

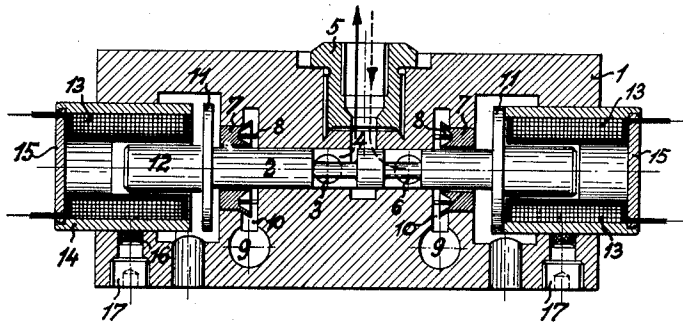
**Jan. 10, 1961**

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**2,967,545**

## MAGNETICALLY ACTUATED SLIDE VALVES

Filed July 1, 1958



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## MAGNETICALLY ACTUATED SLIDE VALVES

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Filed July 1, 1958, Ser. No. 746,033

Claims priority, application Germany July 1, 1957

6 Claims. (Cl. 137—623)

This invention relates to a slide valve actuated magnetically, for example by means of two electromagnets acting in opposite directions on the slide valve.

It is known in such magnetically actuated slide valves to employ either a single magnet or two magnets in combination with a return spring or springs. In such case the magnet or each magnet must be powerful enough to overcome the spring force. Such springs, however, have the effect of reducing the speed of operation of the slide valve or of rendering it non-uniform. With slide valves actuated by magnets with return springs or by plunger-type magnets or double magnets without return springs, the difficulty has arisen that the slide valve must be held by the magnets during operation, so that the magnet coils must be kept energised throughout the period of operation. This usually requires special devices (for example control bars, control cams, relays or the like) to keep the magnets energised. In automatic apparatus with very rapid cycles of operation and consequently with high operation speed and large numbers of operations, such auxiliary devices are often sources of trouble, in addition to the increase in cost which they involve.

For the actuation of the slide valve, closed electromagnets are usually employed, of the type having two supporting points or bearings for the movable magnet core. This type of magnet does not, however, readily lend itself to connection with the slide valve, and couplings have to be provided between the slide valve and the magnet armature or core, for example screw-joint couplings or pin couplings. This type of mounting for the magnet armature, however, has the disadvantage that with high operation frequency for the working process after a large number of operations the bearings wear out, especially when using small magnets and thin spindles for small slide valves, so that the slide valve spindle and the magnet armature are no longer accurately guided. This leads to the airgap between the magnet and the core becoming too small at one point, so that these parts tend to stick and finally to cease to move, thus necessitating renewal of the control device or parts thereof after only a comparatively short period of use.

This disadvantage is avoided by the arrangement according to the present invention, in which at least at one end of the slide valve piston a holding ring is provided, which owing to its accurate fitting or pre-stressing, whilst offering little resistance to the magnetic driving force, acts to hold the slide valve piston in its proper operative position, notwithstanding any shocks or other forces acting on it during the drive. The slide valve is preferably actuated in opposite directions respectively by two electromagnets acting on opposite ends of the slide valve piston.

With the arrangement according to the invention it is possible to simplify the construction by connecting the slide valve piston and the armature or armatures together to form a rigid unit. In this way it is possible to obtain the full advantages of such a rigid connection, which is known in itself for a slide valve with a return spring, namely to avoid sticking of the armature to the

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magnet coil, in association with the bearing support according to the invention, since the bearing support for the slide valve serves at the same time as a guiding bearing for the magnet armature.

In a preferred construction of slide valve according to the invention, the magnet or each magnet is arranged to be axially adjustable, thus enabling the requirements to be fulfilled as to adjustment and positioning of the slide valve, in order to achieve an accurately dimensioned mounting for the magnet or magnets during operation. Such adjustability is in itself known.

In order to achieve high operating speeds with large numbers of operations, the slide valve arrangement according to the invention makes it possible, whilst avoiding the above-mentioned disadvantages of the known slide valve arrangements, to operate with impulse control, so that there is no need to make provision for keeping the magnet energised throughout the working process. For increasing the speed of operation, it is advantageous to provide on the rigid unit comprising the slide valve piston and the magnet armature or armatures, in association with the magnet or with each magnet, a plate which engages on operation of the magnet with the end face of the magnet casing and has an outer diameter corresponding to the outer diameter of the casing. This feature, in the manner known in itself, assists in better utilization of the magnetic field which passes through the plate at the moment of operation.

Thus, a slide valve according to the invention is advantageous for the automatic control of a machine by means of current impulses, which, by means of micro-switches and limit switches controlled by the individual movements in the machine itself, can be tripped out by pressure or stream responsive switches or other switch devices. The construction of the complete control arrangement, is thus materially simplified, is more easily supervised, is less liable to faults and is cheaper.

