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GB 1113946
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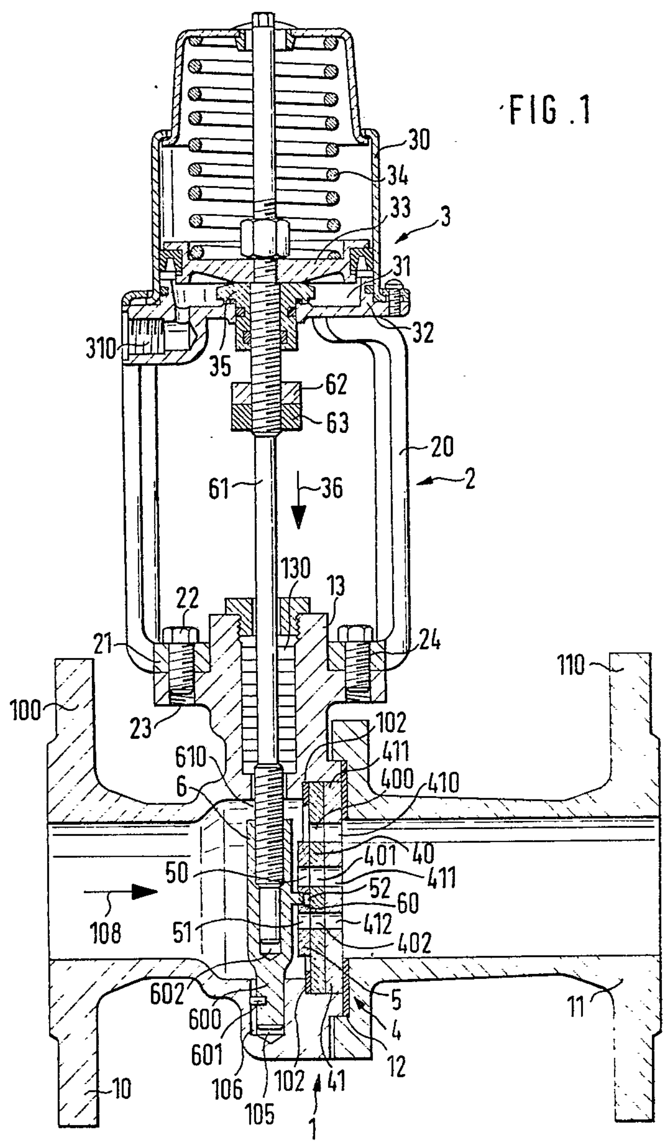
(54) Slide Valve

(57) The valve plate (5) has slots (50, 51) and co-operates with an element (4). The co-operating element (4) is composed of a valve seating (40) which, like the valve plate (5), completely consists of ceramic material, and also of a metallic supporting element (41), which supports the valve seating (40) over the whole surface of the latter and on the side of the seating (40) remote from the valve plate (5). The co-operating element (4) also has slots, the valve plate (5) being capable of covering off or exposing the slots of the co-operating element (4), the slots of the co-operating element (4) being formed by aligned slots (400, 410); (401, 411); (402, 412) in the valve seating (40) and in the supporting element (41). The valve plate (5) is connected, by way of a distance altering screw threaded connection (61, 610), to an element (33) which can be acted on bv a control medium.

FIG. 1



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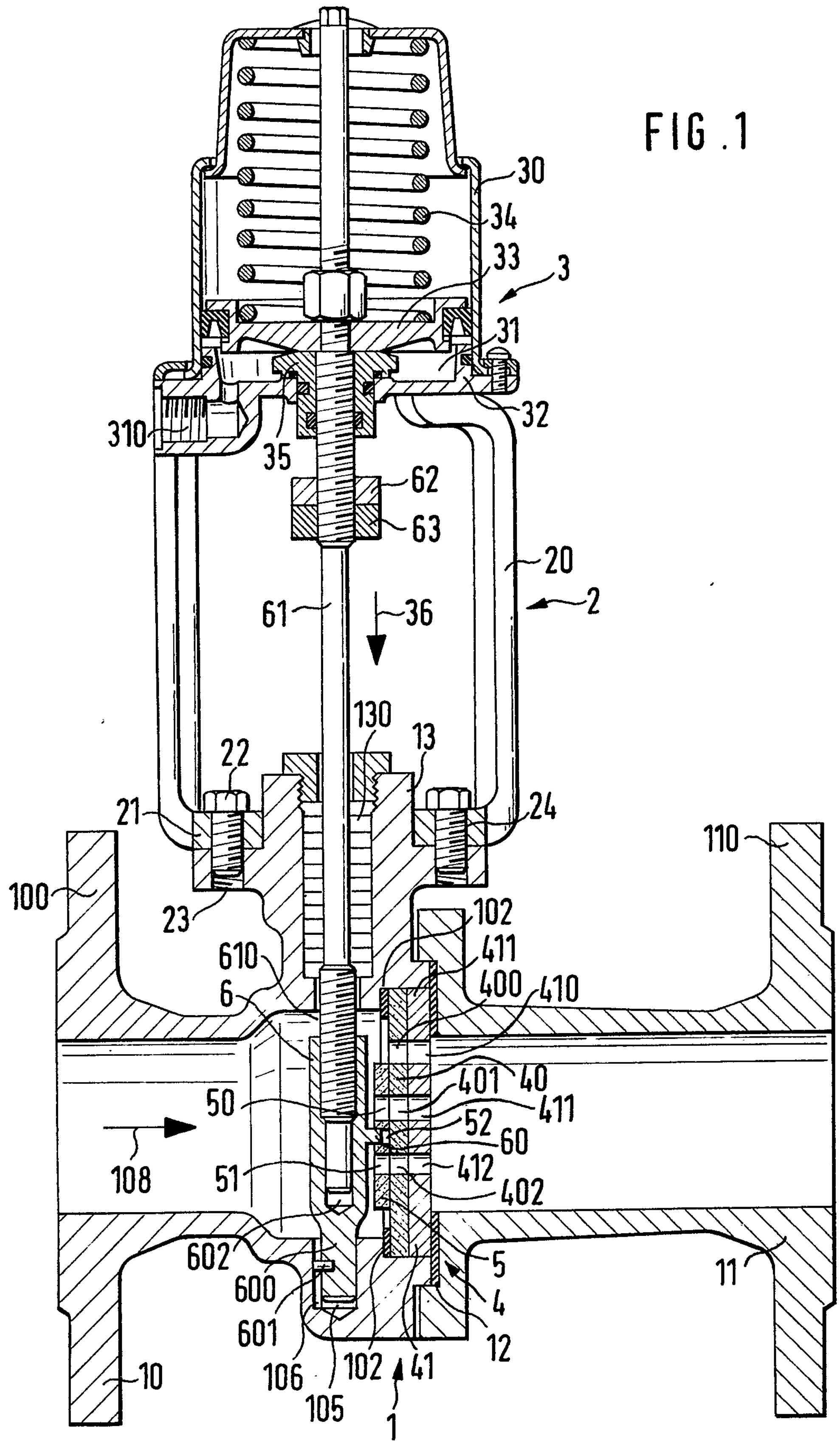
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FIG. 1

