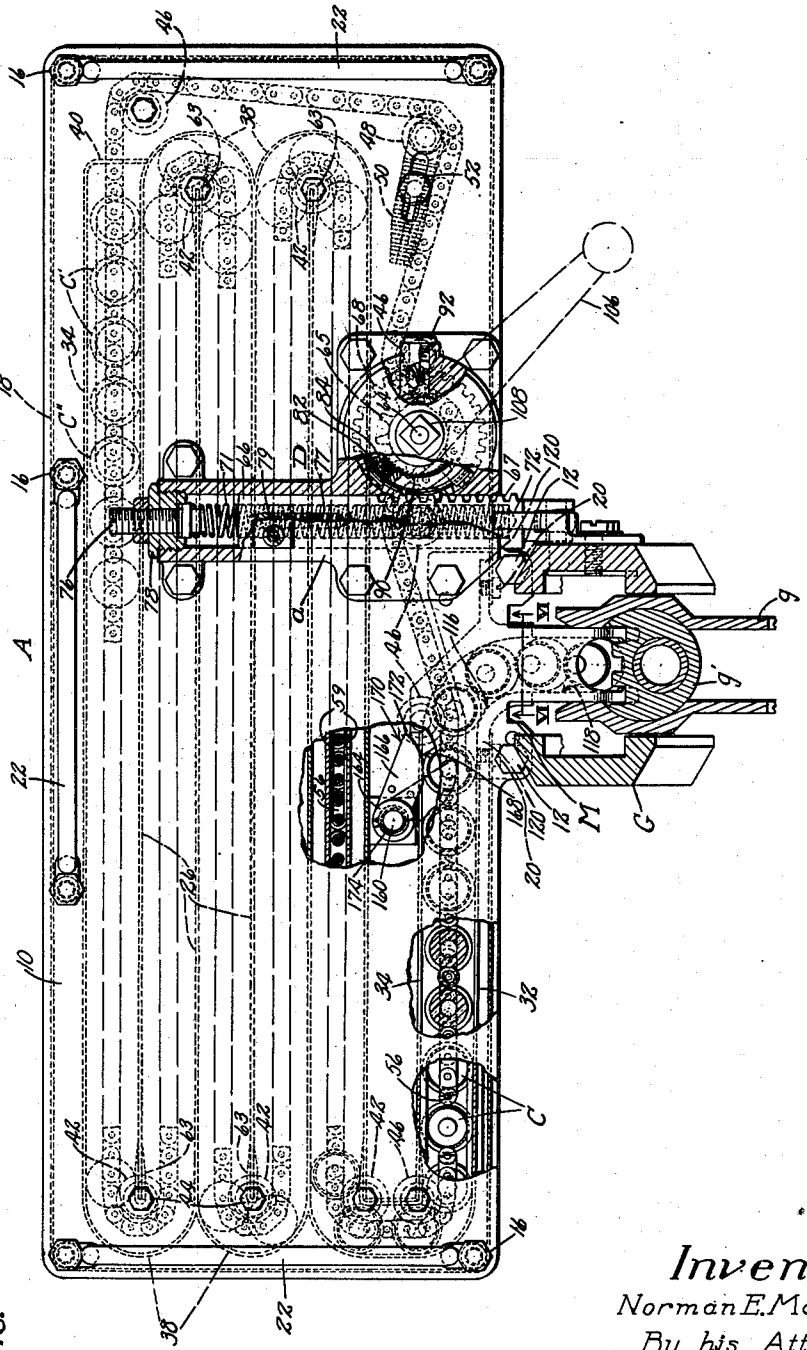


Fig. 2.

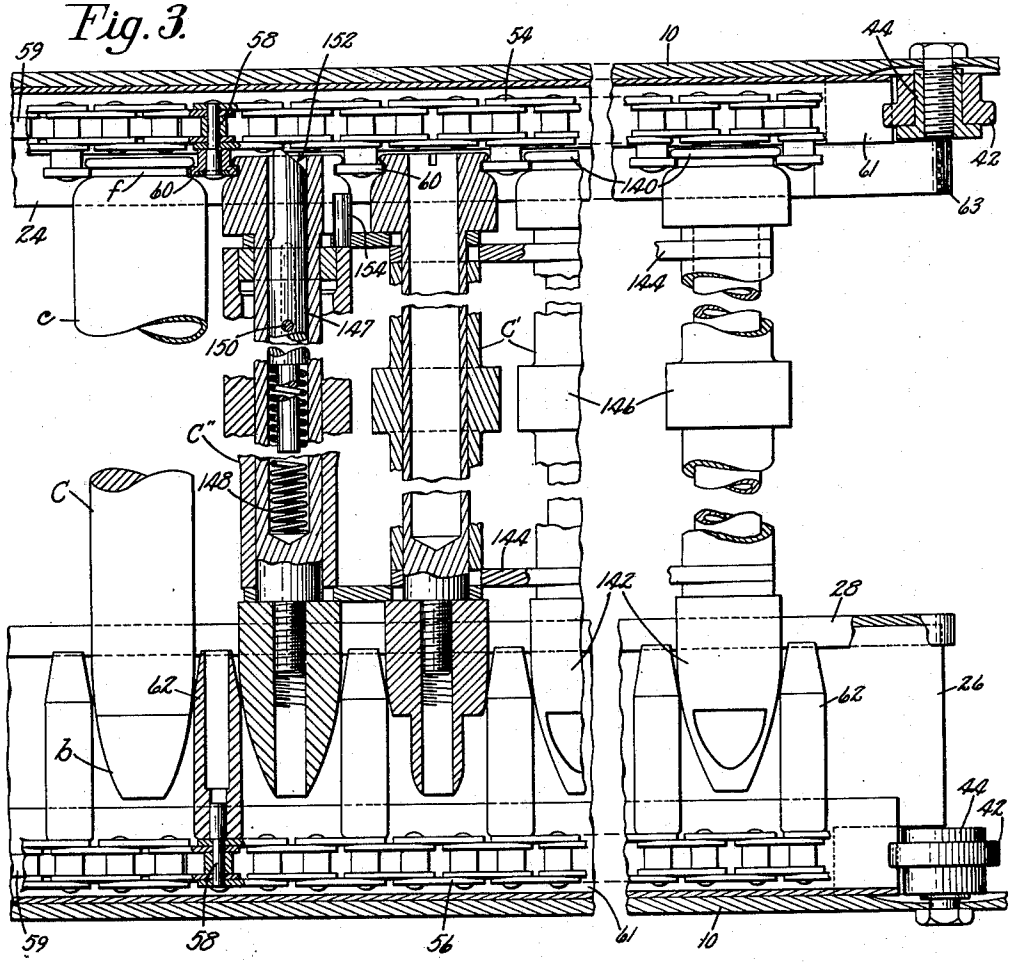
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Fig. 3.



