A pneumatic drive for an active paintball loader capable of supplying paintballs to a paintball marker at a sufficiently high rate that is coordinated with firing the marker using compressed gas to provide the motive power.
PNEUMATIC PAINTBALL LOADER DRIVE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates generally to a paintball loader and, more specifically, to a pneumatically operated drive mechanism for rotating a drive cone in an active feed paintball loader.

[0003] 2. Description of the Prior Art

[0004] The sport of paintball war games continues to grow in popularity. During these war games, participants shoot frangible plastic balls full of a liquid dye at their opponents. The games are sometimes intensely competitive, requiring a participant to aim a gun, known also as a marker, at an opponent while pursuing, fleeing, dodging, or running for cover. Participants are excluded from further play once they have been hit and marked by a paintball. Success in the game requires the capability to fire a large number of paintballs in a short amount of time. A participant might discharge between several hundred and one thousand or more paintballs during the typical game lasting only a few minutes. Success in the game also requires player agility, which include being able to move run, dive, and roll for cover while carrying the marker.

[0005] Agitating paintball loaders are well known in the art of paintball sports, and operate by having a paintball agitator advance balls from the bottom of a loader into an outfeed tube. Active or force feeding paintball loaders are technologically advanced loaders that use battery-operated motors to forcibly drive paintballs from the loader, into an outfeed tube, and into the breech of a paintball marker. Examples of such loaders can be found in U.S. Pat. Nos. 6,213,110, 6,502,567, 6,701,907, and 6,792,933. As paintball loaders have evolved into electronically controlled devices capable of actively or forcibly feeding increasingly greater numbers of paintballs into a paintball gun, the demands upon the electric storage devices powering such loaders has increased accordingly. One problem now arising in such active paintball loaders occurs when the batteries powering the drive mechanisms become discharged, rendering the paintball loader, and indeed the entire marker, effectively inoperable.

[0006] It would therefore, be a great advantage to provide a paintball marker drive mechanism using a more capable motive power supply. It is also desirable that such a mechanism utilize an energy supply already present in conventional paintball markers.

SUMMARY OF THE INVENTION

[0007] Accordingly, it is an object of the present invention to provide a pneumatic mechanism that uses compressed gas to operate the loader drive mechanism. Paintball markers typically carry substantial volumes of compressed gas in cylinders to supply the paintball marker firing mechanism. The cylinders may be recharged following each paintball game thereby providing an easily replenished source of motive power for both the marker and the loader.

[0008] It is a further object of the present invention to provide a pneumatically driven, active paintball loader capable of supplying paintballs to the marker at least as rapidly as the marker's firing rate. Many modern paintball markers are capable of firing up to 25 paintballs per second. The present invention receives input from the marker firing mechanism causing the drive to advance, moving paintballs to the marker inlet each time a paintball is discharged.

[0009] It is a further object of the present invention to provide a pneumatically driven, active paintball loader capable of supplying a quantity of paintballs to the marker sufficient to allow a participant to continue firing at a high rate for the duration of a paintball war game. A participant might discharge over one thousand paintballs during such a paintball game.

[0010] It is a further object of the present invention to provide a pneumatically driven, active paintball loader offering highly reliable performance. Many paintball games continue for only a few minutes during which time participants discharge thousands of paintballs. A participant with a non-functional marker is quickly "marked" and eliminated from the competition.

[0011] It is a still further object of the present invention to provide a pneumatic mechanism for advancing the drive cone in an active paintball loader that is compatible with a variety of known active loader designs and therefore easily retrofit as an improvement to existing designs.

[0012] It is a still further object of the present invention to provide a pneumatically driven, active paintball loader that is durable in construction, inexpensive of manufacture, carefree of maintenance, easily assembled, and simple and effective to use.

[0013] These and other objects are achieved by providing a pneumatic driver for an active paintball loader capable of feeding paintballs at a sufficiently high rate coordinated with firing the paintball marker using compressed gas to provide the motive power.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The advantages of this invention will be apparent upon consideration of the following detailed description of the invention, especially when taken in conjunction with the accompanying drawings wherein:

[0015] FIG. 1 shows a side view of a typical paintball marker and loader of the type the present invention proves useful;

[0016] FIG. 2 shows a side view of a paintball loader and the present invention;

[0017] FIG. 3 shows an exploded view of a paintball feeder structure in conjunction with the present invention;

[0018] FIG. 4 shows the present invention as it interacts with the feed cone of a typical paintball loader;

