July 15, 1958 J. E. CHAPMAN ET AL 2,843,021

AMMUNITION BOOSTER WITH TORQUE LIMITING DEVICE

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Fig. 1.

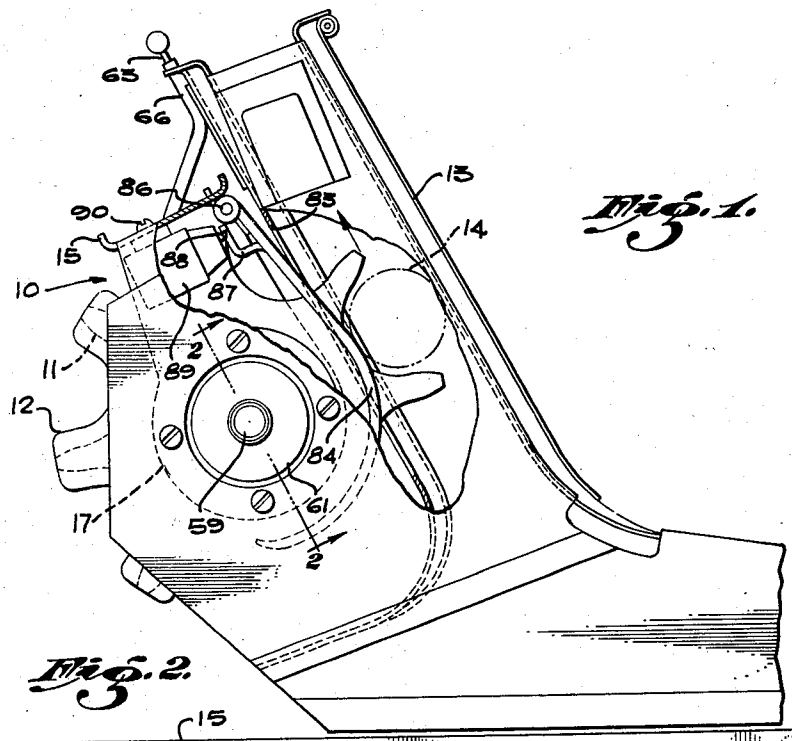

Fig. 2.

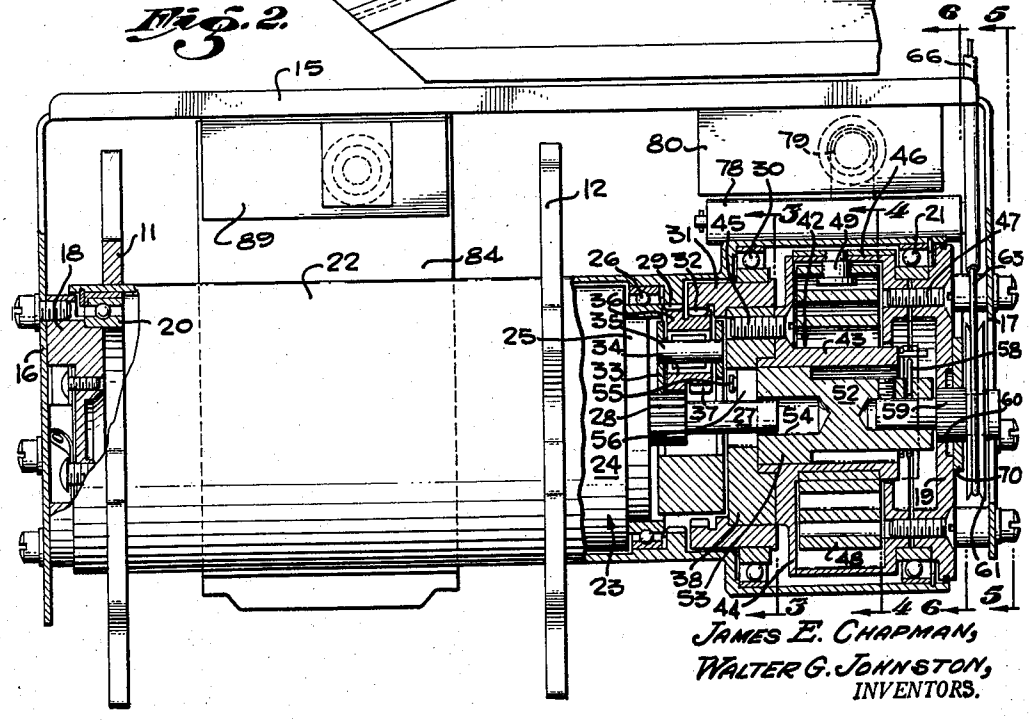

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Fig. 3.