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Fig. 4.

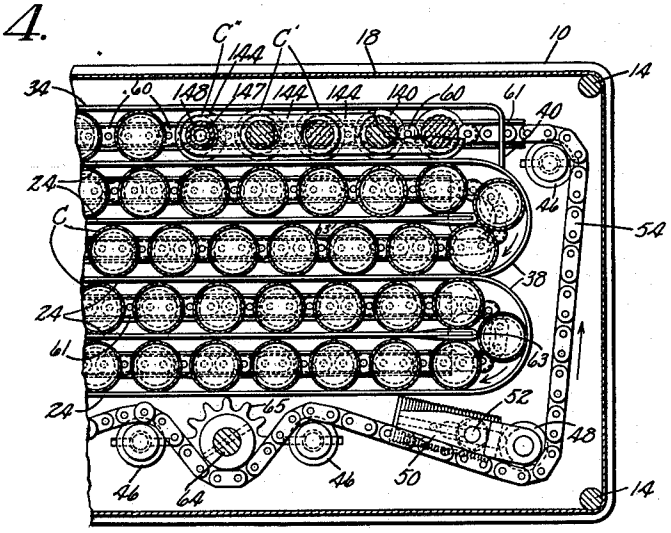
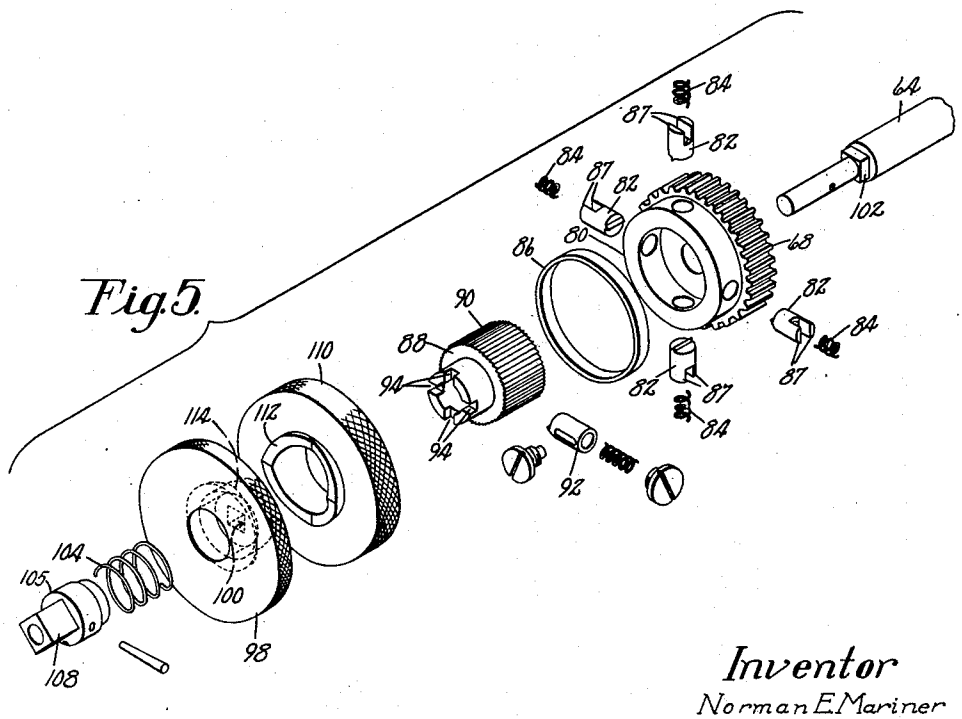


Fig. 5.



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Fig. 8.

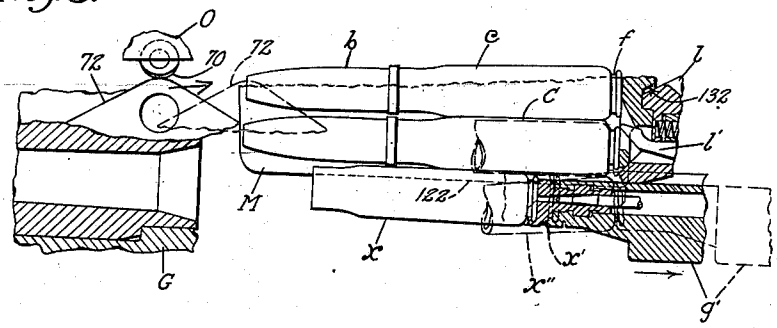


Fig. 9.

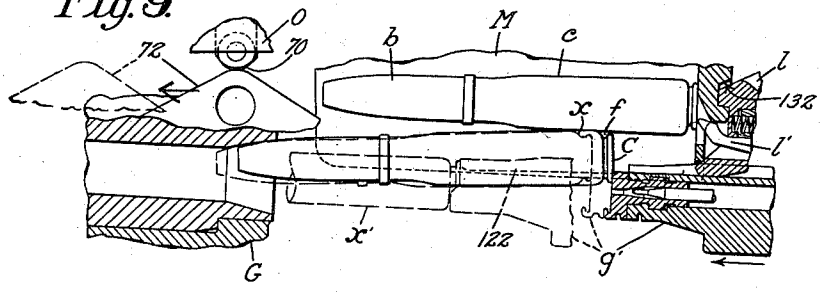


Fig. 7.

