DEVICE FOR CONTROLLING A HYDRAULICALLY OR PNEUMATICALLY DRIVEN CARTRIDGE RAMMING MECHANISM OF AN AUTOMATIC GUN

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The invention relates to a device for controlling an hydraulic or pneumatic control means of a cartridge-ramming apparatus of an automatic gun.

It is known to the art that a comparatively high fire power of a gun over a considerable period of time, combined with reasonable dimensions of cartridge magazine and loading mechanism of the gun, may be obtained by using a cartridge magazine in which the cartridges are arranged parallel to each other and from which the cartridges are, one by one, discharged by lateral movement to a ramming mechanism, by which the cartridges are then pushed forward to the cartridge-chamber of the barrel before firing.

In order to obtain a high firing speed with such an automatic gun it is of utmost importance, that every operative sequence in conveying cartridges from a cartridge-magazine of the gun to a cartridge-guide of the ramming mechanism in a position for being rammed, and for bringing forth the cartridge along said cartridge-guide to the cartridge-chamber, proceed without substantial stop intervals for the cartridge at different stations on its way from the cartridge-magazine to the cartridge-chamber.

For conveying a cartridge between different stations on its way from the cartridge-magazine to the cartridge-chamber of the barrel in an automatic gun of the kind described, the cartridge must obviously, be transported in a number of different directions, namely in part substantially perpendicular to the longitudinal axis of the cartridge, and in part in the direction of the cartridge axis. The transport mechanism for this purpose comprises two means for holding the cartridge steady relative to a cartridge feeding means of the mechanism during a feeding operation, said means during the final part of an operational sequence entering, together with the cartridge, the path, along which the cartridge is to be brought during a following operational sequence.

Consequently, a following operational sequence required for further transport of a cartridge on its way to the cartridge-chamber of the barrel, cannot proceed undisturbed before the cartridge holding means of the mechanism, which provides the next preceding operational sequence for feeding forth the cartridge, are withdrawn from the path for the following movement of the cartridge. On the other hand and in order to avoid undesired delay, a following operational sequence should start at a time so selected that a cartridge and, as the case may be, the means by which it is transported move in the new direction as soon as the path is left free.

With this object in view, the present invention relates to a device of the kind described for ramming cartridges by conveying the cartridges along a cartridge-guide means forward to the cartridge-chamber of an automatic gun by means of a ramming mechanism, said device comprising a reciprocating hydraulic or pneumatic motor, and control means comprising a flow valve for controlling impelling medium for said motor, said control means having a position in which the reciprocating motor receives impelling medium to drive the ramming mechanism in a direction for moving a cartridge forward through the cartridge-guide means, and a position in which the motor receives impelling medium to drive the ramming mechanism back into its rear position ready for a successive motion forward for ramming a cartridge.

In order to provide a starting of the ramming movement of the ramming mechanism without severe interval after a cartridge having been moved forward to the cartridge-guide and also to secure that the ramming mechanism for ramming is not started before the cartridge conveying means by which the cartridge has been brought into the cartridge-guide have moved out of the path of the cartridge during its movement in the axial direction of the cartridge-guide, the device according to the invention is constructed according to the following:

The control means, which comprise a directional flow valve for switching over the motor of the ramming mechanism for driving the ramming means thereof in either direction, comprises a first position and a second position, in which the flow valve receives impelling medium to drive the ramming mechanism in a direction for bringing the flow valve from a first position, in which the motor is connected to a motor driving medium source for driving the ramming means backward in the direction from the cartridge-chamber toward the rearmost position thereof, in which it is in position for starting a following ramming movement, to a second position in which the motor receives driving means for driving the ramming means forward from said rearmost position in the direction towards the cartridge-chamber. Said first flow valve actuating means and said cartridge conveying means by which a cartridge is introduced into the cartridge-guide each comprise actuating members, which are mutually cooperative during a return movement, and during a return movement only, of said cartridge conveying means from the end position thereof for depositing a cartridge in the cartridge-guide means of the ramming mechanism. A second flow valve actuating means is arranged to cooperate with the ramming means of the ramming mechanism, or a component movable therewith, at the end of the ramming movement thereof towards the cartridge-chamber, this second actuating means being arranged to actuate the flow valve to switch the flow valve from said second position to said first position, in which last position the motor, via the flow valve, receives driving means for driving the ramming means in the direction from the cartridge-chamber back to its rearmost position, ready for starting a successive ramming movement.