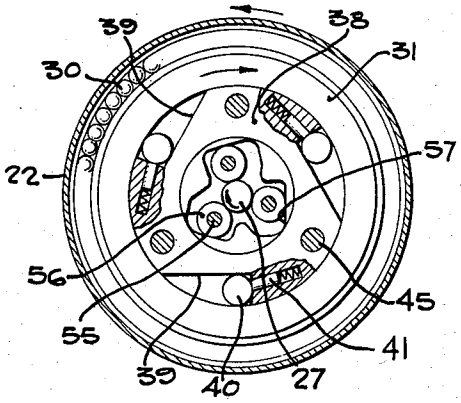


Fig. 4.

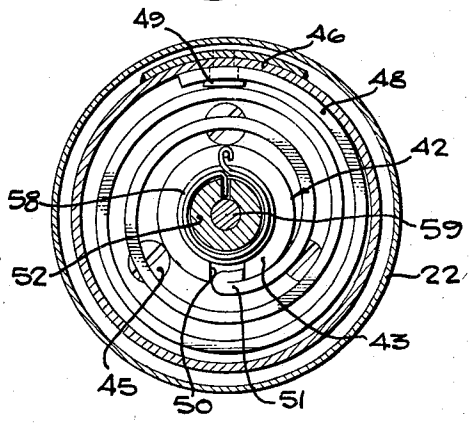


Fig. 5.

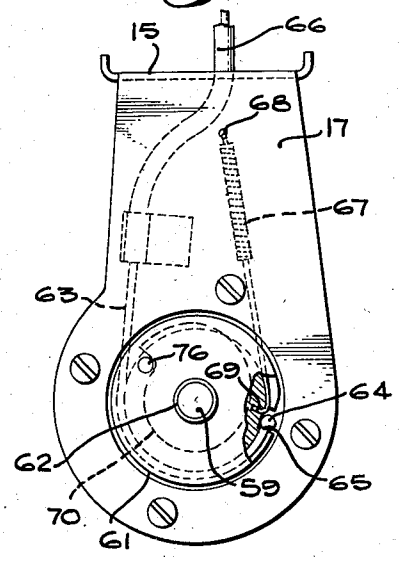
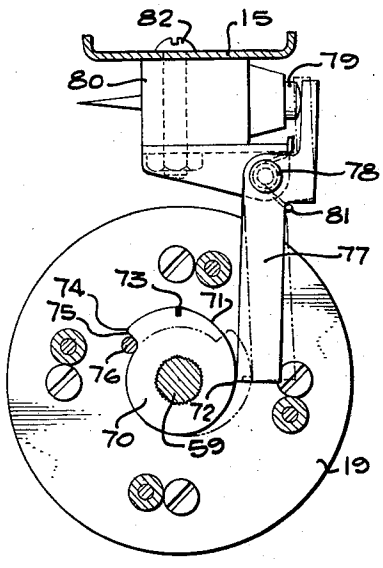


Fig. 6.



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AMMUNITION BOOSTER WITH TORQUE LIMITING DEVICE

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Application December 1, 1952, Serial No. 323,402

8 Claims. (Cl. 89—33)

The present invention relates generally to an ammunition feed booster for augmenting the feed of ammunition in the form of belts of linked cartridges, or other arrangements wherein the cartridges are successively fed to rapid fire guns, such as machine guns or the like.

It is one object of the herein described invention to provide an improved ammunition booster which incorporates novel means for utilizing the torque reaction forces or countertorque developed in the driving mechanism of the booster, by belt-feeding operation, for controlling the operation of the booster driving power means so as to stop the feed of ammunition when the gun stops firing, or may become jammed.