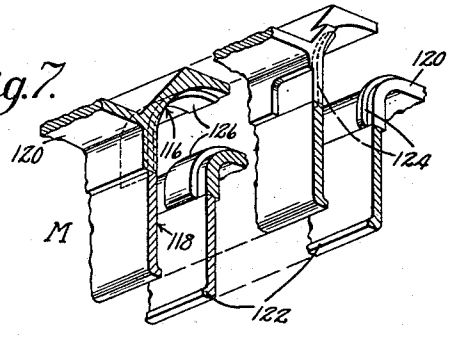
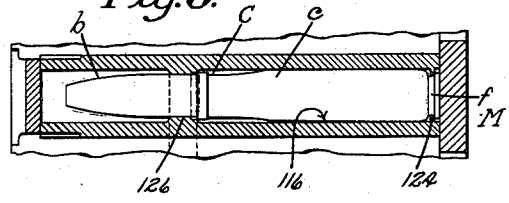


Fig. 6.



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Patented Nov. 29, 1949

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UNITED STATES PATENT OFFICE

2,489,428

MAGAZINE FOR MACHINE GUNS

Norman E. Mariner, Beverly, Mass., assignor to United Shoe Machinery Corporation, Flemington, N. J., a corporation of New Jersey

Application February 21, 1944, Serial No. 523,263

16 Claims. (Cl. 89—33)

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This invention relates to means by which ammunition may be supplied to machine-guns, it being particularly concerned with a magazine which may be mounted on the gun to be fed.

An object of the invention is to present to a gun a relatively large number of cartridges for each loading of the magazine, and to cause their advance to the breech mechanism by simple and compact means, which will facilitate the introduction of the cartridges into the magazine and which will deliver them therefrom accurately and with little resistance to their movement through the magazine and to the operation of the breech mechanism. This object I attain by assembling the cartridges in a casing upon a series of supports, arranged one above another and moving the series of cartridges over successive supports toward or from a delivery-opening in the casing, the direction of movement depending upon whether the magazine is feeding a gun or is being supplied with cartridges. Thus, many cartridges may be arranged in an orderly manner in a quite limited space. Along the supports or shelves, the cartridges are advanced by means preferably consisting of an endless conveyor, which is shown as furnished by chains guided alternately back and forth along the shelves and across a delivery-opening at the bottom of the casing. Through the advancing means a normal force is exerted upon the series of cartridges effective during the greater portion of each period of their advance, thus maintaining their positions in the magazine and, in part, providing for their delivery. The constant or normal force is increased at such predetermined periods as is most effective during the delivery of each cartridge to the gun. This added force may be generated under the power of the gun, as by a cam movable with the breech-block. The actuating means for the conveyor is herein disclosed as a driving member engaging the conveyor, and a normally effective or loaded spring operating gearing from which the power of the spring is communicated, as through ratchet mechanism, to the driving member. My invention also provides stop means co-operating with the conveyor for preventing its loading movement if it fails to receive correctly spaced cartridges; means for ensuring the correct introduction of the cartridges into the mouthpiece for registration with locating means forming a portion of the conveyor; a novel arrangement of dummy-cartridges by which the interlock mechanism of the gun is tripped; and a convenient construction of magazine-casing.

In the accompanying drawings,

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Fig. 1 shows a particular embodiment of my improved magazine in end elevation, attached to the breech-casing of a gun and with parts broken away;

Fig. 2 is a transverse section, taken just in front of the magazine and looking toward the rear, said magazine being in elevation with parts broken away;

Fig. 3, an enlarged broken horizontal section through the magazine, taken above the dummy-cartridges in the upper tier of the magazine;

Fig. 4, a partial section on the line IV—IV of Fig. 1, showing the rear portion of the magazine-casing;

Fig. 5, a separated perspective of the elements carried by the driving shaft outside the casing;

Fig. 6, a horizontal section through the magazine-throat on the line VI—VI of Fig. 2;

Fig. 7, a broken perspective view of the throat;

Figs. 8 and 9, details in sectional elevation illustrating the action of the cam-actuated feeding mechanism upon cartridges during recoil and counter-recoil, respectively;

Fig. 10, an enlarged vertical sectional detail of the clutch mechanism by which the feed-shaft may be turned either manually or under the influence of gun-discharge; and

Fig. 11, an enlarged separated perspective of portions of said mechanism.

A generally cuboidal primary casing A is of a width somewhat greater than the length of the cartridges C, which it is shown as containing, and of a length and height such that the desired number of cartridges, with their advancing means, may be disposed in successive vertical tiers. The elements which furnish the casing or closure are supported upon a mouthpiece M, to be later more particularly described, which is adapted to be mounted upon the breech-casing of a gun G and through which the cartridges are received and delivered. Of the casing elements, horizontally elongated plates 10, 10 form the side-walls, these being attached by screws 12 to opposite ends of the mouthpiece. The plates are stayed and maintained in parallelism by a series of spacers, which may consist of tubes 14, with their ends abutting the inner faces of the plates, clamped in place by screws 15 extending through the plates and threaded into the tubes. To complete the casing by its top, end and bottom walls, a cover-strip 18 of sheet-metal is bent to form over the corner-spacers and attached at its adjacent ends to the mouthpiece by screws 20. Handles 22, by which the casing may be manipulated, are fastened to it by the screws 16 of the

spacers in such locations as are most convenient. Secured to the opposite side-plates 10, as by a welding, are vertical series of parallel horizontal projections 24 and 26, with the ends of each spaced from the ends of the casing and by which series of cartridges are supported in the resulting channels. The projections 24 at one side of the casing serve as shelves, upon which rest the ends of the cartridge-cases *c* just within the grooves *f* adjacent to the primers. The opposite shelves 26 are wider than the shelves 24 and are thickened at their inner edges 28, where rest the bullets of the cartridges, which are of less diameter than the cases. Thus, the longitudinal axes of the cartridges are kept at right angles to the side-walls 10, 10 of the casing transversely of the travel of the conveyor. The lowest pair 30, 32 of the opposite shelves are shorter than their companions, they terminating at the mouthpiece M. The two pairs of projections 34, 34, at the top of the casing and next above the shelves 30 and 32, act only to retain the cartridges below them against upward displacement, rather than as supports. Their special utility is in connection with the loading of the magazine, when it may be inverted. At each extremity of the casing, the ends of the shelves are joined successively to the ones below them by curved cartridge-retaining walls 38, while between one end of the upper projections 34 and the shelves 24 and 26 immediately below them are walls 40 closing the upper channel to the passage of cartridges.

