

[54] **PNEUMATIC GUN WITH LOST MOTION
PISTON-PISTON ROD CONNECTION**[75] Inventor: **Earl L. Fischer**, Bentonville, Ark.[73] Assignee: **Victor Comptometer Corporation**,
Chicago, Ill.[22] Filed: **June 16, 1972**[21] Appl. No.: **263,640**[52] U.S. Cl. **124/13 A**[51] Int. Cl. **F41b 11/00**[58] Field of Search. **124/11 R, 13 A; 92/84,**
92/129; 417/511, 566[56] **References Cited****UNITED STATES PATENTS**

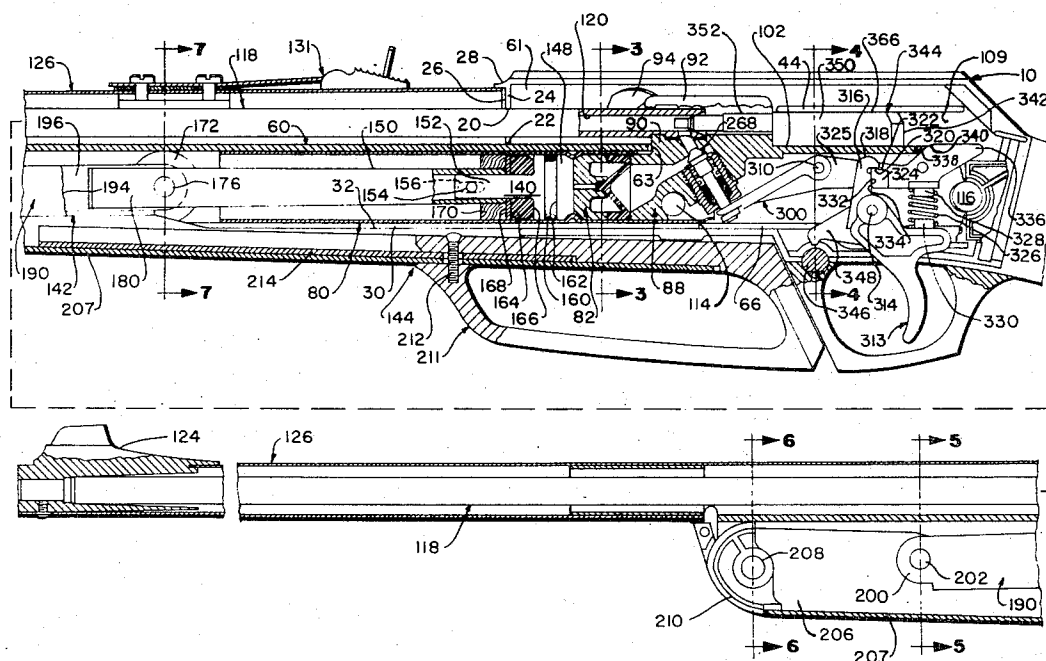
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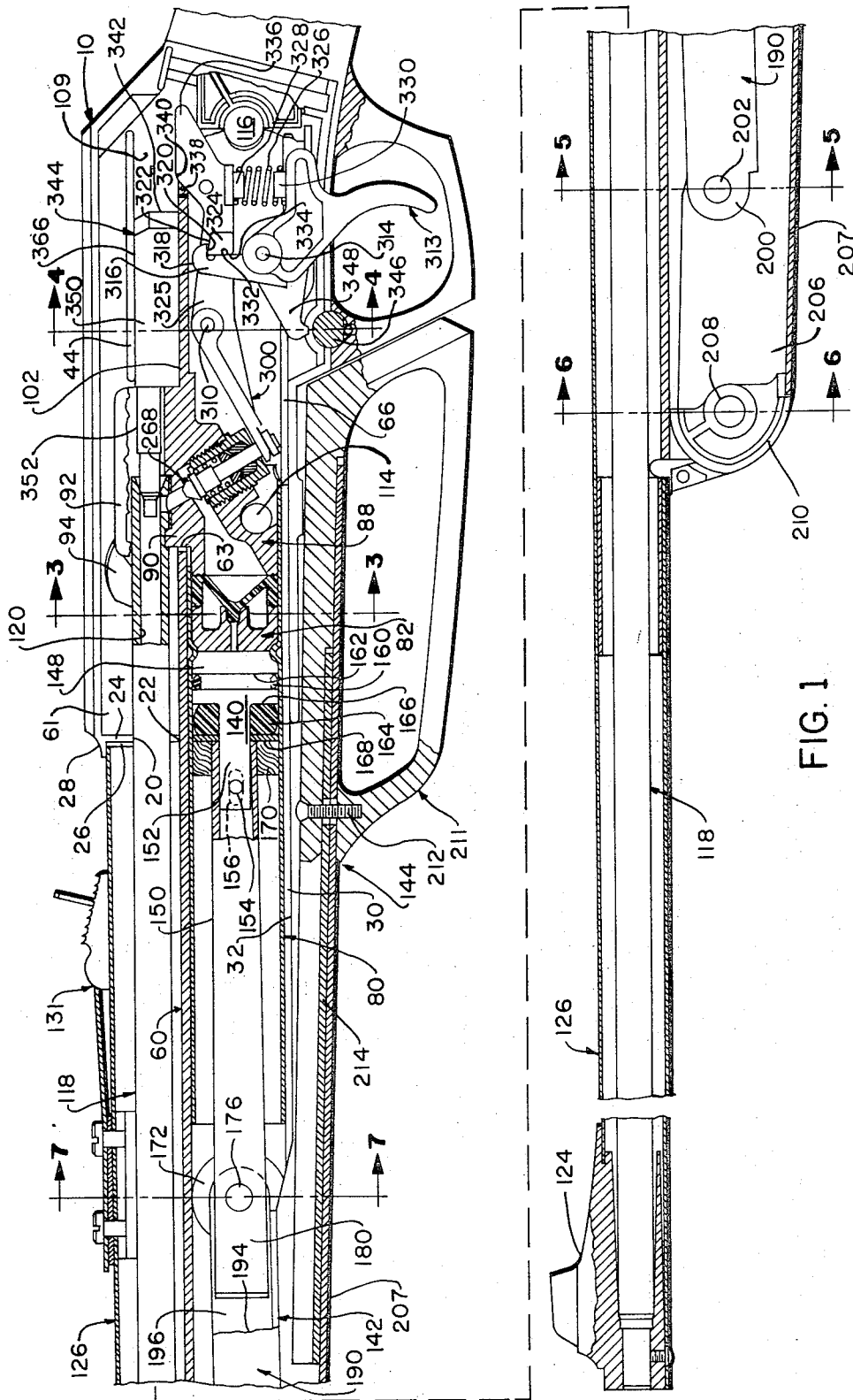
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Primary Examiner—Richard C. Pinkham*Assistant Examiner*—Richard T. Stouffer*Attorney, Agent, or Firm*—Bruce G. Klaas, Esq.[57] **ABSTRACT**