By this arrangement the desired result is obtained; that is, the ramming means is automatically started as soon as the cartridge conveying means by which the cartridge is introduced in the cartridge-guide in a direction perpendicular to the cartridge-axis has left its end position when depositing a cartridge in the cartridge-guide and after the cartridge retaining means of said conveying means have been withdrawn from the path of the cartridge in the longitudinal direction of the cartridge-guide.

In a preferred embodiment of an apparatus according to the invention, the flow valve comprises a directional force means to yieldingly hold the flow valve in said first position in which the motor is connected to the driving medium source to bring the ramming means into and hold these means in the rearmost position, that is the start position for a ramming movement, and a releasable valve retaining means for retaining the flow valve in the second position thereof against the action of said directional force means when the flow valve has been brought into this second position thereof by action of said first flow valve actuating means, as well as releasing means cooperative with said valve retaining means to leave the flow valve free to move back into its first position by action of the directional force means said releasing means being actuated by said second flow valve.
actuating means when these last mentioned actuating means are actuated by the cartridge ramming means at the end of a ramming movement.

The invention will become more clearly apparent from the following description of a preferred embodiment as illustrated in the accompanying drawing in which:

FIG. 1 is a perspective view showing a device according to the invention comprising a ramming mechanism and a cartridge-guide, and a detail of a cartridge-choist for operating said cartridge to the cartridge-guide.

FIG. 2 is a diagrammatical side view of the device according to FIG. 1 after a cartridge has been deposited in the cartridge-guide by means of the cartridge-choist and during the return movement of the hoist.

FIG. 3 is a side view illustrating the device in a position, in which the motor is moving forward during ramming, and

FIG. 4 is a section through an embodiment of a flow valve for controlling the fluid flow to a hydraulic motor of a device according to FIGS. 1-3.

In FIG. 1 the device according to the invention is illustrated in combination with a cartridge-rammer 3, which is located above and movable back and forth along a cartridge-guide 2, here illustrated as comprising upper and lower guide bars 3 and 4, respectively, and mounted rearwardly of a breech ring 5, a breech block and a cartridge-chamber (not illustrated) of the gun barrel 6. A cartridge-choist 7 is movable upwardly and downwardly, as indicated by the double-arrow 8, in a hoist shaft. The hoist 7 is being driven by driving means (not illustrated) and conveys cartridges, one by one, from a cartridge magazine (not illustrated) located below cartridge-guide 2. When lifted by the hoist a cartridge enters into the cartridge-guide between the lower guide-bars 4. To make possible the introduction of a cartridge from below, these lower guide-bars are brought aside from each other during the last part of the upward movement of the hoist, whereafter they are brought back into the position illustrated in the drawing for holding the cartridge, as soon as the cartridge has been introduced between the guide-bars. The means providing this movement of the lower guide bars are not illustrated in the drawing as not being part of this invention.

The cartridge-choist comprises a support platform 9 for a cartridge, said platform 9 comprising front and rear struts 10 to hold a cartridge in the longitudinal direction thereof, the cartridge being held steady in a lateral direction during the upward movement from the magazine by side walls defining the hoist shaft.

The device of the invention comprises an hydraulic piston motor 14, having a piston 38 and a piston rod 13, this piston rod 13 being connected to the cartridge-rammer 1 by means of a lug 12 of the rammer. The cylinder of motor 14 is secured to a part 15, which is stationary relative to the gun barrel during ramming.

The hydraulic motor 14 comprises two fluid duct connections 16 and 17, respectively, for a pressurized fluid, the connections 16 and 17 communicating with cylinder spaces 41 and 40, respectively, on either sides of piston 38. As is described more in detail with reference to FIGS. 2 and 3, the connection 16 and 17 further communicate with a flow control valve 18, and inlet and outlet ducts 42 and 20 respectively. The flow valve 18, illustrated in FIGS. 2-4 in the form of a piston slide valve, is, as is further described below, arranged to cooperate with a first flow valve actuating means to be brought into said actuating means from a position, the "first position" of the flow valve mentioned above, in which motor 14 receives fluid to force the cartridge-rammer 1 into the rear starting position thereof for ramming, and into a position, the "second position" of the flow valve mentioned above, in which the motor receives fluid for forcing the cartridge-rammer forward during ramming.

In the embodiment as illustrated, said first flow valve actuating means comprises a double-armed or bell crank lever 22 which is pivotal about a stationary pivot 21 and comprises an actuating arm 23 arranged to cooperate with a component of the hoist during part of the hoist motion.