[0019] FIG. 5 shows a partial detail view of the preferred embodiment of the present invention;

[0020] FIG. 6 is a schematic diagram showing interaction of the present invention with the firing controls of a typical paintball marker; and

[0021] FIG. 7 is a schematic diagram showing interaction of the preferred embodiment of the present invention with the firing control of a typical paintball marker.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0022] Many of the fastening, connection, processes and other means and components utilized in this invention are widely known and used in the field of the invention described, and their exact nature or type is not necessary for an understanding and use of the invention by a person skilled in the art, and they will not therefore be discussed in
significant detail. Various components shown or described herein for any specific application of this invention can be varied or altered as anticipated by this invention and the practice of a specific application of any element may already be widely known or used in the art by persons skilled in the art and each will likewise not therefore be discussed in significant detail. When referring to the figures, like parts are numbered the same in all of the figures.

[0023] FIG. 1 shows a side elevation view of a typical paintball marker 10, illustrated in phantom, having an attached active feed loader 40 of the type in which the present invention is useful. Paintball marker 10 is a pneumatically-operated gun for discharging paintballs and is well-known in the art. Paintball marker 10 includes a main body 12, a barrel 14, a compressed gas supply cylinder 30, a front handgrip 18, and a rear handgrip 19. The front handgrip 18 projects downwardly from the barrel 14 and, along with rear handgrip 19, provides areas for gripping by an operator of the paintball marker 10. Paintball marker 10 also includes an inlet opening 16 leading to a firing chamber (not shown) in the interior of the main body 12 and a trigger 20. The firing chamber also opens to barrel 14 through which projectiles, paintballs 100 in the preferred embodiment, are propelled. The compressed gas cylinder 30 is typically secured to a rear portion of the paintball marker 10. Compressed gas is supplied to the marker via a pressure regulator (not shown) by gas supply line 32. Loader feed line 34 may be used to provide compressed gas to loader 40 containing the present invention. Alternatively, loader feed line 34 may be connected to compressed gas control line within marker 10, thereby taking advantage of the pneumatic sequencing controls occurring with the marker. The compressed gas cylinder 30 normally contains CO₂, although any compressible gas may be used.

[0024] Operation of marker 10 is selectively controlled by trigger 20 which directs the admission of compressed gas, supplied by storage cylinder 30 via gas supply line 32, to a marker firing control apparatus (shown in FIGS. 6 and 7) for a firing mechanism. The marker firing control apparatus coordinates pressurized gas supply to mechanisms with the marker to fire, reload, and prepare the marker to fire again. The bursts of gas are used to eject paintballs outwardly through the barrel 14 by operation of a firing mechanism. After firing, compressed gas is used to reposition a bolt in the firing chamber to open inlet opening 16 thereby allowing another projectile to be loaded into the firing chamber from the loader 40. Compressed gas in turn used to re-position the bolt so that the marker is ready to fire the projectile in response to a pull of the trigger 20. The paintballs are continually fed by the paintball loader 40 through the inlet tube 16 to the firing chamber. Although FIG. 1 depicts an automatic paintball marker 10, the paintball marker 10 may also be a semi-automatic marker.

[0025] FIG. 2 shows a side view of a paintball loader 40 of the type in which the present invention will prove useful. Active feed paintball loaders are well-known in the art and described in detail in U.S. Pat. No. 6,213,110, "Rapid Feed Paintball Loader," and U.S. Pat. No. 6,502,567, "Rapid Feed Paintball Loader With Pivotable Deflector," the entire contents of which are each incorporated herein by reference. The active feed paintball loader 40 includes a paintball container 42 having a container wall 44 forming an interior area 46. The container 42 may be divided into an upper portion 48 and a lower portion 50. Generally, an exit tube 52 leads from the lower portion 50 of the container 42 to an outlet opening 54, although the exit tube 52 may be positioned at another location in the container 42. The exit tube 52 is positioned adjacent the inlet tube 16 of the paintball marker 10. Feed structure 56 is used to drive or urge the paintballs toward the exit tube 52 and into the inlet tube 16.