To advance the cartridges from the channels furnished by the casing-projections for successive delivery through the mouthpiece M to a gun G, a conveyor is provided. At each side of the casing A at alternate ends of the intermediate shelves and at both ends of the lower projections 34, guide-rolls 42 are rotatable about studs 44 set in the casing-plates 10. These rolls are so located that they direct the conveyor which they guide alternately in opposite directions along the shelves 24, 26 and 30, 32. Beyond both the lower and upper projections 34 at one end of the casing, are similarly mounted rolls 46, the upper rolls lying in a vertical space between the shelves 24, 26 and the casing-wall. These guide the conveyor into co-operation with driving mechanism D, hereinafter described, and finally to the top of the casing above the upper shelves 24 and 26. Another pair of rolls, designated as 48, turn upon blocks 50, and may be clamped, by screws 52 extending through the sides of the casing, in different positions inclined downwardly and outwardly to serve as tightening means. Over the rolls, along a path which appears in Fig. 2 of the drawings, operate two endless sprocket-chains 54 and 56 furnishing the cartridge-conveyor. From the chain 54 at appropriate intervals, the pins 58 joining the links are extended inwardly (Fig. 3), and have rotatable upon their inner extremities flanged rolls 60 of such diameter and so spaced as to enter the grooves *f* in the cartridge-cases. The connecting pins 58 of the opposite chain 56 carry cylindrical tubular extensions 62 with reduced ends inclined oppositely to the tapering ends of the bullets *b* of the cartridges. These extensions are so related to the opposite rolls 60, that they act with them to maintain the longitudinal axes of the cartridges equally spaced, parallel to each other, and at right angles to the chains. The engagement of the roll-flanges with the case-grooves positions the cartridges definitely, longitudinally of their axes. The horizontal runs of both chains are guided and held against sagging by channel-strips 61, with their webs attached to the side-walls 10 and their flanges extending inwardly. Projections 59 from the channel-flanges lie between the opposite links of the chains to hold these against lateral movement. When the cartridges are carried from one level to another, retained against outward displacement by the curved walls 38, they loose the support of the shelves 24 and 26. To prevent their inward displacement at these points from their parallel relation, the narrowed portion 63 of each shelf 24, where it extends along the guide-roll 42, is thickened (Figs. 2 and 3) to give a rounded end with which the cartridges may contact as they are transferred. This thickened portion reaches far enough inwardly to reinforce the weaker narrow end.

The chains 54 and 56 are advanced to feed the cartridges in the magazine through the mouthpiece M into the gun G by the motor or driving mechanism D. The gun, as represented, is of the well known Oerlikon type, of which no description is necessary. The driving mechanism is carried by a secondary casing *a* attached to the front plate 10 of the primary casing A, just at one side of the mouthpiece. Into the casing *a* extends a driving shaft 64, journaled at opposite sides of the primary casing. To the shaft, within the casing A, are fixed sprocket-wheels 65, 65, one of which meshes with each of the chains between two of the rolls 46, 46 beyond the lower casing-projections 34. These rolls are so situated that the chains are held in engagement with arcs of the peripheries of the sprocket-wheels of considerable length. Guided in a cylindrical upward extension of the casing *a* is a tube 66, upon the side of which are rack-teeth 67 meshing with a gear 68 within the casing *a* and rotatable about the shaft 64. The rack extends below the casings *a* and A, and has rotatable upon its lower extremity a roll 70. This roll is forced down by an expansion-spring 71 into the path of a cam-projection 72 upon one of the breech-bars *g*, movable with the breech-block *g'* of the gun. The lower end of the spring rests upon the closed bottom of the tube 66, while the upper end abuts against a screw 76 threaded through a plug 78 closing the top of the casing-extension. By altering the position of the screw, there may be attained a varying normal load applied by the spring to the rack. This phrase "normal load," as employed throughout the specification, is to be understood to mean that predetermined or initial load placed upon the spring 71 through its compression, produced by the position of the screw 76, unmodified by the action of other elements of the mechanism. Through predetermined limited periods, action of other elements of the mechanism augments the normal load by increasing the total load on the spring to a maximum load to give special effects. The force exerted by the spring under the normal load may vary slightly because of the expansion of said spring in causing movement, but this decrease in force is too small to require consideration in connection with the present invention. To limit the downward movement of the tube and to hold it against turning, it has a longitudinal slot 77 into which extends a key 79 fixed to the casing *a*. At the outer side of the gear 68 is a tubular hub or extension 80 (Fig. 5), through which are four equally spaced radial passages, each containing a plunger-pawl 82 backed by an expansion-spring 84 abutting against the circular band 86 surround-

ing the gear-extension. Each pawl is divided at its outer end, and between these spaced projections 87 the band lies. This retains said band in place, and also holds the pawls against rotation about their axes. Rotatable about the shaft 64 within the extension 80, is a sleeve 88 having peripheral ratchet-teeth 90 which the pawls 82 engage. These pawls and ratchet-teeth are so arranged, that when the rack 67 is raised by the cam 72 and the gear 68 is turned thereby, the spring 71 is compressed and fully loaded, but the pawls move idly over the ratchet-teeth so the sleeve 88 remains at rest. When the cam releases the rack, the pawls become effective to rotate the sleeve under the influence of the spring. During the upward movement of the rack, rotation of the sleeve as the pawls travel over it is prevented by a spring-pressed detent 92, movable in the casing *a* and engaging the ratchet-teeth 90 outside the gear-extension 80.

