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PORTABLE STAPLER WITH PNEUMATIC DRIVE

Filed March 8, 1962

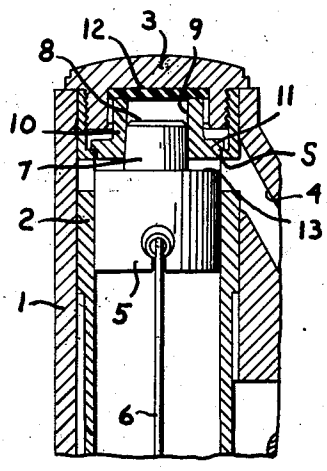


FIG.-1

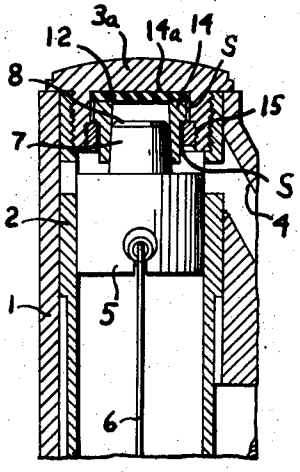


FIG-2

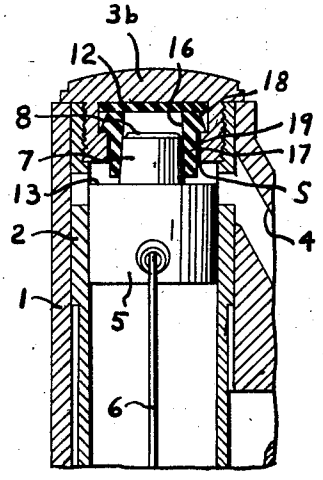


FIG-3

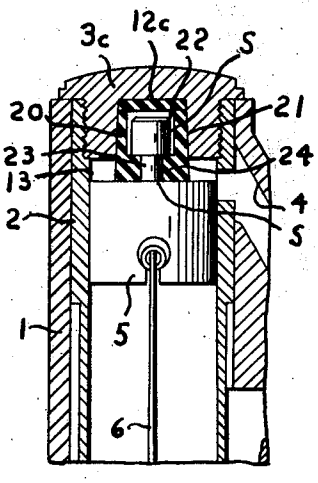


FIG-4

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PORTABLE STAPLER WITH PNEUMATIC DRIVE

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The present invention relates to portable staplers with pneumatic drive and, more specifically, concerns portable staplers of the general type described, for instance in Patent No. 2,983,922 in which a piston under the influence of compressed air actuates a driver for driving staples and the like into a work piece.

In connection with the driving operation carried out by such compressed air operable piston, it is desirable already at the start of the working stroke of the piston to impart upon the piston as high an acceleration as possible in order to obtain a correspondingly strong driving impact. Therefore, efforts have been made to release the piston for its working stroke only after an air pressure of a certain magnitude has been built up on the actuating side of the piston. To this end, i.e., for purposes of holding the piston in its starting position until the desired pressure has been built up on the actuating side of the piston, a magnet has been provided in the cylinder head. According to another heretofore known arrangement, pressure controlled holding pins have been provided which engage the piston until the desired pressure has been built up on the actuating side of the piston and disengage said piston when said desired pressure has been obtained.

The provision of a magnet does not represent an ideal solution because the holding force of the magnet will, due to the rapidly repeated tearing off of the piston at each working stroke, be quickly exhausted. The provision of holding pins has the drawback that these pins quickly wear in view of the fast succeeding impact of the piston, so that these pins become more or less ineffective.

It is, therefore, an object of the present invention to provide an arrangement for use in connection with portable staplers with pneumatic drive, which will hold the pneumatically operable piston in its starting position until a certain pressure has been built up, while overcoming the drawbacks set forth above.

It is another object of this invention to provide an arrangement as set forth in the preceding paragraph, which will be rather simple and highly effective.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing, in which:

FIGURE 1 is a section through the cylinder-head of a portable stapler of the general type involved in the present case in which the pneumatically operable piston is provided with a truncated cone for engagement with a correspondingly shaped insert to effect the holding of the piston in its starting position until a certain pressure has built up.

FIGURES 2, 3 and 4 represent sections similar to that of FIGURE 1 but respectively showing three different modifications for the means adapted to hold the piston in its starting position prior to each working stroke until a certain pneumatic pressure has built up on that side of the piston which is to be subjected to the action of compressed air.