A further object is to provide in connection with an ammunition feed booster, unique means associated with the moving cartridge belt for positively controlling the power means operation, so as to stop the power means as the last cartridge moves off the belt feeding sprocket.

Another object of the invention resides in the provision of a countertorque device of such character that energy may be stored for utilization when the gun starts to fire and the belt moves forwardly in a feeding direction, such energy being available to apply a momentary impulse to the cartridge belt during the starting movement thereof in advance of the actual energization of the power means driving the booster.

Still another object of the present invention is to provide unique anti-roll back release means so as to permit reversed rotation of the booster feed and thus make it possible to withdraw or unload the remaining unfired portion of an ammunition belt from the chute in reverse direction.

It is also an object to provide mechanism of the herein described character which is combined into a compact unitary assembly of such character that it may be mounted within the mechanism housing of the booster and thus protected against the ravages of weather, such as salt spray, dust, humidity, etc.

Briefly stated, the ammunition feed booster of the present invention comprises, in its broad aspect, power means arranged to drive ammunition belt feeding sprockets through a transmission including in this case planetary gearing in which one driving element, such as an orbit or ring gear is supported so that, during the feeding operation, the gear has limited movement in one direction against a spring. The extent of this movement is determined by the spring design and the driving torque reaction force or countertorque developed in the driving means of the booster. As the load increases the driving element moves to further energize the spring. Advantage is taken of this movement, through a suitable motion transmitting connection to actuate a suitable cam or other means for deactivating the power means, which may be accomplished in various ways. For example, the cam may open a switch in the energizing circuit of an electric motor power means.

The utilization of torque reaction means such as briefly described above has the added feature of providing an energized spring which may be utilized to give an initial impulse to the ammunition feed belt, when the gun starts to fire, so as to start the belt feed in advance of actual delivery of power from the power means.

Further objects of the invention will be brought out in the following part of the specification, wherein detailed description is for the purpose of fully disclosing the invention without placing limitations thereon.

Referring to the accompanying drawings, which are for illustrative purposes only:

Fig. 1 is an end elevational view of an ammunition feed booster embodying the present invention, applied to a cartridge belt delivery chute, and having cutaway portions to illustrate details of certain parts of the control mechanism;

Fig. 2 is a longitudinal sectional view of the driving end of the booster, taken substantially on line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view, taken substantially on line 3—3 of Fig. 2;

Fig. 4 is a transverse sectional view, taken substantially on line 4—4 of Fig. 2;

Fig. 5 is an end view of the driving end of the booster, as viewed substantially from line 5—5 of Fig. 2, portions being cut away to disclose certain details of construction of the anti-rollback release mechanism; and

Fig. 6 is a transverse sectional view, taken substantially on line 6—6 of Fig. 2, and showing details of the cam actuated switch means for deenergizing the power means in response to torque reaction forces.

Referring now to the drawings, for illustrative purposes, the present invention is disclosed as embodying an ammunition feed booster mechanism, as generally indicated by the numeral 10, which drives a plurality of peripheral tooth rings or sprockets 11 and 12. These sprockets extend through a suitable opening into a delivery chute 13 so as to engage with cartridges, as indicated in dotted lines by numeral 14 assembled into a conventional belt adapted to be fed through the chute from a storage container to the gun with which the booster is associated. As shown, the cartridge belt feed is in an upward direction through the chute, and, as a consequence, rotation of the sprockets 11 and 12 will be in a counterclockwise direction during the feeding operation.

More specifically, as shown in Fig. 2, the booster mechanism is supported on a cradle frame structure 15 having end legs 16 and 17 to which end caps 18 and 19 are respectively secured in any appropriate manner so as to be retained against movement. These end caps cooperatively form supports for anti-friction bearings 20 and 21 which rotatably support a tubular drum 22 having the sprockets 11 and 12 secured thereto for unitary rotation.

The tubular drum 22, in the portion associated with the sprockets 11 and 12, forms a housing for suitable power means, shown in this case as comprising an electric motor 23 having a stationary frame structure 24 having a reduced end portion 25 which supports another anti-friction bearing 26 which further cooperates to rotatably support the tubular drum 22 at this end of the motor. The rotative structure of the motor 23 includes a stub shaft 27 which carries a suitable driving pinion 28 which forms the sun gear of a compound planetary gear train, subsequently to be described, by which power is transmitted from the power means to drive the drum 22 and associated sprockets 11 and 12 at reduced speed.

