

The present invention concerns a sliding valve according to the introducing part of claim 1.

It is known to use in sliding valves metal as material for the movable or stationary plate. These plates have good mechanical properties, for example a high elasticity and solidity, but have the disadvantage of a high sliding friction. In order to obtain better sliding qualities, it is known to provide the plates with a coating of ceramic material or to produce the plate of ceramic material. Such a valve is described in DE 86 06 140 U1. DE 35 45 266 A1 shows a sliding valve with two stationary plates and a movable plate made of ceramic material. Also the plates shown in DE 33 20 387 A1 of a sanitary valve made in form of a sliding valve are made of ceramic material. The used ceramic material has the disadvantage of being brittle and of responding in a sensitive manner to temperature variations.

It is also known to produce sliding plates of carbon material. These plates have good sliding properties and are unsensitive with respect to temperature variations and aggressive media. However, they have the disadvantage of being brittle and of responding in a sensitive manner to mechanical deformations. Thus, they are difficult to handle and can easily be damaged by pressure shocks of the medium. Such strains for example are produced by closing operations or in a stronger degree in the case of condensate or waste water backflows. Especially in the case of sliding valves having a movable plate and only one stationary plate cooperating therewith, also the charging of the valve opposite the provided flow or throughflow direction of the medium may cause destruction of a plate.

By DE 31 43 384 A1, a sliding member is known which consists of at least two layers of different materials, one layer presenting the running face consisting of a carbon sliding material and at least one further layer of a fibre composite material. The fibre composite material may consist of

fibre-reinforced carbon or of fibre-reinforced synthetic or plastics material. In the case of these sliding members, rotational symmetric or dynamically balanced members are concerned which consist of a basic member of carbon sliding material onto which a layer of fibre composite material is wound so that a sliding member of two layers of different material being firmly connected one to the other is produced. Such sliding members are not adapted to application to sliding valves of the specified kind. Furtheron, the described problem of the sliding plate does not exist in the case of the known sliding members which are provided for application to bearing bushes, washers of axial face seals and for piston separation sliders of rotary compressors.

A further disadvantage is that the sliding plate may be damaged by the forces acting on the plates by the operation means. Especially in the case of rapid adjusting motions, important adjusting forces are produced at the plate by which the fixing places or actuating places, respectively, of the operating means at the sliding plate may break out or the plate may be destructed.

In the case of sliding valves having a rotationally adjustable plate of steel it is known to provide, at the periphery of the plate, a toothing cooperating with an operating member designed in the form of a rack. For sliding plates of carbon material, such kind of acting upon a sliding plate by the operating member is unfavourable since due to the brittleness of the material the toothing or the like easily may be damaged.

The aim of the present invention is to design a sliding valve in a manner such as to avoid the disadvantages of the prior art and to enable valve plates to be designed in a simple manner for actuation by means of operating and fixing means.

This aim is achieved according to the invention by the features of claim 1.

At least one of the plates consists of carbon or synthetic or plastics material and at least in the critical areas a reinforcement by laid-in fibres is provided in order to essentially ameliorate the mechanical properties of this plate. Furtheron, in this way the plate has yet other favourable properties, thus for example a high chemical resistance or a minimal sliding friction. It is particularly favourable to reinforce the webs between two cutouts or perforations by laid-in fibres since the webs run especially the risk of fracture. In this way, in the sliding valves designed according to the invention, the favourable properties of the basic material, for example in the chemical field, are combined with the properties of high mechanical resistance by the reason of compound with the laid-in fibres such as to enable also complicated designs of the plates. A plate designed in such a manner loses its brittleness. The inner cohesion of the material is essentially ameliorated and the mechanical load capacity is increased. The loads occurring during the operation of a sliding valve due to pressure variations of the medium can be endured by a valve designed in such a way without being damaged. By the use of a carbon material as basic material for the plate of a sliding valve, due to its good sliding properties, easy shifting is made possible, and good corrosion and sealing properties are obtained. A valve equipped in such a way is not susceptible to temperature variations.

Good solidity values are obtained by the use of glass-fibres or carbon-fibres as reinforcing means. It is of particular advantage if the compound material reinforced by fibres consists of carbon material with laid-in carbon fibres. Furtheron, also synthetic fibres, for example of aramid, are adapted as reinforcement. Furtheron, due to the design, according to the invention, of a sliding valve it is achieved that the plates may be provided with bores or cavities of the surface by means of which also for a movable plate a simple guiding and fixing possibility can be achieved. This is of particular advantage for plates of rotary sliding valves since these need to be guided

and born centrically in a particular carefully manner. The flow or pattern of fibres advantageously can be matched to the contours of for example bores or to the profile of the surface so that at least at such places of a plate of a sliding valve extremely high mechanical properties are present. Thus, actuating linkages of bars may be directly be screwed into the sliding plate. The improvement of the mechanical properties additionally enables the plates initially being brittle now to be reworked. That's why the plates may be produced in the form of moulded blanks and then the cutouts or perforations may be provided, or for example a tothing at the circumference may be provided subsequently.