[0026] Referring now to FIGS. 2 and 3, a variety of feed structures 56 can be used with the present invention, including an impeller, drive cone, paddle wheel, fan, carrier or other device which can direct or otherwise force or urge paintballs into the exit tube 52. Feed structures are disposed within loaders such that rotation occurs in one direction (e.g. a feed direction) only so that paintballs cannot move away from the paintball marker inlet as a result of reverse rotation of the feed structure. By way of example and not limitation, a drive cone 60 is shown in FIGS. 2 and 3. Drive cone 60 includes base 62 and a plurality of fins 64 which preferably extend in a radial direction from the base 62. The drive cone 60 is connected to a connecting shaft 74 which rotates drive cone 60 thereby forcing movement of the paintballs. Connecting shaft 74 is connected to drive shaft 72 by a slip clutch 76 which is interposed between the two shafts to allow relative motion between them when the resistance on drive cone 60 and connecting shaft 74 exceeds a predetermined value. Drive shaft 72, connecting shaft 74, slip clutch 76 and drive cone 60 are rotatably disposed along a central axis of rotation 71. In an alternate embodiment, one end of slip clutch 76 may be connected directly to drive cone 60 thereby eliminating the connecting shaft 74. Drive gear 80 is rotated about the central axis of rotation 71 by advancing mechanism 90 which interacts with drive gear 80. Drive gear 80 is connected to drive shaft 72 so that it is rotated by advancing mechanism 90, rotational motion is transferred to drive shaft 72. When rotational resistance of drive cone 60 is within predefined torque limit, this rotational motion is transferred through slip clutch 76 to connecting shaft 74 whereby drive cone 60 is rotated. By employing slip clutch 76 to allow relative rotational movement between the drive cone 60 and the drive gear 80 and limiting the torque that can be transferred, drive cone 60 will not be advanced by further rotation of drive gear 80 when the exit feed tube 52 is completely filled with paintballs thereby creating excessive resistance to rotation of the drive cone. In such circumstances, the slip clutch 76 limits torque transferred from drive shaft 72 to drive cone 60 and prevents paintballs from being ruptured in the loader exit tube 52 by the drive cone 60. Ruptured paintballs can cause the loader to jam rendering the marker useless and leaving a paintball player vulnerable during a paintball game. Slip clutch 76 may be in the form of a mechanical torque-limiting clutch such as a serrated clutch, friction clutch, detent clutch, or the like, or the slip clutch may rely on other designs such as a magnetic coupling.

[0027] Referring now to FIG. 4, a partial view of one embodiment of advancing mechanism 90 is depicted and includes pneumatic cylinder 92, advancing shaft 94, and drive gear 80. Advancing mechanism 90 is located on the lower side of loader 40 (shown in shadow). Motive force to advancing mechanism 90 is provided by first inlet opening 91 which receives sequenced, pressurized gas pulses from the marker firing control apparatus, shown in FIG. 6. In an alternate embodiment, an advancing mechanism controller may be disposed within loader 40 and receive sequencing input signals from the marker trigger 20 or other suitable
sources within the marker 10. The pressurized gas causes advancing shaft 94 to extend from pneumatic cylinder 92. When the pressured gas is relieved, the advancing shaft 94 retracts into the pneumatic cylinder 92, preferably by the force of a spring (not shown). The process may be reverse (e.g., gas pressure to retract the advancing shaft and spring to extend) with equal effectiveness. Engaging structure 100 is connected to the exposed end of advancing shaft 94 and includes a first engaging pawl 102 at its distal end. Drive gear 80 has a generally circular, planar structure and includes a plurality of drive teeth 82 substantially uniformly arranged about the circumference of the drive gear. The profile of the teeth 82 and the first engaging pawl 102 is such that the interaction between them forms a ratchet. The first engaging pawl 102 engages the profile of at least one drive tooth 82 as the advancing shaft 94 extends from pneumatic cylinder 92, shown as movement of the engaging structure 100 to the right in FIG. 4, thereby causing drive gear 80 to rotate in a first direction, referred to as a forward direction and shown as direction arrow “A” in FIG. 4. The arrangement of first engaging pawl 102 and the drive teeth 82 on the drive gear 80, and the amount of travel from the advancing shaft 94 as it moves from fully retracted to fully extended provides sufficient rotational input to drive cone 60 as advancing shaft 94 extends so that a paintball is supplied to the marker by the rotation of the drive cone. Insufficient rotation of the drive cone 60 may cause a mis-feed (e.g., no paintball is urged into the firing chamber) while excessive rotation may cause excessive slipping of slip clutch 76 and failure of the clutch due to wear.

