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MACHINE WITH DRIVING PISTON AND MEANS ASSOCIATED WITH THE PISTON FOR ABSORBING SHOCKS AND VIBRATIONS

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Fig. 1

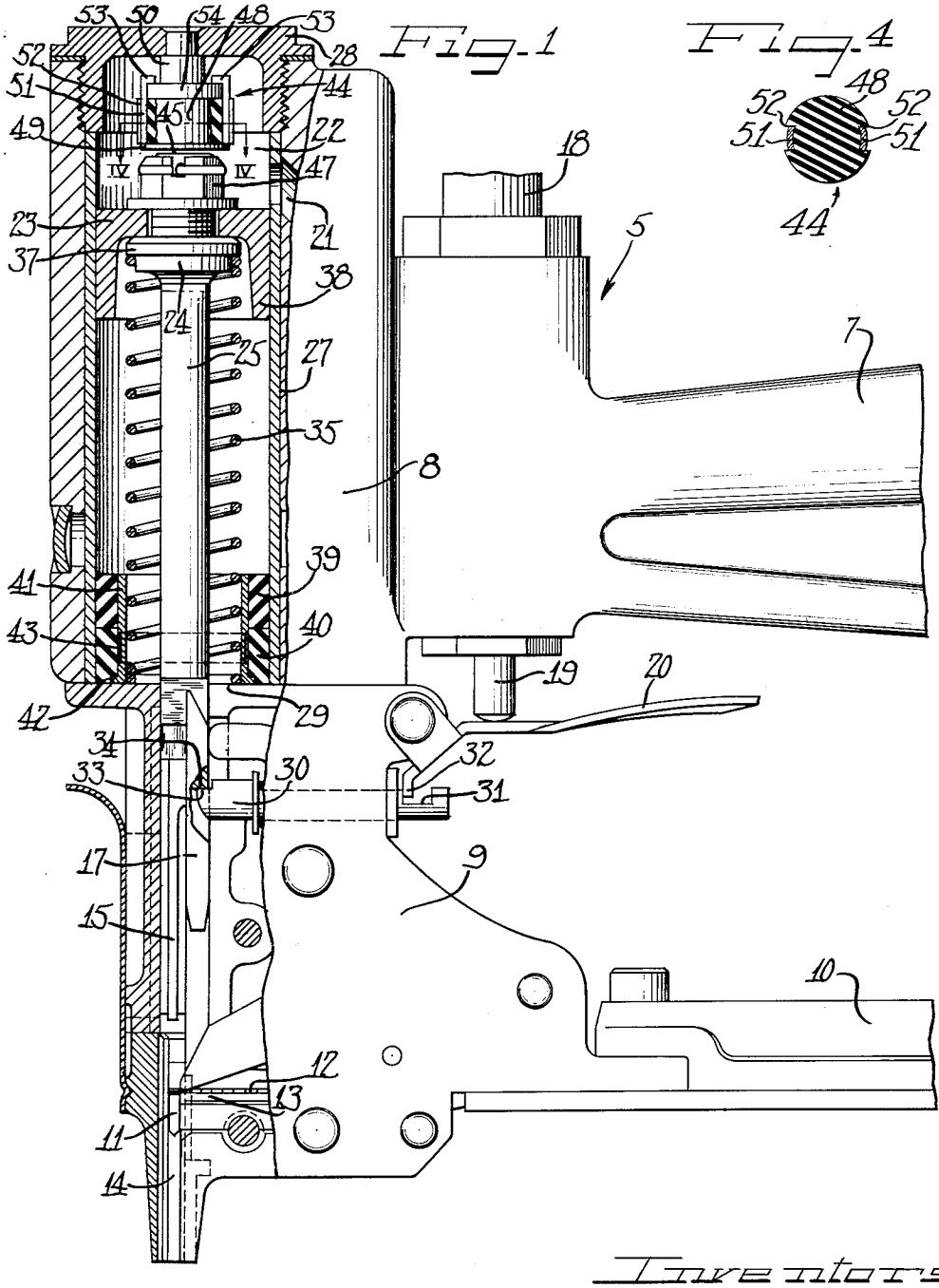

Fig. 4

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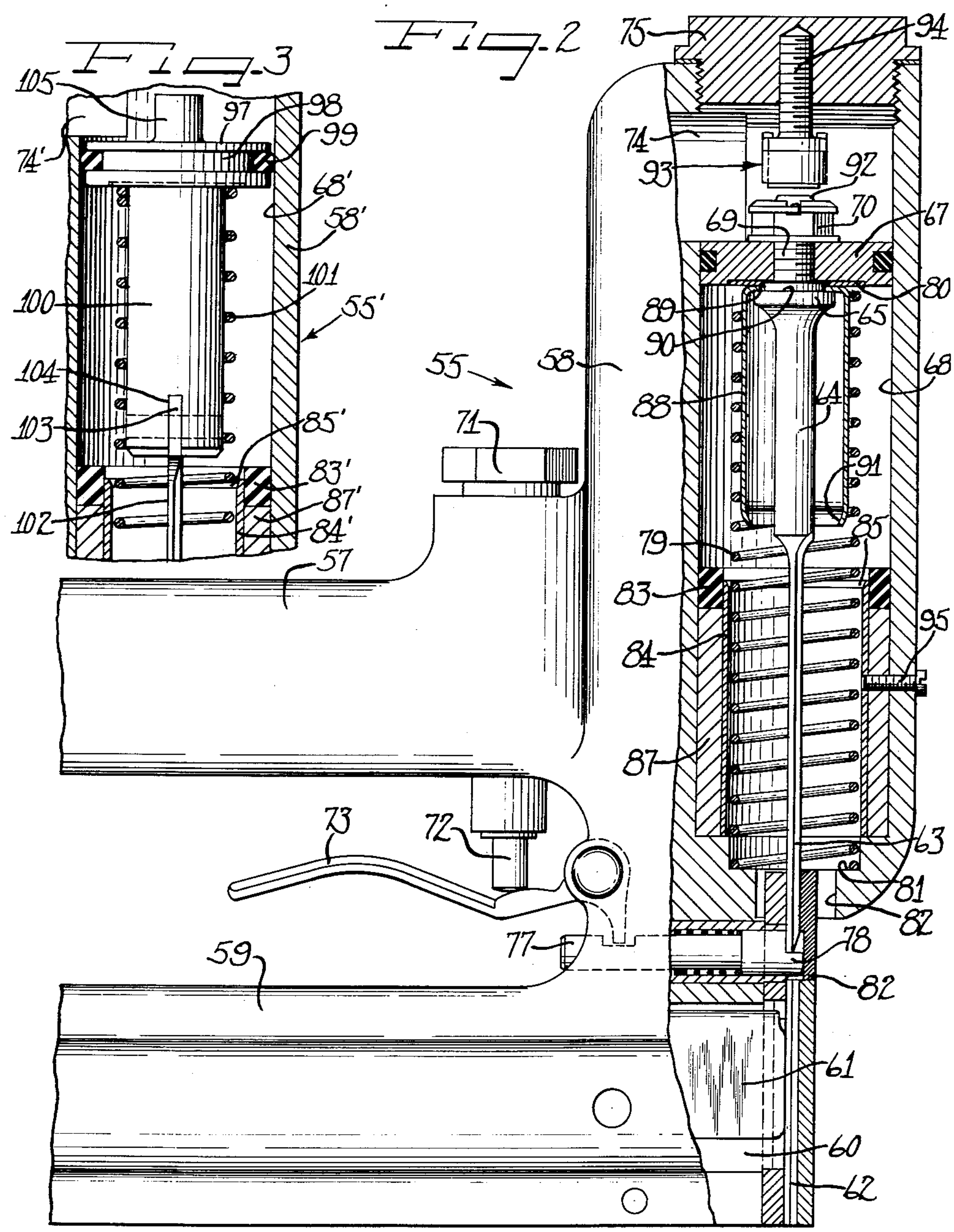
Fig. 3 Fig. 2



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MACHINE WITH DRIVING PISTON AND MEANS ASSOCIATED WITH THE PISTON FOR ABSORBING SHOCKS AND VIBRATIONS

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The present invention relates to improvements in fastener driving machines and more particularly concerns the absorbing of shocks and vibrations in such machines incident to motivation of the plungers or pistons by which the drivers or driving blades of the machines are actuated.

This application is a continuation-in-part of our application Serial No. 394,972 filed November 30, 1953, now Patent No. 2,928,094 issued March 15, 1960.

