Fig. 2

Fig. 3
The present invention has for its object a hydraulic control device enabling intermittent displacements to be imparted to a movable member.

This device is susceptible of receiving numerous applications, but it is more particularly suitable for machine-tools, for example for producing an intermittent feed motion.

This device comprises a transmitter unit and a receiving unit which may be placed at a certain distance from each other and may be connected by means of a flexible piping so that one or the other unit may be movable.

The receiving member receives a reciprocating movement which is non-linearly transformed into an intermittent feed motion by the intermediary of a device comprising a free wheel.

The amplitude of the movement of the receiving member may be varied at will, and consequently that of the movable member may also be varied, even during operation and while in motion. Moreover, the receiving unit comprises an arrangement for hydraulic braking having for its purpose to gradually brake at the end of their displacement the receiving members driven by the hydraulic pressure, to avoid the effect of the jar at the end of the run and consequently to damp the throw of the movable members comprised between the piston of the receiving unit and its free wheel.

The throw of the receiving members being damped, it is permissible to obtain a practically constant value for the displacement of the table for each hydraulic impulse, whatever may be the frequency of the strokes of the piston of the transmitter unit and consequently whatever may be the speed of the injection, the throw of the controlled members comprised between the free wheel and the table being totally negligible.

The appended drawings represent, by way of example which is non-limitative, the application of the invention to the control of a table of a machine-tool.

In these drawings:

Fig. 1 is a sectional view of the entire device.
Fig. 2 is a corresponding partial side view.
Fig. 3 is a corresponding partial plan view.
Fig. 4 is a section of the motor unit and of the receiving unit showing an alternative embodiment.
Fig. 5 is a section of the device shown in Fig. 4 along V—V.

As seen in these drawings, the device according to the invention comprises a transmitter assembly M and a receiving assembly R one of which may be placed at a certain distance from the other and which are connected by a flexible piping C. These assemblies can therefore be carried by moving members.

The transmitter assembly (Fig. 1) comprises a trough 1 in which are placed the different parts and which constitutes an oil reserve. This trough is also provided with a lid 2. The inside constitutes a block 3 forming the body of the cylinder for several pistons. One of the pistons is a plunger 4 which is pushed by a spring 5 and which is subjected to the action of a driving cam 6 through the intermediary of a rocking lever 7. This cam is keyed on a driving shaft 8 which is rotating continuously. Another cam 9 is keyed on the same shaft and is capable of being actuated by means of a lever 10 on a closure piston 11 provided at its base with a small bent passage 12. In line with the piston 11 is situated a differential piston 13—14, subjected to the action of a spring 15. Finally, a third sliding member comprising a piston having three lands 16, 17 and 18 constitutes a working and stopping valve. This valve is controlled by means of a rack 19 the end of which is cut out, with which meshes a pinion 20 affixed to or integral with a controlling lever 21.

The receiving assembly comprises a hollow piston 22, mobile upon a tubular guide 23 and in which opens the piping C. This piston is subjected to the action of a return spring 24. Opposite the piston is a stop 25. The latter is adjustable and screws into a fixed nut 26. The stop 25 is rotatively driven by a rod 27 affixed to or integral with a controlling knob 28. On this rod is keyed a pinion 29, engaging a crown with internal teeth 30 on which is fixed a graduated disc 46.

In the case when the receiving unit controls the intermittent feed motion of a table T, the movement of displacement of the receiving piston 22 is transmitted by a rack 32 with which it is provided to a pinion 33 affixed to or integral with the upper portion of a free wheel 34. The internal portion is in one piece with a bevel pinion 35 in engagement with two bevel pinions 36 and 37. The latter are affixed to or integral with two threaded shafts 38 and 39 turning freely on a shaft 40. A sliding clutch 41, rotating in one piece with a shaft 42 may be put in engagement with one or the other of the wheels 38, 39, 40.

The shaft 42 is affixed to or integral with a screw 43 adapted to screw into a nut 44 solid with the table T.

The operation is as follows:

At each turn of the shaft 8, the cam 6 pushes down the plunger 4 while compressing the spring 5.

Let it be supposed that the lever 21 is in operating position, which is that which is represented.

The oil, put under pressure by the pump piston 4, passes along the pipes b, d, e, the flexible piping C and the pipe p, and lifts the piston 22 while compressing the spring 24. The said piston advances until it is stopped by the stop 25. In the course of this movement, it causes the pinion 33 to turn and this pinion, through the intermediary of the free wheel 34, of the pinion 35 and of one or the other of the pinions 36, 37, 38, 39, according to the position of the sliding clutch 41, Fig. 5, drives the shaft 42. The screw screws itself in the nut 44 and displaces the table T. The direction of motion depends on the position of the sliding clutch 41.

At the moment when the piston 22 meets its stop, the pump piston 4 has not terminated its run and continues to descend. An excess of pressure accordingly takes place, owing to which the differential piston 13—14 is lifted and pushes upwards the closure piston 11 which has been freed by the rotation of the cam 9. When the bottom of this piston uncovers the passage a, there is an opening to exhaust through a, and the passages 12, c and e. The passage 12 is not blocked against flow by the upper side of piston 13 because this latter piston is pulled downwardly by the spring 13 after it has raised the upper portion. The differential piston descends again, but the closure piston remains lifted because the passage 12 is sufficiently narrow for a sufficient pressure to exist at a to maintain the closure piston in its raised position.