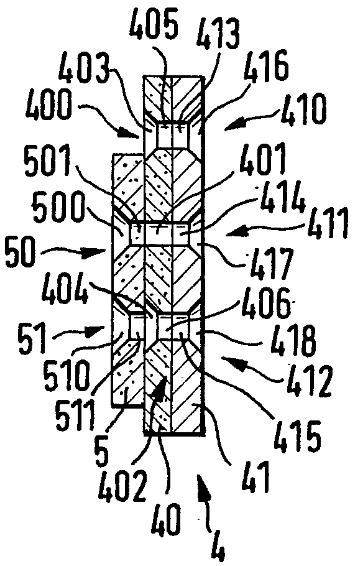
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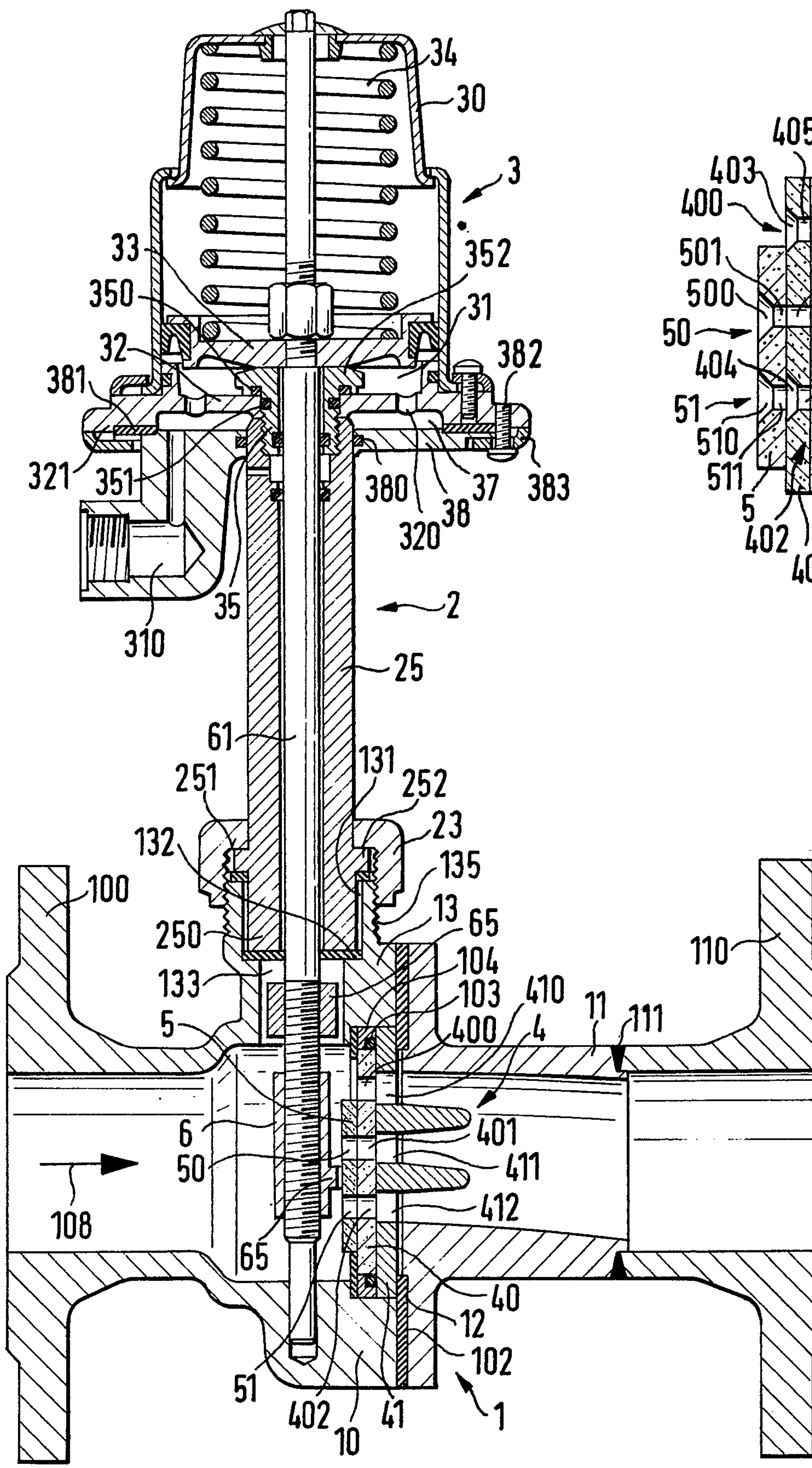
FIG. 2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410
5
400
4
11
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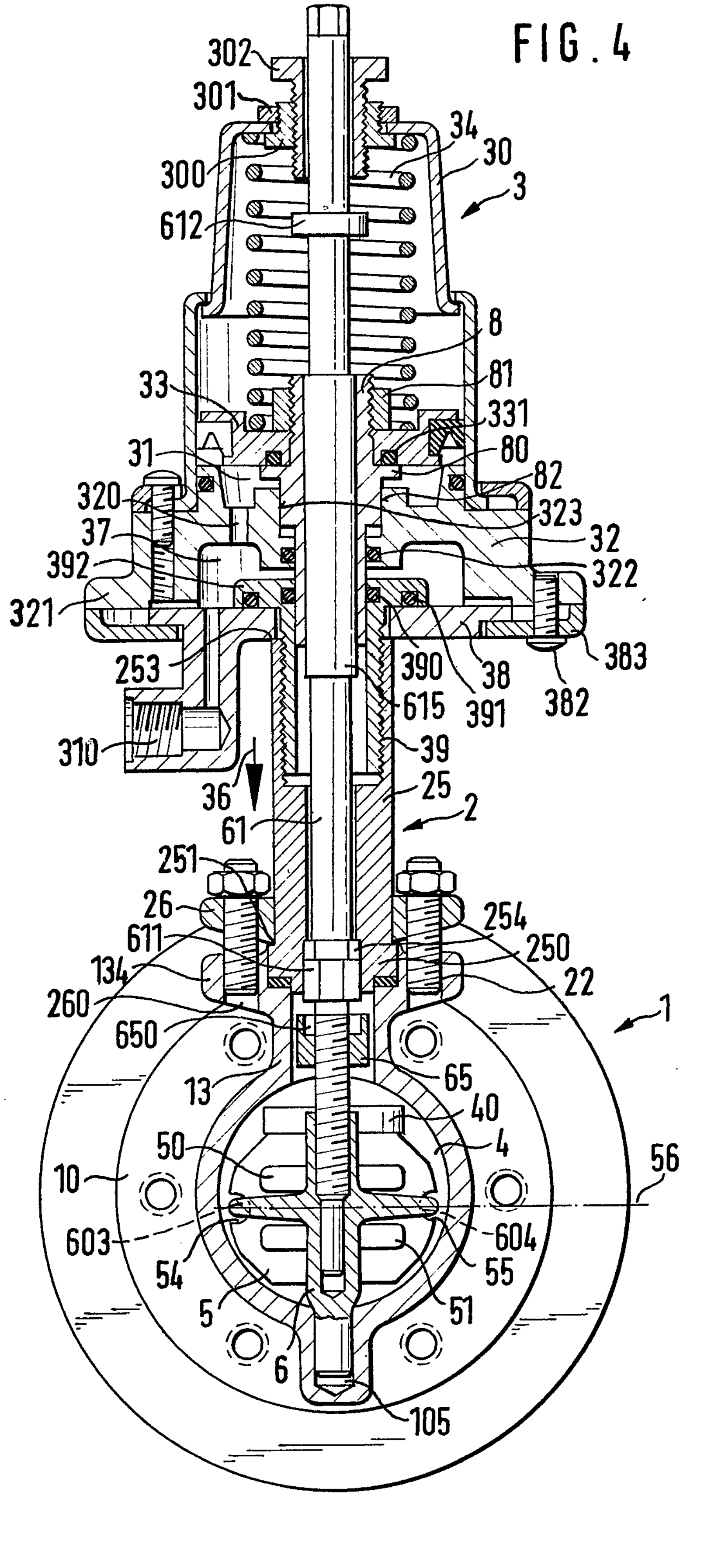
FIG. 3

FIG. 4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390
38
383
391
382
615
310
39
36
25
2
61
251
26
254
611
250
134
22
260
1
650
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65
40
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4
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10
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604
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51
6
105

FIG.5

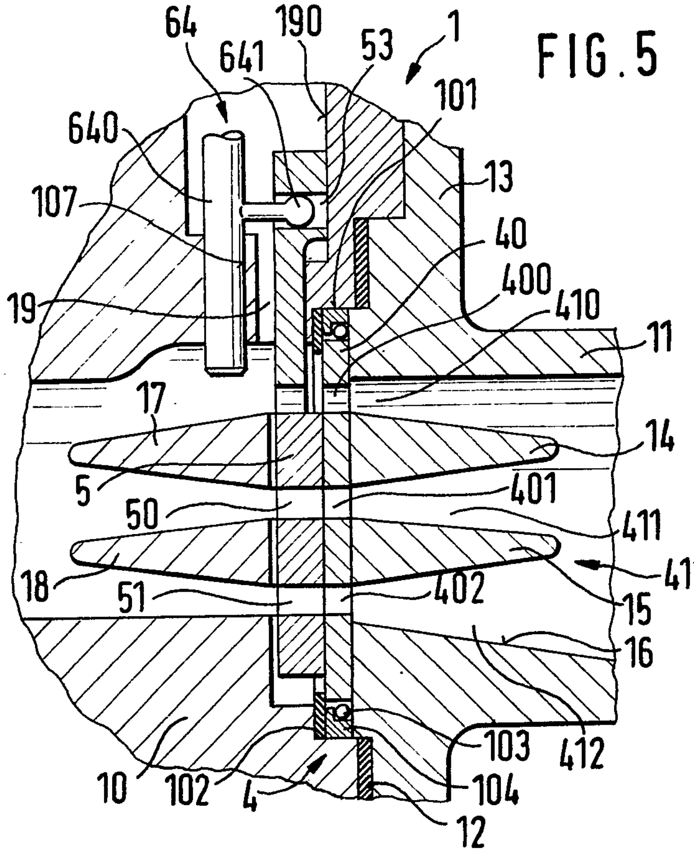


FIG.6

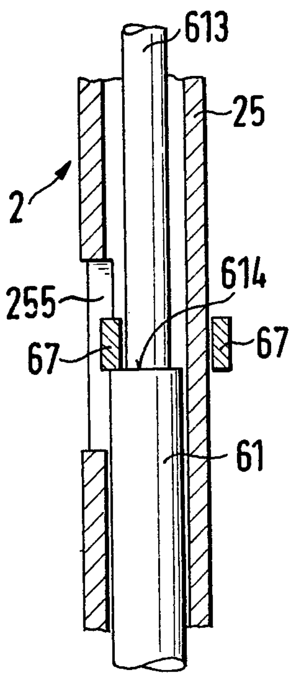
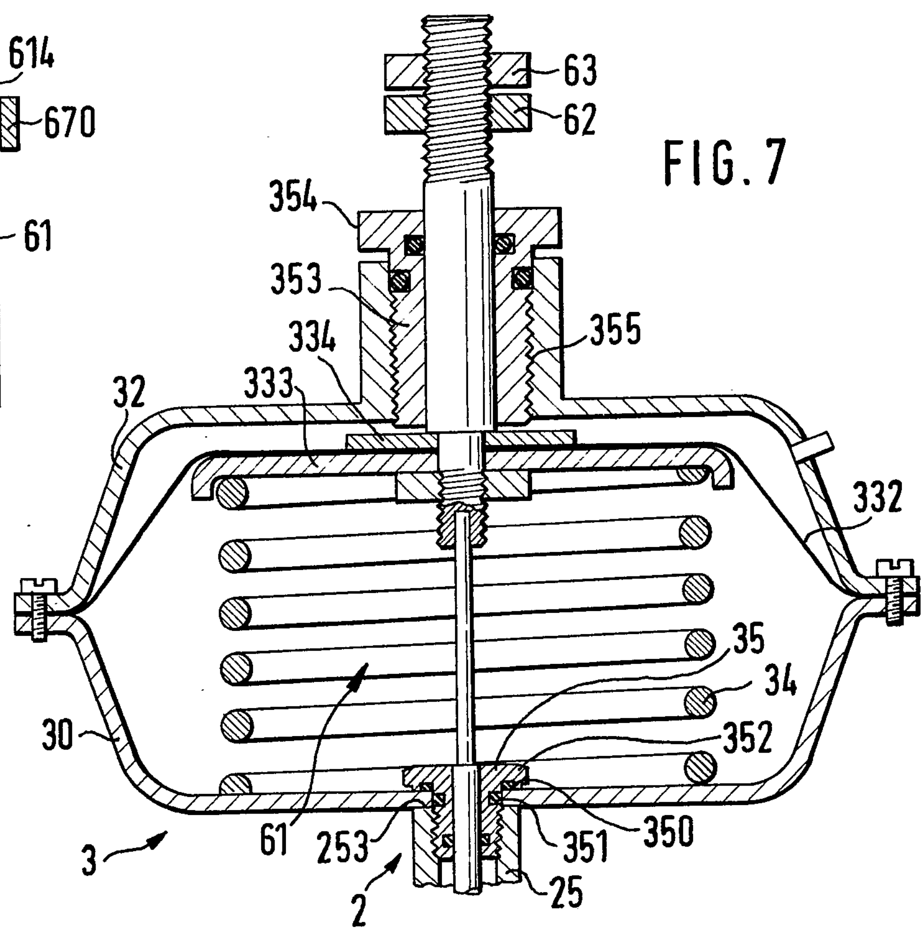