There is herein disclosed a pneumatic gun of the type having an air storage chamber selectively connectable to a firing chamber by a valve. The valve is movable between a closed position and an open position by a trigger actuated control lever. The control lever is movable between cocked and uncocked positions by a manually slidable bolt and is latched in a cocked position by a spring loaded trigger having a latching finger in constant abutting engagement with the control lever. There is a lost motion connection between the control lever and the valve such that the valve is openable by the combined effects of air pressure and a spring by movement relative to the control lever. The storage chamber is formed between cylindrical block members held in spaced relationship in a common cylinder. A combination check valve and sealing annulus is compressibly mounted between the block members. A piston assembly is also mounted in the common cylinder and connected to a piston rod by a lost motion connection enabling movement of the piston assembly relative thereto under the influence of a resilient compressible annulus.

7 Claims, 11 Drawing Figures



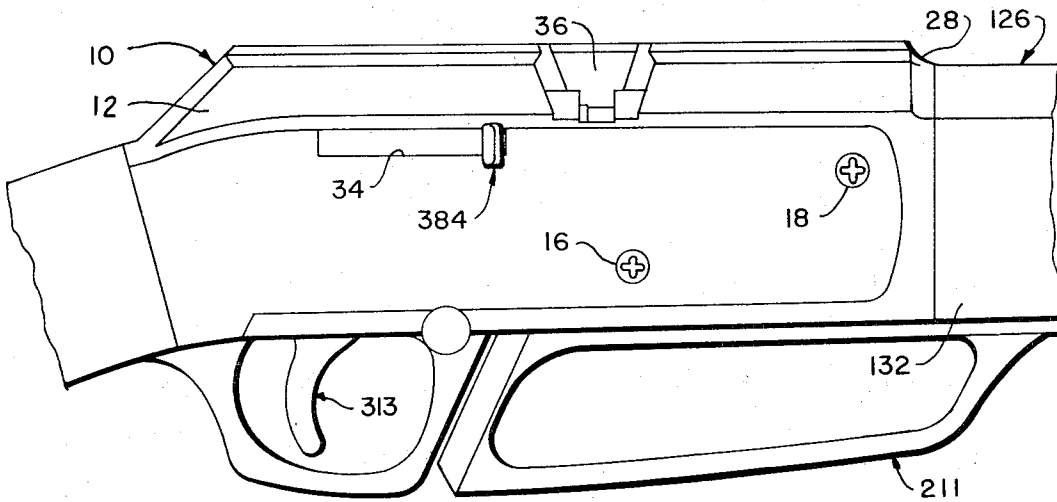


FIG. 2

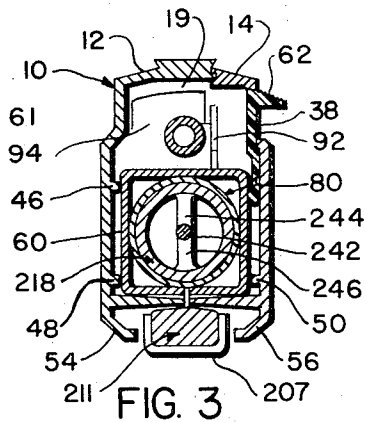


FIG. 3

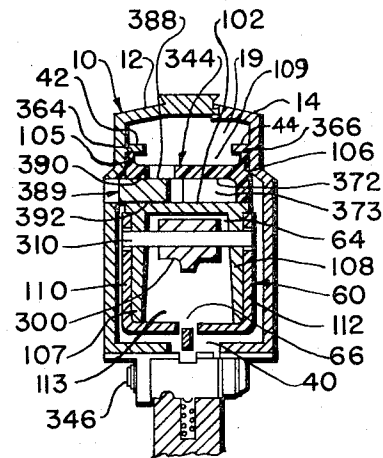


FIG. 4

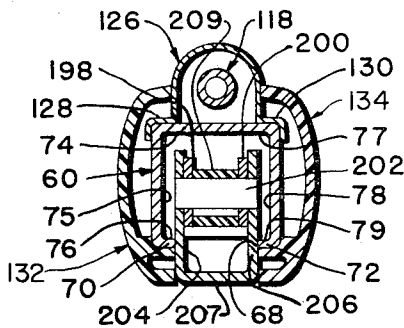


FIG. 5

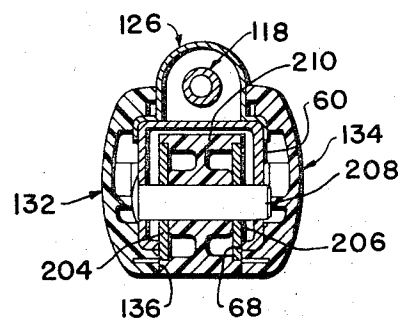


FIG. 6

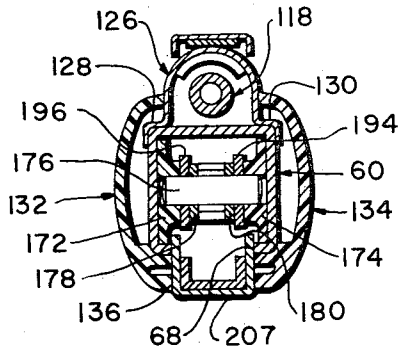


FIG. 7

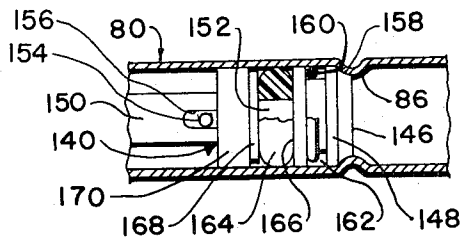


FIG. 8

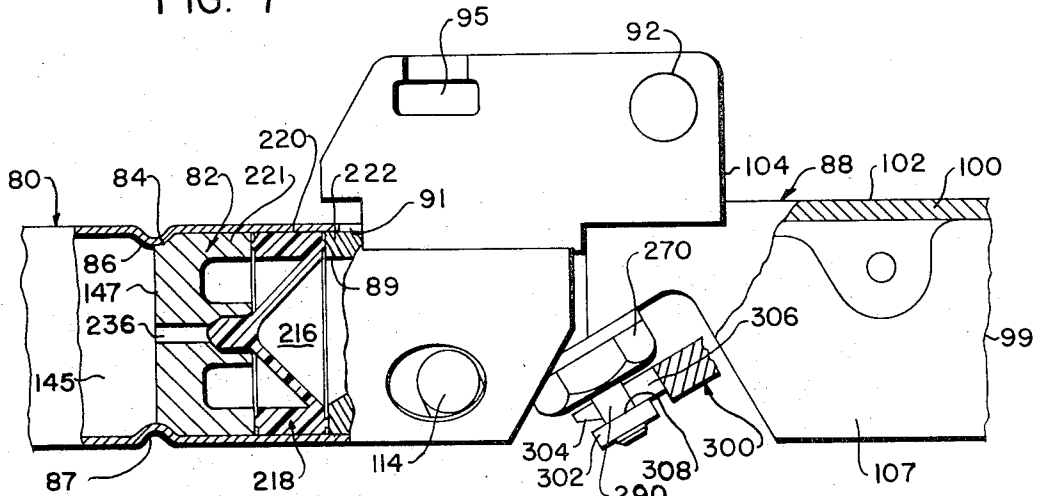


FIG. 9

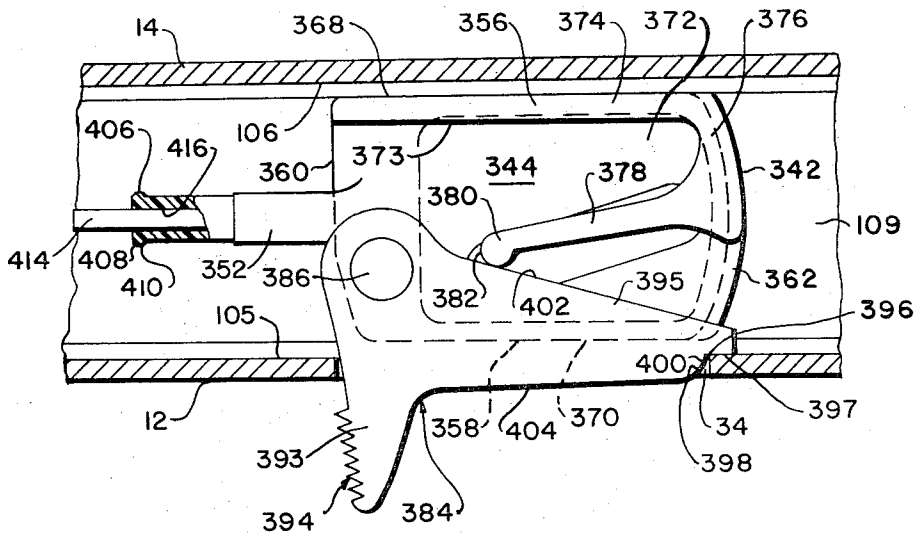


FIG. 10

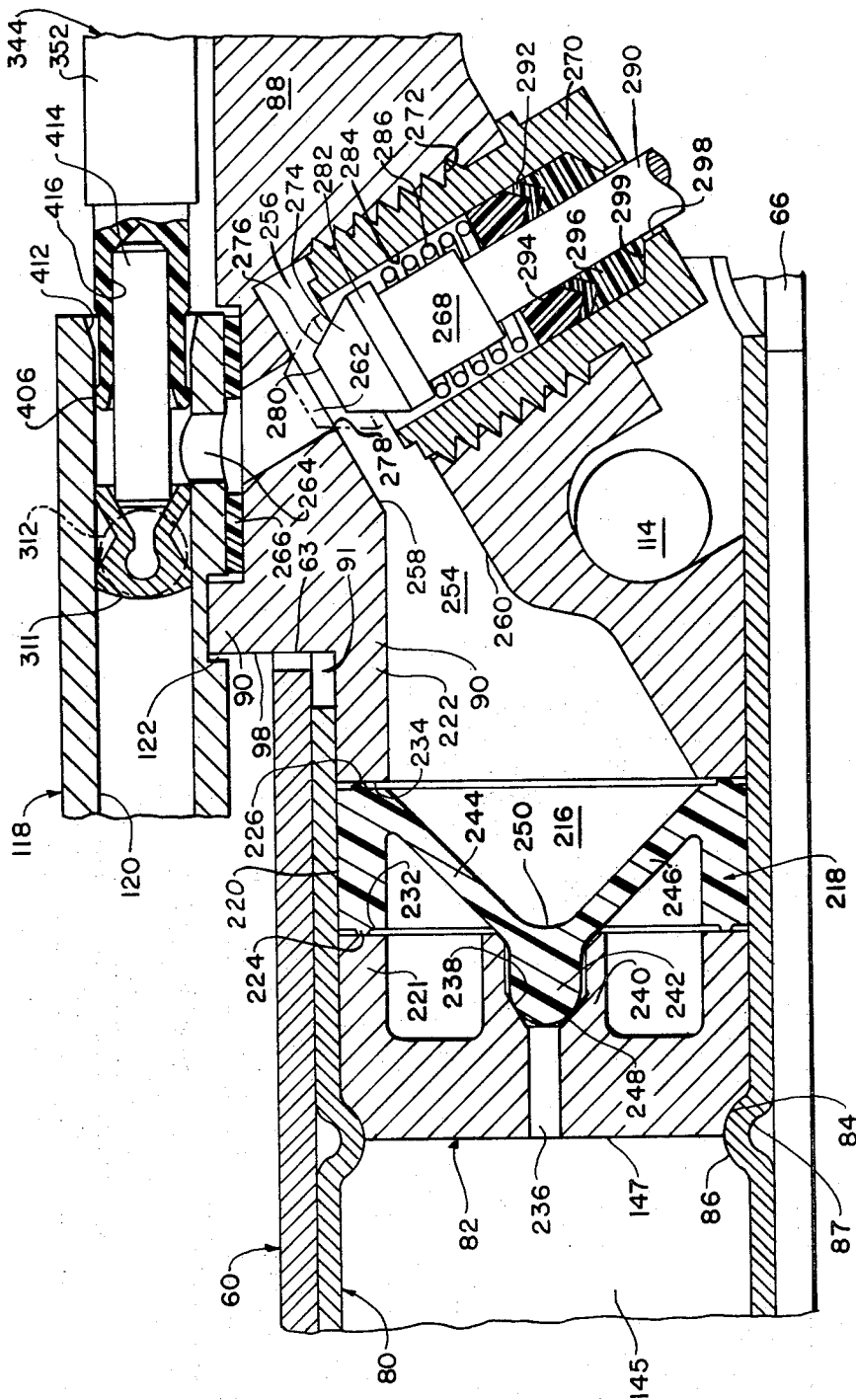


FIG. 11