Rotation of drive gear 80 is transferred by drive shaft 70 to the input of slip clutch 76. Engaging structure 100, including first engaging pawl 102 is constructed of a flexible material, such as plastic, to allow the engaging structure 100 to flex slightly as the advancing shaft 94 retracts into the pneumatic cylinder 92 drawing the engaging structure across the perimeter of drive gear 80. This slight flexing is essential to enable the engaging pawl 102 to move away from the perimeter of the drive teeth 82 and slip past a drive tooth without causing the drive gear 80 to be rotated in a reverse direction. In the preferred embodiment, the engaging structure 100 is made from delrin.

Engaging structure 100 includes a first engaging pawl 102 and a second engaging pawl 104 spaced apart to allow the pawls to interact with drive teeth 82 on opposite circumferential sides of drive gear 80. The profiles of first and second engaging pawls 102, 104 are reversed relative to one another so that as the advancing shaft 94 extends, moving engagement structure 100 into contact with drive gear 80 in a first direction, first engagement pawl 102 will interact with at least one drive tooth 82 and cause rotation of drive gear in the forward (feed) direction. After the advancing shaft 94 is fully extended and begins retracting into the pneumatic cylinder 92, second engagement pawl 104 interacts with at least one drive tooth 82 generally on the opposite circumferential side so that drive gear 80 is rotated, still in the forward direction. In this manner, each movement of advancing shaft 94, whether extending from or retracting into pneumatic cylinder 92, causes drive gear 80 to be rotated in the forward direction thereby increasing the efficiency of the advancing mechanism 90. The arrangement of first engaging pawl 102, second engaging pawl 104, the drive teeth 92 on drive gear 80, and the amount of travel of advancing shaft 94 provides sufficient rotational input to drive cone 60 as a result of the extension/retraction of advancing shaft 94 to supply a paintball to the marker by the resultant rotation of the drive cone 60. Compared to the advancing mechanism shown in FIG. 4, the two-pawl engaging structure 100 is capable of providing sufficient rotational input using an advancing cylinder 92 having a shorter stroke between fully retracted and fully extended. A shorter stroke generally requires less input air thereby reducing the overall air demand of the two-pawl engagement structure.

Also shown in FIG. 5 is a cross-sectional view of pneumatic cylinder 92 in which advancing shaft 94 is axially disposed and allowed to move in opposing axial directions. Piston 98 is connected to one end of advancing shaft 94 and positioned within pneumatic cylinder 92 so that pressurized gas supplied through first inlet opening 91 acts on piston 98 and forces it away from first inlet opening 91. Movement of piston 98 causes advancing shaft 94 to be extended from pneumatic cylinder 92 as long as the supply of pressurized gas is present. Movement of advancing shaft 94 by piston 98 is resisted by return spring 96 which is disposed within pneumatic cylinder 92 so that extension of advancing shaft 94 from pneumatic cylinder 92 compresses the return spring 96. In this manner, when the pressurized gas force is removed from piston 98, return spring 96 will force the piston toward the first inlet opening 91 thereby retracting advancing shaft 94 into the pneumatic cylinder 92. The process may be reversed (e.g., gas pressure to retract the advancing shaft and spring to extend) with equal effectiveness.

In an alternate embodiment, return spring 96 may be removed, a second inlet opening into the pneumatic cylinder 92 added opposite end to first inlet opening 91, and a second pressurized gas pulse supplied drives piston 98 to retract advancing shaft 94 into pneumatic cylinder 94. A schematic for this alternate embodiment is provided in FIG. 7.

In yet another embodiment, advancing mechanism 90 and drive gear 80 are replaced by a pneumatic stepper drive (not shown). The stepper drive is a commercially available item that provides a predetermined amount of rotational movement in response to a pneumatic input signal or pressure pulse. The amount of rotation provided by the stepper drive is selected to provide sufficient rational of the drive cone 60 to urge a paintball into the marker inlet 16, but not so much rotation that excessive slip of slip clutch 76 occurs. Commonly available units include those providing 90 and 180 degrees of shaft rotation when supplied with the pneumatic pulse. One preferable stepper drive is the vane type rotary actuator series NCR811BW by SMC Corporation having a 180 degree rotation per pulse. Stepper drives generally require slightly larger gas volumes for operation compared to the preferred embodiment, but offer greater simplicity in design and improved reliability.

In FIG. 6, shown in a schematic diagram of the firing controls of a typical paintball marker in which the present invention is useful. In the embodiment shown, pressurized gas to operate advancing mechanism 90 is provided from the same pneumatic controls that fire and load the paintball marker. In other embodiments, a solenoid may be provided to actuate the loader advancing mechanism 90 using a variety of readily available inputs from the marker.
to indicate that the marker has been fired and the loader should provide paintballs to the marker.