FIG.7



SPECIFICATION
Slide Valve

This invention relates to a slide valve, comprised of a valve housing, and a valve plate which is shiftable transversely of the direction of through flow of the fluid to be controlled. This valve plate has slots which extend transversely of the direction of its working stroke, and co-operates with an element which also has slots extending transversely of the working stroke of the valve plate, the valve plate being capable of covering or exposing the slots of the said co-operating element and the co-operating surfaces of the valve plate and the element consisting of ceramic material.

The co-operating parts of the valve have usually been made of metal (US-PS 3,159,177): however, metals are subject to a relatively high degree of wear.

It is known for eliminating this drawback, to render the co-operating surfaces more resistant by arranging for them to receive a ceramic coating through plasma coating (see brochure "Jordan Valve — Sliding Gate Control Valve", page 4, right-hand column, section "Jordanic"). Plasma coating is a difficult process which requires a number of working procedures not only for applying the coating but also for subsequent work, so as to give the slots, which have been partially closed during coating, the precisely required size and shape.

Underlying this invention is the object of so constituting a slide valve of the type defined at the outset so that the co-operating valve closure parts will be resistant and yet nevertheless, simple and inexpensive to produce.

According to the invention it is proposed that the co-operating element should be composed of a valve seating, which like the shiftable valve plate, completely consists of ceramic material, and also of a metallic supporting element, which supports the valve seating over the whole surface of the latter on its side which lies remote from the valve plate, the slots of the co-operating element are constituted by mutually aligned slots in the valve seating and in the supporting element. As the co-operating element consists of two parts, insofar as the element forming the valve seating is concerned, attention can be primarily devoted to the valve closure performance of this element and to the resistance which this element needs for this purpose; on the other hand, the element constituted as the supporting element is not subjected to frictional stress so that, insofar as this supporting element is concerned, attention has to be primarily devoted to the problem of absorbing compressional forces applied to the valve seating by the fluid medium to be controlled. This division of the co-operating element into two separate elements permits simple and economic manufacture, while at the same time a high degree of resistance of the co-operating valve closure part is achieved. These co-operating valve closure parts are, however, not coated with a ceramic material but actually consist of such a ceramic material.

The supporting element may be exchangeable or may be constituted as an integral part of the valve housing. If the supporting element is exchangeable then it will be possible, through simple interchange of the valve closure part, to convert the slide valve to other rated flow cross-sections, which may be important if the valve is being used as a control valve. If, on the other hand, the supporting element is constituted as an integral component of the valve housing less parts are needed, with the result that the slide valve will be less complicated.

By reason of the fact that the medium flowing through the slide valve is not deflected, a valve of this kind functions at a particularly low noise level. A further improvement is realised if the supporting element is constructed so as to promote good flow conditions. This may be achieved in a simple way, by the use of a corresponding cross-sectional shape pattern of the slots. In an advantageous and optimum manner an additional noise damping effect is achieved if the supporting element comprises ribs which extend parallel to the slots and taper in the direction of through flow of the fluid medium. The noise damping effect of the supporting element may be reinforced if the valve plate or the valve housing is constructed, on the side at which the fluid medium enters, in such a way as to promote good flow conditions; advantageously, the drive connection for the valve plate is located outside the flow of the fluid medium to be controlled by the valve.

It is also possible, by separation of the valve seating and supporting element, to construct the element which co-operates with the valve plate in such a way as to promote good flow conditions without any danger arising of coating defects caused by a complicated shape of the body to be coated.

As the valve seating is not adjustable relative to the supporting element it will be found preferable, for the purpose of compensating for tolerances and with a view to eliminating turbulence, if the side of the slot is smaller, in the direction of the working stroke of the valve plate, in the valve seating than in the supporting element.

In order to subject the valve seating to the smallest possible stressing, as this seating is made of ceramic — and therefore brittle — material, the valve seating which abuts the supporting element, is resiliently located or retained by means of seals, both on its side lying remove from the supporting element and also in radial directions. Thus, the valve seating is floatingly mounted.

In slide valves thermal shocks may occur which, in the case of ceramic material, present problems insofar as ceramic materials are bad heat conductors. Thermal shocks do not usually occur in the case of the valve plate, which is surrounded by the fluid medium at the side at which the fluid medium enters and at the side surfaces. This is not so in the case of the valve seating, which can be covered and exposed and which, advantageously, therefore consists of a ceramic material which is particularly resistant to thermal shocks, if the occurrence of such thermal shocks is to be expected.

In the case of valves in which the valve seating is not at the same time a stop for the closure part it is an extremely complicated and difficult matter to set the precise working stroke. With slide valves according to the present invention the valve closure parts, which consist of ceramic (which is a brittle material), should not serve as stop means, so as thereby to prevent the occurrence of stress in the parts. It is therefore essential to find means for adjusting the working stroke which are independent of the valve plate. This is essential for reliable operation for preventing damage being inflicted on the valve plate, which consists of brittle material. It is known, for adjusting the valve plate relative to the stationary operating element, to arrange on the positioning spindle an entraining member which, with the assistance of one or more adjusting nuts, can be axially shifted and then secured in the position of adjustment selected (US-PS 3,517,697 and 3,159,177). The adjustment of the valve plate relative to the stationary co-operating element is extremely complicated in this procedure. Initially the entraining member is given a coarse adjustment before the co-operating element has been introduced and before insertion of the valve plate. It is then ascertained — by installing the co-operating element and bringing the valve plate into engagement with the entraining member, and also by installing the drive unit — whether the slots in the valve plate and in the co-operating element register with one another. The adjustment procedure is repeated a number of times until these slots do register with one another; the valve plate and the co-operating element must be repeatedly taken out and then re-installed. The adjustment cannot be checked simultaneously with the adjustment but only after the adjustment has been carried out. Even if use is made of special tools for performing this adjustment on this side of the valve housing at which the entraining member is located, this checking work, performed by adjusting tools introduced into the valve housing, cannot take place simultaneously with the adjustment work itself, or at least the checking work is rendered appreciably more difficult. Furthermore, in the case of the ceramic parts proposed according to the invention, there is increased risk of damage occurring, during the adjustment procedure, through the ceramic parts having to be removed repeatedly and then re-installed. In accordance therefore with a modification of the invention the drive unit can be rotated relative to the valve housing and locked in any desired position of rotation thus assumed, while the element of the drive unit acted on by the fluid control medium, and the valve plate, are connected to each other by way of a distance altering screw threaded connection, the part of the screw threaded connection connected to the drive unit being non-rotatably guided by the drive unit, and the part of the screw threaded connection which is connected to the valve plate being non-rotatably guided by the valve housing. Thus, due to the drive unit being rotatable relative to the valve housing, the valve plate can be adjusted, whereupon the drive unit can be locked in any desired position of rotation which it has thus assumed relative to the valve housing. The connection between the valve body and the drive unit which has previously been discontinued for the purpose of effecting the relative turning movement is then restored. Checking of the exact adjustment of the valve plate can be performed simultaneously with the adjustment itself, according to the particular type of valve in question, due to the fact that, during the adjustment work, no tools prevent the operative looking into and through the valve housing. An adjustment procedure of this kind is also advantageous in the case of other valves in which delimitation of the working stroke is not intended to be done by the valve closure part itself.

The screw threaded connection between the driven elements in the drive unit and in the valve housing may be achieved in different ways, and may lie at different points within this area. In accordance with a preferred embodiment of the invention the screw threaded connection is between the positioning spindle, which is non-rotatably connected to the drive unit, and the valve plate, which is non-rotatably guided in the valve housing. The positioning device is preferably constituted as a positioning sleeve which is screwed onto the positioning spindle.

Conveniently, the entraining member, which moves the valve plate, is carried by the positioning sleeve, as in this way a simple mode of construction within the invention is achieved.

When the valve plate is adjusted by rotating the positioning spindle, the positioning sleeve must be prevented from following this rotation. For this purpose it is possible to equip the positioning sleeve with a lug or longitudinal groove with which a corresponding element or part of the housing co-operates; alternatively, the valve plate would require a lateral guide, along which the positioning sleeve would then be guided, as a result of which the valve plate would, in operation, be subjected to increased friction during the positioning work. According to a further feature of the invention, the entraining member is therefore bifurcated, and at the same time forms the means for preventing rotation of the positioning sleeve. If, then, for adjusting the valve plate, the positioning spindle is turned, an entraining prong, which engages in a corresponding recess in the valve plate, comes into abutment with the co-operating element, and is thus prevented from being turned further.