PNEUMATIC GUN WITH LOST MOTION PISTON-PISTON ROD CONNECTION

BACKGROUND AND SUMMARY OF INVENTION

This invention relates to pneumatic guns having an air storage chamber with pumping means to fill the storage chamber with compressed air and trigger operated valve means to release the compressed air to fire the gun. In the prior art, guns of this type have utilized relatively complicated air compression systems, air storage systems, air delivery systems, and actuating mechanisms therefor. Among the various problems involved with such guns are: (1) arrangement of the various components in a compact manner so as to require a minimum of space, (2) smooth easy operation of the actuating mechanisms, and (3) easy and complete compression of air.

It is a primary purpose of the present invention to provide a new and improved pneumatic gun system in which the need for complicated expensive and hard to operate mechanisms has been reduced to a minimum while providing new and improved performance. To this end, new and improved air compression apparatus have been associated in a new and improved manner.

DRAWING

FIG. 1 is a side elevational view partly in section and with parts removed showing a presently preferred embodiment of the invention;

FIG. 2 is a partial side elevational view of the other side of the gun shown in FIG. 1;

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a cross-sectional view taken along the line 4—4 of FIG. 1;

FIG. 5 is a cross-sectional view taken along the line 5—5 of FIG. 1;

FIG. 6 is a cross-sectional view taken along the line 6—6 of FIG. 1;

FIG. 7 is a cross-sectional view taken along the line 7—7 of FIG. 1;