With respect to the resistance properties it is particularly favourable if the flow or pattern of fibres is matched or adapted to the stress pattern in the plate, i. e. if the fibres are disposed in the region of the tensile stress and the flow or pattern of fibres corresponds to the direction of the tensile stresses.

It is particularly advantageous to provide for the plates with lugs or attachments which are connected to the actuation means of the plate or which are acted upon by the actuation means. Due to the reinforcement, the lugs have sufficient solidity. The reinforcement, particularly the outer contour of the plate, enables the plate to be received by a holder or mounting by means of which for example it can be hold without any possibility of rotating and upon which the actuating means may act. In this respect, the plate may also be pressed into the holder or mounting.

It is of particular advantage to place the fibres in the region of supports inserted in the plates. In this way, the latter are connected to the plates in an improved manner. A breaking-out is prevented.

Hereafter the invention is described with the aid of drawings

in which

- Figure 1 represents a sliding plate with throughflow-openings in section;
- Figure 2 represents a sliding plate with a representation of the flow or pattern of fibres;
- Figure 3 represents a sliding plate with a representation of the flow or pattern of fibres in section;
- Figure 4 represents a stationary plate with a circular cutout as throughflow-opening for the medium, in section;
- Figure 4' represents a stationary plate with a lug and a bore;
- Figure 5 represents a sliding valve in section;
- Figure 6 represents a plate of a rotary sliding valve having a toothing at the circumference;
- Figure 7 represents a plate of a rotary sliding valve having a bore;
- Figure 7' represents a rotatable and a stationary plate of a sliding valve partially in section;
- Figure 8 and Figure 9 represent a plate having a receiver or mounting;
- Figure 10 shows a section through a plate having a toothing;
- Figure 11 shows a section through a plate having a receiver or mounting;
- Figure 12 represents a plate with a laid-in support;
- Figure 12' represents a plate with a laid-in support in section.

The sliding plate 1 (movable plate) represented in Figure 1 consists of a carbon composite material. It is reinforced by fibres 2 in its part 11 facing away from sliding surface 13. It is particularly advantageous for good sliding properties and a good sealing to design the sliding plate in a way such that the immediate region of the sliding surface 13 is without fiber insertion so that a sliding untroubled by the fibres 2, on a contact surface of another plate or disk may occur. The fibres 2 of plate 1 are inserted in a non-orientated manner

which has been indicated by representation with hatches and circles. In this way tensile stresses may be absorbed in all directions. A sharp separation line between an area of the plate in which fibres are inserted or laid-in, and an area where no fibres are inserted or laid-in, is not necessary. A separation is only necessary insofar as the sliding surface has to be free of fibres. The mechanical properties of the sliding plate according to the invention enable the plate to be provided with a threaded bore 3 for receiving a not shown valve operating bar. A breaking out of the screw thread is prevented by the fibres. The sliding plate 1 additionally has a lug or attachment 35 which, too, can serve to receive an operating means. The sliding plate 1 is provided with cutouts or perforations 15 which form the penetration or throughflow openings for the flowing medium. The movable plate 1 cooperates with a stationary plate (not shown) which has corresponding cutouts. In known manner in this way the flow of a liquid or gaseous medium, for example steam, is controlled. In spite of the contact pressure necessary for the sealing, plates which are designed according to the invention and which consist of a carbon composite material with carbon material and carbon fibres, of sliding valves are soft-running and unsensitive with respect to mechanical and thermal stresses. Due to the provision of lugs for holding and operating means, for example in the form of a square, at the side opposite the sealing surface, the sliding plate can be operated in a simple and direct manner.

Figure 2 represents a sliding plate 1 having cutouts 15 for the throughflow of the medium. The flow or pattern of fibres and their orientation are indicated by means of lines. The fibres are orientated longitudinally and transversally with respect to the cutouts 15 having a longitudinal form, a greater quantity of fibres being orientated parallel to the cutouts in the web 155, since here higher tensile stresses appear. The fibres being orientated in different directions are interlaced in tissue-like manner and are laid-in or embedded into the sliding plate 1 such as not to protrude out of the sliding surface. In the case

of valves which seal only at one side, the fabric or tissue 25 is provided in the composite material at that side of the sliding plate 1 which is opposite of the sealing sliding surface. Here, especially in the case of condensate or waste water return shocks or backflows, the most important tensile stresses arise. For the reinforcement it is also possible to provide fibre fabrics or tissues in which the fibres are orientated in more than two orientation directions.