Provision is preferably made, for keeping the forces acting on the ceramic part small, and also for the purpose of enabling the surface of the valve plate to be given optimum use, for the valve plate to comprise, at its outer periphery and for the two entraining prongs of the entraining member, two diametrically opposite openings in the centre plane extending transversely of the direction of the working stroke. This form of construction of the entraining member is also advantageous with other known slide valves. As the openings for receiving the entraining prongs are at the outer periphery of the valve plate, the whole surface of the valve plate is available for the provision of slots, so that this surface is given optimum use. Thus this surface, for the same cross-sectional surface of the slots, may be smaller than is true in the case of known slide valves of this kind. Consequently, the slide valve may, as a whole, be smaller than the hitherto known slide valves of this kind. As the valve plate sticks firmly, through adhesion, to the valve plate, this reduction in surface area also reduces the surface to which the adhesion force can be applied. As, further, the slots may be larger than hitherto and may be continuous, relatively large surfaces in the remaining surface of the valve plate, may be recessed opposite the surface surrounding the slots, as a result of which the adhesion force may be further reduced.

Even if, in principle, it is possible to provide one slot in the above mentioned centre plane of the valve plate, it has been found to be particularly advantageous to so constitute the valve plate that the latter has an even number of slots which are arranged symmetrically of the centre plane. In this way it is ensured — with favourable utilisation of surface area — that the medium does not have to be deflected between the junction of the two entraining prongs and the slots in the valve plate, so that the slide valve can now operate at only a very low noise level.

The positioning sleeve may be constituted in various ways, for example it may have the form of a sleeve through which the whole of the positioning spindle projects. In this case the entraining member is solely guided by the positioning spindle, and particularly high demands are placed on the accuracy of manufacture of the positioning spindle. It is, therefore, advantageous if the positioning sleeve has a head bore in which the positioning spindle ends, the positioning sleeve extending, at its end lying remote from the drive unit, into a guide bore in the valve housing. The positioning spindle may be given shorter dimensions due to the guidance of the positioning sleeve with the entraining member; further, exact orientation is not an important matter. Due to the guidance of the positioning sleeve itself by the valve housing the positioning spindle is in practice only used for positioning purposes. The working strokes transmitted to the valve plate in this embodiment are therefore more accurate, so that both a more accurate adjustment and also a more accurate regulation (when the slide valve is used as a control valve), and also more reliable valve opening and closing movements (when the slide valve is used as a check valve), are achieved.

According to a particularly favoured embodiment of the invention the connecting element is constituted as a sleeve which receives the positioning spindle and whose cylindrical end is rotatably mounted in a bore of the housing. As, in such an embodiment of the slide valve, the sleeve is mounted in a recess which thus securely holds the sleeve — even when the sleeve has not yet been fixed in its final position — adjustment of the valve plate is possible in a particularly simple manner.

The connecting element may be secured in various ways, for example by arranging for the valve housing to comprise screw threaded bores for receiving screws, which are guided through arcuate slots in the connecting elements — these slots enabling the connecting element to turn — and are screwed into the housing. Naturally, the arcuate slots may be provided in the valve housing, and the screw threaded bores in the connecting element. Also, both connecting element or elements and also the valve housing may comprise arcuate slots for receiving screws with nuts on their ends. Preferably, if the connecting element is constituted as a sleeve, the latter comprises an annular shoulder with which is associated a clamping element, which can be attached to the valve housing.

Due to the rotation of the drive unit relative to the valve housing, the drive unit assumes a fortuitous position of rotation relative to the valve housing and to the predetermined direction of fluid flow through the latter. Generally speaking, this is undesirable, not only for optical reasons, but also by reason of the connection to the control duct for the fluid control medium. Indeed, in practice, a specific orientation of the connection of the drive unit is, generally speaking, required. With this in view, in accordance with a further modification of the invention, the drive unit is rotatably fixed on the connecting element.

For the purpose of preventing rotation of the positioning spindle in the seals in the housing appendage or in the connecting element, which is only possible with a large degree of expenditure of power, it will be advantageous if the drive unit is assigned a carrier plate which carries a drive housing, which can rotate relative to the carrier plate after a securing (fixing) device has been untightened, the drive housing containing an element which can be acted on by the control medium e.g. an electromagnet or a piston which can be controlled hydraulically or pneumatically. Conveniently, the element which can be acted on by the control medium is a piston, which delimits a pressure space which is in communication, by way of at least one opening, with a chamber provided between the drive housing and the carrier plate, this chamber having a feed opening for the control medium.

The carrier plate, which may be identical with the cylinder base or may be a component which is separate from the cylinder base, is carried by the connecting element in such a way that it can rotate although it is axially held in position. This is preferably accomplished through the connecting element carrying, at its end lying closer to the drive unit, a stop which itself comprises, at its end nearest the drive unit, a flange-like widened portion, the base of the drive unit being resiliently clamped, by means of seals, between this widened portion and the end of the connecting element.

The screw threaded connection between the driven elements in the drive unit and in the valve housing may be constituted in various ways. In accordance with one favourable embodiment the part of the screw threaded connection which is non-rotatably guided in the drive unit is constituted as a carrier of the element which can be acted on by the control medium, and is screwed on to the positioning spindle. Thus, adjustment of the valve closure part takes place solely in the area between the drive unit and the connecting element, so that the connection between the valve housing and the said connecting element does not have to be discontinued. When a carrier of this kind is used in conjunction with a carrier plate which is separate from the cylinder base of the drive unit, it will be advantageous if the wall of the drive housing nearest the carrier plate serves as the means for non-rotatably guiding the drive unit for the carrier.

If the drive unit — after adjustment of the positioning sleeve and, hence, of the valve plate has been completed — is turned on the connecting element, further turning of the positioning spindle must be prevented, as such further rotation of the positioning spindle would cause an alteration of the adjustment which has been effected. This precaution may be achieved by arranging for the seals, which seal the positioning spindle relative to the sleeve, to exert such a great frictional force on the positioning spindle that the latter is, by this expedient alone, prevented from following the turning movement of the drive unit, as the sleeve is reliably prevented from turning due to its connection to the valve housing. However, it may be advantageous additionally to assign the positioning spindle means for preventing it from rotating relative to the connecting element. Advantageously, for this purpose, the connecting element comprises an internal polygonal guide in which the positioning spindle is guided by way of an external polygonal guide.

In order to ensure that the working stroke of the valve closure part may be delimited not only in one direction of the working stroke, through the piston coming into abutment with a stop, but also in the opposite direction, it is proposed, in accordance with a further modification of the invention, to assign to the positioning pin a stop which delimits the working stroke brought about by the control medium. When such a delimitation of the working stroke is provided in the embodiment of the invention in which the sleeve and the positioning spindle have co-operating polygonal profiles, the stop has, for the purpose of realising a compact form of construction, an opening for receiving the external polygonal guide of the positioning spindle.

In order to enable the working stroke stop to be positioned without dismantling the apparatus, the positioning spindle preferably has a fixed stop, while the counter-abutment in the valve housing, in the connecting element, or drive unit, is adjustable and is arranged so as to be accessible from outside the part which accommodates it. In another favourable embodiment of the invention the stop is adjustably arranged outside the drive unit on the positioning spindle, and co-operates with the drive unit. In order to achieve a particularly compact form of construction a screw threaded bushing is preferably provided in the housing of the drive unit on the side at which the control medium enters, one side of this bushing serving as a stop for the element which is acted on by the control medium and the other side of the bushing serving as a counterabutment for the stop arranged on the positioning spindle. For the purpose of ensuring, during adjustment of the valve closure part, that the path of the working stroke is not simultaneously altered, the screw thread bushing is, conveniently screwed in the housing of the drive unit, and has the same pitch as the screw threaded connection between the drive unit and the valve closure part.

The invention solves in a simple manner a problem which is intrinsic to slide valves. Slide valves require a high resistance to wear, high operating reliability and simple adjustability, which is specially adapted to the particular requirements of valves of this kind. In such valves extremely small working strokes are aimed at, which also appreciably increase the working life of the sealing elements, which are subjected to stresses applied through the movements involved. However, such small working strokes place high reliance on very accurate guidance and adjustment of the co-operating valve closure parts, so as to achieve satisfactory operation.

Further details and advantages of the present invention should become apparent from the following description with reference to the accompanying drawings, in which:—

Figure 1 shows a slide valve constituted according to the invention, including a drive unit, in longitudinal cross-section;

Figure 2 is a cross-sectional view of another embodiment of the valve closure parts of the valve shown in Figure 1;

Figure 3 is a cross-sectional view of a modified embodiment of the slide valve, with altered cross-section, and with the drive unit rotated relative to the housing of the slide valve;

Figure 4 is a cross-section of another modification of the slide valve according to the invention, with feed opening for the control medium rotatable relative to the drive unit;

Figure 5 is a further modification of the apparatus according to the invention, in which the supporting element is an integral component of the valve body, which is constructed so as to promote good flow conditions;

Figure 6 shows part of the connecting element between the drive unit and valve, the working stroke for controlling the valve plate being limited in accordance with the invention; and

Figure 7 is another embodiment of the invention, the working direction being the opposite of that shown in Figures 1, 3 and 4.

The invention will first be explained by reference to Figure 1.

The slide valve comprises a valve housing 1, which, by way of a connecting element 2 is connected to a drive unit 3. The valve housing 1 consists of two parts 10 and 11 which are connected to one another in a conventional way (which is not shown) the joint between these two parts 10 and 11 being sealed off, so as to prevent leakage of the medium to be controlled, by means of a seal 12. Each part 10, 11 of the housing 1 carries a flange 100, 110 with which the parts 10 and 11 are either integral or to which they are connected with the interposition of a seam weld 111 (Figure 3). The flanges 100, 110 serve for establishing a connection with other structures or with a duct or tube (not shown).