The arrangement according to the present invention is characterized primarily in that the piston and the cylinder-head for receiving the piston in its starting position or at the end of its retraction stroke, are provided with preferably conical frictional surface means of such a design that it will engage the piston at the end of its return stroke—which also represents the starting position for the next stroke—so as firmly to retain the piston. Preferably, the arrangement is such that the piston is provided with a truncated cone-shaped member adapted to enter a correspondingly hollow body with an inner conical surface, while the dimensions of said truncated cone and said inner conical surface are such that the truncated cone-shaped member will be held in engagement with the inner surface of said hollow member. It is, of course, also possible to reverse the arrangement, viz. to arrange in the cylinder-head a truncated cone-shaped member while providing the engaging conical surfaces within said piston. The fit of the piston in the hollow member in the cylinder-head may be determined by various means as, for instance by the selection of a more or less small conical angle, by adapting the material of the interengaging surfaces to each other with regard to elasticity and smoothness of said surfaces, by the precision of the fit, and finally by determining the power for driving the piston at the end of its return stroke by compressed air or spring pressure into engagement with the corresponding surfaces of the hollow member in the cylinder-head. Preferably, a plurality or all of said steps are selected and adapted to each other. In this way, the present invention makes it possible to determine the air pressure upon the piston at the instance of its detachment from the hollow member and thereby also to determine the magnitude of the driving impact.

In order to assure complete coaxality of the two conical parts at the instance of engagement with each other, according to a further feature of the invention, one of the two conical members is journalled with a slight transverse play—if desired, under a certain springiness—so that the interengagement of said conical parts will be effected in a self-centering manner with simultaneous and uniform engagement of the adhering surfaces.

Referring now to the drawings in detail and FIG. 1 thereof in particular, FIG. 1 shows a cylinder **1** of a portable stapler with a cylinder sleeve **2** mounted in cylinder **1**. The cylinder sleeve **2** has at its upper end threadedly connected thereto a cylinder-head **3**. The cylinder and cylinder sleeve are provided with a compressed air supply passage **4** through which compressed air for carrying out a driving stroke is conveyed to the actuating annular area **13** of a piston **5** which has connected thereto a staple driver **6**. In FIG. 1 piston **5** occupies its retracted position at the end of a working cycle, which position may also be termed the starting position prior to the start of a working cycle.

According to the arrangement of FIG. 1, piston **5** has connected to its upper end face a truncated cone **7** which is coaxial with piston **5**. As will be seen from FIG. 1, the taper of the truncated cone **7** is rather slight so that the conical surface of the truncated cone **7** is rather steep. At its very end face, the truncated cone **7** is bevelled at the surface **8**.

Mounted in the upper end of the cylinder sleeve **2** is a hollow member **10** with a conical bore of the same taper as the truncated cone-shaped member **7**. The hollow member **10** is a steel bushing provided with a flange **11** by means of which, under a slight play *s* in transverse direction, it rests on an annular surface of the cylinder sleeve **2**. The bushing **10** is held in its position by the cylinder lid **3** firmly screwed into the upper portion of cylinder sleeve **2**. Between the cylinder lid **3** and the adjacent end faces of bushing **10** there is provided a slightly elastic buffer **12** of rubber or synthetic material.

At the end of the return stroke of piston **5**, which return stroke may be effected either by compressed air or a spring in a manner known per se, the truncated cone **7** of the piston **5** is forcibly driven into the inner cone **9**, while the play *s* will, if necessary, permit a

certain transverse displacement in cooperation with the bevelled surface 8, whereby simultaneously the two conical surfaces of truncated cone 7 and bushing 10 will completely and on all sides engage each other, so that the cone 7 will hold piston 5 in the cylinder-head with considerable force, as a result of which the piston 5 is retained in its return stroke end position or—which means the same—in its starting position for the next following stroke. This holding force must be overcome by building up the pressure of the compressed air admitted through passage 4 and acting upon the annular area 13 of the piston 5. If the said air pressure acting upon the annular area 13 has built up to such an extent that the frictional force between the outer conical surface of part 7 and inner conical surface of part 9 has been overcome, the truncated cone-shaped portion 7 is pushed out of the hollow member 10 and the working stroke of piston 5 is initiated at corresponding increased acceleration. Thus, by appropriately selecting and adapting the above-mentioned factors, it is possible, for instance when working at an operating pressure of the compressed air of five atmospheres above atmospheric pressure, to increase the pressure at which the truncated cone-shaped portion 7 will detach itself from hollow member 10 to a pressure of three atmospheres above atmospheric pressure. Any possible excess forces occurring when the truncated cone-shaped member 7 enters the bushing or hollow member 10, are absorbed by the elastic buffer or cushion 12. The degree of elasticity or softness of the material of which said buffer 12 is made may, if desired, also influence the extent of the adherence of member 7 to member 10.

