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CONTROL SYSTEM FOR A PNEUMATICALLY OPERATED AIR INLET VALVE

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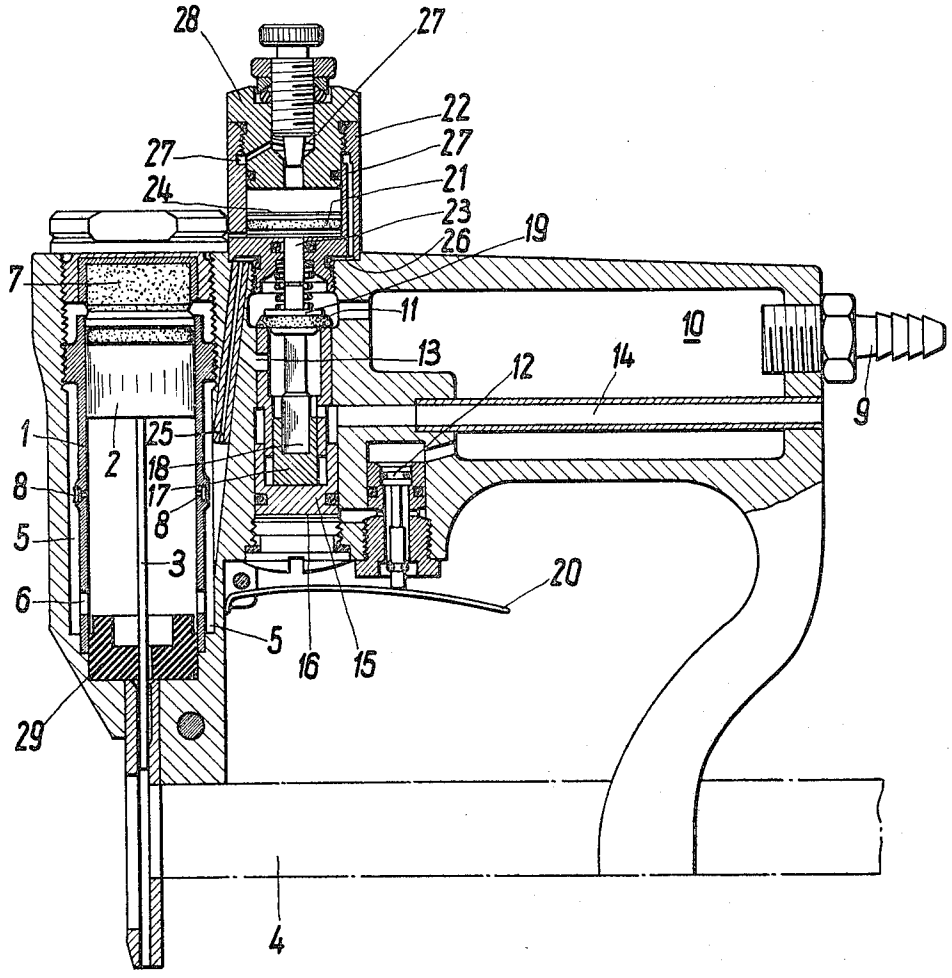

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CONTROL SYSTEM FOR A PNEUMATICALLY OPERATED AIR INLET VALVE

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ABSTRACT OF THE DISCLOSURE

A control system for a pneumatically operated air inlet valve for a pneumatic driving apparatus for nails, etc., using a differential piston cylinder unit for automatically repeating the operating cycle of the driving piston.

The prior art discloses a control system for a pneumatically operated air inlet valve of a pneumatic driving apparatus for nails, staples and the like for the automatic repetition of the operating cycles comprising operating stroke and return stroke, of the driving piston after initial opening of the air inlet valve constructed as differential piston cylinder unit by varying the air pressure acting on the larger valve piston surface and by using the operating air for closing the air inlet valve.

Such a control system permits the repeated driving-in of the aforementioned fastening means into the workpiece without requiring a separate actuation by the operator for each driving operation. The object of the invention is to simplify the aforementioned control method and of the control devices already proposed in this context.

According to the invention, it is provided that the working air used for closing the air inlet valve represents part of the compressed air stored intermediately in known manner for the piston return and is supplied directly to a valve piston surface acting in the closing sense, the said surface being larger than the opening piston surface and being in constant communication with the air return storage chamber. In this manner and as soon as the air storage chamber is filled with compressed air towards the end of the operating stroke, the air inlet valve is automatically closed against the resistance of the fresh working air acting upon the (smaller) opening piston surface so that the working cylinder chamber disposed above the working piston is vented in known manner and the piston is returned by the intermediately stored air. As a result of the expansion of the intermediately stored compressed air the pressure of the return air drops so that the closing force exerted by the said air on the air inlet valve diminishes until finally the force acting on the (smaller) piston surface in the opening sense once against becomes larger that the closing force and the air inlet valve is once again opened. By suitable dimensioning (in a manner already known to the expert) of the cross-section through which the air is ducted it is possible for such timing to be obtained that the piston shall have completed its return stroke at that moment of time and will be ready for the next working stroke initiated by renewed opening of the valve. For as long as the compressed air pressure is maintained on the opening valve piston surface—for example by continued operation of an appropriate operating valve—the operating cycle described heretofore will be automatically repeated.