Owing to the full of pressure, the piston 22 is brought back upon its seat by the spring 24. This movement is transmitted to the part 34, but, in this direction, the pinion 35 is not rotated by the free wheel, so that the table T remains motionless.

When the piston 4 has terminated its descending course, it begins to rise again under the action of the spring 5, which presses it against the lever 7 in contact with the cam 6. This rise produces a full of pressure. The ball 45
lifts and allows oil to re-enter through the passages k, j and i. The piston 4 terminates its ascending course, then the cam 6 compels it to descend again. The downward movement by the piston 11 had preliminarily taken place through the action of the cam 9. The cycle begins again. It is desirable that, at each descent of the piston 4, the table T effects a feed movement.

The amplitude of the feed is determined by the adjustment of the stop 25, obtained by operating the knob 28. The stroke of the piston 22 can vary from 0 up to 10 maximum, in passing through all the intermediate values. The adjustment is continuous. The amplitude of the movements of the table varies in a corresponding manner. The feed given to the table is read on the graduated scale carried by the disc 46.

When the lever 21 is lowered, in the position shown in broken lines in Fig. 1, the valve 16 is lifted and the passage d is put in communication with f. The pump piston 4 then moves without producing any effect. It is the position of rest for the receiving mechanism.

In the arrangement shown in Fig. 4, the receiving group R is similar to that of Fig. 1, but it comprises in addition a piston 53 disposed so as to be parallel to the receiving piston 4. This piston 53 is provided laterally with a rack which is in engagement with the pinion 33 actuated by the piston 22. It can slide without play in a cylinder 54 and is provided at its end with a conical passage 55. A ball 57 allows this cylinder to be rapidly filled with the oil contained in a container 55. The transmitter assembly M shows, with respect to the arrangement shown in Fig. 1, some modifications of detail having for their object to simplify the apparatus.

The cam 6 actuates directly the transmitting piston 4. The hydraulic injection is direct in the flexible piping C which is extended from a rigid pipe 58. A check-valve 45 is provided, automatically, to prevent the liquid from escaping back into the cylinder 1. A check-valve 49 opens and closes the oil passage through which escapes freely the liquid displaced by the piston 4. After the withdrawal of the upper lip of the piston 52, a spring 50 brings the check-valve 49 back in its closing position.

The operation is as follows:

When the receiving piston 22 is lifted by the oil under pressure coming from the transmitter group, it causes the pinion 33 to turn. The piston 53, in engagement with the pinion moves therefore in the opposite direction.

At the end of the working stroke of the receiving piston 22, the piston 53 has entered in the cylinder 54. The oil contained in the latter escapes by the passage 56, the cross-section of which decreases gradually, thereby creating a back-pressure which is increasing to the greatest extent at the close of the stroke of the piston 22. This back-pressure gradually opposes the movement of the receiving members and ensures a stopping without shock.

It is the piston 53 which, during the return stroke of the piston 22, comes in contact with the adjustable stop; this contact takes place under a limited pressure since it is only subjected to the action of the return spring 24.

What I claim is:

1. In a hydraulic control device for imparting an intermittent displacement to a movable member, a casing, at least one cylinder in said casing, a working fluid in said casing and in said cylinder, means for compressing said fluid in said cylinder, said means comprising a piston in said cylinder, and means for displacing said piston in said cylinder, independent means for returning said piston to its initial position, a second cylinder externally of said casing, a second piston in said second cylinder, fluid-conveying means connecting the first cylinder to the second cylinder upon displacement of said first-named piston in said first-named cylinder under the influence of said displacing means, said closure device being displaceable to open said passageway, said third cylinder communicating with said fluid-conveying means whereby said excess pressure acts upon said differential piston to move said differential piston into contact with said closure device to close said passageway, and valves means for supplying fluid to said first-named cylinder.

2. A hydraulic control device as claimed in claim 1, in which the independent means for returning the said first piston to its initial position comprise a spring.

3. A hydraulic control device as claimed in claim 1, comprising a stop which is adjustable adapted to limit the stroke of the second piston.

4. A hydraulic control device as claimed in claim 1, in which the fluid-conveying means connecting the two cylinders aforesaid includes a flexible pipe.

5. In a hydraulic control device for imparting an intermittent displacement to a movable member, a casing, means defining at least one chamber in said casing, a working fluid in said casing and said chamber, means for compressing said fluid in said chamber, said means comprising a piston in said chamber, and means for displacing said piston in said chamber, independent means for returning said piston to its initial position, defining a second chamber externally of said casing, a second piston in said second chamber, fluid-conveying means connecting the first chamber to the second chamber, means mechanically connecting said second piston with said movable member to be displaced to transmit its movements of said piston to said member, said mechanically connecting means including a one-way drive, and a motion-reversing device, means defining an exhaust outlet from said first-named chamber and means defining a passageway connecting said first-named chamber with said exhaust outlet, means defining a third chamber in said casing, a differential piston in said third chamber, a closure device normally closing said passageway whereby an excess pressure is created in said first-named chamber, said closure device being displaceable to open said passageway, means for retracting said differential piston away from said closure device, and means acting upon said closure device to close said passageway, and valves means for supplying fluid to said first-named chamber.

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