FIG. 8 is a partial side elevational view, partly in section, of a pump head assembly;

FIG. 9 is an enlarged side elevational view, partly in section, of the storage chamber and release valve body assembly;

FIG. 10 is an enlarged bottom view of the bolt and bolt handle assembly; and

FIG. 11 is an enlarged cross-sectional view of the air supply system.

DETAILED DESCRIPTION

I. Receiver, Housing and Valve Block Assemblies

A. Receiver Assembly

The gun mechanism is housed in a metallic receiver assembly 10 comprising nested receiver halves 12, 14 held together by suitable fastening devices 16, 18 and providing an elongated mechanism enclosure 19 having a generally rectangular cross-sectional configuration. A circular barrel opening 20 and a square pump housing opening 22 are provided in a front wall 24 of the receiver assembly located rearwardly of a forwardly facing recess 26 provided by a rim 28. A bottom wall 30 extends forwardly a substantial distance to provide an

elongated support surface 32. A bolt handle opening 34 is provided on one side of the receiver assembly, as shown in FIGS. 2 and 10. In addition, a tapered access opening 36 is located forwardly of the bolt handle opening. Another access opening 38 may be provided on the opposite side, as seen in FIG. 3. A trigger opening 40, FIG. 4, is provided at the bottom of the receiver assembly and suitable stock attachment means are provided at the rear. A pair of bolt guideway ribs 42, 44, FIG. 4, and a number of support ribs 46, 48, 50, FIG. 3, are provided on opposite sides of the receiver assembly. A pair of inwardly inclined flanges 54, 56 define a downwardly opening pumping lever recess 58, FIG. 3.