Figure 3 represents a sliding plate 1 which has no cutouts. It is adapted for application to a sliding valve such as is shown by DE 33 90 493 C2. Besides this, the invention may also be applied to rotary sliding valves of the kind which is shown in DE 33 20 387 A1. The sliding plate 1 is designed to seal at both sides and to have no interruptions. A multilayer fabric or tissue 25 of glass-fibres is provided in the sliding plate 1 between the sealing and sliding surfaces 13. The composite material of the sliding valve consists of synthetics or plastics, for example synthetic resin plus fibre material. In the same way also another appropriate fibre material, for example aramid, may be used as a fibre material.

Figure 4 represents in section a stationary annular plate 4 having a circular cutout 15 for the throughflow of the medium. The fibres here are orientated to be parallel to the outer contour or profile in correspondance with the annular form of the plate 4.

Figure 4' represents a stationary plate 4 of a fibre-reinforced carbon composite material and having a lug 35 which fixes the plate in the housing of the sliding valve against rotation. The plate furtheron shows a bore 5 by means of which, by means of a centering bolt which catches into the housing of the sliding valve 10, it can be fixed in a nonrotatable manner, alternatively or in addition to lug 35.

Figure 5 represents a sliding valve 10 having a stationary plate

4 with cutouts 15 for the throughflow of the medium, and a movable plate 1 for the control of the throughflow. The latter plate, for controlling the throughflow, is shifted in linear manner perpendicularly with respect to the cutouts 15, the plates thus being movable one with respect to the other. However, the invention may also be applied to sliding valves in which more than two plates are provided for movement relative to the housing.

Figure 6 represents a plate 1 for a rotary sliding valve. Unblocking of the throughflow openings is effected by rotating the movable plate 1. For this purpose, the plate 1 has, at its outer circumference, a tothing 6 which cooperates with a rack 61. The latter, for its part, is operated by the adjusting mechanism of the rotary sliding valve. The tothing at the outer circumference of the valve plate is made as an integral part during the production and is reinforced by laid-in fibres. Advantageously the fibres in the circumferential part of plate 1 are orientated according to its outer contour (see Figure 10). This results in a particular high solidity of the tothing 6. Due to this kind of inserting the fibres the advantage is obtained as in the case of rolled screw threads. A sliding plate 1 with a tothing can be produced in a more simple way if the tothing is not reinforced by laid-in fibres. In this case the tothing at the outer circumference may be produced for example by simple milling.

Figure 7 represents a plate 1 of a rotary sliding valve from that side with which it contacts a stationary plate 4. In the center of plate 1 a blind hole bore 5' can be seen, by the aid of which in connection with a bolt the plate 1 is rotatably mounted on the stationary plate 4. This is shown in Figure 7'. The valve stem 62 engages with its lug 621 having the form of a cylinder, into a bore 5 of plate 1. By linear movements of the valve stem 62 which are imparted by the lug 621 to the plate 1, same is rotated and the valve is opened or closed. Especially at the bore 5, in the case of rapid adjusting motions, forces

are produced which, due to the fibre reinforcement, can be absorbed by the plate 1 in a way such that no damages occur. In the region of the bores 5 the fibres may be distributed with a higher density than in the remaining part of the plate. In the same manner as in the case of a plate movable in a linear manner, also in the plate of a rotary sliding valve, especially during condensate or waste water backflows, high tensile stresses are produced in the webs 155, which stresses can lead to destruction of the plate. It is also of particular advantage to reinforce also the webs 155 of the plate by fibres in addition to the reinforcements in the region of the lug of the drive element of the plate in which region stresses already occur during normal operating conditions of the valve.

Figure 8 represents a plate of a rotary sliding valve which is held, without any possibility of rotating, by means of an annular receiver or mounting 7. However, also sliding plates which are movable in a linear manner can be fixed by means of a receiver. The receiver 7 has a nose 71 with which the valve stem cooperates. In order to produce a connection which is stiff against rotation, between receiver 7 and plate 1, the receiver 7 is pressed onto plate 1. In this way in the latter stresses are produced which are absorbed by the laid-in fibres so that during operation and during pressing the receiver 7 onto plate 1 no damages occur in the latter. Especially the region of the outer circumference of the plate 1 runs the risk of being damaged during the pressing-on operation of the receiver 7 onto plate 1. For absorbing these stresses the plate 1 is reinforced by fibres at its outer circumference by this reason. The flow or pattern of fibres thereby corresponds to the outer contour or profile of the plate. The plate 1 shown in figure 8 represents in its center the blind hole bore 5 by which it is connected to the stationary valve plate by means of a bolt in a centrically guided manner. Figure 8 represents the plate 1 from that side by means of which it cooperates sealingly with a stationary valve plate.