One of these parts 10, 11 of the housing 1, (in the embodiment illustrated the part 10), comprises an opening 101 for receiving a stationary co-operating element 4, with which a valve plate 5, which is slidable transversely of the direction of through passage of the medium, co-operates. The valve plate 5 consists of ceramic material and is supported from the co-operating element 4. This co-operating element 4 consists of a first plate, which constitutes the valve seating 40, and is also made of ceramic material, and against which the valve plate 5 sealingly abuts, and also of a second plate, which is of metal and serves as a supporting element 41 for the valve seating 40, which is supported over its whole surface area by the supporting element 41.

For the purpose of resiliently mounting the elements (valve seating 40 and supporting element 41), which constitute the co-operating element 4, and also for the purpose of sealing the part 10 relative to the part 11 of the valve housing 1, a seal 102 is provided between the parts 10 and 11 in the opening 101, on the side nearest the valve plate 5. The valve seating 40 abuts the seal 102, while the supporting element 41 abuts the seal 12.

The co-operating element comprises slots which extend transversely of the direction of the working stroke of the valve plate 5 and which are constituted by mutually aligned slots 400 and 120, 401 and 411 and 402 and 412 in the valve seating 40 and in the supporting element 41, while the valve plate abutting against the valve seating 40 has slots 50 and 51. In the illustrated position of the valve plate 5, the upper edge of the valve plate 5 is clear of the slots 400 and 410: the slot 50 is clear of the slots 401 and 411; and slot 51 lies clear of slots 402 and 412, so that the medium can flow through the housing.

The valve plate 5 comprises an entraining opening 52 in which engages an entraining member 60 which is connected to an axially displaceable positioning sleeve 6. A head bore 602 of the positioning sleeve 6 is arranged, by means of a screw thread 610, on the end of a positioning spindle 61, while the end 600 of the sleeve 6 lying remote from the positioning spindle 61 is guided in a bore 105 in the part 10 of the valve housing 1.

Means are provided for preventing rotation of the positioning sleeve 6. These means consist of a longitudinal groove 106 formed in a wall surface of the bore 105 and a guide pin 601 engaging in this groove 106 and carried by the ends 600 of the position sleeve 6.

The part 10 comprises an appendage 13 through which the positioning spindle 61 is guided, the valve housing being sealed off by means of seals 130. The positioning spindle 61 is connected to the drive unit 3. This drive unit 3 has a cylinder 30, in which is provided a pressure medium chamber 31 which communicates, by way of an opening 310, with a control medium duct (not shown). The pressure medium chamber 31 is delimited, on its side lying closest to the housing 1, by the cylinder base 32, and, on its side lying remote from the valve housing 1, by a piston 33 to which the positioning spindle 61 is connected. Piston 33 is biased by a return spring 34 which is supported by the cylinder 30 at the end of the piston 33 remote from the cylinder base 32. An adjustable stop 35 positioned in the cylinder base 32 serves to delimit the working stroke of the piston 33 and, accordingly, also of the valve plate 5 in the direction of arrow 36.

Two lock nuts 62 and 63 are arranged on the positioning spindle 61, between the stop 35, in which the positioning spindle 61 is slidably mounted, and the valve housing 1, the nuts 62 and 63 co-operating with the stop 35 and serving to delimit the maximum working stroke of the piston 33 and, hence, also of the valve plate 5.

The connecting element 2 consists of a number of struts 20, which may also be combined to form a sub-assembly in the form of a cage. These struts 20 are connected to the drive unit 3 in a manner not illustrated. At their end nearest the housing the struts 20 have segment-like sections 21, which, when the connecting element 2 is in the form of a cage, are combined to form a ring and have elongate holes 24 for receiving screws, 22, which can be screwed down into corresponding screw threaded bores 23 in the appendage 13.

The apparatus of which the structure has been described above functions in the following manner:—

The fluid medium to be controlled flows through the housing 1 in the direction of the arrow 108 when the valve plate 5 is in the position illustrated. In this position of the valve plate 5 the drive unit 3 is not acted on by the control medium, so that the biasing spring 34 has brought piston 33 to a point at which it abuts the stop 35. The fluid medium to be controlled by the valve exerts on the valve plate 5 and on the valve seating 40 a pressure which, under some circumstances, may be of considerable magnitude. Due to this pressure, strong bending pressures are applied to the co-operating element 4. However, the valve seating 40, which co-operates with the valve plate 5, consists, as does also the valve plate 5, of a ceramic material. Further, such materials can only resist extremely small tension and bending stresses, although they are more resistant to pressure, even high pressure. As a supporting element 41, which consists of metal, is associated with the valve seating 40, this supporting element 41 can take up or absorb the applied stresses. The valve seating 40 so abuts the supporting element 41 that the slots 400 and 410, 401 and 411 and 402 and 412 align with one another in pairs. Due to the valve seating 40 thus abutting against the supporting element 41 the valve seating is not subjected to any tensional or bending stresses, but only to compressional stress.

Thus, the valve seating 40, due to the supporting element 41 associated with it, may consist completely of ceramic material, so that it can be simply and economically made. As the valve plate 5 is also, by way of the valve seating 40, supported by the supporting element 41, this is also true of the valve plate 5. The desired characteristics of the valve closure parts are now achieved with a form of manufacture which, in comparison with that hitherto employed, is simpler and more economic.

In the open position of the slide valve, in which the piston 25 abuts the stop 35, the valve plate assumes its lower end position, in which the slots 50 and 51 align with the slots 401/411 and 402/412 in the co-operating element 4, and in which the upper edge of the valve plate exactly reaches the slot 400/410, although it leaves the latter completely unobstructed.

When the slide valve is to be closed, a fluid control medium is passed to the pressure chamber 31, as a result of which the piston 33 is moved, against the force of biasing spring 34, until the lock nut 62 abuts against the stop 35. In this position the solid surfaces of valve plate 5 cover off the slots 400/410, 401/411 and 402/412 of the co-operating element 4. The slide valve is then in its closed position.

If a control element is provided in the control duct communicating with the opening 310 the valve plate 5 can naturally assume corresponding intermediate positions, so that the slide valve can be used both as a check (stop) valve and also as a control valve.

The valve plate 5 and also the valve seating 40 should not be subjected to any stress, as the ceramic parts are brittle and only have low strength when subjected to such stresses. Exact delimiting of the working stroke of the valve plate 5, and also adjustment of the latter, relative to the co-operating element 4, is therefore an essential prerequisite for achieving accurate and reliable operation of the slide valve. This adjustment is carried out in the following way:—

The connecting element 2 with the mounted drive unit 3 is inserted into the appendage 13 of the valve housing 1, and the positioning spindle 61 is screwed the required distance into the positioning sleeve 6. After the bipartite co-operating element 4 and by the valve plate 5 have been introduced, the entraining member 60 of the positioning sleeve 6 is brought into engagement with the entraining opening 52 in the valve plate 5, whereupon the two parts 10 and 11 of the valve housing 1 are attached to each other. While the positioning spindle 61 is being screwed into the positioning sleeve 6 the latter is prevented from turning the guide pin 601, which is guided in the longitudinal groove 106. When the positioning spindle 61 is being screwed into the positioning sleeve 6, the progress of the valve adjustment can be observed by the operative looking, in the longitudinal direction through the valve housing 1 and observing the relative position of the slots 50 and 401/411 and 51 and 402/412. Thus, no engagement or manipulation is actually necessary inside the valve housing. However, accurate adjustment is possible without the assistance of expensive and special tools.

When the desired position, which corresponds to the above described open position of the slide valve, has been reached the connecting element 2 can be fixed in any desired position of rotation by means of its elongated holes 24. This may be reliably effected in particular by providing twice the number of screw threaded bores 23 as elongated holes 24, as in this way the connecting element 2, which can turn relative to the housing 1, can be fixed in any desired position of rotation by the screws 22 which are introduced into an elongate hole 24 and screwed into a screw threaded bore. The setting and adjustment of the valve plate will then have been completed.

Figure 2 shows a valve plate 5, and also a co-operating element 4, which are designed to promote good fluid flow conditions. For this purpose the slots 50 and 51 in the valve plate 5 are so constituted that they comprise, in the direction of fluid flow through, initially a tapering section 500, 510, which is followed by a section 501, 511 of constant cross-section. In a similar way the slots 400 and 402, which can be completely freed for fluid flow through, by the valve plate 5 have a first, tapering section 403, 404 and a second section 405, 406 of constant cross-section. In contradistinction, each of the slots 410, 411 and 412 of the supporting element 41 has a section 413, 414, 415 of constant cross-section which is followed by a section 416, 417, 418 of increasing cross-section. In this way the size of the transition from the cross-section of the part 10 of the housing 1 to the cross-section of the slots 400/410, 50/401/411 and 51/402/412 is reduced, so that the medium flowing through the housing 1 forms less eddies and is therefore quieter in operation in comparison with the form of construction shown in Figure 1.

A further reduction in operating noise can be achieved if the ribs 42 and 43 are integral with the supporting element 41, run parallel to the slots 410, 411 and 412, and taper in the direction of fluid through flow indicated by arrow 108, as in this way further calming of the fluid medium passing through the valve is achieved (Figure 3).

As is shown in Figures 1 to 3, the supporting element 41 is exchangeably mounted in the housing 1, as a result of which a high degree of flexibility is achieved in respect of use of the valve.