The modification shown in FIG. 2 differs from that of FIG. 1 in that the bushing 10 has been replaced by a bushing 14 which may be of steel, and is exclusively journalled in cylinder-head 3*a*. The bushing 14 with an inner conical surface 14*a* is retained in the cylinder-head 3*a* by means of a ring 15 screwed into the cylinder-head 3*a* and pressing the bushing 14 against the buffer 12 in said cylinder-head 3*a*. Also in this instance, a transverse play *s* for centering the parts 7 and 14 is provided, and more specifically in this instance, between the threaded ring 15 and the bore in the cylinder-head 3*a* on one hand and the bushing 14 on the other hand. The other parts of FIG. 2 correspond to those of FIG. 1 and therefore have been designated with the same reference numerals as in FIG. 1.

With the embodiment of FIG. 3, the bushing 17 with the inner conical surface 16 consists of a synthetic material of sufficient hardness as, for instance, polyamide or polyurethane but is sufficiently yieldable so that its collar 18 can be pressed by an inwardly extending flange 19 of cylinder-head 3*b* into a position in which it will be head with a slight lateral play *s*. This play, however, may not be necessary if the synthetic material for the bushing 17 has sufficient elasticity. If the material for the insert or bushing 17 consists of a synthetic material of a certain pressure elasticity, its bore 16 may be slightly steeper than the outer conical surface of the truncated cone-shaped member 7 so that the said member 7 will, when entering bushing 17, elastically widen the same whereby the pressure and thereby the holding force between members 7 and 17 will be increased. Moreover, the yieldability of the synthetic material will, in cooperation with the buffer disc 12 soften the shock occurring during the braking of the piston to a standstill at the end of its retraction stroke. The bushing 17 may be of such length that it protrudes beyond the bottom surface of the cylinder-head 3*b*. In the course of hte operation of the stapler, the elastic insert or bushing will deform in axial direction in such a way that its end face will be contacted by the end face 13 of the piston 5 whereby the insert 17 will aid in the absorption of the axially effective force. This makes it possible to limit the elastic deformation of said insert and thereby the holding force for the piston in its retracted position.

The modification shown in FIG. 4 differs materially from the modifications of FIGS. 1 to 3 in that the cylinder-head 3*c* directly contains the inner cone. More specifically, the inner cone is formed by the wall of a slightly conical formation 20, whereas the outer cone is formed by a part not firmly connected to piston 5. The said outer cone is represented by a truncated cone 21 slipped over a narrow or stud portion 22 of piston 5. Said stud portion 22 is provided with a throat 23 engaged by an inner collar 24 of truncated cone-shaped member 21. Also in this instance, there is a slight play provided between the throat 23 and the annular portion of the inner collar 24. This transverse play together with the elastic extensibility of the synthetic material of member 21 makes it possible to slip member 21 over the stud portion 22. The length of stud 22 is so limited that its end face, when occupying the position shown in FIG. 4, has a sufficient distance from buffer 12 in order not to affect the adhering position of the conical surfaces.

Within the range of throat 23, the annular truncated cone-shaped member 21 is pressed together by axial forces so that the adherence will be correspondingly reduced, and the detachment of the piston from its adhering position will be facilitated. This may be of particular importance with small devices which have no return spring.

If the adhering surfaces have a plane shape, the piston, instead of being provided with a truncated cone-shaped member, will be provided with a wedge-shaped member, and the counter surfaces in the cylinder head will be provided on a pair of jaws which, if desired, may be journalled so as to spring in transverse direction. This will principally not change the features described above in connection with the inserts 10, 14 and 17.

It is, of course, to be understood that the present invention is, by no means, limited to the particular constructions shown in the drawings, but also comprises any modifications within the scope of the appended claims.

While the play "*s*" which is determined by the degree of the taper of the truncated cones may vary in narrow limits a play of 0.1 to 0.2 millimeter has been found effective with the arrangements shown in the drawings.

What I claim is:

1. In a portable stapler having a cylinder and a cylinder head closing one end thereof, and inlet means in said cylinder for admitting compressed air; a piston provided with staple driver means and reciprocable in said cylinder from a starting position into an end position and vice versa, said piston also being provided with an effective surface area continuously communicating with said inlet means and operable in response to a certain pressure acting upon said effective surface area to actuate said piston for performing a driving stroke from said starting position to said end position, first holding means in said one end of said cylinder, and second holding means connected to said piston and telescopically received in said first holding means in said starting position of said piston, said first and second holding means adhering to each other by friction only and at a force sufficient to balance only a certain air pressure acting on said piston area which is less than said first mentioned certain pressure.

