G. DUFFING.

HYDRAULIC LOCKING DEVICE FOR BRAKING, ADJUSTING, AND OTHER PURPOSES.

APPLICATION FILED MAR. 17, 1910.

1,178,996. Patented Apr. 11, 1916.

Fig. 1

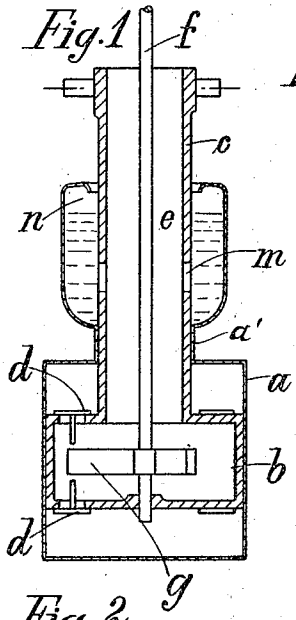


Fig. 2

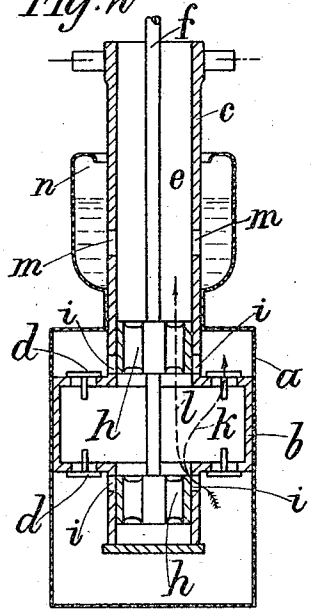


Fig. 3

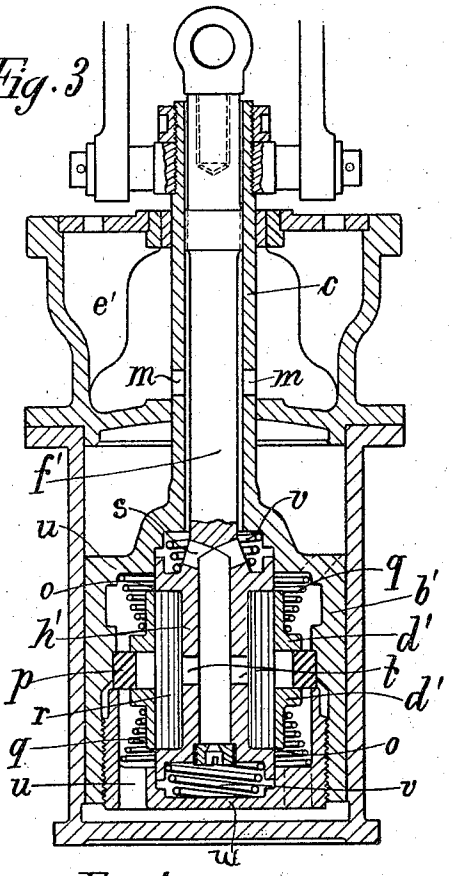
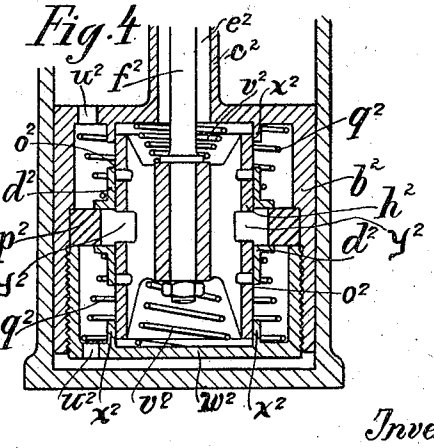


Fig. 4



Witnesses:

W. P. Burks

A. F. Houman

Inventor:

Georg Duffing

By Wm. Gallaher Hicks

Atty

THE COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

GEORG DUFFING, OF MÜLHEIM-ON-THE-RHINE, GERMANY.

HYDRAULIC LOCKING DEVICE FOR BRAKING, ADJUSTING, AND OTHER PURPOSES.

1,178,996. Specification of Letters Patent. Patented Apr. 11, 1916.

Application filed March 17, 1910. Serial No. 549,901.

To all whom it may concern:

Be it known that I, GEORG DUFFING, of Mülheim-on-the-Rhine, Germany, have invented certain new and useful Improvements in Hydraulic Locking Devices for Braking, Adjusting, and other Purposes, of which the following is a specification.