However, it is frequently not necessary to alter the rated flow cross-section of the co-operating element 4, in which case the supporting element 41 does not have to be exchangeable. A form of construction of this kind is shown in Figure 5. The valve seating 40 is constituted as in the case of Figure 1 or Figure 2. In this embodiment the supporting element 41 is an integral part of part 11 of the valve housing 1 and comprises ribs 14 and 15. However, if desired, the ribs 14 and 15 may be carried by an insert (not shown) which can be inserted in the valve housing 1. Also, the part 11 tapers opposite the direction of through flow of the medium, for a distance such that the inner wall 16 extends as far as the slot 412 of the supporting element 41.

The embodiments of the supporting elements 41 described by way of example show that the supporting element 41 can be constituted in various ways for promoting good fluid flow conditions.

In the case of slide valves which function with the assistance of a valve plate 5 which is slidable on a co-operating element 4 it is known, for the purpose of reversing the working direction, to insert the co-operating element 4 in the housing 1 with this element 4 turned through 180°. In this way (referring to Figure 1), when the drive unit is not acted upon by fluid pressure medium, the slots 400/410, 401/411 and 402/412 of the co-operating element 4 are covered by the valve plate 5 whereas, when the drive unit 3 is being acted on by fluid pressure medium, the valve plate 5 completely frees the slot 402/412 and, by means of slots 51 and 50 also frees slots 401/411 and 400/410. If the part 11 is symmetrically constituted, in respect of its surfaces which serve for attachment to the part 10, the part 11 with ribs 14 and 15 can then, for the purpose of reversing the working direction of the drive unit 3, be turned through 180° relative to the part 10, and then be re-attached to the part 10.

An adjustment of the working stroke and of the starting position of the valve plate 5 occurs in a similar way as was described above subject to the difference that, in this case, when adjustment is being effected the piston 33 must be acted on by the fluid control medium so that, in the other end position, the slot 50 frees the slot 401/411, the slot 51 frees the slot 402/412 and the lower edge of the valve plate frees the slot 400/410.

As Figures 2, 3 and 5 show, it is possible, according to the particular practical application intended, to design both of the valve closure parts (valve plate 5 and co-operating element 4) in such a way as to promote good flow conditions.

As is shown in Figure 5, the valve housing 1 may be constructed — on the side at which the fluid medium arrives, that is to say in the region of the part 10 of the valve housing — in such a way as to promote good flow conditions through the housing. This is accomplished by arranging for the valve housing to carry ribs 17 and 18 which lie in the area between the slots 400, 401 and 402 of the valve seating 40 and which extend parallel to the slots 50 and 51.

The connection between the positioning spindle 61 and the valve plate 5 may be established in the manner shown in Figure 1, in which the ribs 17 and 18 (not shown) have openings in which the positioning sleeve 6 is guided. Further, it is also possible to lengthen the valve plate 5 in the direction of the positioning spindle 61 and to connect, outside the path of flow of the fluid medium, the valve plate 5 to a positioning sleeve 64; in Figure 5 only the end, constituted as a pin 640, of the positioning sleeve 64 is visible. The inner space of the part 10 of the valve housing 1 through which the fluid medium passes, is substantially completely sealed off relative to the appendage 13, that is to say it is sealed off apart from the guide bore 107 for the pin 640 of the positioning sleeve 64 and an opening 19 through which the valve plate 5 penetrates into the appendage 13. In this area the valve plate 5 has in its centre area an entraining opening 53 — alternatively, the valve plate 5 may have two diametrically opposite entraining openings — with which the entraining member 641 of the positioning sleeve 64 co-operates. The guide surface 190 for the valve plate 5 may lie in the vicinity of the appendage 13.

As shown in Figure 3, and with a view to protecting the supporting element 41 from wear, the slots 410, 411 and 412 of the supporting element 41 are larger than the slots 400, 401 and 402 in the valve seating 40. Also, in this way it is possible to compensate for manufacturing tolerances; such compensation is important if the valve seating 40 is not adjustable relative to the supporting element 41.

As shown in Figures 3 and 5, and for the purpose of maintaining as small as possible the load to which the valve seating 40, which is of ceramic material, is subjected, the valve seating 40 is not simply clamped between two seals 102 and 12, which axially locate or retain the valve seating 40, but is also resiliently retained in the radial direction. As the valve plate 5 and the valve seating 40 consist of ceramic material, and such ceramic materials have a strong tendency to adhere to one another through a sticking action which is reinforced by the pressure of the fluid medium to be controlled by the valve, there is a risk that the valve plate will carry the valve seating 40 with it when the valve plate 5 is shifted. For taking up this movement there is provided a seal 103, which radially surrounds the valve seating 40 and is mounted in a retaining ring 104. The retaining ring is itself radially clamped, together with the supporting element 41, between the seals 102 and 12. Thus, the seals 103 and 102 serve to axially and radially retain or locate the valve seating 40, so that the valve seating 40 is floatingly, that is to say resiliently mounted. When, in the case of a resilient mounting of this kind of the valve seating 40, the latter is shifted to some extent radially relative to the supporting element 41, the above described formation of the slots 400/410, 401/411 and 402/412 effects a compensation for this movement.

For the purpose of the invention the word "slots" means any kind of openings in the valve closure parts which are provided for the through flow of the fluid medium. In order to ensure that the smallest possible working stroke is required, these openings are usually kept small (in the direction of the working stroke) in comparison with their widthwise direction.

If there is a danger of the occurrence of thermal shocks the valve seating 40, only small surface areas of which are, in comparison with the valve plate 5, exposed to the medium to be controlled by the valve, will be made of a ceramic material which is particularly resistant to thermal shocks, while it may be quite satisfactory to select, for the valve plate 5, ceramic materials which are normally temperature sensitive.

The slide valve of the invention may be modified in a number of ways. Thus, the drive unit 3 may be of any desired construction; the positioning spindle 61 may be acted on, in opposition to the biasing force of the spring 34 or of some other resilient force storing means, directly or indirectly, e.g. through the intermediary of a bell crank lever linkage, pneumatically, hydraulically or electromagnetically.

Also, the connecting element 2 may be differently constructed. As shown in Figure 2 the connecting element is in the form of a sleeve 25 which receives the positioning spindle 61 and carries the drive unit 3. For receiving the sleeve 25 the appendage 13 comprises a bore 131 which is delimited by the shoulder 132 and which lies continuously of a smaller bore 133, which communicates with the inner space of part 10 of the valve housing 1 and receives a nut 65 which, with the assistance of suitable means (e.g. a grub screw) is held in position on the positioning spindle 61. The bore 133 receives the cylindrical end 250 of the sleeve 25 and is of a diameter which is such that the sleeve 25 is firmly guided by the bore 133 and can easily be rotated in this bore 133 so that, through turning the sleeve 25, the valve plate 5 can be axially brought into the required position, as the positioning sleeve 6 is prevented from rotating.

The nut 65 serves (instead of the lock nuts 62 and 63 shown in Figure 1) for delimiting the working stroke of the valve plate 5; for this purpose the nut 65 co-operates with the end face 250 of the sleeve 25.

For the purpose of securing the sleeve 25, which is rotatable in the valve housing 1, after completion of the adjusting work, the appendage 13 of the part 10 of the valve housing 1 comprises an external screw thread 135 onto which a sleeve (box) nut 23 can be screwed. The box nut 23 engages over an annular flange 252 on the sleeve 25, and thus presses this sleeve 25 against the shoulder 132 of the appendage 13. Suitable means may be provided for reducing friction between the box nut 23 and the sleeve 25 so that, when the box nut 23 is tightened, the sleeve 25 will not rotate with the positioning spindle 61, so that it is thus ensured that adjustment of the valve plate 5 will not be adversely affected.

It is also possible, for fixing the sleeve 25 on the valve housing 1, to provide a flange 124 at the end of the appendage 13 (Figure 4), and a flange 26 freely arranged on the sleeve 25 co-operating with the flange 124. The flange 26 comprises bores 260 for receiving screws 22. At its end 250 nearest the valve housing 1 the sleeve 25 has, outside the appendage 13, a shoulder 251 which faces away from the appendage 13 and on which the flange 26 is supported. When the valve plate has been adjusted, the sleeve 25 — being in any desired position of rotation relative to the flange 26 — can be connected to the appendage 13 by means of the screws 22. The flange 26 thus represents a clamping element for the sleeve 25.

Also, the way in which the positioning sleeve 6 is prevented from turning may be accomplished in various ways. Instead of the guide pin 601 and the longitudinal groove 106 in the bore 105, the entraining member 60 of the positioning sleeve 6 may be bifurcated (Figure 4). The two entraining prongs 603 and 604 engage in diametrically opposite openings on the periphery of the valve plate 5. For this purpose the valve plate 5 comprises, in the centre plane 56 extending transversely of the direction of the working stroke, two diametrically opposite openings 54 and 55 at its outer periphery (Figure 2). Two entraining prongs 603 and 604 engage in these openings 54 and 55 and are carried by the common entraining member 60. When, for the purpose of adjusting the valve plate 5, the positioning spindle 61 is turned, an entraining prong 603 or 604 of the bifurcated entraining member 60 abuts the co-operating element 4 and is thus prevented from further turning movement.

The above description shows that optimum functioning can only be achieved if the relative positions between valve plate 5 and co-operating element 4 can be exactly adjusted and maintained during the work. With simple means the entraining prongs 603 and 604 effect, by their symmetrical engagement in the valve plate 5, a centreing of the valve plate 5, the entraining member 60 on the positioning pin 61 automatically swinging into the correct position. Lateral elements for the valve plate 5 are thus not necessary in the case of this embodiment of the invention. At the same time, the entraining prongs 603 and 604, of which the position is fixed by the guidance of the entraining member 60 on the positioning pin 61, prevent any obliquity of the valve plate 5 relative to the direction of the working stroke. In this way it is ensured that the valve plate 5 will not become wedged, and also no stresses occur in the valve plate 5.