2. In a portable stapler having a cylinder and a cylinder head closing one end thereof, and inlet means in said cylinder for admitting compressed air: a piston provided with staple driver means and reciprocable in said cylinder from a starting position into an end position and vice versa, said piston also being provided with an effective surface area continuously communicating with said inlet means and operable in response to a certain pressure acting upon said effective surface area to actuate said piston for performing a driving stroke from said starting position to said end position, first holding means in said one end of said cylinder, and second holding means connected to said piston and telescopically received in said first holding means in said starting position of said piston, said first and second holding means adhering to each other by

friction only and at a force sufficient to balance only a certain air pressure acting on said piston area which is less than said first mentioned certain pressure, one of said holding means having a bore tapering slightly outwardly toward the other holding means, and the other one of said holding means comprising a member tapering inwardly toward said one holding means in conformity with the taper of said slightly tapering bore.

3. An arrangement according to claim 1, in which one of said holding means has a slight transverse play relative to the other holding means.

4. In a portable stapler having a cylinder and a cylinder head closing one end thereof and also having inlet means in said cylinder for admitting compressed air: a piston provided with staple driver means and reciprocable in said cylinder from a starting position into an end position and vice versa, said piston also being provided with an effective surface area continuously communicating with said inlet means and operable in response to a first certain pressure acting upon said effective surface area to actuate said piston for performing a driving stroke from said starting position to said end position, bushing means inserted into said cylinder head and provided with a bore tapering outwardly slightly toward said piston, said bushing means being held in its position between said cylinder head and the inner wall of said cylinder, and a truncated cone-shaped member connected to said piston and tapering in conformity with the slightly tapering bore of said bushing for frictional engagement therewith at said starting position, said frictional engagement being such as to balance a second certain air pressure acting on said piston area and less than said first certain pressure.

5. An arrangement according to claim 4, which includes threaded ring means securing said bushing means in said cylinder head.

6. In a portable stapler having a cylinder and a cylinder head closing one end thereof, and inlet means in said cylinder for admitting compressed air: a piston provided with staple driver means and reciprocable in said cylinder from a starting position into an end position and vice versa, said piston also being provided with an effective surface area continuously communicating with said inlet means and operable in response to a first certain pressure acting upon said effective surface area to actuate said piston for performing a driving stroke from said starting position to said end position, said cylinder head being provided with an inwardly extending flange confining a bore, insert means inserted into said bore and provided with an outwardly extending flange extending over said inwardly extending flange of said cylinder head, said insert means being of elastic synthetic material to permit passage of said outwardly extending flange through the bore confined by the inwardly extending flange of said cylinder head, resilient buffer means mounted between

said cylinder head and the outwardly extending flange of said insert means to hold the outwardly extending flange of said insert means between said buffer means and the inwardly extending flange of said cylinder head, said insert means having a bore tapering outwardly slightly toward said piston, and a truncated cone-shaped member connected to said piston and frictionally engaging said tapering bore in the starting position of said piston with a force balancing a second certain pressure on said piston area less than said first certain pressure.

7. An arrangement according to claim 6, in which the free end of said insert means protrudes from said cylinder head toward said piston area.

8. In a portable stapler having a cylinder and a cylinder head closing one end thereof, and inlet means in said cylinder for admitting compressed air: a piston provided with staple driver means and reciprocable in said cylinder from a starting position into an end position and vice versa, said piston also being provided with an effective surface area continuously communicating with said inlet means and operable in response to a first certain pressure acting upon said effective surface area to actuate said piston for performing a driving stroke from said starting position to said end position, said cylinder head having a bore with a surface tapering outwardly slightly toward said piston, and a conical member mounted on said piston for frictional engagement with said tapering bore in said cylinder head in the starting position of said piston, said frictional engagement of said conical member with the wall of said tapering bore in said cylinder head being such as to balance a certain second air pressure acting on said piston area and less than said first certain pressure.

9. An arrangement according to claim 8, in which said conical member has an axial bore and an inwardly extending flange at the piston end of said bore, and a stud on the end of said piston and provided with an outwardly extending into said bore and collar extending over the inwardly extending flange, said conical member being of an elastic synthetic material permitting the passage of said collar through the bore confined by said flange.

10. An arrangement according to claim 4, which includes buffer means interposed between said cylinder head and said insert means.

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