[0034] Marker firing control apparatus 200 is selectively actuated by a person using trigger 20. Firing control apparatus 200 is connected to pneumatic gas supply 30 from a regulated supply line 32. Firing control apparatus 200 directs a pneumatic firing signal to marker firing mechanism 210. It also directs pneumatic signals to marker cocking/loading mechanism 220 along pneumatic cocking line 222 and pneumatic loading line 224 to manage the position of a firing bolt within the marker. The position of the firing bolt determines when marker is ready to receive a paintball through inlet opening 16 (not shown in FIG. 6). The pneumatic loading signal present in pneumatic loading line 224 may also be used to signal the loader advancing mechanism 90 to actuate feed structure 56 and supply paintballs to the marker. Pneumatic advancing line 240 conveys the pneumatic signal present in pneumatic loading line 224 to the advancing mechanism 90 through inlet opening 91 in the advancing mechanism’s pneumatic cylinder thereby cycling advancing mechanism 90 as the marker is being reloaded.

[0035] FIG. 7 shows a variation of the firing controls in which the loader advancing mechanism uses pneumatic pressure to move the advancing shaft in both direction (e.g., a return spring 96 is not present). Operation is as described in connection with FIG. 6, except that a pneumatic retraction line 242 is connected to the pneumatic cocking line 222 to provide a pneumatic pulse to retract advancing shaft 94. Marker cocking and loading signals are commonly inverse to one another, that it when one is present, the other is not. Using these inverse alternating signals provides a convenient source to cause advancing mechanism 90 to reciprocate and drive the marker feed structure 56 to cause a near-constant supply of paintballs to the marker.

[0036] Although the invention has been described in connection with specific examples and embodiments, those skilled in the art will recognize that the present invention is capable of other variations and modifications within the scope of the invention but beyond those described herein. Changes in the details, materials, steps and arrangements of part which have been described and illustrated to explain the nature of the invention will occur to and may be made by those skilled in the art upon a reading of this disclosure within the principles and scope of the invention. The foregoing description illustrates the preferred embodiment of the invention, however, concepts, as based upon the description, may be employed in other embodiments without departing from the scope of the invention as presented in the following claims.

Having thus described the invention, I claim as new and for which a Letters Patent of the United States is desired to be secured is:

1. A drive mechanism for use with an active paintball loader comprising:
   a drive shaft positioned along a central axis and rotatable about said central axis;
   a feeder structure positioned along said central axis and rotatable in one direction about said central axis;
   a slip clutch controlling the connection between said drive shaft and said feeder structure;
   a drive member connected to said drive shaft and rotatable about said central axis generally in unison with said drive shaft;
   a compressed gas supply; and
   an advancing mechanism moved by gas from said compressed gas supply with a controller selectively coordinating the gas supplied to said advancing mechanism, said advancing mechanism rotating said drive member.

2. The drive mechanism as described in claim 1, further comprising a paintball marker generating a signal indicating the said marker is ready to receive a paintball and sending said signal to said controller, said controller upon receiving said input signal causes a loading signal to be directed to said advancing mechanism.

3. The drive mechanism as described in claim 1, wherein said advancing mechanism is a pneumatic actuator connected to said drive shaft that causes said drive shaft to rotate.

4. The drive mechanism as described in claim 3, wherein said pneumatic actuator is a pneumatic stepping motor and said drive member connects said pneumatic stepping motor to said drive shaft.

5. The drive mechanism as described in claim 1, wherein said slip clutch is a friction clutch.

6. The drive mechanism as described in claim 1, wherein said slip clutch has a serrated coupling.

7. The drive mechanism as described in claim 1, wherein said slip clutch has a magnetic coupling.

8. The drive mechanism as described in claim 1, wherein said drive member is a generally circular planar structure having a perimeter with a plurality of ratchet teeth extending radially from said perimeter.

9. The drive mechanism as described in claim 8, wherein said advancing mechanism further comprises:
   a cylinder containing a piston;
   at least one inlet opening into said cylinder;
   an elongate link linearly movable in first and second opposing directions and having first and second opposing ends, said first end connected to said piston; and
   a first pawl and a second pawl connected to said second end of said elongate link, said first pawl and second pawl separated by said drive member and arranged to interact with said drive member on opposite sides of said perimeter, movement of said link in said first direction engages said first pawl into at least one tooth of said plurality of ratchet teeth and said second pawl at least one tooth thereby rotating said drive member in a feeding rotational direction, movement of said link in said second direction engages said second pawl into at least one tooth of said plurality of ratchet teeth and said first pawl moves past without engaging from said ratchet teeth and thereby causing rotation of said drive member in said first rotational direction.