B. Housing Assembly

A pump assembly housing 60 extends within and forwardly of the receiver assembly through opening 22. The central portion of the housing has a square cross-sectional configuration, FIG. 3, and is supported on the bottom wall of the receiver assembly between the inwardly extending ribs 46, 48, 50 in spaced relationship to the side walls of the receiver assembly. A B—B storage chamber 61, FIG. 3, may be provided above the housing opposite slot 38 and connected by a conventional shot feed tube-partition assembly (FIG. 3) to the barrel bore to enable the gun to fire B—B type ammunition (shown in phantom in FIG. 11) as well as pellet type ammunition as shown in FIG. 11. A molded plastic B—B loading door 62 may be slidably mounted between the adjacent side walls of the receiver and the housing. The upper wall of the housing terminates at 63, FIG. 1, to provide a valve housing slot 64, FIG. 4, extending rearwardly therefrom. The bottom wall of the housing is provided with a trigger slot 66, FIG. 1, of suitable size and shape. A downwardly opening linkage slot 68, FIGS. 5 and 6, is provided at the front end of the housing between opposite inwardly extending flange portions 70, 72, which also provide roller trackways defined by inner side surfaces 74, 75, 76 and 77, 78, 79, respectively, FIG. 5.

The housing fixedly supports an elongated tubular cylinder member 80 mounted therewithin. A cylindrical block 82 is fixedly mounted intermediate the ends of the cylinder with a curved shoulder 84 abutting a semi-circular rib 86, FIG. 9, defined by a radially inwardly deformed portion 87 of the cylinder wall.

C. Valve Block Assembly

A valve block 88 has a cylindrical nose portion 89 closely fitted within the rear end of the cylinder. An upwardly extending rib 90, FIG. 11, is located within corresponding slot portions 64, 91, FIG. 11, of the housing and the cylinder, respectively. A longitudinally extending flange portion 92 abuts an upwardly rearwardly inclined B—B feed track (not shown) extending from the B—B storage chamber 61, adjacent a transverse deflection plate 94 forming the rear end wall of the storage chamber and mounted in a slot 95 in the flange portion, to a B—B feed opening (not shown) located behind the rear end of the barrel. A forwardly facing abutment surface 98, FIG. 11, on the block rib 90 is spaced from the housing surface 63. The rear portion 99, FIG. 9, of the block is channel-shaped with an upper wall 100 providing a bolt slide surface 102 and a rearwardly facing bolt abutment surface 104. The bottom surfaces of the inwardly extending ribs 42, 44, and side surfaces 105, 106 on opposite side walls of the receiver assembly are cooperatively arranged relative to the slide sur-

face 102 to define an elongated bolt guideway 109 as shown in FIG. 4. Downwardly extending side walls 107, 108 on the rear portion of the block are nested within adjacent parallel side walls 110, 112 of the housing, as shown in FIG. 4, to define an enclosure 113 for the firing mechanism. The receiver assembly, housing, cylinder and valve block are relatively fixed by a pin 114 and a screw 116, FIG. 1.

II. Barrel and Forearm Assemblies

A tubular barrel 118 having a bore 120 extends through receiver assembly opening 20 and is provided with a notch 122, FIG. 11, cooperable with block rib 90 to locate the rear end of the barrel on the valve assembly. The front end of the barrel is supported in a front sight member 124 fixed on the forward end of a shroud member 126 supported on housing 60 by flange portions 128, 130, FIG. 7. The rear end of the shroud is received beneath the rim 28 of the receiver assembly and a rear sight assembly 131 is fixed on the shroud.

The side surfaces of the barrel, shroud, and housing are covered by elongated molded plastic forearm members 132, 134, FIGS. 5-7, secured to the housing by suitable fastening means (not shown). A downwardly opening linkage slot 136 is provided between the bottom ends of the forearm members opposite the housing slot 68, FIG. 6.

III. Pump Assembly and Actuating Mechanism

A reciprocal pump assembly 140, movable between an extended position, shown in FIGS. 1 and 8, and a retracted position (not shown) is connected by linkage means 142 to a pivotally mounted pumping lever 144 for compression of air in a variable volume compression chamber 145, FIG. 9, defined by the rear end wall 146, FIG. 8, of the pump assembly and the front wall 147 of the block 82.

The pump assembly comprises piston means in the form of a cylindrical piston member 148 and piston rod means in the form of a hollow tubular piston rod member 150, FIG. 1. A shaft portion 152 of the piston extends into the rear end of the rod and is attached thereto by a pin 154 fixed on the shaft portion and extending through opposite elongated slots 156 in opposite sides of the rod member to provide lost motion connecting means permitting limited sliding movement of the piston 148 relative to the rod 150 as hereinafter further described. A curved shoulder 158 is provided on the rear end of the piston to define a groove which will cooperatively receive the front portion of the rib 86 in a fully rearwardly extended position of the piston, as shown in FIGS. 1 and 8. An O-ring type sealing member 160 is mounted in a groove 162 on the periphery of the piston. A resilient compressible and expandable piston positioning means in the form of an elastomeric annulus 164 is compressibly mounted circumjacent shaft portion 152 between a forwardly facing abutment surface 166 on the head portion of the piston and an abutment washer annulus 168 held directly against the rear end of the rod, as shown in FIGS. 1 and 8. A lubricating felt washer 170 is also mounted circumjacent the shaft portion 152. The elastomeric annulus acts as a spring to normally fully rearwardly extend the piston relative to and away from the rod with pin 154 rearwardly located in slots 156. The elastomeric annulus also acts as a resilient cushion permitting the piston to be moved forwardly relative to the rod with pin 154 moving toward the forward ends of the opposite elongated slots 156. The forward end of the piston rod is

supported by a pair of molded plastic rollers 172, 174, FIG. 7, mounted on a pin 176 attached to forwardly extending rod flanges 178, 180, and rollable along the trackway in the housing 60 provided by opposite interior housing surfaces 74, 75, 76 and 77, 78, 79, FIG. 5.