Adjacent the driving end of the motor 23, the drum 22 is provided with gear teeth which cooperate to form a first ring or orbit gear 29 of the planetary gear train. Also rotatably supported for relative rotation within the drum 22 by means of anti-friction bearing 30 is a tubu-

lar member 31 which is formed with internal gear teeth so as to provide a second ring or orbit gear 32.

Surrounding the pinion 28, there is provided a conventional spider assembly 33 which rotatably supports a plurality of compound planet gears 34, each of which is rotatable on a pin 35. Each of the compound gears embodies a pair of integral or connected gears 36 and 37, the gear 36 being somewhat larger in this case than the gear 37.

As shown in Fig. 2, a cam member or element 38 surrounds the stub shaft 27 with its outer peripheral face adjacent the inner periphery of the tubular member 31, the periphery of the cam member being provided with a plurality of inclined recesses 39, as shown in Fig. 3 in each of which is disposed a roller 40, the rollers being normally urged toward the shallower portions of the recesses by means of spring actuated plungers 41. These parts coact to form a one-way clutch which in this instance forms a free-wheeling locking means between the cam member 38 and the tubular member 31 which carries the orbit gear 32. It will be noted that the tubular member 31, as viewed in Fig. 3, may be rotated freely in a counterclockwise direction, but when rotated relative to the cam member 38 in a clockwise direction will cause the rollers to move in the same direction in their respective recesses and firmly wedge between the tubular member 31 and the cam member 38 so as to lock these parts together for a purpose to be explained subsequently.

The compound planetary gear train and cam member 38, as thus far described, constitute an arrangement which is similar to the arrangement which has been fully disclosed and described in the copending application of James E. Chapman, Serial No. 74,972, filed February 7, 1949, and now issued as Patent No. 2,757,576 covering Ammunition Feed Booster. In that arrangement, the cam member corresponding to the present member 38 was stationary, and under such circumstances, the operation of the planetary gear train was the same as in the present case, and briefly as follows: When the electric motor 23 is energized, the shaft 27 and driving pinion 28 will rotate in a clockwise direction, as viewed in Fig. 3. At this time, the orbit gear 29 is initially stationary so that upon rotation of the pinion 28, the compound planet gears will be rotated about their respective axes in a counterclockwise direction, and the compound gears caused to revolve in a clockwise direction in an orbit concentric with the axis of the sun gear or driving pinion 28. As a result of this movement, the compound planet gears exert a thrust against the orbit gear 32 in a direction to move the tubular member 31 clockwise and cause the rollers 40 to wedge between the tubular member 31 and the cam member 38. If the cam member 38 is now restrained against clockwise movement, the driving force will be transfererd to the orbit gear 29 and cause it to rotate in a counterclockwise feeding direction.

In the present invention, instead of having the cam member 38 anchored so as to be stationary, it is proposed to mount this cam member so that it will have limited movement and can move against an opposing biasing force under the effect of the torque reaction force or countertorque exerted upon the tubular member 31 during the feeding operation.

An arbor 42 having a tubular hub 43 and a radial end flange 44 is secured to the cam member 38 by means of a plurality of screws 45 which connect the flange portion and support the tubular hub 43 so that it projects concentrically around the axis of rotation of the stub shaft 27. A cupped member 46 is supported by screws 47 from the stationary end cap 19, and cooperates with the tubular hub 43 and radial end flange 44 to provide an annular concentric housing for a coiled spring 48, one end of which is secured by an anchor pin 49 at one end to the stationary member 46, and at its other end to the tubular hub 43. As shown in Fig. 4, the hub 43 is provided with a longitudinally extending slot 50 within which the inner end of the spring 48 is anchored by folding the end of the spring back upon itself as shown at 51, this folded portion being inserted in the slot and held therein by the overlying convolutions of the spring. With the arrangement just described, it will be apparent that the limited movement of the cam member in a clockwise direction will have the effect of winding up this spring which will thus act to oppose the cam rotational movement in a clockwise direction, but permit the cam to move a greater or less amount depending upon the torque reaction forces, for a purpose which will subsequently be explained more fully.