The control apparatus according to the invention for performing the control method proposed herein is based on a pneumatically operated driving-in apparatus for

nails, staples and the like in whose operating cylinder the operating piston executes a working stroke when the air inlet valve is opened and executes a return stroke when the said valve is closed, the cylinder chamber disposed above the working piston being in communication with atmospheric air when the air inlet valve is in the closed position and the return stroke of the operating piston is applied under the effect of compressed air which is stored on completion of the working stroke in an air storage chamber constantly in communication with the cylinder chamber disposed below the working piston, the pneumatically operated air inlet valve having a differential piston onto whose smaller active surface the operating air pressure acts constantly while the said operating compressed air reaches the larger active surface only by operating an actuating valve.

In a control apparatus of the kind described according to the invention a compressed air duct is provided which constantly connects the air storage chamber with the larger valve piston surface.

If the driving-in apparatus is provided with an air inlet valve which is depressed into the closing position by the constant action of the working air onto the smaller piston surface and is opened by the supply of working air onto the oppositely directed larger valve piston surface by means of an operating valve, a valve piston section will advantageously be provided with an even larger piston surface which is in constant communication via the compressed air duct with the air storage chamber and acts in the closing sense of the air inlet valve.

However, if the control apparatus is intended for an air inlet valve which is depressed into the opening position by the constant action of the working air onto the smaller piston surface and is closed by the supply of working air onto the oppositely directed larger piston surface by means of the operating valve which will then be in its condition at rest while operation of the operating valve causes the larger valve piston surface to be vented, the invention accordingly provides that the compressed air duct constantly connects the air storage chamber with the larger valve piston surface if the operating valve is in its working condition while this connection is interrupted with the operating valve in the condition of rest.

The invention is illustrated in the drawing showing a cross-section of a staple driving apparatus with an air inlet valve of the first-mentioned kind.

The working cylinder **1** has disposed in it in known manner a reciprocating working piston **2** which, with the driver **3** (and with each operating stroke) drives a staple, supplied from the magazine **4**, which is only indicated, into a workpiece.

The cylinder **1** is surrounded by an air storage chamber **5** which is in constant communication via the bores **6** with the cylinder space disposed below the piston **2**. Towards the end of the operating stroke compressed air, which reaches the top of the piston **2**, held in its position at rest by the magnet **7** in a manner to be described hereinafter, passes through the openings **8** into the storage chamber **5** where a certain quantity of such air is intermediately stored. If the pressure of the working air has dropped sufficiently during venting of the cylinder chamber above the piston **2**, the said piston will be moved back by the stored air transferred into the cylinder **1** through the bores **6**.

The fresh working air which flows through the connection **9** into the hollow chamber **10** in the handle of the driving-in apparatus presses, in the condition of rest illustrated, both on the valve disc **11** of the air inlet valve as well as on the operating valve **12**. In this position, the cylinder chamber disposed above the working piston **2** will be connected to the atmosphere via the inlet duct **13** and the venting pipe **14**. This also applies to the piston

section **15** of the air inlet valve whose active surface **16** is vented along the tappet of the operating valve.

The piston section **15** is non-positively connected via the intermediate member **17** and the shank **18** to the valve disc **11** and together with the said valve disc forms a differential piston, the active surface **16** of the piston section **15** being larger than the active surface **19** of the valve disc **11**.

If the operating valve **12** is opened by pulling upward of the manual trigger **20**, air will pass from the hollow chamber **10** to the piston surface **16** of the valve piston section **15** while the venting system of the operating valve will be closed in the manner disclosed in the drawing. Owing to the larger active surface **16** of the piston section **15** relative to the active surface **19** of the valve disc **11**, the shank **18** with the valve disc **11** will be moved upwardly whereupon initially the connection between the inlet duct **13** and the venting pipe **14** will be interrupted and whereupon operating air flows past the valve disc **11** through the inlet duct **13** into the upper chamber of the cylinder **1** on to which the piston **2** acts and thus initiates the working stroke of the said piston.

In the apparatus, already known to this extent, the invention proposes a further valve piston **21** which is slidable in a housing **22** surmounted on the apparatus and whose operating direction corresponds to that of the valve disc **11**. As the said valve piston is mounted on the shank **18** with its tappet **23** it may also be regarded as a further section of the differential valve piston. Its active surface **24** is still larger than the oppositely acting surface **16** of the piston section **1**.