The piston assembly is reciprocally operable in the cylinder 80 by means of a channel-shaped drag link 190 having rear end flange portions 194, 196, FIG. 7, pivotally attached to pin 176 and front end flange portions 198, 200, FIG. 5, pivotally attached to a pin 202 mounted between flange portions 204, 206, FIG. 6, of a channel-shaped actuating lever member 207 pivoted on the forward end of the housing by a pin 208. A plastic retainer sleeve 209 may be mounted between the flanges 198, 200 about pin 202. A plastic guide and enclosure rim 210, FIG. 6, is mounted on the pin 208 between and about the flanges 204, 206. An operating handle 211 is attached by suitable fastening means 212 to the rear of the actuating lever member 207 which has a channel-shaped reinforcing member 214.

IV. Air Supply System

A compressed air storage chamber 216 is provided between the cylinder block 82 and the valve block 88. A chamber sealing and valve means in the form of an elastomeric member 218 of rubber or the like, having a cylindrical rim 220 approximately equal in thickness to axially extending block rims 221, 222, FIG. 9, is compressibly mounted therebetween. Axially extending ribs 224, 226 on the member 218 are compressed between the side surfaces 232, 234 of the block rims.

An air inlet passage 236 in block 82 connects the variable volume air chamber 145 in front of the block to the storage chamber 216 through a conical valve seat 238 in a rearwardly extending hub portion 240. A check valve 242, in the form of a forwardly projecting cylinder is integrally connected to and supported on the rearward portion of rim 220 by forwardly extending resilient flexible flanges 244, 246, FIG. 3, and has a semi-spherical nose portion 248, FIG. 11, cooperable with the valve seat 238 to close passage 236. High pressure compressed air in passage 236 will temporarily unseat the valve 242 to permit flow of air to the storage chamber 216 during a compression stroke while high pressure air in the storage chamber will reseat the valve, as soon as pressure equalization occurs, due to the resilience of the support flanges 244, 246 and the force of the high pressure air in the storage chamber acting forwardly against the rear surface 250 of the support flanges.

The rear portion of the storage chamber is formed in the front of valve block 88 by a chamber 254, FIG. 11, which terminates rearwardly in an upwardly slanting relative narrow passage 256 of generally rectangular cross-sectional configuration having a pair of opposite parallel forwardly inclined surfaces 258, 260. Air passage means in the form of a compressed air outlet passage 262 extends at right angles to surface 258 and communicates with an inlet passage 264 in the rear end of the barrel through a compressible sealing washer 266 held in compression between adjacent outer peripheral surfaces of the valve block and the barrel.

Referring now to FIG. 11, an air release valve means 268 is reciprocally supported in a valve plug 270 threadably mounted in a valve bore 272 in block 88 opposite the air outlet passage 262. The release valve

comprises a head portion 274 having a conical tapered outer surface 276, adapted to sealingly engage a valve seat 278 circumjacent passage 262, and terminating in a flat pressure applying surface 280 for a purpose to be hereinafter described. A cylindrical rim portion 282 guides the valve in a bore 284 in the valve plug 270 and seats one end of a compression spring 286 by which the valve is biased to a closed position relative to passage 262. A reduced diameter valve portion supports the compression spring. A stem portion 290 extends through suitable sealing means such as a V-shaped sealing washer 292 of low density polyethylene material or the like, through correspondingly shaped washer seating rings 294, 296, of Delrin material or the like, and through a plug bore 298 of reduced diameter. Spring 286 compressibly retains the washer 292 and valve ring 294, 296 against each other and a tapered seat 299 at the bottom of bore 284.

The lower end of the valve is operably connected to operating means in the form of a control lever 300 by cam type lost motion connecting means comprising a washer 302 fixed to the valve stem. A curved cam surface 304 on the bottom of a bifurcated finger portion 306 of the control lever engages the upper surface 308 of the washer to positively cam the valve downwardly to the open position while otherwise permitting relative movement between the valve stem and the control lever. The control lever 300 is centrally pivoted on a pin 310, mounted between flange portions 107, 108 of block 88, for pivotal movement between a cocked, valve closed, position, FIG. 1, and a released, valve open, position, FIG. 11. In this manner, the valve head 274 is moved off the valve seat 278 to permit high pressure air in the storage chamber to flow through passages 262, 264 to the barrel bore to fire a conventional pellet 311 or B-B 312 from the gun. At the moment that the outlet passage 262 is opened high pressure air acts on valve end surface 280 to exert a valve opening force there-against whereby the valve is opened quickly and held open until the high pressure air has escaped from the storage chamber to fire the pellet from the gun. Thereafter, the spring 286 is effective to close the valve and to hold the valve closed until subsequently released by the control lever 300.

V. Cocking And Firing System

The air release valve 268 and control lever 300 are operable by rearward pivotal movement of a trigger member 313 pivoted on block 88 by a pin 314. Latch and release means in the form of an upwardly extending latch finger 316 terminates in a curved cam surface 318 and has a generally downwardly facing latch surface 320 engageable with an abutment surface 322 on a latch lug 324 on the rear portion 325 of the control lever to releasably hold the control lever in a cocked firing position, against the bias of a compression spring 326 seated on opposite aligned projections 328, 330 between rear end portions of the trigger and the control lever, with transverse surfaces 332, 334 also in abutting engagement. Thus, when the trigger is pulled rearwardly, surfaces 320, 322 are disengaged and the compression spring 326 is then effective to pivot the control lever about the pin 310 to actuate the valve 268. The rear end portion 336 of the control lever extends upwardly so as to protrude through slot 338 in the upper wall 102 of the valve block and be located in the bolt guideway 109, FIG. 1, in the released position. A curved cam surface 340 on the top of the rear portion

of the control lever is engageable by the rear end 342 of manually operable bolt means in the form of a slidable bolt member 344 to recock the trigger and control lever by forcing the rear end of the control lever downwardly against the bias of the compression spring 326 with lug 324 engaging curved cam surface 318 and forcing the latch finger forwardly until the lug clears surface 318 whereupon the spring will move the latch finger rearwardly over and into abutting engagement with the lug along surfaces 320, 322, 332, 334 to hold the trigger and control lever in the cocked position. A safety mechanism is provided by selective abutting engagement between a manually slidable member 346 and a flange portion 348 of the trigger as shown in FIG. 1.