An important object of the present invention is to provide improved cushioning and vibration damping structure for the fastener driving mechanism of fastener driving machines.

Another object of the invention is to provide novel bumper means for the driving pistons or plungers of fastener driving machines.

A further object of the invention is to provide not only improved bumper structure for driving stroke impact of the driving piston or plunger of a fastener driving machine, but also improved bumper structure for stopping the return or recoil stroke for such a piston or plunger.

Yet another object of the invention is to provide improved means for damping vibrations in the return springs of fastener driving mechanism in fastener driving machines.

It is also an object to provide improved return spring guide means for spring biased plunger actuated mechanism.

Other objects, features and advantages of the present invention will be readily apparent from the following detailed description of certain preferred embodiments thereof taken in conjunction with the accompanying drawings in which:

Figure 1 is a side elevational view, partially in vertical section, of the front portion or driving head section of a fastener driving machine, embodying features of the present invention.

Figure 2 is a side elevational view, partially in vertical section of a modified fastener driving machine embodying features of the invention;

Figure 3 is a fragmentary vertical section and elevational view showing a further modified driving piston and spring guide structure, and

Figure 4 is a sectional detail view taken substantially on the line IV—IV of Figure 1.

Referring to Figure 1, a fastener driving machine 5 is depicted which is preferably of the pneumatically actuated type including a handle portion 7 to the front end of which is integrally connected a driving head portion 8 to the lower end of which is suitably attached a fastener handling and feeding assembly unit 9 to the lower rear end portion of which is connected a fastener supply or magazine structure member 10. In the present instance the machine 5 is constructed and arranged to form and drive sheet metal staples 11 from a preformed strip 12. The staple strip is delivered from the magazine structure 10 onto an anvil 13 aligned therewith in the lower portion of the feeding and handling assembly 9. At the

forward end of the anvil 13 is a vertical staple driveway 14 within which is reciprocably operable a driver 15 guided reciprocably in the upper portion of the assembly 9 and having at the rear thereof staple forming means 17 operable in conjunction therewith to form the next succeeding staple blank in the strip 12 into U-staple form incident to severance and driving of the staple 11 on the forward extremity of the strip by the driver 15.

In the present instance operation of the driver 15 is effected by pneumatic power. To this end, pneumatic fluid supplied through a conduit 18 and under the control of a valve having a stem 19 arranged to be manually actuated by a lever 20 is adapted to deliver through a passage 21 into the upper end portion of a cylinder 22 within which is reciprocably slidably disposed a plunger or piston 23 carried on a head 24 of a shank or stem 25 on the upper end portion of the driver 15. It will be observed that the cylinder 22 occupies the major vertical extent of the head structure 8 within a bore 27 closed at its upper end by a closure cap 28. At its lower end, the bore 27 is partially closed by the upper end portion of the housing of the lower unit 9, with a free pressure release opening 29 communicating with the cylinder chamber below the piston 23.

When the operating lever 20 is actuated to crack the valve the pneumatic fluid, such as compressed air, delivers through the passage 21 into the head room within the cylinder 22 above the piston 23 and develops a pressure head therein until a delayed action mechanism including a sear pin 30 is released by continued valve-actuating movement of the lever 20 to take up a predetermined lost motion within a clearance notch 31 in the butt end portion of the pin by means of an actuating lug 32 on the forward end portion of the lever. When a front end shoulder 33 on the sear pin is withdrawn from a downwardly facing shoulder 34 on the driver 15, the built up pressure head in the cylinder 22 over the piston 23 drives the piston and thereby the driver under full staple driving downward thrust within the cylinder 22 in opposition to a coiled compression type return spring 35 concentric about the piston rod or stem 25. At its upper end the spring 35 thrusts against a head shoulder 37 while at its lower end the spring bottoms on and thrusts against the upper end of the housing of the staple handling unit 9. As the return spring 35 is compressed during the driving stroke, the compression loading thereof gradually builds up a retarding reaction against the piston 23, reaching a maximum at the end of the driving stroke. There is, nevertheless, a tendency of the piston 23, due to its high speed acceleration, to overrun the spring 35.