For this purpose, the hoist platform 9 comprises a lug 11, which can cooperate with arm 23 over part of its way when moving together with the platform. A second arm 24 of lever 22 is, by means of a connecting rod 25, coupled to an arm 26 of a further bell crank lever 28, a second arm 29 of which is cooperative with flow valve 19 to switch over the flow valve from said first to said second position thereof.

The arrangement of the first flow valve actuating means thus described, and in particular the actuating arm 23 thereof, and lug 11 of the cartridge-choist is such that lug 11 can pass past arm 23 during an upward movement of the hoist without the flow valve 18 being actuated, while, for a downward movement of the hoist from the uppermost position thereof after the introduction of a cartridge in the cartridge-guide, lug 11 cooperates with arm 23 to swing the arm out of the path of lug 11. Suitable means for obtaining such cooperation between lug 11 and arm 23 are as such obvious from the embodiment and are, as diagrammatically illustrated in the drawings.

The embodiment illustrated in the drawings, this second flow valve actuating means comprises a double-armed lever 32, which is pivotal about a pivot 31 and comprises two arms 33 and 34. The lever arm 33 is cooperative with a part of the cartridge-rammer 1, for instance lug 12 secured thereto, and is so arranged that it is actuated to swing lever 32 about pivot 31 when the cartridge-rammer reaches the end of its forward motion during ramming, and the lever arm 34 is cooperative with the flow valve to switch over the flow valve 18 from the "second" into the "first" position thereof.

As illustrated in FIGS. 2 and 3 the cartridge-rammer 1, which comprises a detent 37 cooperating with the case-bottom of a cartridge 36 for pushing forward the cartridge in cartridge-guide 2 during ramming, is connected to the motor piston 38 by means of a piston connecting rod 13, the diameter of which is rather large as compared with the diameter of the motor cylinder. Then, if the piston, as is the case in the device illustrated in FIGS. 2-4 for one of said positions of the flow valve, is being exposed to the same impelling fluid pressure on both sides of the piston, the piston will be pushed in the piston rod direction by a force proportional to the pressure of the fluid and the sectional area of piston rod 13. The inlet duct 42 for the fluid permanently connects, by means of a duct 43, to the connection 17 of the cylinder space 40 surrounding piston rod 13, while the connection 16 to the cylinder space 41 on the opposite side of piston 38 connects, in dependence of the position of flow valve 18, either to the inlet duct 42 via the inlet duct 19 of the flow valve 18, or to an outlet duct 20 for the fluid, leading to a fluid sump. In the first instance the hydraulic motor 14 exerts a force on the cartridge-rammer to move it forward for a ramming motion, while in the second instance the cartridge-rammer is exposed to a force in the opposite direction, the magnitude of which is proportional to the fluid pressure and the area of the annular
surface of piston 38 constituting an end wall of the annular cylinder space 40.

Flow valve 18 comprises a slide valve member 51, illustrated in form of a twin-piston, which is slidable arranged in a bore 50 and movable between one position, FIGS. 2 and 4, in which duct 44 communicates with the outlet duct 20 and the inlet duct 19 is closed, this position constituting the "first position" of the flow valve. The flow valve 18 further comprises a directional force means, a spring 52, tending to bring the piston 51 into an end position in which the flow valve is in said first position, and a member 30 arranged to cooperate with arm 29 of the said first flow valve actuating means 21–29 to push the position illustrated in FIG. 3, against the action of spring 52, during a downward movement of the cartridge-hoist 9. Flow valve 18 is thus brought into the said second position thereof, in which the connection between duct 44 and outlet duct 20 is blocked, and duct 44, via flow valve 18, connects to inlet duct 19.

After having been brought into this position by said first flow valve actuating means 21–29, the piston 51 is prevented from returning to its said first position by a releasable retaining means, a preferred embodiment of which is illustrated diagrammatically in FIGS. 2 and 3 and more in detail in FIG. 4.

In this embodiment the member 30 which is cooperative with the first flow valve actuating means 21 through 29, consists of a pin extending in the direction of movement of valve member 51, and the releasable retaining means comprises a member 33 having an aperture which is so dimensioned that the internal walls thereof cooperate with pin 30 for retaining the piston against movement in the direction of the force exerted by spring 52 when the disc, by abutting against an edge of which rests on an abutment 53 which is located eccentrically relative to the limb being tilted into an oblique position. As soon as the disc has moved into this position, pin 30 is being locked against further movement in the direction of the force exerted by spring 52, that is in the right-hand direction in FIG. 3. A spring 55 aids in bringing the disc 54 into its locking position.