Referring now To FIGS. 1, 4 and 10, the bolt member 344 comprises a generally hollow body portion 350 of generally rectangular peripheral configuration and a forwardly extending cylindrical portion 352 integrally formed of molded plastic material such as Delrin or the like. The body portion has a continuous upper rim comprising spaced parallel side walls 356, 358 and end walls 360, 362. The upper surfaces 364, 366 of the side walls slidably engage the lower surfaces of the ribs 42, 44 and the side surfaces 368, 370 slidably engage the inner side surfaces 105, 106 of the receiver halves 12, 14. A central transverse flange 372 extends between the side walls 356, 358 and the end walls 360, 362, and defines a bolt handle cavity 373 therebelow. The bottom portion 374 of side wall 358 and a portion 376 of the rear end wall 362 extend below the flange 372 to slidably engage the upper surface 102 of the valve block. An integral resilient deflectable spring finger 378 extends diagonally inwardly from the end of the rear wall portion 376 and terminates in a nose portion 380 having a rounded cam surface 382 engaging a plastic handle member 384 pivotally mounted in cavity 373 on a downwardly extending pin 396 integral with the bolt body portion. The upper handle surface 388 slidably engages the bottom surface 390 of the flange 372 and the bottom handle surface 392 slidably engages the valve block upper surface 102. The bolt member is slidably supported on the valve block surface 102 for sliding movement between a forwardly extended firing position, FIG. 1, and a rearwardly retracted loading and cocking position (not shown), by the bottom surfaces of wall portions 374, 376, the bottom surface of the front wall portion 360, the bottom surface of the spring finger 378, and the bottom surface 392, of the handle member 384. An actuating lever portion 393 of the handle member extends laterally outwardly from the pivotal connection beyond the handle cavity 373 through handle slot 34 in the receiver half 12 and terminates in a finger gripping portion 394 by which the bolt and the bolt handle may be manually pivotally manipulated between a latching position, FIG. 10, and a release position (not shown). A latching finger portion 395 of the handle extends longitudinally and laterally rearwardly from the pivotal connection and terminates in a latching notch 396. A handle locating abutment surface 397 is engageable with the adjacent inner side surface 105 of the receiver rearwardly adjacent the slot 34 to limit pivotal outward movement of the bolt handle. An inclined bolt holding abutment surface 398 extends outwardly from surface 397 and releasably engages the rear edge 400 of the slot 34 to latch the bolt in the forward firing position. The inner side surface

402 of the bolt handle extends diagonally inwardly into the bolt handle cavity to slidably engage and resiliently inwardly deflect the spring finger 378 to thereby resiliently continuously bias the bolt handle toward the latching position. The outer side surface 404 of the bolt handle is slidably engageable with the rear edge of the slot 34 to permit inward pivotal movement of the handle from the latched firing position to the release position permitting rearward movement of the bolt from the firing position to the loading position.

Cylindrical portion 352 is centrally located relative to the body portion and extends forwardly from the front wall thereof in axial alignment with the barrel bore 120. A sealing lip 406, having a conically tapered surface 408 and a cylindrical rim 410, is provided at the front end of the bolt to be sealingly received in the rear end of the barrel bore through a conical opening 412. A magnetic pin 414 is fixedly mounted in a bore 416 in the front of the bolt to position a pellet 311 or B—B 312 in the firing position as shown in FIG. 11.

VI. Operation.

In order to obtain a supply of compressed air, pumping lever handle 211 is grasped and pulled outwardly from the stowed position of FIG. 1. The pumping lever 144 is pivoted about pin 208 and pulls drag link 190 forwardly and downwardly to move pivot pin 176 longitudinally along the tract in housing 60 on rollers 172, 174. The piston rod 150 and piston 140 are pulled forwardly to a retracted position (not shown) providing maximum volume in the compression chamber 145. Reverse movement of the lever from the extended position to the retracted position moves the piston member through an air compression stroke from the retracted position of maximum chamber volume to the extended position of minimum chamber volume. During the compression stroke, the piston of the present design will always bottom on the block member 82 without jamming, regardless of manufacturing tolerances, because of the lost motion connection means between the piston and the piston rod, which is provided by the pin 154 and elongated slots 156, and the spring-cushion effect of the elastomeric annulus 164, which extends the piston into abutting engagement with the surface 147. Thus, the volume of the compression chamber 145 is reduced to a minimum on each stroke to obtain higher compression of the air with a minimum of effort.

High pressure air is forced from the compression chamber through passage 236 against check valve 242 and forces the check valve rearwardly by resilient deflection of the support flanges 244, 246 integrally connecting the valve to the rim portion 220 which is compressibly held between block rims 221, 222 to seal the air storage chamber 216 therebetween. When the piston bottoms, the resilience of the valve supporting flanges and high pressure air in the storage chamber 216 acting thereagainst move the valve back onto the valve seat 238 to hold the high pressure air in the storage chamber. Several compression strokes may be utilized to build a desired level of pressure in the storage chamber.