According to the present invention, at termination of the driving stroke the now substantially decelerated piston 23 comes to rest at the lower edge of a depending annular skirt portion 38 thereof against a resilient shock absorbing bumper comprising a pair of similarly dimensioned, coaxially disposed contiguous upper and lower resilient annuli 39 and 40, respectively. Both of the bumper annuli 39 and 40 are preferably of an oil resistant material to avoid deterioration thereof in the presence of lubricating oil in the cylinder. Moreover, the upper resilient bumper annulus 39, against which the piston skirt 38 makes direct contact is preferably formed from a highly impact resistant non-metallic material, preferably an elastomer such as natural or synthetic rubber or other rubber-like material. On the other hand, the lower cushioning, resilient annulus 40 is preferably made from a similar but softer cushioning material, as is practicable since it is protected by the upper annulus 39 from direct impact engagement by the piston skirt.

To confine the bumper annuli 39 and 40 against spreading radially inwardly into interfering relation with the adjacent lower coils of the return and deceleration spring

35, a preferably metal retainer ferrule, or cylinder or ring or bushing 41 is interposed between the inner walls of the resilient annuli and the coil spring. Upward climbing of the ferrule or bushing 41 relative to the cushioning annuli under impact compression of the annuli is avoided by the provision of an outturned lower marginal flange 42 on the bushing to underlie the adjacent lower end of the lower cushioning annulus 40 which thus presses the foot or retaining flange 42 downwardly against the supporting base afforded by the top of the housing of the staple handling structure 9.

Improved cushioning, shock absorbing resilient deflection of the lower, softer bumper annulus 40 is provided for by an annular outer peripheral flow relief groove 43 in the lower portion of the ferrule or bushing 41 opposing the lower annulus. Through this arrangement, not only is an efficient shock absorbing bumper provided for the piston, but by having the inner diameter or periphery of the bushing 41 closely disposed about the outer diameter of the coils of the return spring 35, transverse vibrations of the spring coils are substantially precluded and any tendency toward development of a vibrational harmonic in the spring is damped. This derives from the fact that not only is the bushing or ferrule 41 of a different vibrational frequency, but by being closely encompassed and during piston impact tightly gripped by the resilient annuli 39 and 40 efficient vibration deadening or damping results.

Upon release or relief of pneumatic pressure upon the head of the piston 23 at the end of a driving stroke, the loaded return spring 35 snaps the piston back to starting position. At the end of the return stroke, a shock absorbing head bumper 44 is engageable by an upward crown projection 45 on the driver head 24 and projecting up through the piston 23 to enable removable attachment of the piston to the head by means of a castellated nut 47.

In a preferred form, the crown bumper 44 (Figs. 1 and 4) includes a rubber or rubber-like bumper block 48 held in position above the crown projection 45 by a combination buffer plate and retainer 49 engageable with a depending supporting stud 50 carried by the crown of the closure cap 28. The buffer and retainer plate 49 is provided with upstanding marginal arms 51 arranged to fit in vertical peripheral grooves 52 in the bumper block 48. At their upper ends the arms 51 are provided with inturned retaining terminal flanges 53 for overlying a lower end terminal flange 54 on the supporting stud against which the bumper block 48 abuts in thrusting relation. Through this arrangement, the bumper block 48 is laterally expansible between the arms 51 incident to impact compressive thrusts thereagainst applied by the driver crown 45 through the buffer plate 49. At the same time the retaining terminal flanges 53 of the arms are free to move upwardly in the clearance space between the supporting flange 54 of the supporting stud and the adjacent inner face of the closure cap 38. On backing off of the driver crown 45 the bumper 48 expands and returns the retaining plate 49 and thus the arm terminals 53 into the position in which the arm terminals 53 engage as suspension supports upon the supporting flange 54.

It may be mentioned that before provision of the return stroke bumper 44, and the vibration damping afforded thereby, breakage of the rod 25 and the driver unit 15 was experienced due to conflict of vibrations from the opposite ends thereof meeting with explosive stress intermediately of the unit in the repeated operations of the driver.

Cooperatively, the driving stroke bumpers 39 and 40, and the return stroke bumper 40 effectively damp sensory vibrations during operations of the machine.

In Figure 2 is shown a modified machine 55 which is more especially adapted for driving preformed staples. To this end, the machine 55 includes a handle 57 at the forward end of which is an integral head structure 58 in the present instance connected integrally in one piece, as for example in a unitary casting, with the forward end portion of a fastener supply magazine 59. Within the magazine is mounted a staple track 60 upon which rides a staple pusher 61 by which staples carried by the track 60 are urged successively into a vertical staple driveway 62 provided at the forward extremity of the magazine under the head 58 within which a vertically reciprocable driver in the form of a blade 63 is operable to drive the staples from the driveway out of a lower exit opening into work over which the machine is placed for that purpose.