The device further comprises a releasing means for the retaining means thus described, consisting of a releasing member in form of a pin 35, cooperative with said "second flow valve actuating means" 31 through 34 and arranged to push disc 54, against the action of spring 55, to a position, in which pin 30 is left free to move in the right-hand direction, FIG. 3, by action of spring 52.

The function of a device according to the invention will be described in the following, beginning from a situation, in which a cartridge, together with the cartridge-hoist 7, is conveyed upwardly towards cartridge-guide 2 from a cartridge outlet part of the magazine. At this moment, the fluid flow control piston 51 of flow valve 18 occupies the position illustrated in FIG. 2, said position being the "first position" mentioned above, in which the cylinder space 41 communicates with the fluid outlet duct 20 via the flow valve, and the cartridge-rammer 1 has been brought to and is held in the position illustrated in FIG. 2 by fluid pressure prevailing in the annular cylinder space 40. The cartridge-rammer 1 is thus in a position, in which it is ready for ramming. Shortly before the hoist has reached the position in which the cartridge has been introduced into the cartridge-guide 2 to be deposited therein, lug 11 of the hoist will pass past dent 23a on arm 23, without, however, the flow valve means being actuated. After the cartridge has been deposited in the cartridge-guide, hoist 7 commences its downward movement, as indicated by arrow 60 in FIG. 2, during which movement lug 11 engages dent 23a; which, for this direction of movement of the hoist, catches the lug, and, by articulating arm 23, actuates said "first flow valve actuating means" 21–29, as illustrated by arrow 61. As a consequence, pin 30 and piston 51 are pushed, against the action of spring 52, into the position illustrated in FIG. 3.

As soon as lug 11 has moved past dent 23a, while articulating arm 23, the "first flow valve actuating means" 21–29 returns to its original, rest position by action of a directional force, for instance gravity, the valve piston 51 however being retained in the position thereof illustrated in FIG. 3. In this position the cylinder space 41 is connected to the fluid inlet duct 42, the outlet duct 20 being blocked by the piston 51. Consequently, the motor piston 14 is forced forward, bringing the cartridge-rammer 1 and the cartridge with it forward towards the cartridge-chamber of the barrel.

Towards the end of the ramming motion the cartridge-rammer hits arm 33 of the second flow valve actuating means 31–34, which in its turn actuates pin 35 to push the retaining disc 54 of the valve retaining means 53–55 into a position, in which pin 30 is left free to move in its longitudinal direction within the aperture of disc 54. The retaining means thus having been released, the piston 51 returns, by influence of spring 52, to the position in which cylinder space 41 of the fluid motor is connected to outlet duct 20, the cartridge-rammer thus being brought back to and is held in its start position for a successive ramming movement.

This succession of operations is then repeated after the introduction of a next cartridge in the cartridge-guide by means of the hoist.

While the invention has been described in detail with respect to certain now preferred examples and embodiments of the invention, it will be understood by those skilled in the art, after understanding thereof, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, to cover all such changes and modifications in the appended claim.

What is claimed is:

A device for ramming cartridges by conveying a cartridge along a cartridge-guide means forward to the cartridge-chamber of an automatic gun, said device comprising, in combination:

a ramming mechanism including a reciprocating ramming means;

a reciprocating pressure fluid-operated motor;

the control means including a flow valve for controlling the flow of pressure fluid to said motor;

discarding means for feeding a cartridge to the cartridge-guide means;
said flow valve having a first position, in which said motor is connected to a source of pressure fluid for driving said ramming means backward from a forward position thereof towards a rearmost position thereof in which said motor is in position for starting a following ramming movement, and a second position in which the motor is connected to said fluid source for driving the ramming means forward from said rearmost position in the direction towards the cartridge-chamber, and said control means further including a first flow valve actuating means for moving the flow valve from said first position to said second position during a return movement of said cartridge conveying means from an end position thereof for feeding the cartridge to the cartridge-guide means;

a second flow valve actuating means cooperative with the ramming means at the end of the forward movement thereof for moving the flow valve from said second position to said first position;
said cartridge conveying means being movable upwardly and downwardly in a reciprocating movement between a position to feed the cartridge to the
cartridge-guide means and a position externally of said cartridge-guide means to receive the cartridge to be conveyed to the cartridge-guide means, and said first flow valve actuating means including unidirectional actuating members to actuate said first flow valve actuating means during the return movement only of the cartridge conveying means from said end position thereof, to feed the cartridge to the cartridge-guide means.

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