As the valve plate 5 always has one solid (i.e. continuous) surface more than there are slots 50 and 51, and can thus cover off one slot more than there is in the valve plate itself, it is usual for the co-operating element 4 to comprise one slot more than the valve plate 5. For the purpose of realising the straightest possible through flow of the fluid medium to be controlled through the valve plate 1 and through the co-operating element 4, the valve plate 5 has, in the case of all the illustrated embodiments of the invention, an even number of slots 50 and 51, which are disposed symmetrically at the centre planes 56. The rated flow cross-section surface is therefore divided up into an uneven number of slots 400/410, 401/411 and 402/412 in the co-operating element 4; this automatically determines the size of the even number of slots 50 and 51 in the valve plate 5, this number of slots being less by one slot than the number of slots in the co-operating element 4.

Through adjustment of the valve plate 5 the position of rotation of the drive unit 3 relative to the housing 1 alters. For the purpose of bringing the drive unit 3 with its opening 310 into the required or necessary position of rotation the drive unit 3 is rotatably fixed on the connecting element 2, which is constituted as a sleeve 25 (Figure 7). This may be realised in principle in various ways.

Figure 7 illustrates, by way of example an embodiment of the invention in which the working direction of the drive unit 3 is the opposite of that of the embodiments illustrated in Figures 1 to 3. In this embodiment the control medium does not co-operate with the piston but with a diaphragm 332, which is clamped in position between the cylinder base 32 and the cylinder 30 and is attached to the positioning pin 61 by means of diaphragm plates 333 and 334. At its end lying nearest the drive unit 3 and the sleeve 25 defines a shoulder 253 against which the cylinder 30 is pressed by the stop screwed into the sleeve 25. In this embodiment this stop 35 extends through a central bore in the cylinder 30, a flange like extended portion 352 on the end of the stop 35 lying closer to the drive unit 3 overlying this central bore and extending some distance beyond it. At its surfaces nearest the surfaces of the cylinder 30 which supports the stop 35, the stop 35 has seals 350 and 351 by means of which the cylinder 30 is resiliently clamped in position. The stop 35 is so tightened that the seals 350 and 351 satisfactory perform their sealing function, although the cylinder 30, and hence the drive unit 3 connected to it, can be rotated relative to the stop 35.

When the drive unit 3 is rotated, for bringing it into the required position after the valve plate 5 has been adjusted, the positioning pin must no longer be able to turn. According to the particular embodiment in question of the apparatus according to the invention the automatically locked condition of the positioning spindle 61 is in itself so effective that no other special measures need to be adopted. For example, this is usually the case where the embodiment illustrated in Figure 1 is concerned (see seals 130).

In the other embodiments of the invention, relative turning between the positioning spindle 61 and the connecting element 2 e.g. the sleeve 25, is rendered completely impossible; this is in any case — according to the particular form adopted for the seal in the sleeve 25 (e.g. metal bellows) — very advantageous or even necessary. For this purpose the positioning spindle 61 has means for preventing it from rotating and which fix its position or rotation relative to the sleeve 25 (or to some connecting element 2 constituted in some other way). In the embodiment shown in Figure 4, the end 250 of the sleeve 25 has an internal polygonal guide 254 in which the positioning spindle 61 is guided by means of an external polygonal guide 611. However, for the purpose of enabling the working stroke of the valve plate 5 to be adjusted — while at the same time a compact form of construction is realised — the nut 65 on its side nearest the external polygonal guide 611 has a correspondingly dimensioned cylindrical opening 650.

The cross-section of the polygonal guide may for example be triangular, tetragonal or hexagonal.

Naturally, it is possible to replace this guide by a similar guide situated at the other end of the sleeve 25.

The whole drive unit 3 does not necessarily have to be rotatably arranged on the connecting element 2. As is shown in Figure 3, the cylinder base 32 has bores 320 by means of which the pressure chamber 31 is connected to a second chamber 37 instead of to an opening 310, this second chamber 37 being closed off by a supporting plate 38 and communicating, by way of an opening 310, with the fluid control medium duct (not shown). The supporting plate 38 is sealed off relative to the sleeve 25 by means of a seal 380 and relative to the cylinder base 32 by means of a seal 381, and, by means of a clamping ring 383 and screws 382, is clamped to the cylinder base 32 which extends radially outwardly in the form of a flange 321. After the clamping effect has been discontinued by loosening the screws, the supporting plate 38 with the opening 310 can thus be turned relative to the drive unit 3.

In the case of slide valves of the above defined type it is of special importance, for their satisfactory operation, that the working stroke should be delimited in both directions, this being ensured by means of stops which do not co-operate with the valve plate 5, so that this ceramic part shall not be subjected to stress. In the embodiments illustrated, delimitation of the working stroke in one direction is effected by means of the piston 33 and stop 35. In the embodiment illustrated in Figure 1 delimitation of the working stroke in the other direction is achieved by means of two lock nuts 62 and 63 screwed onto the positioning spindle 61. The lock nuts 62 and 63 are arranged in a completely unexposed fashion, and are therefore readily susceptible of adjustment; however, in this case, an elaborate or expensive connecting element 2 has to be provided. In the case of the embodiments shown in Figures 3 and 4 a simple connecting element 2, constituted as sleeve 25, can be used; however, adjustment of the working stroke is only possible when the apparatus has been dismantled.

Other modified forms of these stops are however, possible. Such a modified form of stop is explained below with reference to Figure 4, and combines the advantage of the provision of a simple connecting element with the advantage of good accessibility and, hence, of simple adjustability of the stop.

A stop 302 is adjustably mounted on the end of the cylinder 30 (of the drive unit 3) remote from the valve housing 1, by means of a screw threaded bushing 300, which is fixed in the cylinder 30 by means of a lock nut 301. A stop ring 612 is arranged on the positioning spindle 61. The stop ring 612 may be integral with the positioning spindle 61 or may be adjustably arranged on the positioning spindle 61 for the purpose of effecting coarse delimitation of the working stroke. Fine adjustment of the working strokes is then permitted by means of the stop 302. As this stop 302 is accessible from outside the drive unit 3 or from outside the connecting element 2 the limits of the working stroke can be determined at any time without difficulty.

Thus, the working stroke of the valve plate 5 is fixed by the stop 35 and also by the stop 302, while the distance altering screw connection (screw thread 610 in the above described embodiments) enables the fluid control effect achieved by the working stroke to be adjusted.

Figure 6 shows means for delimiting the working stroke which are of similar compactness. In this embodiment the positioning spindle 61 has a shoulder 614 which faces the drive unit 3 and adjacent is a section 613 of the positioning spindle 61 which is of reduced diameter, and which is either constituted as an intermediate section (of the positioning spindle 61) of reduced diameter, or the positioning spindle 61 continues to maintain this reduced diameter beyond this intermediate section. An opening 254 is provided in the sleeve 25 of the connecting element 2 through which a stop 67 extends, this stop 67 being so carried by the sleeve 25 by means of a co-operating element 670, constituted as a clamp, that the section 613 of reduced diameter of the positioning spindle 61 is not adversely affected by the stop 67 and, when the shoulder 614 abuts against the stop 67, prevents further movement of the positioning spindle 61 in the direction of the drive unit 3.

In the embodiment shown in Figure 7 a screw threaded bushing 353 is screwed into the cylinder base 32, the side nearest the drive unit 3 of the bushing 353 serving as a stop for the diaphragm plate 334, so that the diaphragm 332 and the end of the latter remote from the drive unit 3 serve as a stop for two lock nuts 62 and 63 which have been screwed on to the end of the positioning spindle 61 remote from the valve housing 1. The screw threaded bushing 353 has a polygonal profile 354 at its outer end. According to the invention the screw thread 355 has the same pitch as that of the screw thread of the said distance altering screw threaded connection (screw thread 610 in the previously described embodiments).

When the working stroke — which is determined by the distance of the lock nut 62 from the end surface of the screw threaded bushing 353 nearest the lock nut 62 when the diaphragm plate 334 abuts against the other end of the screw threaded bushing 353 — has been preset by means of the lock nuts 62 and 63, it is possible through rotation of the drive unit 3 and connecting element 2 relative to the valve housing 1 and to the screw threaded bushing 353, to effect an alteration in the fluid control effect achieved by the working stroke without the path of the working stroke itself being thereby altered, as the screw threads 610 (see Figures 1, 3 and 4) and 355 have the same pitch. Rotation of the drive unit 3 and of the connecting element 2 relative to the valve housing 1 is carried out in the above described manner. Rotation of these parts relative to the threaded bushing 353 is carried out, with the assistance of a suitable tool (e.g. a gripping tool), by preventing the screw threaded bushing 353 from following the rotation of the drive unit 3, so that the relative positioning between screw threaded bushing 353 and the valve housing remains unaltered during this adjustment.

If the stop 35 is screwed into the cylinder base 32 this way of adjusting the working stroke can also be accomplished with the apparatus shown in Figure 3, if one and the same pitch is selected for the stop 35 and the screw thread 610.

In principle, the distance-altering screw threaded connection may be located at any desired point in the element transmitting movement from the drive unit 3 to the valve plate 5. In the embodiments described above with reference to Figures 1, 3 and 4 this point lies between the positioning spindle 61 and the positioning sleeve 6.

