APPARATUS FOR THE MULTI-STAGE, HYDRAULIC-MECHANICAL BRAKING OF THE FORWARD MOVEMENT OF A DISPLACEABLE BARREL OF AN AUTOMATIC FIRING WEAPON

Inventors: Jurg Zellweger, Neerach; Ernst Hurlemann, Zurich, both of Switzerland

Assignee: Werkzeugmaschinenfabrik Oerlikon-Bührle AG, Zurich, Switzerland

Filed: Jan. 12, 1973

Appl. No.: 323,336

Foreign Application Priority Data
Jan. 18, 1972 Switzerland

U.S. Cl. ......................... 89/177, 89/43, 188/318
Int. Cl. ......................... F41f 19/14
Field of Search .............. 89/43 R, 177; 188/284, 188/285, 286, 287, 318

References Cited
UNITED STATES PATENTS
3,512,449 5/1970 Stoner.............................. 89/177
1,744,514 1/1930 Thompson ..................... 89/43 R

Primary Examiner—Stephen C. Bentley
Attorney, Agent, or Firm—Werner W. Kleeman

ABSTRACT

An apparatus for the multi-stage, hydraulic-mechanical braking of the forward movement of a displaceable barrel or tube of an automatic firing weapon comprising a hydraulic brake having a cylinder, a brake piston equipped with check valves arranged in said cylinder, a mechanical brake connected in series with said hydraulic brake, said mechanical brake having a set of springs. During a first portion of the forward movement of the barrel of the firing weapon the check valves are open. A ring member is provided which is displaceable out of a work position into a rest position by the piston and there are also provided stop means for limiting the stroke of such ring member. A spring is provided which strives to retain the ring member in its work position, in which position it closes the check valves of the brake piston as soon as it comes to bear during a second portion of the forward movement of the barrel of the firing weapon against the brake piston. The set of springs is arranged in the cylinder and the ring member is located between the brake piston and the set of springs for transmitting the forward moving forces to the set of springs during a third portion of the forward movement of the barrel of the firing weapon past the starting position.

5 Claims, 3 Drawing Figures
APPARATUS FOR THE MULTI-STAGE, HYDRAULIC-MECHANICAL BRAKING OF THE FORWARD MOVEMENT OF A DISPLACEABLE BARREL OF AN AUTOMATIC FIRING WEAPON

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved apparatus for the multi-stage, hydraulic-mechanical braking of the forward or advancing movement of a displaceable barrel or tube member of an automatic firing weapon equipped with a hydraulic brake having a cylinder in which there is arranged a brake piston equipped with check or non-return valves, and a mechanical brake is connected in series with the hydraulic brake, the mechanical brake having a set of springs.

With a known piece of equipment of this type the hydraulic-mechanical braking of the forward or advancing movement occurs in two stages. The forward movement, up to the starting position, takes place with a constant throttle cross-section and the forward movement past the starting position takes place against the force of a set of springs.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide an improved construction of apparatus wherein the forward or advancing movement, up to the starting position, already occurs in two stages in that the throttle cross-section is considerably reduced shortly prior to reaching the starting position.

Another object of the invention relates to an improved apparatus for the multi-stage, hydraulic-mechanical braking of the forward movement of a displaceable barrel or tube member of an automatic firing weapon, which apparatus is as structurally compact as reasonably possible and can be easily exchanged as unit at the weapon.

Now in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the inventive apparatus is manifested by the features that the check valves are open during a first portion of the forward movement of the barrel of the firing weapon, that a ring member is arranged to be displaceable out of its work position into a rest position by the piston. Stop means serve to limit the stroke of such ring member and there is provided a spring which strives to retain the ring member in its work position where it closes the check valves of the brake piston as soon as it comes to bear against the brake piston during a second portion of the forward movement of the barrel of the firing weapon.