This invention relates to locking or adjusting devices.

The ordinary forms of adjusting and locking devices now employed usually consist of a piston located in a hydraulic cylinder, in which all the free space in the cylinder is completely filled with liquid, so that under certain conditions the piston is absolutely locked against motion in either direction. Such an apparatus must be so arranged that the amount of liquid located in the free space on one side of the piston is exactly equal to the amount of liquid located on the other side, when the piston is in its intermediate position. This necessitates a piston rod, or its equivalent, which extends through both ends of the cylinder, and also necessitates two stuffing boxes for the piston rod. In the ordinary devices employed, it is absolutely essential to keep the stuffing boxes tight, since a leakage of liquid from the free space detrimentally effects the operation of the device.

An object of my invention is to produce an adjusting and locking device, in which the piston rod of the operating piston extends through one end only of the hydraulic cylinder, and in which the stuffing boxes are not essential.

A further object is to produce a device of the character described, in which means are employed for simplifying and perfecting the operation of the device.

A further object is to produce a device in which means are employed for automatically maintaining the necessary quantity of liquid in the free space of the hydraulic cylinder.

These, and other objects, I attain in a device embodying the features herein described, and illustrated in the drawings accompanying and forming a part of this application

In the drawings, Figure 1 is a sectional view of a constructional or diagrammatic arrangement of a device embodying my invention. Fig. 2 is a sectional view and discloses a less diagrammatic arrangement of a device embodying the principle of operation of the device illustrated in Fig. 1. Fig. 3 is a sectional view of a preferred form of apparatus which embodies my invention; and Fig. 4 is a sectional view of a modified form of the apparatus shown in Fig. 3.

In Fig. 1, I have shown a simple form of apparatus embodying my invention, which is capable of being rigidly locked against motion in either or both directions, and is capable of permitting motion in one direction and of being rigidly locked against motion in the other direction. The device consists of a cylinder *a* closed at one end, a hollow piston *b* located in the cylinder *a* and provided with a hollow piston rod *c*, the interior of which communicates with the interior of the piston. The rod *c* projects upwardly through an opening *a'* formed in one end of the cylinder *a* and its interior communicates with an equalizing receptacle or chamber *n* through ports *m*. The chamber *n* surrounds the rod *c* and is illustrated as being integrally formed with a collar or flange formed on the cylinder *a* around the opening *a'*. The receptacle *n* is adapted to be filled with any suitable liquid, such as oil, and performs the function of an equalizing space for the free space on each side of the piston *b* within the cylinder *a*. With such an arrangement, it is not necessary to provide a stuffing box for the rod *c*, since any leakage from the cylinder *a* will be received by the chamber *n*. It is, however, essential that the fit between the rod and the opening *a'* be as close as possible, so that the leakage will be reduced to a minimum.

In the device illustrated, the upper end of the chamber *n* is shown open. In devices adapted to operate in a horizontal position, it is necessary to close the open end of the chamber *n* by means of a stuffing box or suitable packing gland. It will be apparent, however, that such an arrangement does not introduce the difficulties encountered with devices of this character ordinarily employed, since pressure in the chamber *n* is approximately equal to atmospheric pressure, and there is very little tendency for the liquid to leak past the stuffing box or gland.

Ports are provided in each side of the piston *b* and form a means of communication between the free spaces in the cylinder, above and below the piston, and the interior of the piston. These ports are provided with

non-return valves *d*, the operation of which may be controlled by a cross-head *g* located in the piston and provided with an actuating rod *f*, which extends upwardly through the hollow piston rod and projects beyond it. The cross-head *g* is located between the stems of the valves *d* and is capable of being moved upwardly to open the upper valve *d*, and downwardly to open the lower valve *d*. The cylinder *a* may be stationary, and in the device illustrated, it is assumed to be stationary. The rod *c* is adapted to be connected at one end to an apparatus or an agent, which tends to move the piston either up or down, or which alternately tends to move it up and down; and the device illustrated is adapted to control the movements of the apparatus or agent connected to the rod *c*.