It is desired either to make the spring mechanism effective to turn the shaft 64, thereby advancing the conveyor-chains 54 and 56 to feed to the gun the cartridges which they engage, or to disconnect said spring mechanism, so the travel of the chains may be reversed manually during the loading of the magazine. For this purpose the reduced outer end of the sleeve 88 has pairs of opposite depressions 94, 94, which may receive pairs of projections 96, 96 upon the inner extremity of a collar 98, surrounding the shaft 64 and having an opening 100 fitting about an angular shoulder 102 upon said shaft outside the sleeve. An expansion-spring 104, interposed between the collar and a sleeve 105 fast upon the outer end of the shaft, tends to seat the projections in the depressions and the opening about the shoulder. The collar has a knurled flange, which may be grasped to shift said collar outwardly beyond the end of the shoulder, with the projections 96 withdrawn from the depressions 94, and then turned about its axis until the collar-opening is out of registration with the shoulder 102. The spring 104 now holds the collar against the end of the shoulder, disengaged from the sleeve. With the collar released from the shoulder and the projections 96 held by the spring 104 in the depressions 94, the force which the spring 71 applies to the rack 67 will be communicated through the gear 68, its extension 80, the pawls 82, the ratchet-teeth 90 and their sleeve 88 with its depressions 94, the collar 98 and its projections 96, to the shoulder 102 of the shaft 64, and thus to the sprocket-wheels 65 and the chains 54 and 56. This is as appears in Fig. 1, the driving mechanism D being prepared for the delivery of the cartridges from the magazine. With the collar-opening 100 withdrawn from the shaft-shoulder and its projections from the sleeve-depressions, and turned until the opening and shoulder are out of registration, as shown in Fig. 11, the shaft is freed from the effect of the spring 71 and the intermediate connections. A hand-crank 106 may be applied to the squared end 108 of sleeve 105, and the chains caused to travel freely in a direction opposite to that produced by the spring. Thus the cartridges are caused to advance into the magazine from without for its loading, as they advance oppositely in withdrawal from the magazine under the influence of the spring 71 in the loading of the gun. As applied to the travel in either direction, the word "Advance" has the meaning given by Webster's New International Dictionary—"to make to go on." Because of the force applied by the spring

through the gear 68 and sleeve 88 to the collar 98, it may be difficult to withdraw the collar-projections 96 from the sleeve-depressions 94. To facilitate this operation, there is shown as interposed between the inner side of the collar-flange and the side of the casing *a* about the sleeve, a disk 110 of considerable diameter. The engaging surfaces of the disk and casing are plane, but at the other side the disk has cam-projections 112, which may lie within similarly formed depressions in the collar when the collar-projections engage the sleeve-depressions, or may be turned against co-operating projections 114 upon the collar. The camming effect exerted through the large disk is sufficient to overcome the resistance to withdrawal of the collar-projections from the sleeve-depressions without undue effort. After this, a completion of the movement of the collar may easily be effected.

The mouthpiece M is at the center of the casing A, so the weight at opposite sides of the gun is in substantial balance, and rests at its opposite sides upon the top of the breech-casing of said gun. It has an upper cartridge-receiving passage 116 within the casing and at which the lower magazine-shelves 30 and 32 terminate, and a delivery-passage 118 into which the receiving passage merges and which extends downwardly for entrance into the breech-casing close to the path of the breech-block *g'*. The stated relation of the cartridge-receiving and -delivering passages applies to the feed of the gun. For loading the magazine, this relation is reversed. The passages are of a length transversely of the magazine and of a width sufficient to allow the travel of the cartridges through them. The upper wall of the passage 116 is cut away at each side to receive the chains 54 and 56. From the opposite sides of the junctures of the two passages, extend horizontal portions 120, 120 to which the cover-strip 18 of the casing A is attached. Upon each side of the lower delivery-opening of the mouthpiece from the passage 118 is a lip or flange 122, extending from points near the rear of the magazine, part way toward the barrel-end and being inclined downwardly and forwardly. These lips support the terminal-cartridge delivered by the chains and pressed against them by the driving mechanism D, while through the forward space beyond the lips the terminal-cartridge is carried by the breech-bolt for introduction into the gun-barrel. In the loading of the magazine, the cartridges are introduced successively through the space, thrust back upon the lips and then up through the passages 118 and 116 for engagement with the projections 60 and 62 of the chains. It is necessary that the groove *f* at the primer-end of each cartridge shall be in position, as it leaves the passage 116, to receive the flanges of each of the advancing chain-rolls 60. This is ensured by forming upon opposite sides of the passage projecting ribs 124, 124 (Figs. 6 and 7), of such dimensions as to enter the grooves in the cartridge-cases and in registration with the groove-engaging flanges of the rolls. Further, to compel the forcing of the cartridge back upon the lips until its groove is alined with the ribs 124, the opposite sides of the passage 116 have a second pair of ribs 126, 126. These are of a size and so placed that the only part of the cartridge which can pass between them is the bullet *b*, beyond the rotating band. Only if the cartridge is properly related to the ribs 126, and therefore to the ribs 124, can it be forced up into the passage 116 for correct engagement by the chains and

travel with them through the magazine. The mouthpiece also has means for separably securing the magazine to the gun. From the forward extremity of each side of the mouthpiece, a pin 130 projects to be received beneath a hook *h* upon the top of the breech-casing. At the rear, the mouthpiece is provided with a depression 132 for engagement by the usual latch-lever *l* pivoted upon the breech-casing. With the latch-lever is associated the usual lever *l'* and other elements of the interlock mechanism of the Oerlikon gun, which maintains it charged after the last cartridge in the magazine has been fired. The counter-recoil-spring is thus held in its compressed relation, while the magazine is being removed from the gun to receive its supply of cartridges. Upon release of the cartridges C by the projections on the conveyor-chains 54 and 56 and their descent into the mouthpiece, the tapering form of their cases *c* causes them to assume positions inclined downwardly at their bullet-ends. To compensate for this, and to maintain the force of the conveyor upon the entire series of cartridges, thus holding the terminal-cartridge firmly upon the lips 122 of the magazine, the surfaces of the mouthpiece to which the plates 10, 10 of the casing A are attached are inclined upwardly and forwardly. This correspondingly inclines the entire casing, so that as the cartridges are released by the chain-projections to enter the mouthpiece their inclination is substantially that of those in said mouthpiece. Continuity of pressure upon the bullet-ends of the cartridges is thereby assured.