The set of springs is arranged in the cylinder and the ring member is located between the brake piston and the set of springs for transmitting the forces of the forward movement to the set of springs during a third portion of the forward movement of the barrel of the firing weapon past the starting position.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawing wherein:

FIG. 1 is a longitudinal sectional view through a preferred constrictional embodiment of the invention:

FIG. 2 illustrates on an enlarged scale details of the apparatus depicted in FIG. 1; and

FIG. 3 is a fragmentary view showing a detail of the arrangement of FIGS. 1 and 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawing, and according to the showing of the exemplary embodiment of inventive apparatus depicted in FIG. 1 such dampening equipment will be understood to possess a cylinder or housing which is secured in any suitable and therefore not particularly illustrated manner at a stationary gun mount. Serving as the attachment means there is provided, for instance, at the cylinder or housing threading. In the cylinder or housing there is displaceably mounted a piston rod. This piston rod is hollow and fabricated as one piece with a piston. A sleeve member is displaceably mounted internally of the piston rod. The piston rod is closed at both ends by closure plugs and or equivalent closure elements. Between the plug and the sleeve member which is displaceable in the piston rod there is arranged a helical spring which strives to displace the sleeve member away from the closure plug. The sleeve member together with the spring serves to produce a pressure upon a suitable fluid medium, typically oil, located in the piston rod, and this oil can flow through a throttle bore into the annular compartment between the cylinder or housing and the piston rod. The cylinder furthermore possesses a floor or bottom portion and is closed by a cover member. The piston rod is sealingly guided both in the floor portion as well as at the cover member. Between the cover member and the piston rod thereof is surrounded by a recoil spring.

As particularly well seen by referring to FIG. 2, the piston possesses a number of bores, the ends of which always have a smaller diameter than the remaining portion of such bores. These bores can be closed by a ring member. Adjacent the displaceably arranged ring or ring member there is a further annular or ring member which is secured to the piston rod. Between both of the ring members and there is arranged a helical spring, this spring strives to displace the ring member against the piston and therefore to close the bores. The ring member forms a valve plate for the check or non-return valves formed by the components which only permit the oil to flow in known manner in one direction through the bores. These bores can be closed at their other end by a further ring member. This ring member is likewise displaceably mounted upon the piston rod. A spring strives to press the ring member against the piston. The spring bears upon the ring member and upon a sleeve member which is likewise displaceably arranged at the piston rod. This sleeve member possesses a flange upon which bears a set of annular or circular springs. This set or bank of annular springs bears against the floor or bottom of the cylinder or housing. The sleeve member which is displaceably arranged upon the piston rod is displaceably guided by means of its flange in the cylinder.

A sleeve member is arranged between the cylinder or housing and the piston, and such sleeve mem-
This sleeve member 32 possesses a slot 33, as best seen by referring to FIG. 3. This slot 33 renders it possible that, during displacement of the piston 13 and the housing 10, the oil can flow from one side of the piston 13 to the other side thereof. The shape of the slot 33 is chosen such that the recoil force generated during firing of the weapon will be transmitted as constant force to the stationery gun mount. The ring member 27 possesses a cam or dog 34 which extends into a slot 35 to the sleeve member 32, so that the ring member 27 is only displaceable to a limited extent in the sleeve member 32 until the cam 34 contacts a stop 36 which is formed by the slot 35.

The mode of operation of the described dampening apparatus is as follows:

During return movement of the movable portion of the weapon the piston rod 12 is shifted upwards out of the position depicted in FIG. 1, resulting in compression of the spring 21 and the annular compartment 30 in which such spring is located is reduced in size. The hydraulic fluid medium which is located in such annular compartment flows through the slot 33 of the sleeve member 32 to the other face or side of the piston 13, whereby the slot 33 will always become more and more closed due to displacement of the piston, so that the throughpassage cross-section for the fluid medium will continuously reduce. When finally no fluid medium at all can flow through the slot 33. At this moment of time the recoil of the weapon has terminated and the recoil spring 21 has been completely compressed together. This recoil spring 21 strives to again displace the weapon back into its starting position. The ring member 27, during recoil of the weapon, also has shifted upwards until reaching its stop 36. Since the ring member 27 cannot be displaced upwards to the same extent as the piston 13 it will be recognized that during the recoil action an intermediate compartment or space has been formed between the piston 13 and the ring member 27, and within which intermediate compartment there can flow the fluid medium into the bores 22. As soon as the piston 13 again moves downwards i.e. during the forward movement thereof the ring member 24 is raised owing to the pressure of the fluid medium in the bores 22, and the fluid medium can flow back through the bores 22 during a first stage of the forward movement of the piston into the annular compartment 50 above the piston 13 to the other side thereof. However, as soon as the piston 13 impacts against the ring member 27 during the forward movement at the end of the first stage the bores 22 are closed, and the fluid medium during a second stage can only then flow back through the narrower portion of the slot 33 from the lower face of the piston 13 to the upper face thereof. Due to the sudden closure of the bores 22 by means of the ring member 27 and the simultaneous reduction in size of the slot 33 there is increased the resistance against the forward or advancing movement of the weapon to such an extent that the weapon and the piston 13 only can return back into their starting position and cannot move past such starting position. As soon as the weapon is located in its starting position then, in known manner, the non-illustrated breech housing causing a further advancing or forward movement of the weapon. This further forward movement of the weapon past its starting position will be absorbed in the usual way by the set of annular springs 31. Upon compression of the set of springs 31 the fluid medium, in which there is located such springs, cannot be expressed through the slot 33 to the other side or face of the piston 13 because it is closed by the ring member 27, this fluid medium essentially flowing through the bore 18 to the inside of the piston 13. Since during this movement the throughpassage cross-section of the slot 33 is very small the forward movement of the weapon past the null position is intensively braked, and the weapon moves back into its starting position under the force of the set of annular springs 31, in other words, after reaching the forwardmost position the movable component of the weapon is returned to its starting position under the force of the set of springs 31.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto, but may be otherwise variably embodied and practiced within the scope of the following claims. Accordingly,