The device operates in the following manner:—Let it be supposed that the rod *c* is connected to an actuating agent, which tends to alternately raise and lower the piston *b*, and that it is desired to have the actuating agent move from an intermediate position to a position such that the piston *b* will move upwardly a predetermined amount. In accomplishing this, I raise the cross-head *g*, by means of the actuating rod *f*, and thereby open the valve *d*, located on the upper side of the piston. Under these conditions, the piston is capable of moving upwardly under the influence of an upward force, but remains locked against downward motion by the practically incompressible liquid in the free space of the cylinder below the piston. When the piston moves upwardly in response to an upward force, transmitted to it by the agent or apparatus connected to the upper end of the rod *c*, a flow of liquid from the space above the piston into the interior of the piston takes place through the upper port. The upward motion of the cylinder causes the lower valve *d* to open and permits of a flow of liquid from the interior of the cylinder to the free space below the cylinder. The liquid ejected from the free space above the piston is not sufficient to fill the increasing free space below the piston, and, consequently liquid from the equalizing chamber *n* is drawn into the cylinder *b*, through the ports *m*, and is delivered, past the lower valve *d*, to the free space below the piston. If, during the upward motion of the piston, the actuating force on the rod *c* is reversed, the lower valve *d* will be immediately closed, by a reversal of the flow of liquid through the port it controls, and will prevent a downward motion of the piston *b*, since it will confine the liquid in the free space below the piston. After the piston has risen the determined amount, the upper valve *d* will be automatically closed, since its valve stem will be raised off of the cross-head *g*. This will lock the piston against further upward motion, since the liquid in the free space above it is confined.

If it is desired to permit a downward motion of the piston, the cross-head *g* is moved downwardly to open the lower valve *d*, so that the liquid below the piston may be discharged into the interior of the piston. The downward motion of the piston will cause the upper valve *d* to open and will also cause liquid to enter the free space above the piston, through the port controlled by that valve. The liquid discharged from the free space below the cylinder is more than is necessary to fill the increased free space above the piston; consequently, the excess liquid is delivered to the chamber *e*, within the rod *c*, or to the chamber *n*, through the ports *m*.

In the constructional form shown in Fig. 2, the hollow piston rod *c* again forms the equalizing space *e*, which is in constant communication with the interior of the piston *b*. In this case, however, the equalizing space *e* is capable of communicating with the free space in the cylinder above and below the piston *b*, not only through the valves *d* but also through the passages *i* controlled by the slides *h* on the rod *f*. In this construction, if the adjusting rod *f* is moved it does not, as in the previous example, positively open certain of the valves *d*, but it is provided with cylindrical slides *h* snugly guided in the hollow piston rod *c* and adapted to open or to close the passages *i* leading to both cylinder-chambers. For instance, on moving the adjusting rod *f* in the downward direction so as to open the lower passages *i* while closing the upper passages *i*, the locking or braking piston *b* is free to follow the downward movement, as the liquid driven from the free space in the cylinder below the piston escapes in the direction of the arrows *k* and *l* as shown, partly into the free space in the chamber above the piston and partly into the equalizing space *e*. If the adjusting rod *f* is raised, the upper passages *i* are opened and the lower passages *i* are closed. The piston *b* is then free to follow the upward movement and the liquid driven from the free space above the piston enters the free space below the piston, and an auxiliary supply of liquid is also delivered to the free space below the piston from the equalizing space *e*.

In the constructions shown in Figs. 1 and 2 the equalizing tank or space *e* is in constant communication, for instance, through ports *m* in the hollow piston rod *c*, with a receptacle *n* which receives any liquid that may escape therein owing, for instance, to leakages between the piston rod and its guide. Such liquid thus flows back into the equalizing tank and from the latter again passes into the braking or locking cylinder *a*. Consequently no absolutely tight stuffing

boxes need be provided on the piston rod guide. As already stated, the arrangement of the equalizing tank e may be used also in connection with all kinds of hydraulic brakes.