Within the tubular hub 43 of the arbor 42, there is positioned a cylindrical anti-rollback clutch which comprises an elongate cam member 52 having an enlarged head portion 53 containing an end opening socket 54 adapted to receive the end of the stub shaft 27 therein and rotatably support this end of the cam member. The head portion carries a plurality of pins 55, in this case three, which project from its inner face and on which are rotatably mounted clutch rollers 56. These rollers are respectively associated with inclined cam surfaces 57 at the inner periphery of cam member 38, and along which the rollers 56 are adapted to roll. The rollers are also in contact with the outer surface of stub shaft 27. With this arrangement, it will be noted by reference to Fig. 3, that during normal drive in which the shaft 27 rotates clockwise, the rollers will be moved to a position which will enable free rotation of the shaft 27 in a driving direction. However, in the event that the shaft 27 should be rotated in a reversed direction, which would occur during retrogressive movement of the ammunition belt, the rollers 56 are moved by the action of a spring 58, which interconnects the hub 43 and cam member 52, in a direction along the cam surfaces 57 such that they wedge between these surfaces and the periphery of the motor shaft. Reverse movement of the shaft will initially move the cam member 38 in a reversed direction which will tend to unwind the spring 48. This being a heavy spring, the member 38 will only move a slight distance before it acts to prevent reversed movement of the shaft, or anti-rollback. However, the rollers may be released to permit removing a belt in a reversed direction, when necessary, as will later be described.

The opposite end of the cam member 52 carries a shaft extension 59 which projects through an opening 60 in the end cap 19. Adjacent the outer end of the shaft extension 59, a pulley 61 is supported for free rotation and retained against removal by a snap ring 62. Provision is made for rotating the pulley 61 in a clockwise direction by means of a flexible cable 63 which has one end carried over a portion of the grooved periphery of the pulley, this end being anchored by an anchor member 64 which is positioned in a peripheral slot 65 of the pulley. The other end of the cable is carried through a conduit 66 to a convenient point where the operator may manually pull the cable to turn the pulley. Rotation of the pulley in a clockwise direction is opposed by the action of a coiled spring 67, one end of this spring being anchored as shown at 68 to the end leg 17 of the cradle frame. The other end of the spring is provided with a hook 69 which is connected with the bottom of the pulley groove adjacent the anchor member 64.

Between the pulley 61 and the outer face of end cap 19, a cam member 70 is connected to the shaft extension 59, as by a splined connection or other means. As shown in Fig. 6, the cam 70 is illustrated as having a cam lobe 71 which extends from a point 72 of minimum throw to a point 73 of maximum throw. From point 73 to a point 74, the cam radius is of constant value. At the point 74, the cam lobe terminates in an end shoulder 75 which is disposed in the path of movement of a pin 76 carried by the pulley 61. With this arrangement, it will be seen that, although the pulley is freely rotatable on

the shaft 59, rotation of the pulley will actuate the shaft 59 with a rotative movement by acting through the cam member 70. Thus, rotation of the shaft 59 in a clockwise direction will operate to move the clutch rollers 56 to a released position with respect to the motor driving stub shaft 27 so as to permit retrogressive movement of the ammunition belt, when necessary, as previously explained.

Referring again to Fig. 6, a cam follower lever 77 is supported on a pivot 78 for rocking movements. One end of the lever is associated with the cam 70 while the other end is associated with a switch button 79 for operating normally closed contacts of switch assembly 80 to open position, when the button 79 is depressed. The follower lever is normally biased in a clockwise direction by a spring 81. The switch 80 and associated follower lever are supported as a unit from the cradle frame 15 by means of suitable mounting bolts 82.

The contacts of switch assembly 80 are utilized for controlling deactivation of the power means upon the occurrence of a torque reaction force or countertorque above a predetermined value. Under normal operating conditions, the cam member 38 and connected hub 43 together with the cam member 52 and connected shaft 59 form an assembly in which the parts will move about the axis of shaft 59 in unison and assume an angular circumferential position governed by the amount of torque reaction forces. Thus, it will be appreciated that movement of the cam 70 sufficiently to actuate the switch contacts will depend upon the design of the spring 48 which biases the clockwise movement of the cam member 38 under the torque reaction force, as previously explained.