In order to load (or unload) the gun and cock the firing mechanism, the handle 384 on the bolt 344 is grasped and pulled rearwardly to a retracted cocking and load position (not shown). The arrangement of the handle is such that the handle first pivots inwardly to clear the abutment surface 398 relative to the edge 400 of the receiver slot 34 and then moves rearwardly along

surface 105 to the retracted position. During rearward movement, the rear wall 362 of the body portion will engage the cam surface 340 of the control lever 300, if the gun is uncocked, and force down the rear portion of the control lever by pivotal movement about pin 310. Downward pivotal movement of the rear end of the control lever exerts a pivotal force on the trigger 313 through compression spring 326 and maintains cam surface 318 of the latch finger 316 in engagement with the side surface 334 of the latch lug 324. When the latch lug clears the cam surface, the compression spring acts to pivot the upper end of the latch finger over the latch lug with surfaces 320, 322 and 332, 334 engaging to hold the control lever in a cocked position until released by pulling the trigger rearwardly about pin 314 to move latch finger surface 320 off of lug surface 322 whereupon the compression spring 326 will be effective to pivot the control lever from the cocked position to a valve releasing firing position.

In the retracted cocking and loading position, the cylindrical bolt portion 352 is moved rearwardly to clear the rear end of the barrel, loading slot 36 and B—B opening 96. A pellet or B—B may then be loaded into the rear end of the barrel through the slot 36 or the opening 96. The bolt is then manually moved forwardly to an extended firing position, FIG. 1, with the magnetic pin on the front of the cylindrical bolt portion pushing the B—B or hollow pellet into firing position with the sealing lip 406 entering the tapered barrel shoulder 412 to engage and seal the end of the bore. In the forward firing position, the bolt handle is pivotally outwardly biased by spring finger 378 to seat the handle latch surface 398 against the receiver slot abutment surface 400 and prevent rearward movement of the bolt.

Pivotal movement of the control lever 300 to the firing position pulls the release valve 268 open against the bias of compression spring 286, FIG. 11, due to engagement between cam surface 304 on the bottom of the end of the control lever actuating finger and the upper surface 308 on the abutment washer 302 attached to the valve stem. As soon as the valve head 274 clears the valve seat 278, high pressure air in the storage chamber 216 rushes into outlet passage 262 and exerts a rearward force on the valve head upper end surface to maintain the valve open against the bias of compression spring 286 until the pressure of the air in the storage chamber is reduced and the pellet has been fired by passage of the air into the barrel bore behind the pellet through inlet passage 264.

Since the inventive concepts may be otherwise variously embodied, it is intended that the following claims be construed to cover alternative embodiments except insofar as limited by the prior art.

I claim:

1. In an air gun or the like operated by compressed air, the invention comprising:

an air compression cylinder in said gun,

a fixed end wall in said cylinder defining one end of a variable volume air compression chamber in said cylinder,

a reciprocable piston means slidably mounted in said cylinder and having end wall means defining the other end of said variable volume air compression chamber and being movable between a retracted position, located in axially spaced relationship to said end wall and defining a maximum volume air

compression chamber, and an extended position with said end wall means abutting said end wall and defining a minimum volume air compression chamber,

piston rod means operably connected to said piston means and being movable during a compression stroke between a retracted position and an extended position,

lost motion connecting means between said piston means and said piston rod means permitting limited relative axial movement of said piston means relative to said piston rod means between a fully extended position with said end wall means located a maximum distance away from said piston rod means and a variably retracted position with said end wall means located a lesser distance from said piston rod means,

the distance of said end wall means in the fully extended position from said piston rod means being such as to assure abutting engagement between said end wall means of said piston means and said end wall of said cylinder before said piston rod means reaches a fully extended position,

the distance of limited variable movement of said piston means relative to said piston rod means provided by said lost motion connecting means being such as to enable said piston rod means to reach a fully extended position,

resilient compressible and expandable means operative between said piston means and said piston rod means to bias said piston means toward the fully extended position relative to said piston rod means and to permit movement of said piston means toward said piston rod means after engagement of said end wall means of said piston means with said end wall of said cylinder,

a first transverse abutment surface on said piston means and facing said piston rod means,

a second transverse rigid abutment surface on said piston rod means and facing said piston means,

said resilient compressible and expandable means being mounted between and in constant engagement with the first and second abutment surfaces thereby maintaining said piston means in the fully extended position relative to said piston rod means until the piston means is forced toward the piston rod means by forces acting on said end wall means

of said piston means during movement of the piston rod means to the extended position,

an annular rib in said cylinder adjacent said end wall of said cylinder, and an annular groove in said end wall of said piston means corresponding to said annular rib, and

said rib being received in said groove in the extended position of said piston rod.

2. The invention as defined in claim 1 and wherein:

said resilient compressible and expandable means comprising an annulus of resilient compressible and expandable material.

3. The invention as defined in claim 2 and wherein:

said piston means comprising a reduced diameter shaft portion and an enlarged diameter head portion

said first transverse abutment surface being an end surface of said head portion intersecting said shaft portion,

and said annulus being mounted circumjacent said shaft portion.

4. The invention as defined in claim 3 and wherein:

said piston rod means comprising a tubular shaft portion, and

said shaft portion of said piston means being telescopically received within said shaft portion of said piston rod means.

5. The invention as defined in claim 4 and wherein said lost motion connecting means comprising a pin and slot connection between the shaft portions of said piston means and said piston rod means.

6. The invention as defined in claim 4 and wherein:

said second abutment surface comprises an annulus of rigid material mounted on said shaft portion of said piston means between said annulus of resilient compressible and expandable material and said shaft portion of said piston rod means.

7. The invention as defined in claim 1 and wherein:

said end wall of said cylinder being metallic, and said end wall means of said piston means being metallic.

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