The space above the piston surface **24** is in communication via a compressed air duct **25**, an annular duct **26** and various extending bores or ducts **27** in the housing **22** or its screw cap **28** with the air storage chamber **5**. As soon as working air flows through the openings **8** towards the end of the working stroke and thus fills the air storage chamber **5**, part of this compressed air will flow through the ducts **25**, **26** and **27** into the interior of the housing **22** to act on the surface **24** of the valve section **21**. Since the piston surface **24** is larger than the oppositely acting surface **16** of the piston section **15**, the air inlet valve will be pressed into the closing position (while the air disposed below the valve piston surface **16** is pressed back along the shank of the operating valve **12** into the hollow chamber, the said operating valve **12** continuing to remain in the open position).

The positive closing of the air inlet valve causes the cylinder chamber above the operating piston **2** to be vented via the inlet duct **13** and the venting pipe **14** so that the operating piston **2** is moved back into its upper starting position by the force exerted by the compressed air intermediately stored in the air storage chamber **5**. At the same time the stored compressed air which maintains the air inlet valve above the piston section **21** in the closed position, is expanded and together with the pressure in the air storage chamber **5** the pressure acting on the surface **24** of the valve piston section **21** also drops (in actual fact, immediately after the operating piston **2** is lifted off the buffer **29**, the residual compressed air may escape along the driver **3** to atmosphere, but owing to the kinetic energy imparted to it, the piston reaches its upper limiting position very rapidly).

When the pressure drops below the minimum value depending on the sizes of the valve piston surfaces and the duct cross-sections, the force exerted by the piston section **15** onto the valve disc **11** owing to the constant action of the operating air once again increases and becomes larger than the oppositely directed force exerted by the piston section **21** so that the air inlet valve once again opens and a new operating cycle begins.

If instead of the arrangement described heretofore a piston type air inlet valve is provided of the kind disclosed and described in U.S. Patent No. 3,278,103 (for example FIGURE 1), which opens under the effect of the force constantly acting on the smaller piston surface when the larger piston surface, also under operating air pressure in its static position, is vented by opening of the operating valve, the arrangement will be so disposed in the manner described initially that the venting path of the operating valve is extended to the air storage chamber.

If the apparatus disclosed in the drawing to illustrate the invention is required to execute single blows, the duct system **26/27** is closed in a suitable manner while at the same time the chamber above the piston surface **24** is connected to the atmospheric air.

What I claim is:

1. A pneumatic fastener applying device including a cylinder and a piston movable therein in a cycle consisting of a working stroke and a return stroke, means providing an air storage chamber communicating with said cylinder adjacent the end toward which said piston moves on its working stroke, an inlet valve, an inlet air chamber for working air under pressure, said inlet chamber communicating with said inlet valve whereby air under pressure impinges against said inlet valve, said inlet valve comprising a differential piston having piston surfaces to which air under pressure is selectively directed for opening or closing said inlet valve, air passage means interconnecting said inlet valve and said cylinder opposite said storage chamber to supply working air to said piston for said working stroke upon movement of said inlet valve, a manually operable pilot valve in fluid communication with said inlet valve for admitting air under pressure to one piston surface of said inlet valve to effect shifting thereof in one direction to admit working air under pressure from said inlet chamber to said piston for effecting said working stroke, and fluid passage means from said storage chamber to said inlet valve and supplying air under pressure from said storage chamber to another piston surface to move said inlet valve in the opposite direction and thereby to cut off air under pressure from said inlet chamber to said cylinder, and a port from said cylinder to said storage chamber opened by said piston near the end of the working stroke of the piston whereby air under pressure above said piston enters said storage chamber and passes to the opposite side of said piston to effect said return stroke and to said fluid passage means for closing the inlet valve.

2. A pneumatic fastener applying device as set forth in claim **1** wherein said inlet valve piston has a piston surface of predetermined area exposed to said inlet chamber and closing off said air passage means to said cylinder, said inlet valve piston further having a second piston surface of larger area in fluid communication with said pilot valve for admitting air under pressure to move said inlet valve and thereby to open said air passage means to said inlet chamber, said inlet valve piston having a third piston surface of still larger area and exposed to the fluid passage means from said storage chamber to move said inlet valve in the opposite direction.

References Cited

UNITED STATES PATENTS

622,576	4/1899	Waugh	91—300
653,247	7/1900	Kimman	91—300
712,438	10/1902	Shaw	91—300
1,018,983	2/1912	Padbury	91—300
1,494,030	5/1924	Slater	91—300
3,301,139	1/1967	Garfinkel	91—355
3,353,453	11/1967	Ramspeck	91—356
3,278,102	10/1966	Siegmann	227—130
3,278,104	10/1966	Becht et al	227—130
3,278,103	10/1966	Juilfs et al.	227—130

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