The magazine-chains 54 and 56 carry permanently such a number of dead or dummy-cartridges C' and C'' (Fig. 3), that the feeding force of the spring 71 will be effectively applied to the last live cartridge to be delivered from the magazine to the gun, as said live cartridge passes through the mouthpiece-passages 116, 118 beyond the direct feeding action of the chains. These dummies have portions 140 and 142 for correct engagement with the chain-rolls 60 and projections 62, respectively, and are joined loosely at their opposite ends by links 144 to form a delivery-unit. Cylindrical enlargements 146 near the centers of the dummies come into engagement with each other, as they enter the mouthpiece and lose the positioning effect of the chain-projections, this ensuring their parallelism and proper feeding effect. The leading dummy C' has means for actuating the interlock-lever *l'*. This consists of a plunger 147 movable within a longitudinal bore and urged outwardly by an expansion-spring 148 interposed between the bottom of the bore and the plunger. Displacement of the plunger from the bore by the spring is prevented by a pin 150 passing through the wall of the dummy into a longitudinal slot in its plunger. Movement of the end of the plunger outside the bore is normally limited by engagement of its inclined end 152, first with the chain 54 and then with the wall of the mouthpiece. When the delivery of the last live cartridge C is completed, the plunger-end has passed beyond the retaining wall of the mouthpiece. Here the end 152 strikes the interlock-lever *l'* and trips it, to keep the gun charged or cocked. A pin 154 projecting from one of the links 144 lies in a depression in the adjacent end of the dummy C'' to maintain the surface at 152 in the correct angular relation about the longitudinal axis of the plunger for its action upon the interlock-lever. When this leading dummy is in interlock-controlling position at the exit of the mouthpiece, the last dummy of the set is still retained between the chain-projections. Consequently, upon reversal of chain-travel for loading the magazine, they are drawn back until what is now the leading dummy strikes the walls 40 and stops the movement.

It is of course important that every space between the cartridge-engaging projections of the conveyor-chains 54 and 56 shall be occupied, when loaded, by the successive introduction of cartridges through the mouthpiece M. To ensure this, a stop device associated with one of the chains prevents inward movement of the cartridges through the action of the crank 106, if a space between the projections has been left vacant. From one of the plates 10 just inside the opening of the mouthpiece-passage 116 and between the lowest shelf 24 and the projection 34 beneath it, a stud 160 extends. This stud has inside the path of the chain 54 a shoulder 162, and to its inner extremity is fixed a collar 164. Arranged to turn upon the stud, just within the shoulder and above the primer-ends of the cartridge-cases acted upon by the chains, is a stop shown as in the form of a plate 166, the under edge 168 of which curves upwardly from the stud above the opening of the mouthpiece-passage 116 to meet the straight upper edge 170 at a point 172. A torsion-spring 174, joined at its ends to the plate 166 and the collar 164, exerts a force urging said plate toward the cartridge-cases passing beneath it. As long as the cartridges are so introduced through the mouthpiece that every space, between the cartridge-engaging projections from the chains moving from right to left in Fig. 2, receives one, the curved edge 168 will ride upon the cartridge-cases, and the point 172 will be held above them. If, however, a space between the projections is unoccupied, the spring will compel the stop-plate to enter said space. Then its point will lie in the path of the next approaching cartridge, arresting the receiving movement of the chains until they have been turned back by the crank and the vacant space supplied. In the opposite or feeding movement of the chains, the stop-plate floats upon the cartridges, it being freely lifted by their engagement with the curved edge 168.

When the magazine is empty, the linked dummy-unit will be within the passages of the mouthpiece M. The leading dummy C'' is at the mouth of the passage 118, in its interlock-tripping position, and the last dummy C' at the opposite end of the unit is still between the chain-projections at the opening of the passage 116. In preparation for loading the magazine, the projections of the collar 98 at the driving mechanism D are withdrawn from the depressions of the sleeve 88, if necessary with the aid of the cam-disk 110, and this disengagement maintained by rotating the collar until it rests against the squared shoulder 102 of the driving shaft 64. The crank 106 is applied to the end 108 on the shaft and turned to cause the lower runs of the chains 54 and 56 to travel from right to left (Fig. 2) over the shelves 30 and 32. As this occurs, the dummies will successively assume their places between the rolls 60 of the chain 54, and the projections 62 of the chain 56. They are followed by live cartridges C, pressed in a continuous series through the mouthpiece-passages between the chain-rolls and projections. The mouthpiece-ribs 124 enter the grooves *f* in the cartridges, registering these with the flanges of the chain-rolls 60, and the ribs 126 compel the co-operation with the grooves of

the ribs 124. If there is failure to maintain the continuity of supply, the plate 166 engages the first cartridge following the vacant space, compelling the travel of the chain to be reversed and the cartridges correctly introduced into the mouthpiece. This continues until the magazine has received its full supply of, say, one hundred cartridges. This condition is made evident by the stopping of the travel of the chains because of the contact of the leading dummy C' with the walls 40 at the ends of the upper shelves 34 and 36. It is to be noted that the only manual force exerted directly upon the cartridges in loading, is that necessary to carry the short series through the mouthpiece into the receiving spaces of the chains. All other force is applied with little effort through the ample leverage furnished by the crank. In this loading, since the cartridges are held positively in parallelism by the engagement of the chain-projections, they cannot be displaced from this relation to cause clogging. With the magazine thus supplied, and the collar 98 turned to free it from the shoulder 102 of the shaft, the collar-projections enter the depressions in the sleeve 88. The crank is turned in the opposite direction to bring the terminal-cartridge against the mouthpiece-lips 122 and the rack 66 is raised manually so there is created a load applied by the spring 71 to the conveyor-chains 54 and 56 to hold the terminal-cartridge under relatively light pressure, ready for delivery. This pressure is exerted through the gearing 67, 68, and ratchet mechanism 82, 90 and the clutch 94, 96. The crank is removed and the magazine is ready for application to the gun.