What is claimed is:

1. An apparatus for the multi-stage, hydraulic-mechanical braking of the forward movement of a displaceable barrel member of an automatic firing weapon, comprising a hydraulic brake incorporating a cylinder, a brake piston equipped with check valves arranged in said cylinder, a mechanical brake connected in series with the hydraulic brake, said mechanical brake being equipped with a set of springs, said check valves being opened during a first portion of the forward movement of the barrel member of the firing weapon, a displaceable ring member capable of moving between a working position and a rest position, said displaceable ring member being displaceable out of the working position into a rest position in depending upon the movement of the piston, stop means for limiting the stroke of the displaceable ring member, a spring member which strives to retain the displaceable ring member in its working position where said displaceable ring member closes the check valves of the brake piston as soon as it comes to bear during a second portion of the forward movement of the barrel member of the weapon against the brake piston, said set of springs being arranged in said cylinder, said displaceable ring member being located between the brake piston and the set of springs for transmitting the forces of the forward movement of the barrel member to the set of springs during a third portion of the forward movement of the barrel member past its starting position, a sleeve member arranged between the inner wall of said cylinder and the brake piston, said sleeve member having a first slot through which a fluid medium can flow from one face of the brake piston to the other face thereof, said first slot extending over the length of the stroke of the piston and becoming wider in the direction of the forward movement of the barrel member, and wherein the forwardly extending end of the first slot which extends past the starting position of the brake piston is considerably narrower than the remaining portion of the first slot.

2. The apparatus as defined in claim 1, wherein said brake piston possesses continuous substantially axially extending bores and a further spring-loaded ring member defining said check valves, said further spring-loaded ring member forming a valve plate for said check valves, said displaceable ring member and said
5 further spring-loaded ring member bearing against the axially extending bores of said brake piston.

3. The apparatus as defined in claim 1, wherein said sleeve member possesses a second slot, said displaceable ring member having a cam extending into said second slot, the end of said second slot and the cam forming said stop means for limiting the stroke of the displaceable ring member in one direction.

4. The apparatus as defined in claim 1, further including a sleeve arranged between the piston rod and the set of springs, said sleeve having a flange which in the starting position of the brake piston is clamped between the displaceable ring member and the set of springs.

5. An apparatus for the two-stage hydraulic braking of the forward movement of a displaceable barrel member of an automatic firing weapon, comprising a hydraulic brake incorporating a stationary cylinder, a brake piston arranged in said cylinder, said brake piston having two faces and being equipped with check valve means, said check valve means being opened during a first stage of the forward movement of the brake piston, a displaceable ring member arranged within said cylinder, said displaceable ring member being provided with a cam, means defining a first slot having opposed ends, said cam extending into said first slot, the opposed ends of said first slot defining stops for limiting the stroke of said displaceable ring member, a spring striving to press the displaceable ring member towards one of the stops and in which position the displaceable ring member closes the check valve means as soon as the brake piston during its forward movement during the start of a second stage of the forward movement of the brake piston impacts against the ring member, means defining a second slot by means of which fluid medium can flow from one face of the brake piston to the other face, said second slot extending over the entire length of the stroke of the brake piston, said second slot having a forward end which is considerably narrower than the remainder of said second slot.

* * * * *