On its upper end portion the driver 63 includes a rod section 64 having a head 65 supporting a piston 67 operable reciprocably within a cylinder 68 in the head 58 aligned with the driveway 62. Attachment of the head 65 to the piston is effected by means of a reduced diameter crown stem 69 projecting up from the head through the piston body and engaged by a castellated nut 70 by which the piston is secured thereto.

Pneumatic fluid for motivating the piston 67 and thereby the driver 63, is supplied to the machine by means of a suitable conduit secured into a fitting 71 at the forward end of the handle 57 behind the head 58. Control of the motivating pressure fluid is by means of a valve having a stem 72 arranged to be actuated by an operating lever 73 under the handle 57 for feeding of the fluid through a passage 74 into head room in the upper portion of the cylinder 68 closed by a cap member 75.

Similarly as in the machine 5, the driver 63 is restrained against movement in a driving stroke until a full pressure head has developed thereabove. This is effected by means of a sear pin 77 having a front end shoulder 78 engageable under the driving tip of the driver. Withdrawal of the sear pin 77 by the lever 73 is effected in a lost motion interval following cracking of the pressure fluid control valve.

In the driving stroke of the driver, a return and deceleration spring 79 is loaded. This is a coiled compression spring thrusting at its upper end against the piston 67 concentrically about the rod portion 64 through the medium of a thrust plate 80. At its lower end the spring 79 bottoms against a shoulder 81 of the head portion of the housing of the machine about a breather opening 82.

Means are provided for not only damping shocks at the termination of the driving stroke of the driver and on the return stroke thereof, but also for damping vibrational rythms of the return spring 79 throughout its length while also maintaining the cylindrical shape of the spring although subjected to sudden shocks or longitudinal driving forces in the operation of the machine. To this end, a driving terminus bumper is provided including an elastomeric natural or synthetic rubber or rubber-like bumper ring 83 which is possessed not only of resistance to lubricant such as oil, but is also highly resistant to permanent deformation by impacts thereagainst of the piston 67. In the present instance the lower bumper ring 83 is maintained against compressing radially inwardly by a tubular retainer bushing or ferrule 84 of preferably substantially hard metal such as steel tubing. The internal diameter of the retainer tube 84 is preferably only slightly greater than the outside diameter of the spring 79 and the length of the tube 84 is preferably such as to encompass a substantial lower portion of the spring for thereby serving as a retainer against lateral displacement of the spring in operation. It will be observed that the upper inner margin of the sleeve 84 is chamfered as shown as 85 to avoid catching of the coils of the spring thereabove on the upper edge of the retaining tube.

In order to support the bumper annulus 83 in a position projecting somewhat above the upper edge of the retainer tube 84, a second or lower bumper annulus 87 is provided which in the present instance is a fairly rigid material. By preference the material of the supporting ring 87 is of a dead nature or at least of a very

low vibrational frequency such as aluminum whereby to afford a sound deadening engagement about the sleeve 84.

Cooperatively related to the retainer sleeve 84 and disposed internally of the spring 79 is a depending retainer sleeve 88 within the upper coils of the spring and of an external diameter just slightly less than the inside diameter of the coils. At its upper end portion the internal sleeve 88 has an annular inturned attachment flange 89 which is clamped between a shoulder 90 on a head 65 and the abutment or thrust washer 80. At its lower end the sleeve 88 is turned in slightly to provide a chamfer lip 91 to avoid catching of the coils of the spring as the retainer sleeve or bushing 88 drives down within the lower coils of the spring during a driving stroke. It will be observed that the length of the respective lower external guide sleeve 84 and the upper internal guide sleeve 88 is so correlated that in the at rest condition of the assembly not substantially more than a coil of the spring 79 is free therebetween and during a driving stroke the coils of the spring 79 are maintained effectively against lateral displacement. Furthermore, during stroking movements of the driver there will be some interengagement of the coils of the spring with respectively the lower and upper retainer and guide sleeves 84 and 88 which will effectively damp virbrations in the spring.