Figure 9 represents the plate 1 from its backward side. Nose 71 is provided at the receiver 7 and, by means of a bolt, is actuated by the valve stem 62 which can rotate the valve plate. The receiver 7 extends annular-like from the circumference of the plate to the plain side of the plate 1. Due to the reinforcement of the plate 1 by fibres it furtheron is possible to provide a lug 35 such as in figure 1 also at the plate 1 of a rotary sliding valve for example at its outer circumference such as to enable the valve stem 62 to cooperate directly therewith. The insertion of fibres ascertains the solidity of the lug 35.

Figure 10 represents a part of a plate 1 of a rotary sliding valve in which figure the flow or pattern of fibres 2 is shown. The plate 1 is provided, at its outer circumference, with a toothing 6 serving as a drive. In the base body, too, the fibre orientation is unorientated as has already been shown in figure 1. For increasing the solidity of the toothing 6, the fibres 2 at the contour of the plate 1 are disposed in correspondance with its form. The flow of fibres 2 is uninterrupted in the toothing 6 which increases the solidity. The fibres 2 of the base body of the plate 1, that means in this context unorientated fibres, are also present in the toothing 6. In this way a particular high solidity is obtained there. In corresponding manner also a lug 35 serving to receive the operating means, of the plate 1 (Figure 1, Figure 4') may be reinforced by fibres 2.

Figure 11 represents a part of a plate 1 which is surrounded by a receiver 7. In the outer region of the plate 1 same is reinforced by fibres 2. A flow or pattern of fibres is shown in which the fibres 2 are not orientated in direction.

Figure 12 represents a part of a plate 1 of which a support forms an integral part. At its outer side it has a toothing 6. For a form-fit connection bores 85 are provided into which, during production, the composite material penetrates. The composite material is reinforced by fibres (here not shown). A breaking-out of the support 8 thus is prevented. Besides supports

having a toothing in practice any support form may be incorporated into the base body of the plate 1. Besides a disposition at the circumference which is particularly favourable for plates of rotary sliding valves, lug 35, as it is shown in figure 1, may as well be executed in the form of a laid-in support. Thus, it is particularly advantageous in the case of rotary sliding valves to incorporate a centering bolt of the kind shown in figure 7' into one of the plates 1. This may as well also be done for example with threaded bushes or holders for pressing springs. In addition to the lug for operating means, the supports may also serve exclusively or in addition for further reinforcing the plate 1 so that same is particularly solid.

Figure 12' represents, in section, a plate 1 according to the invention having a support 8 which already during the production of the plate has been laid-in.



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1. A sliding valve for controlling the throughflow of liquid or gaseous media, having a housing, [and] having plates (1, 4) arranged transversely to the throughflow direction so as to be movable relative to one another and cooperating in a sealed manner, at least one plate having a perforation (15) for the throughflow of the medium as well as attachments (6, 8, 35) and/or recesses (5) or a receiving profile for a mounting (7) for retaining, guiding or actuating means, **characterized in that** at least one of the plates (1, 4) consists of a carbon material or plastics material, reinforced by inlaid fibres (2) at least in the region of the recesses (5) and/or attachments or the receiving profile.
2. A sliding valve according to Claim 1 having a plate with a plurality of perforations separated by a web, **characterized in that** the web (155) is reinforced by fibres (2) between two perforations (15).
3. A sliding valve according to Claim 1 or 2, **characterized in that** the fibres (2) are carbon fibres.
4. A sliding valve according to Claim 1 or 2, **characterized in that** the fibres (2) are glass fibres.
5. A sliding valve according to Claim 1 or 2, **characterized in that** the fibres (2) consist of a plastics material.
6. A sliding valve according to one or more of Claims 1 to 5, **characterized in that** the fibres (2) are embedded as a tissue (25).
7. A sliding valve according to one or more of Claims 1 to 6, **characterized in that** the fibres (2) extend in a plane parallel to the sliding face (13) of the plate (1; 4).
8. A sliding valve according to one or more of Claims 1 to 7, **characterized in that** the orientation of the fibres is adapted to the stress pattern in the plate (1; 4).
9. A sliding valve according to one or more of Claims 1 to 8, **characterized in that** the fibres (2) are arranged at a distance from the sliding face (13) of the plate (1; 4), so that the sliding face of the plate (1; 4) is free of inlaid fibres.



10. A sliding valve according to one or more of Claims 1 to 9, with a plate with attachments (35), **characterized in that** the attachments (35) are constructed as teeth (6).
11. A sliding valve according to one or more of Claims 1 to 10, **characterized in that** the pattern of the fibres (2) is adapted to the profile of the attachments (35) and/or of the recesses (3; 5).
12. A sliding valve according to one or more of Claims 1 to 11, **characterized in that** the external profile of the disc for receiving a mounting (7) is reinforced by fibres.
13. A sliding valve according to one or more of Claims 1 to 12, **characterized in that** the plate (1; 4) is reinforced by fibres in the region of supports (8) inlaid in the plate.