A further constructional form is shown in Fig. 3. In this case the valves d' arranged within the hollow piston b' are axially movable along the surface of a slide h' and are provided with controlling edges o coöperating with those on the slide h'. The common valve seat is constructed in the form of a simple ring p held in place by a screwed-in piston cover or end w and against which the valves d' are pressed by springs q. The slide h' forms part of the adjusting rod f', and is provided with recesses r for the passage of the locking liquid. The equalizing tank e' subjected, for instance, to atmospheric pressure, is in constant communication with the spaces r located between the two valves through passages m and s, as well as through passages t arranged in the slide h'. This slide h' is relieved of the locking pressure as much as possible by the upper and lower guide. The space in the piston b' is in communication with the free spaces in the cylinder above and below the piston through the ports u. Assuming for instance the adjusting rod f' and consequently the slide h' to be raised, it will be seen that the upper valve d' by means of its controlling edges o will create a free passage for the liquid. The locking piston b' is thus free to follow the upward movement and the liquid displaced thereby from the upper cylinder-chamber escapes through the passage between the upper controlling edges o and through the lower valve d' into the lower cylinder-chamber, the quantity of liquid required for equalizing purposes being supplied from the equalizing tank e'. The more the piston approaches its new position of rest, the more the controlling edges o are closed. The reverse is the case if the adjusting rod f' and the slide h are moved in the downward direction. In the constructional form according to Fig. 3, provision moreover is made of elastic intermediate members, such as for instance pressure springs v interposed between the adjusting rod and the locking piston and its rod or extension. These elastic intermediate members have the tendency to constantly maintain the adjusting slide h' in its central position within the locking piston and to render the speed of adjustment dependent in a favorable manner on the force acting on the slide rod, for it will be seen that on the force of adjustment increasing, the free cross section for the passage of the locking liquid is simultaneously increased so that from both causes the piston moves in a more rapid manner.

Fig. 4 represents a constructional form of the invention in which the adjusting slide h^2 is guided within the hollow locking piston b^2 so as to be completely relieved of locking liquid pressure. The slide h^2 is in effect a hollow piston valve and is provided with an upper and lower series of ports o^2, each of which communicates with the interior of the valve and is respectively controlled by the upper and lower valves d^2. Each valve d^2 is annular and surrounds the slide or piston valve h^2, and is held to its seat on the ring p^2 by the coiled spring q^2. An annular flange x^2 is provided on the inner face of each end of the piston b^2 and these flanges coöperate with the valves d^2 in forming an inclosing cage for the slide or piston valve h^2. A series of ports y^2 are located between the valves d^2, when the slide h^2 is in the normal or intermediate position, and the flow of liquid through them is controlled by the valves d^2. The hollow piston rod c^2 is constructed so as to form the equalizing tank e^2, or it may terminate upwardly in an equalizing tank or space, if desired. As in the previous case, pressure springs v^2 are interposed between the slide h^2 and the locking piston b^2 to cause the slide to always maintain its central position when the adjusting rod is free. When the adjusting rod f^2 is moved upwardly, the upper series of ports o^2 are raised above the upper edges of the valves d^2. This places the interior of the slide h^2 in communication with the free space in the cylinder a^2, above the piston b^2, and permits the piston b^2 to move upwardly in response to an upward force. During the upward motion of the piston, liquid enters its interior from the free spaces in the upper portion of the cylinder a^2, through the ports u^2, and passes through the upper series of ports o^2, through the interior of the slide h^2, through the ports y^2, past the lower valves d^2, and out through the lower ports u^2 into the free space in the cylinder below the piston b^2. The preponderance of liquid pressure above the lower valve d^2 over the liquid pressure below the valve is sufficient to open the valve against the force of its closing spring, during this upward motion of the piston, and an auxiliary supply of liquid will be delivered from the space e^2 into the free space below the piston, to supply the excess demand for liquid beyond that which the free space above the piston can supply. The equalizing space e^2 is always in communication with the interior of the slide h^2. As the piston b^2 moves upwardly, in response to the upward force, it carries with it the upper valve d^2, and consequently moves the valve to close the upper ports o^2. When the ports o^2 are closed, the piston b^2 is again locked against motion. When the rod f^2 is moved downwardly to

open the lower series of ports o^2, the piston b^2 is capable of being moved downwardly, and liquid is discharged from the free space below the piston into the free space above the piston, and also into the equalizing space e^2. During this motion of the piston b^2, the upper valve d^2 is automatically opened by the preponderance of liquid pressure below it.

In any of the cases hereinbefore described, the liquid of the equalizing tank may be supplied either at atmospheric pressure or, if desired, under high or low pressure, as will be easily understood.

I claim:

1. A hydraulic braking device, comprising a cylinder, a piston mounted for movement within the cylinder and having valved passages formed therein and communicating with the free spaces at the ends of the cylinder, an equalizing space for delivering liquid to or receiving liquid from the passages of said piston during relative motion between the piston and the cylinder, and means movably mounted within the piston for controlling the operation of the valves of said passages.