For the active use of the magazine, the spaced portions 120 of the mouthpiece M are placed upon the top of the breech-casing of a gun G with the lower extremity of the passage 118 receiving the top of the breech-block g'. It is there secured by its projections 130 beneath the hooks h and by the latch-lever l of the gun. The action of the magazine upon the cartridges in the discharge of the gun is illustrated in Figs. 8 and 9 of the drawings. Considering the recoil of the breech-block, it will be seen in Fig. 1, that initially the cam 72 in its forward position is separated by a substantial space from the roll 70 of the driving mechanism D. There is consequently placed by the chains 54 and 56 upon the series of cartridges in the magazine only the pressure produced by the normal load upon the spring 71. This, which has been sufficient to hold the leading cartridge C in place against the mouthpiece-lips 122 ready to receive the action of the breech-block, is now urging the cartridge against the top of said breech-block, it causing relatively slight resistance to the movement of withdrawal of the empty cartridge-case x from the barrel of the gun as the breech-block recoils. This is as represented in full lines in Fig. 8. At a point indicated by the primer-end of a cartridge x', the cam 72, in its full-line position in Fig. 8, has reached the roll 70, and raised the rack 66 to apply to the spring 71 its full maximum load. Immediately thereafter, the forward tapered upper surface of the breech-block comes into engagement with the cartridge C, and the force of the loaded spring is utilized until the cam has reached the dash-line position, this lowering the cartridge through the space above the breech-block taper onto the lips 122 of the mouthpiece. As the breech-block approaches the dash-line position, the empty cartridge-case, now indicated at x'', is being acted upon by the ejecting mechanism of the gun, and the pressure upon it of the next descending cartridge aids in its discharge. During the remainder of the recoil of the breech-block, the normal force of the spring 71, as determined by adjustment of the screw 76, acts to hold the leading cartridge C upon the magazine-lips, ready for the counter-recoil. The action upon counter-recoil is represented in Fig. 9. The cam 72 has passed to the rear of the roll 70 in its recoil, and is shown in its full-line position as having reached the roll in its return and loaded the spring 71 to its maximum. During the travel of the cam to its dash-line position, the maximum spring-load is placed upon the chains of the magazine to lower the cartridge, as indicated in dash-lines at x, as the breech-block continues to push it along the lips 122. This maximum pressure upon the cartridge is also available to urge it down, as will be seen at x', with the flange at the primer-end fully seated in the lips of the face-piece. The breech-block is here shown in dash-lines. At this point the passage of the cam beyond the roll leaves only the normal force of the spring 71 upon the magazine-chains, this being utilized to maintain the succeeding cartridge in the magazine in contact with the breech-block of the gun.

With continued pressure of the trigger upon the gun, the delivery from the magazine, as above described, continues automatically until the live cartridges are exhausted. At this time, the dummy C'' reaches the delivery-opening of the mouthpiece M, and its plunger 147 trips the interlock mechanism of the gun to hold this cocked. The magazine may now be released from the gun by actuating the latch-lever l and removed to receive its supply by cartridges, as already described. It should be observed, that in the feed of the cartridges from the magazine, there is applied to them, throughout the greater part of the feeding cycle, an advancing effect which is varied in accordance with the work to be done. The normal or minimum force of the spring 71 is utilized when this is adequate and increased under the power of the gun during both the recoil and counter-recoil, when the application of a greater force is more effective. Wear and resistance to movement of the breech-block are thus lessened. There is no spring to be loaded manually during the filling of the magazine and no necessity for considering the magnitude of the load for varying numbers of cartridges. The spring employed is small, and the bulk and cost of the magazine are therefore decreased. During both loading and feeding, the resistance of the cartridges to movement through the magazine is minimized, because there is absent the friction resulting from contact with one another. There is a further decrease in friction because the cartridges may turn between the chain-projections in their travel, this being facilitated by the presence of the rotatable chain-rolls 60. The cartridges being held in definitely spaced relation at both ends by the chain-projections, they cannot become displaced and thereby cause jamming.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A cartridge-magazine comprising a casing having opposite side walls and provided in its lower portion with an opening through which the cartridges may pass, a vertical series of shelves fixed to each of the opposite side walls and being arranged in pairs with the shelves of each pair spaced from each other transversely

of the casing and thus arranged for engagement with the ends only of horizontal series of cartridges, and an endless conveyor arranged to travel in engagement with successive series of the cartridges while leaving said cartridges free for movement upon the shelves.

2. A cartridge-magazine comprising a casing having opposite side walls and provided in its lower portion with an opening through which the cartridges may pass, a vertical series of shelves fixed to each of the opposite side walls and being arranged in pairs with the shelves of each pair spaced from each other transversely of the casing and thus arranged for engagement with the ends only of horizontal series of cartridges, and an endless conveyor arranged to travel along the shelves of each of the side walls and provided with portions arranged to engage one of the ends of each cartridge to advance it along the shelves while permitting it to rotate about its longitudinal axis.

3. A cartridge-magazine comprising a casing having opposite side walls, a vertical series of shelves fixed to each of the opposite side walls and being arranged in pairs with the shelves of each pair spaced from each other transversely of the casing and thus arranged for engagement with the ends only of horizontal series of cartridges, and an endless conveyor arranged to travel in engagement with successive series of the cartridges while leaving said cartridges free for movement upon the shelves, the casing having a mouthpiece at which one of the pairs of shelves terminates and to which the conveyor delivers the cartridges to fall by gravity for utilization.