At the end of the return stroke, a crown extremity 92 on the crown stem 69 is engageable with a crown bumper 93 which in general respects is the same as the crown bumper 44 and includes a stud 94 secured into the inner side of the crown of the closure cap 75 concentric with the driver rod 64. Since the bumper 93 is in other respects the same as the bumper 44, recital of the other details of the bumper need not be here repeated.

Means such as one or more screws 95 may be provided for securing the spring guide and vibration damping guide sleeve assembly 84, 87 in place.

It will be appreciated that in the operation of the machine 55 not only are undesirable fatiguing vibrations damped in the driver unit, but sensory vibrations are also effectively damped by the bumper and vibration damping structure.

Although the machine 5 has been shown as equipped to form and drive sheet metal staples and the machine 55 has been shown as equipped to handle preformed staples, it will be appreciated that the features of the vibration damping and bumper structure of the two machines are interchangeable.

In Figure 3 is shown a modification in the driving and blade carrying plunger or piston in a machine 55' which in other respects may be substantially the same as in the machine 55. To this end, a one piece machine or cast piston 97 is provided having a peripheral groove 98 in which is mounted a resilient sealing ring such as an O-ring 99 engageable with the cylindrical wall 68' inside the head portion 58' of the machine.

Depending centrally from the piston 97 is a preferably cylindrical solid boss 100 which is of a length and diameter to fit within a coiled compression return spring 101 substantially the same as the guide sleeve 88 in Figure 2. That is, the boss 100 is of a diameter just slightly less than the inside diameter of the coils of the spring 101 and is of a length such that in the addressed condition of the assembly not substantially more than a coil of the spring 101 is free between the lower chamfered tip or end of the boss 100 and the lower external spring guide and vibration damping assembly including the resilient bumper 83', the hardened guide sleeve 84' having its upper end internally chamfered at 85' and mounted within the vibration absorbing and guide and supporting sleeve lower bumper member 87', of similar construction and function as in Figure 2. Thereby, during stroking movements of the piston 97 there is provided internal and external guide for the coils of the spring 101 and effective vibration damping for the spring.

In addition to its spring guiding and vibration damping functions, the boss 100 serves as a support and connector for a driving blade 102 which may essentially be the same as the blade 63 of Figure 2. However, the blade 102 has a head end portion 103 which is fitted into a downwardly opening complementary slot 104 in the lower end portion of the boss 100 and is secured in such slot by suitable means such as by pinning the same.

At its upper end, the piston 97 has a crown protuberance in the form of an upwardly projecting central short boss 105 serving as a spacer stop for engagement with a bumper such as the bumper 93 in Figure 2 or the bumper 44 in Figure 1.

On its under face the piston 97 may be provided with a thrust washer set into a recess therein about the boss 100, and corresponding substantially to the thrust washer 80 in Figure 2.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

We claim as our invention:

1. In a pneumatically-operated fastener driving machine including a fastener driver and a piston with a rod portion to which the driver is operatively related, a coiled return spring about the rod portion and normally acting to return the piston to a non-operating position and also serving as an operating stroke terminal buffer, said piston having an annular downwardly directed marginal flange, and a resilient bumper engageable by said flange at the terminus of the driving stroke of the piston, said bumper comprising a resilient annulus structure and a rigid retaining sleeve within said resilient annulus structure and freely encircling said spring for retaining the annulus structure against radially inward displacement into interfering relation with the spring, said sleeve having a radially outwardly turned lower end flange underlying the annulus structure to prevent climbing of the sleeve relative to the annulus structure in operation.

2. In a driving machine including a driver, a pneumatic piston and cylinder assembled with respect to the driver for actuating the driver in driving and return strokes, and a terminal bumper engageable by the piston at the end of a driving stroke, said bumper comprising a resiliently yieldable non-metallic annulus structure and a rigid confining sleeve internally of the annulus structure, said confining sleeve having a flow relief groove therein opposing said annulus structure for improving the resilient yieldability of the resilient annulus structure.

3. In a driving machine including a driving plunger, an impact absorbing cushion for said plunger comprising a bumper annulus of a resilient high impact resistant elastomer and a backup bumper annulus interposed between said resilient annulus and a supporting surface, and a confining tube internally of the bumper annuli and retaining said resilient annulus against inward displacement during impact thereagainst of the plunger.