10. The drive mechanism as described in claim 9, further comprising a spring disposed within said cylinder such that a compressed gas supplied to said at least one inlet opening of said cylinder causes said piston to move in one direction, and said spring causes said piston to move in an opposite direction.

11. The drive mechanism as described in claim 9, further comprising a first and a second opening in said cylinder such that a compressed gas supplied only to said first opening causes said piston to move in one direction, and a compressed gas supplied only to said second opening causes said piston to move in an opposite direction.
12. The drive mechanism as described in claim 8, wherein said advancing mechanism further comprises:
    a cylinder containing a piston;
    at least one inlet opening into said cylinder;
    an elongate link linearly movable in first and second opposing directions and having first and second opposing ends, said first end connected to said piston; and
    a pawl connected to said second end of said elongate link, said pawl arranged to interact with said perimeter of said drive member, movement of said link in said first direction engages said pawl into at least one tooth of said plurality of ratchet teeth thereby rotating said drive member in a feeding rotational direction, movement of said link in said second direction causing said pawl to move past without engaging said ratchet teeth.

13. In a paintball marker powered by a compressed gas supply having a firing chamber, a firing chamber inlet tube, a trigger apparatus initiating discharge of a first paintball from said chamber and introduction of a second paintball into said chamber via said inlet tube; an active loader having a container for holding a plurality of paintballs, a rotating feeder structure mounted on a bottom portion of said container, and an exit tube exiting from the bottom portion of said container and leading to said inlet tube of the paintball gun, the improvement comprising:
    a drive shaft positioned along a central axis and rotatable about said central axis;
    a feeder structure positioned along said central axis and rotatable in one direction about said central axis;
    a slip clutch controlling the connection between said drive shaft and said feeder structure, said slip clutch limiting torque transferred from said drive shaft to said feeder structure;
    a drive member connected to said drive shaft and rotatable about said central axis generally in unison with said drive shaft; and
    an advancing mechanism moved by gas from said compressed gas supply with a controller selectively coordinating the gas supplied to said advancing mechanism, said advancing mechanism rotating said drive member, rotation of said drive member being generally transferred to said feeder structure within torque transfer limits of said slip clutch, rotation of said feeder structure causing paintballs from said container to be moved into said exit tube.

14. The improvement of claim 13, further comprises an input signal generated by said marker indicating that said marker is ready to receive a paintball, said marker sending said signal to said controller, said controller, upon receiving said input signal, generating a loading signal and directs a loading signal to said advancing mechanism.

15. The improvement of claim 13, wherein said advancing mechanism is a pneumatic actuator connected to said drive shaft that causes said drive shaft to rotate.

16. The improvement of claim 15, wherein said pneumatic actuator is a pneumatic stepper motor and said drive member connects said pneumatic stepper motor to said drive shaft.

17. The improvement of claim 16, wherein said drive member is a generally circular planar structure having a perimeter with a plurality of ratchet teeth extending radially from said perimeter, said advancing mechanism further comprising:
    a cylinder containing a piston;
    at least one inlet opening into said cylinder;
    an elongate link linearly movable in first and second opposing directions and having first and second opposing ends, said first end connected to said piston; and
    a first pawl and a second pawl connected to said second end of said elongate link, said first pawl and second pawl separated by said drive member and arranged to interact with said drive member on opposite sides of said perimeter, movement of said link in said first direction engages said first pawl into at least one tooth of said plurality of ratchet teeth and said second pawl at least one tooth thereby rotating said drive member in a feeding rotational direction, movement of said link in said second direction engages said second pawl into at least one tooth of said plurality of ratchet teeth and said first pawl moves past without engaging from said ratchet teeth and thereby causing rotation of said drive member in said first rotational direction.

18. The improvement of claim 17, further comprising a spring disposed within said cylinder such that a compressed gas supplied to said at least one inlet opening of said cylinder causes said piston to move in one direction, and said spring causes said piston to move in an opposite direction.

19. The improvement of claim 17, further comprising a first and a second opening in said cylinder such that a compressed gas supplied only to said first opening causes said piston to move in one direction, and a compressed gas supplied only to said second opening causes said piston to move in an opposite direction.