More specifically, the cam 70 is so positioned on the shaft extension 59 that the point 73 will have moved to a position which will open the contacts of switch 80, when the torque reaction force reaches a predetermined value. As an example, let it be assumed that it is desired to deactivate the power means when the torque reaction force corresponds to the application of a cartridge or ammunition belt weight of 90 pounds upon the sprockets 11 and 12. The cam 70 may be adjusted by applying the desired weight to the sprockets 11 and 12. This will act to turn the hub 43 and thus wind the spring 48, movement of hub 43 acting through spring 58 to carry the shaft 59 with it, as previously explained, to a corresponding position in accordance with the applied weight. The point 73 is then positioned in contact with the associated end of the cam follower lever, thus acting to swing it counterclockwise to its extreme position of movement. The switch 80 is then adjusted so that at this position of the cam follower, the button 79 will be in a position to actuate the contacts to their open position. With this adjustment, the power means will be deactivated whenever the torque corresponding with the 90 pound ammunition belt weight occurs. It will be apparent that the cam may be further moved from point 73 to point 74 so as to release the anti-rollback mechanism, without affecting the operation of the switch 80.

The operation of the switch 80 by the movement of cam 70 is also used for controlling the booster in response to stoppage and starting of the belt feed at the gun. For example, when the gun stops firing, movement of the belt at the gun stops. However, the booster motor continues to run and drive the belt, with the result that the torque reaction forces cause the spring 48 to wind up further and at the same time move the cam 70 to a position in which the contacts of switch 80 are opened, whereupon the booster stops with the spring 48 in a stressed condition. Upon resumption of gun firing, the belt is released at the gun for feeding movement. The stressed spring 48 now acts to give the belt a momentary kick or initial impulse which starts boosting the belt feed in advance of actual delivery of power from the booster motor. As soon as the belt feed is started by the gun and with the assistance of the spring 48, the cam 70 moves to a point where it closes the contacts of switch 80 to activate the booster motor.

For controlling the deactivation of the power means, so as to shut-down the power means when the last cartridge leaves the feeding sprockets 11 and 12, control switch means are provided which are activated by the feed belt and the cartridges thereon. As shown in Fig. 1, the chute 13 is provided with a side opening 83 which is adapted to be closed by a trap door 84, which is hingedly supported at one end by a conventional hinge 85 and is normally biased to a position closing the opening 83 by a suitable spring 86. As shown, the free end of the door is curved so that when a belt is in the chute 13, the advancing cartridges will ride over the door and hold it in the position shown.

Adjacent the hinged end of the door, the door is provided with a projection 87 which is cooperatively associated with a switch button 88 for controlling normally open contacts of a switch mechanism 89, this mechanism being supported from the cradle frame 15 by suitable bolts 90. With a belt cartridge, as shown in dotted lines and indicated by the numeral 14, holding the trap door 84 in the position shown, the contacts of switch mechanism 89 will be maintained in closed position. However, when the last cartridge has moved through the chute to a position permitting closure of the trap door by swinging in a counterclockwise direction, the switch button 88 will move outwardly so as to open the switch contacts. By placing these contacts in a suitable control circuit for the power means, the power means may be deactivated as the last cartridge leaves the feed sprockets.

Various modifications may suggest themselves to those skilled in the art without departing from the spirit of our invention, and hence we do not wish to be restricted to the specific form shown or uses mentioned, except to the extent indicated in the appended claims.

We claim:

1. An ammunition feed booster, comprising: a rotatable sprocket; a driving motor having a shaft and an energizing circuit; an element resiliently biased against movement in one direction; transmission means for driving said sprocket and element from said shaft at reduced speed including a first clutch member movable to clutched and non-clutched positions with respect to said element, and in the non-clutched position enabling over-running rotation of said sprocket in feeding direction; a second clutch member associated with said shaft movable to clutched and non-clutched positions with respect to said element, and in the non-clutched position enabling rotation of said shaft in a feeding direction, but in clutched position opposing its rotation in a reversed direction; means normally biasing said second clutch member toward clutched position; a cam connected for movement with said second clutch member in response to movements of said element; means for controlling said energizing circuit including contacts actuated by said cam; and means including said cam for manually moving said second clutch member to non-clutched position.