By a simple constructional arrangement of all parts of the device, a surprising result is obtained. Undesired change of position of the slide valve, when the magnets are deenergised, by shock or vibration or from other causes is prevented in a very simple way by the use of two rubber-like rings of plastic material at opposite ends. The bearing support is common to the magnet cores and to the slide valve, thus giving a simpler magnet construction, with no jamming and no lost movement. By means of the magnet plates, a reliable control is ensured, even with very short current impulses, which can arise with higher operating frequency and with precision controls. Since the magnet coils are arranged for being permanently switched in, they can be kept continuously in operation. Especially favourable conditions result from precontrolling slide valves.

Further features of the invention will be clear from the following description of a preferred arrangement of an electromagnetically actuated pre-controlling slide valve with impulse operation, as illustrated in the accompanying drawing.

The arrangement of two-way or three-way or four-way slide valves is well-known in itself and need not be described in detail here. In the pre-controlling slide valve shown, the pressure medium flows from the inlet pipe 3 through the reversing conduit 4 and the securing screw 5 therein to the working point, and in the reverse position (when the slide valve 2 has moved from the position shown to the left) the medium flows back through the conduit 4 to the exhaust pipe 6. Undesired change of position of the slide valve is prevented by means of the two holding rings 7, which are so formed that notwithstanding strong shocks or vibration or movement of the control device casing they will hold the slide valve accurately in position, while at the same time they will

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offer little resistance to the impulse operating movement of the smooth slide valve 2 due to the magnets. The arrangement of the holding rings 7 at the ends of the slide valve provides for satisfactory operation in either direction. Spacer rings 8 act to prevent displacement of the holding rings 7 in the axial direction along the center line of the casing, and lipped edges on the holding rings insure that they are firmly held in their mountings, so that no special securing means need be provided. Leak oil is stripped from the slide valve 2 by the holding rings 7 and is led away through the annular grooves 10 into the oil leak pipes 9, so that the magnet spaces are kept free of oil.

A reliable control by short current impulses is thus achieved by the good bearing support afforded by the holding rings 7 for the magnet cores, by the favourable flow of the magnetic lines of forces through the magnet plates, and by the adjustable mounting of the magnets. The same bearing support serves both for the magnet cores or armatures 12 and for the slide valve 2. This simple form of bearing support is free from play owing to the good fitting of the casing and the slide valve 2, and is automatically lubricated. There is no risk, even after long use, of lateral engagement and sticking of the magnet cores and the inner walls of the coils. Since the movable magnet cores 12 and the slide valve 2 form a single unit, there can be no question of any jamming or lost movement between these parts. The magnet plates 11 are connected rigidly to the slide valve 2 and the magnet cores 12, and their outer diameter is equal to that of the magnet casings 14. Consequently, the lines of force flow almost completely in iron and thus contribute towards an improvement in the driving force. Each electromagnet, consisting of the casing 14, the coil 13 and the cover 15, but without the core 12 and the magnetic plate 11, is axially adjustable in its mounting. Thus, the stroke of the slide valve 2 and of its operative edges is adjustable. The magnets are secured in their positions of adjustment by the screws 17 acting through pads 16 of plastic material.

What I claim as my invention and desire to secure by Letters Patent is:

1. A control comprising a casing having an elongated bore therein and transverse bores opening into said elon-

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gated bore at spaced positions for the conveying of a hydraulic medium, a cylindrical slide in said elongated bore, said slide including two end sections and a central section of substantially the same diameter as said elongated bore and intermediate sections of lesser diameter connecting the first said sections, a movement of said slide in said elongated bore selectively connecting said transverse bores, electromagnets mounted in said casing at opposite extremities of said elongated bore and including coils concentric with said slide, cores on the ends of said slide and operatively disposed with respect to said coils for attraction thereby, said elongated bore having enlarged portions between said central section and said coils, and holding rings firmly fitted in said enlarged portions and encircling the end sections of said slide, said rings firmly engaging said end sections to maintain positions of the slide selected by energization of said electromagnets and to prevent leakage of the hydraulic medium.

2. A control as claimed in claim 1 wherein the enlarged portions each include axially adjacent sections of different diameter, the associated holding ring being mounted in the latter said section of smaller diameter and including a peripheral lip flaring into the latter said section of larger diameter.

3. A control as claimed in claim 2 comprising spacer rings in said enlarged portions bracing the holding rings in position.

4. A control as claimed in claim 1 comprising adjustment means in said casing for adjustably fixing the positions of the coils.

5. A control as claimed in claim 4 comprising an annular housing in said casing for each of said coils and fixed in position by said adjustment means.

6. A control as claimed in claim 5 comprising circular magnet plates on the slide adjacent said cores, the annular housings and plates having corresponding diameters.

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