4. A cartridge-magazine comprising a casing provided with an opening, a series of shelves projecting from opposite sides of the casing and upon which the cartridges may rest, endless conveyor means movable in opposite directions along successive shelves in engagement with the cartridges to effect their travel over said shelves, and means, associated with the shelves farthest removed from the casing-opening for limiting the movement of the cartridges into said magazine in the direction of cartridge introduction from said opening and through which limiting means the cartridge-engaging means passes.

5. A cartridge-magazine comprising a casing provided with a mouth-piece having a passage and extending into the casing and upon which mouthpiece said casing rests, a series of cartridge-supports arranged one above another in the casing with the lowest supports in the casing terminating at the mouthpiece, an endless conveyor movable along the supports, and means arranged to move the conveyor alternately in opposite directions along the supports and from the lowest supports through the wall of the mouthpiece, thereby to introduce cartridges into or deliver them from the casing.

6. A cartridge-magazine comprising a casing, two series of shelves projecting in alined pairs from opposite sides of the casing with the shelves of each pair spaced from each other so that only the ends of the cartridges may rest upon them, two series of rolls rotatable at opposite sides of the casing and at opposite ends of the series of shelves, an endless chain movable over each series of rolls and along the shelves and having projections engaging the ends of the cartridges loosely to cause them to roll upon the shelves while traveling thereover, and means for advancing the chains.

7. A cartridge-magazine comprising a casing,

a series of shelves projecting in alined pairs from opposite sides of the casing with the shelves of each pair spaced from each other so that only the ends of the cartridges may rest upon them, rolls rotatable at opposite sides of the casing and at opposite ends of the shelves, cartridge-retaining walls joining the ends of the shelves outside the rolls and within the casing, endless chains movable over the rolls along the shelves and retaining walls and having projections for engagement with opposite ends of the cartridges, and means for advancing the chains.

8. A magazine for cartridges having grooves at the primer ends comprising a casing, a series of shelves projecting from opposite sides of the casing and upon which the ends of the cartridges may rest, rotatable rolls attached to each of said opposite sides of the casing and located at the opposite ends of the shelves, endless chains movable over said rolls and thence along the shelves, the chain at one side of the casing having rolls entering the grooves at the primer-ends of the cartridges and the chain at the opposite side of the casing being provided with projections extending between the bullets of said cartridges, and means for advancing the chains.

9. The combination with a machine-gun provided with a breechblock movable in opposite directions during a loading cycle, of mechanism for supplying cartridges to the gun and comprising a conveyor movable to advance a series of cartridges toward the gun, an expansion-spring acting upon the conveyor to cause the advance of the cartridges, means effective throughout the loading cycle to compress the spring, a substantially triangular cam movable by the breechblock and having a surface inclined to an apex, and means operated by said cam in its movement by the breechblock for compressing the spring, said cam being inclined from the apex to permit the force thus stored in the spring to be applied to the conveyor.

10. A cartridge-magazine comprising a casing provided with a mouthpiece, a conveyor guided to travel in the casing and having means by which cartridges introduced through the mouthpiece are maintained in spaced relation, and means arranged to enter a space in the conveyor which has failed to receive a cartridge and to contact with a cartridge in the conveyor thereby to prevent movement of said conveyor in the direction of cartridge-introduction.

11. A cartridge-magazine comprising a casing provided with a mouthpiece, a conveyor guided to travel in the casing and having spaced portions for engagement during the travel of the conveyor with successive cartridges introduced through the mouthpiece, and a member at the opening of the mouthpiece into the casing mounted within the casing for movement by the introduced cartridges and with the end toward the mouthpiece movable between the spaced portions of the conveyor from between which portions the cartridge is missing and arranged in said movement to contact with a cartridge in the conveyor, thereby to prevent movement of said conveyor in the direction of cartridge-introduction.

12. A cartridge-magazine comprising a casing provided with a mouthpiece, a conveyor guided to travel in the casing in either of two directions and having spaced portions for engagement during the travel of the conveyor with successive cartridges introduced through the mouthpiece, and a stop member at the opening of the mouth-

piece into the casing for the conveyor movable between the spaced portions from between which portions the cartridge is missing, said stop member being arranged for engagement with the cartridges in the conveyor, thereby to prevent travel of the conveyor in the direction of cartridge-introduction but permitting movement in the opposite direction.

13. A cartridge-magazine comprising a casing provided with a mouthpiece, a conveyor guided to travel in the casing and having spaced projections for engagement in the travel of the conveyor with successive cartridges introduced through the mouthpiece, a stop pivoted upon the casing at the opening of the mouthpiece into said casing and having a portion receiving contact of the cartridges to hold it above their path and another portion movable into said path if a cartridge is missing and arranged for engagement with the succeeding cartridge in the conveyor to prevent the introduction of said cartridge into the casing.

14. A cartridge-magazine comprising a casing, an endless conveyor guided to travel in the casing as a permanent part of the magazine and having locating means by which the cartridges introduced into the casing are maintained in spaced relation and in definite longitudinal positions, and a mouthpiece for the casing arranged to receive the cartridges one by one and deliver them successively to the conveyor to assume thereon their spaced relation, said mouthpiece having means which compels the registration of the cartridges with the longitudinal locating means of the conveyor.

15. A magazine for cartridges having cases provided with grooves at the primer-ends comprising a casing, a conveyor guided to travel in the casing and having cartridge-spacing projections which include portions entering the grooves in the cartridge-cases at the primer-ends, and a mouthpiece for the casing through which the cartridges are introduced, said mouthpiece having a projection entering the case-grooves and registering with the groove-entering portions of the conveyors.

16. A magazine for cartridges having cases provided with grooves at the primer-ends comprising a casing, a conveyor guided to travel in the casing and having cartridge-spacing projections which include portions entering the grooves in the cases at the primer-ends, and a

mouthpiece for the casing through which the cartridges are introduced, said mouthpiece having a projection entering the case-grooves and registering with the groove-entering portions of the conveyors and a second projection preventing the advance of the cartridges through the mouthpiece unless their grooves are alined with the first-mentioned projection.

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