Figure 4 illustrates an embodiment of the invention in which the screw threaded connection is between a carrier 8 of the element (e.g. a piston 33), which is acted on by the fluid control medium, and the positioning spindle 61. The carrier 8 comprises a flange 80 against which — with the assistance of a seal 331 provided in the piston 33 — the piston 33 sealingly abuts by a nut 81 screwed onto the carrier 8. The carrier 8 is screwed onto a screw thread 615 of the positioning spindle 61 and extends through the cylinder base; the carrier 8 and the cylinder base 32 have co-operating polygonal profiles 323 and 82, which reliably prevent relative rotation between drive unit 3 and carrier 8. Adjacent the co-operating polygonal profiles 323 and 82 the bore in the cylinder base 32 and also the outer periphery of the carrier 8 have circular profiles, a sealing ring 322 being provided in the bore of the cylinder base which receives the carrier 8.

The stop 35 of the embodiment of Figure 1 is replaced, in this embodiment, by a bushing 39 which is screwed into the sleeve 25 and into which projects the end of the carrier 8. For sealing purposes the bushing 39 carries, on its inner face, a seal 390. The supporting plate 38 is sealingly and resiliently clamped, by means of a further sealing ring 391, between a flange-like widened portion 392 of the bushing 39 and a shoulder 253 of the connecting element 2.

For the non-rotatable guidance of the positioning spindle 61 in the valve housing 1 an internal polygonal guide 254, is, again, provided in the valve housing, a complementary external polygonal guide 611 of the positioning spindle 61 co-operating with this internal polygonal guide 254.

When the screws 382 have been loosened, the drive housing, which is constituted by the cylinder base 32 and the cylinder 30 is turned relative to the supporting plate 38 and the valve housing 1. The cylinder base 32 carries the support 8 with it; according to the particular direction of rotation the support 8 shifts the positioning spindle 61 (which is prevented from rotating) either towards or away from the valve housing 1. When the required adjustment has been completed, the supporting plate 38 can be brought into the required position of rotation for the purpose of correspondingly positioning the opening 310 provided for the infeed of the fluid control medium before the position of the drive housing 30, 32 has been fixed, relative to the supporting plate 38, by tightening the screws 382.

The non-rotatable guidance of the support 8 may also occur in a different way, for example from the cylinder 30 and through the intermediary of the piston. The non-rotatable guidance effected by the valve housing or drive housing 30, 32, may take place directly by this housing or with the interposition of the connecting element 2.

If an electromagnet is used as the element of the drive unit 3 which can be acted on for control purposes, the electro-magnet — and this represents a modification of the form of construction illustrated in Figure 4 — is adjustable relative to the valve housing 1 by the support 8, to which the electromagnet will then be fixed in some suitable way. Also, the distance between the element which is acted upon, that is to say the electromagnet, and the valve plate 5 is in this way altered by rotation of the drive housing 30, 32 relative to the positioning spindle 61.

Further modifications of the valve are possible, within the ambit of the invention, by interchanging elements with one another or through their replacement with equivalent elements, or by any desired combination of the means used.

Claims

1. A slide valve, comprising a valve housing and a valve plate which is shiftable transversely of the direction of through flow of the fluid medium, this valve plate comprising slots which extend transversely of the direction of the working stroke, the valve plate co-operating with a co-operating element which also comprises slots which extend transversely of the working stroke of the valve plate, the valve plate being capable of covering off or exposing the slots of the said co-operating element, the co-operating surfaces of the valve plate and of the co-operating element consisting of ceramic material, characterised in that the co-operating element consists of a valve seating which, like the shiftable valve plate completely consists of ceramic material, and also of a metal supporting element, which supports the valve seating over the whole surface area of the latter and on the face of the valve seating which lies remote from the valve plate, the slots of the co-operating element 4 being constituted by mutually aligned slots in the valve seating and in the supporting element.

2. A slide valve according to claim 1, wherein the supporting element is exchangeable.

3. A slide valve according to claim 2, wherein the supporting element is integral with the valve housing 1.

4. A slide valve according to any of claims 1 to 3, characterised in that the supporting element is constituted so as to promote good fluid flow conditions.

5. A slide valve according to claim 4, wherein the supporting element comprises ribs which extend parallel to the slots and taper in the direction of through flow of the fluid medium.

6. A slide valve according to any of claims 1 to 5, wherein the valve plate is constituted so as to promote good fluid through flow conditions.

7. A slide valve according to any of claims 1 to 6, wherein the valve housing is constituted, on that side at which the fluid medium arrives, so as to promote good flow conditions of the fluid medium.

8. A slide valve according to any of claims 1 to 7, wherein the drive connection for the valve plate is effected outside the flow of the fluid medium to be controlled.

9. A slide valve according to any of claims 1 to 7, wherein the size of the slots is smaller, in the direction of the working stroke of the valve plate in the valve seating than in the supporting element.

10. A slide valve according to any of claims 1 to 9, wherein the valve seating, which abuts against the supporting element, is resiliently secured both on its face lying remote from the supporting element and also in axial directions, this effect being achieved by means of seals.

11. A slide valve according to any of claims 1 to 10, wherein the valve seating consists ofa ceramic material which is resistant to thermal shocks.

12. A slide valve according to any of claims 1 to 11, with a drive unit which is connected by way of a connecting element to the valve housing, and comprises an element which can be acted on by a control medium, this element being itself connected, by way of a positioning spindle, to the valve plate, wherein the drive unit is rotatable relative to the valve housing and can be fixed in any such position of rotation assumed, and the element which can be acted on by the control medium, and the valve plate are interconnected by way of a distance altering screw threaded connection; the part of the screw threaded connection which is connected to the drive unit, being guided by the drive unit, and the other part of the screw threaded connection being non-rotatably guided by the valve housing.

13. A slide valve according to claim 12, wherein the screw threaded connection lies between the positioning spindle which is connected to the drive unit and the valve plate which is non-rotatably guided in the valve housing.

14. A slide valve according to claim 13, comprising a positioning device constituted as a sleeve which is screwed on to the positioning spindle.

15. A slide valve according to claim 14, with an entraining member for the valve plate, this entraining member being adjustable from the positioning spindle, and wherein the entraining member is carried by the positioning sleeve.

16. A slide valve according to claim 15, wherein the entraining member is bifurcated and constitutes the means for preventing the positioning sleeve from rotating.

17. A slide valve according to claim 16, wherein a valve plate for two entraining prongs of the entraining member comprises, at its outer periphery and in the centre plane extending transversely of the direction of the working stroke, two diametrically opposite openings.

18. A slide valve according to any of claims 1 to 17, wherein the valve plate has an even number of slots which are arranged symmetrically of the centre plane.

19. A slide valve according to any of claims 14 to 18, wherein the positioning sleeve comprises a head bore in which the positioning spindle ends; and the positioning sleeve extends at its end remote from the drive unit, into a bore in the valve housing.

20. A slide valve according to any of claims 12 to 19, wherein the connecting element is constituted as a sleeve which receives the positioning spindle and of which a cylindrical end is rotatably mounted in a bore of the valve housing.

21. A slide valve according to claim 20, wherein the sleeve comprises an annular shoulder with which is associated a clamping element attachable to the valve housing.

22. A slide valve according to any of claims 12 to 21, wherein the drive unit is rotatably fixed on the connecting element.

23. A slide valve according to claim 22, wherein a supporting plate is associated with the drive unit and carries a drive housing which can be turned relative to the supporting plate after an attachment device has been released from its clamping condition, the drive housing, containing an element which can be acted on by the control medium.

24. A slide valve according to claim 23, wherein the element which can be acted on by the control medium is a piston, which delimits a pressure space communicating, by way of at least one opening, with a chamber between the drive housing and the supporting plate and has a feed opening for the control medium.

25. A slide valve according to claim 23 or claim 24, wherein the supporting plate is carried so as to be rotatable but axially retained by the connecting element.

26. A slide valve according to any of claims 22 to 25, wherein the connecting element carries, at its end nearest the drive unit, a stop which comprises, at its end nearest the drive unit, a flange-like widened portion; the base or the supporting plate of the drive unit being resiliently clamped between this widened portion and the end of the connecting element by means of seals.

27. A slide valve according to any of claims 12 to 26, wherein the part of the screw threaded connection which is non-rotatably guided in the drive unit is constituted as a carrier of the element, which can be acted on by the control medium, and is screwed onto the positioning spindle.

28. A slide valve according to claim 27, wherein the wall nearest the supporting plate, of the drive housing serves as means for non-rotatably guiding the drive unit for the carrier.

29. A slide valve according to any of claims 22 to 28, wherein means are associated with the positioning spindle for preventing rotation of the latter, this means fixing the position of rotation of the spindle relative to the connecting element.

30. A slide valve according to claim 29, wherein a section of the sleeve, which forms the connecting element, comprises an internal polygonal guide in which the positioning spindle is guided by means of an external polygonal guide.

31. A slide valve according to any of claims 12 to 30, wherein a stop is associated with the positioning spindle and delimits the working stroke produced by the control medium.

32. A slide valve according to claim 30 or

claim 31, wherein the stop has an opening for receiving the external polygonal guide of the positioning spindle.

33. A slide valve according to claim 31, wherein the positioning spindle comprises a fixed non-adjustable stop, while a counterabutment in the valve housing, connecting element or in the drive unit, is adjustable and is arranged so as to be accessible outside the part which receives it.

34. A slide valve according to claim 31, wherein the stop is adjustably arranged, outside the drive unit, on the positioning spindle, and co-operates with the drive unit as a counter-abutment.

35. A slide valve according to claim 34, wherein a screw threaded bushing is situated in the housing of the drive unit, at the side at which the fluid control medium is introduced, one end of the bushing serving as a stop for the element which is acted on by the fluid control medium and the other end of which serves as a counterabutment for the stop arranged on the positioning spindle.

36. A slide valve according to claim 35, wherein the screw threaded bushing is screwed into the housing of the drive unit, and has the same pitch as a screw threaded connection between the drive unit and a valve plate.

37. A slide valve constructed and arranged to operate substantially as hereinbefore described with reference to any of Figs. 1 to 7 of the accompanying drawings.

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