2. An ammunition feed booster, comprising: a rotatable sprocket; a driving motor having a shaft and an energizing circuit; an element resiliently biased against movement in one direction; transmission means for driving said sprocket and element from said shaft at reduced speed including a first clutch member movable to clutched and non-clutched positions with respect to said element, and in the non-clutched position enabling over-running rotation of said sprocket in a feeding direction; a second clutch member associated with said shaft movable to clutched and non-clutched positions with respect to said element, and in the non-clutched position enabling rotation of said shaft in a feeding direction, but in clutched position opposing its rotation in a reversed direction; means normally biasing said second clutch member toward clutch position; a cam connected for movement

with said second clutch member in response to movements of said element; and means for controlling said energizing circuit including contacts actuated by said cam.

3. An ammunition feed booster, comprising: a cartridge moving member; a driving motor having a shaft and an energizing circuit; a differential planetary transmission driven from said shaft and including first and second rotatably mounted orbit gears, the first of said gears being connected with said member and initially held against rotation by the load on said member, whereupon rotational movement is transmitted to said second gear; a rotatable member; means biasing said rotatable member against rotation in one direction; means activated by the initial movement of said second gear for drivingly connecting it with said rotatable member, whereupon further continued movement of said second gear in the same direction is opposed and terminated by said biasing means depending upon driving torque reaction forces and rotational movement transferred to said first gear to drive the cartridge moving member; and means for controlling said motor including contacts in said circuit having an operating connection with said second gear.

4. An ammunition feed booster, comprising: a cartridge moving member; driving power means having a shaft; a differential planetary transmission driven from said shaft and including first and second rotatably mounted orbit gears, the first of said gears being connected with said member and initially held against rotation by the load on said member, whereupon rotational movement is transmitted to said second gear to drive it in one direction; spring means having a connection with said second gear for resiliently opposing and terminating its rotation in said one direction in accordance with driving torque reaction forces, whereupon rotational movement is transmitted to said first gear to drive the cartridge moving member; and means having an operating connection with said second gear for deactivating said power means in response to a predetermined movement of said second gear.

5. An ammunition feed booster, comprising: power means; ammunition feeding means driven by said power means and including a planetary transmission having a rotatably mounted orbit gear; means for biasing said orbit gear, said means including a spring and limiting movement of said gear upon its being rotated a predetermined extent in one direction under torque reaction forces; and means actuated in response to a further movement of said orbit gear in said one direction under a predetermined increase of the torque reaction forces for deactivating said power means.

6. An ammunition feed booster, comprising: power means; ammunition feeding means including a cartridge advancing sprocket driven by said power means; a gear connected with said feeding means, said gear being movable in one direction by torque reaction forces set up in said sprocket during cartridge feed; a spring actuated by said movement and energized in accordance with said torque reaction force to oppose and limit said gear movement; and means actuated in response to a predetermined movement of said gear for deactivating said power means.

7. An ammunition feed booster, comprising: a chute for feeding cartridges to a position of use, said chute having an opening therein; electro-magnetically driven means having axially spaced sprockets extending into the chute for advancing said cartridges therein, including an energizing circuit; a hinged closure for said opening positioned between said sprockets and having a portion adapted to swing in one direction into said chute, in the absence of advancing cartridges, to one position in the line of travel of cartridges therein, but being moved in an opposite direction by advancing cartridges to another position; and means for controlling said circuit including a switch actuated by movements of said closure to said positions.

8. An ammunition feed booster, comprising: a chute; electric-magnetic power means having an energizing circuit; means actuated by said power means for advancing cartridges along said chute in a feeding direction; means for controlling said circuit including a switch; and an actuating member for said switch extending into said chute in the line of movement of said cartridges, said member acting to maintain said switch in one position of operation so long as it is engaged by advancing cartridges, but operating to actuate said switch to another position of operation upon advancement of the last cartridge out of engagement with said member.

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