4. In a driving machine including a driving plunger, an impact absorbing cushion for said plunger comprising a bumper annulus of a resilient high impact resistant elastomer and a backup bumper annulus interposed between said resilient annulus and a supporting surface, a confining tube internally of the bumper annuli and retaining said resilient annulus against inward displacement during impact thereagainst of the plunger, and a coiled compression return spring for the plunger bottoming at one end through said tube and engageable with the inner diameter of the tube upon tendency of coils thereof to displace laterally during approach of the plunger to the bumper.

5. In a driving machine including a driving plunger, an impact absorbing cushion for said plunger comprising

a bumper annulus of a resilient high impact resistant elastomer and a backup bumper annulus interposed between said resilient annulus and a supporting surface, a confining tube internally of the bumper annuli and retaining said resilient annulus against inward displacement during impact thereagainst of the plunger, a coiled compression return spring for the plunger bottoming at one end through said tube and engageable with the inner diameter of the tube upon tendency of coils thereof to displace laterally during approach of the plunger to the bumper, and a spring guiding and vibration damping projection on the plunger internally of said spring and cooperating with said tube to damp vibrational rythms of the spring throughout its length and to maintain the spring in cylindrical shape although subjected to sudden shocks in operation of the machine.

6. In combination in a machine including a piston operated plunger and a cylinder within which the piston is reciprocably operable, a coiled compression return spring thrusting at one end against the piston and at the opposite end against a thrust shoulder, and a vibration damper about the spring adjacent to said thrust shoulder and including a tubular member about the spring and vibration damping means between the tubular member and the wall of the cylinder.

7. The construction of claim 6 wherein the vibration damper comprises a pair of resilient annuli one of which is exposed at the top of said tubular member for bumper impact thereagainst of the piston.

8. The construction of claim 6 wherein the vibration damper comprises an impact bumper annulus exposed adjacent the end of the tubular member nearest the piston for impact bumper engagement by the piston, and a low vibrational frequency metal annulus supporting the resilient annulus.

9. In a driving machine assembly including a plunger, a coiled return spring thrusting toward the plunger, an elongated spring guide and vibration damper projecting from the plunger internally of the spring, and a driver attached to the plunger and including a head portion with a portion of the guide and damper disposed between said head portion and the plunger.

10. In a driving machine assembly including a piston having a driver attached thereto and including a head portion opposing the piston, a coiled return spring about the driver and head thrusting toward the piston, and a tubular spring guide and vibration damper internally of the spring and including attachment means secured in assembly with said head, said attachment means including a radially inturned flange at the end of the tubular member clamped between said head and the piston.

11. In combination in a fastener driving machine, means defining a cylinder, a piston operator reciprocably movable in said cylinder, means for normally biasing the piston into a neutral position, the piston having projecting thereabove a head stop member, and a resilient bumper projecting from the top of the cylinder and engageable by said stop member to define a maximum return limit for the piston and thus a predetermined head room above the piston, said resilient bumper including a supporting stud and a resilient body carried by the stud on the side of the stud nearest the piston stop member, said resilient bumper member having interposed between the lower face thereof and the piston bumper member an impact plate, said plate having attachment legs projecting up from the periphery thereof past the resilient bumper member and retainingly engageable with the stud.

12. In a piston operated driving machine assembly wherein a piston is reciprocable in a cylinder and includes biasing means normally returning the piston to a neutral position, a return stop bumper and head room assuring member including a supporting stud having a downwardly facing head flange thereon, a resilient bumper engaging the lower face of the head flange, and means for connecting the resilient bumper to said head flange and leaving the sides of the resilient bumper free for lateral expansion, said retaining means including an impact body interposed between the resilient bumper and said head flange and having arm means projecting up past the resilient bumper and retainingly overlying the upper side of the head flange, with clearance above the head flange for movement of the arm means relative to the head flange incident to compression of the resilient bumper upon piston impact against the impact body.

13. In a driving machine including a reciprocable plunger, a coiled return spring normally acting to return the plunger to one end of its reciprocable stroke, a resilient bumper structure defining the opposite end of the reciprocable stroke of the plunger and engageable by the plunger with substantial impact, said bumper structure including resilient bumper means and a rigid retaining sleeve within which the resilient bumper means is confined against any substantial transverse shifting, said sleeve freely encircling said spring, and means retaining said sleeve against axial displacement.

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