2. A hydraulic braking device, comprising a cylinder, a piston mounted for movement within the cylinder and having passages formed therein communicating with the free ends of the cylinder, an equalizing space communicating with the piston passages and formed within the piston rod, valves for controlling the delivery of fluid through the piston passages, and means slidably mounted within the piston and movable relative thereto for controlling the operation of said valves.

3. In a hydraulic braking device, a cylinder, a hollow piston movable with relation to the cylinder and so located therein as to confine in opposite ends of the cylinder bodies of liquid which take no part in the act of moving the piston, passages formed in the piston for transferring liquid from one of the bodies to the other, an equalizing space communicating with said passages for delivering liquid thereto or for receiving liquid therefrom during relative motion between the piston and the cylinder, valves for controlling said passages, and means movable with relation to both the piston and the cylinder for controlling the operation of said valves.

4. A hydraulic braking device, comprising a cylinder, a piston mounted for movement within the cylinder, and having passages formed therein and communicating with the free spaces at each end of the cylinder, a hollow piston rod for said piston with its interior passage in communication with said piston passages, oppositely disposed valves for controlling the delivery of liquid from and to the free spaces of the cylinder through the piston passages, an equalizing space communicating with the interior of the piston rod, and means for controlling the operation of the valves and communication between said equalizing space and the free spaces of the cylinder.

5. In a hydraulic braking device, a cylinder, a hollow piston located within the cylinder movable with relation thereto and provided with valved passages communicating with the interior of the cylinder and with an equalizing space located within the piston rod of said piston, valves for said passages, an adjusting rod located within the hollow piston rod and a crosshead mounted on the adjusting rod and located within the piston for opening said valves.

6. A hydraulic braking device, comprising a cylinder, a piston mounted within and movable relative of the cylinder and having passages formed therein communicating with each free space of the cylinder and with a passage provided through the piston rod, an equalizing space communicating with said piston passages through the piston rod, oppositely disposed pressure responsive valves for controlling the delivery of liquid through the piston passages, valve means slidably mounted within the piston for controlling the operation of said valves and for controlling communication between said passages and said spaces, and means extending through the piston rod for actuating said valve means.

7. In a hydraulic locking or braking device, a cylinder, a hollow piston located in said cylinder and provided with an equalizing space, and passages extending through the wall of the piston and communicating with the interior of the piston and the free space in the cylinder above and below the piston, valves controlling said passages and means reciprocable within said piston and relatively thereto for actuating said valve.

8. In a hydraulic locking or braking device, the combination with an equalizing receptacle, of a cylinder, a hollow locking or braking piston located in said cylinder and provided with passages connecting the interior of the piston with the free space in the cylinder, valves located in said piston, an adjusting rod, and a slide mounted on said rod and provided with passages located between the slide and said valves for the passage of liquid between the equalizing receptacle and the piston.

9. In a hydraulic locking or braking device, the combination with an equalizing receptacle, a cylinder, a hollow piston provided with passages connecting the interior of the piston with the free spaces of the cylinder, a piston rod secured to the piston and provided with an interior passage, communicating with the interior of the piston and said receptacle, valves controlling the pas-

sages in the piston, a valve seat common to the valves, a slide coöperating with said valves and on which the valves are axially guided, and an adjusting rod on which said slide is mounted.

10. In a hydraulic locking or braking device the combination with an equalizing receptacle of a hollow locking or braking piston, valves controlling the passage of the liquid between the equalizing receptacle and hollow piston, a slide coöperating with said valves and slidable relatively to said piston, and means for yieldingly supporting the said slide and tending to hold the same in central position within the piston, substantially as set forth.

11. In a hydraulic locking or braking device the combination with an equalizing receptacle, of a hollow locking or braking piston, valves controlling the passage of liquid between the equalizing receptacle and hollow piston, a slide coöperating with said valves and springs interposed between the said slide and the walls of the piston, an adjusting rod for operating said slide, a tubular guide for said adjusting rod, and springs interposed between the adjusting rod and the said tubular guide substantially as and for the purpose set forth.

12. In a hydraulic locking or braking device, the combination with an equalizing receptacle of a hollow piston communicating with said equalizing receptacle, valves controlling the passages for the liquid between said piston and receptacle, springs for yieldingly supporting said valves, a slide coöperating with said valves and springs interposed between both faces of the said slide and the adjacent walls of the piston, all substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

GEORG DUFFING.

Witnesses:
LOUIS VANDORY,
BESSIE F. DUNLAP.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."