The invention relates to a hydraulically pulsed wrench in accordance with the precharacterizing clause of Claim 1.

In the case of this known hydraulically pulsed wrench (DE-PS 34 01 082), the main plates are urged under spring force against the elliptical inner wall of the striker. The further plates are constructed in one piece with the output shaft and lie offset with respect to the centre plane of the striker. As a result of this, the main plates and the further plates only come into sealing contact with the associated sealing strips of the striker housing once during a 360° rotation of the striker housing, with the result that a pulse acting on the output shaft is then generated. So that the further plates, constructed in one piece with the output shaft, bear in perfectly sealing manner against the associated sealing strips of the striker housing, the sealing strips and the further plates have to be manufactured very precisely. This means that this hydraulically pulsed wrench can only be manufactured in a complicated and costly manner. Moreover, the bearings of the output shaft are loaded to an uneven extent as the rotary pulse is generated as a result of the asymmetrical distribution of the plates, so that the bearing points are subjected to considerable load and wear prematurely.

Further known is a hydraulically pulsed wrench (CH-PS 447 073) in which the output shaft has four plates arranged at angular spacings of 90° from one another and are biased radially outwards by springs. After each 180° rotation of the striker housing, all four plates come to bear in sealing manner against sealing strips of the striker housing. This results in the output shaft being turned in the direction of rotation of the housing in abrupt or pulsed manner after each 180° rotation of the striker housing. Since the sealing position is reached after each 180° rotation, the acceleration distance of the output shaft is relatively short, with the result that the torque generated by the output shaft is correspondingly small.

The object of the invention is to construct the generic

hydraulically pulsed wrench in such a way that it can be manufactured more simply and at lower cost without having a negative effect on the generation of the rotary pulse.

This object is achieved, in the case of the generic hydraulically pulsed wrench, according to the invention by the features of Claim 1.

In the case of the hydraulically pulsed wrench according to the invention, it is not only the main plates, as in the case of the generic hydraulic wrench, but also the further plates which are mounted in the output shaft. When the striker housing rotates, the further plates are forcibly controlled in their position with respect to the output shaft and the sealing strips by the servo-type members, which cooperate with the control tracks. As a result, the effect that all the plates bear in sealing manner against the associated sealing strips only in a single position on a 360° rotation of the striker housing is achieved in a structurally very simple way. Thus, on a 360° rotation, in each case only one double-strike pulse is generated and transmitted to the output shaft. As a result of the forcible control of the further plates, the associated sealing strips can be manufactured simply because the forcible control is constructed such that the further plates bear in perfectly sealing manner against the sealing strips of the striker housing, even with relatively large manufacturing tolerances. This makes it possible to arrange the main plates and the further plates symmetrically with respect to the axis of the output shaft, so that the output shaft and its bearing points are not loaded unevenly on generation of the rotary pulse. Thus, the hydraulically pulsed wrench according to the invention also has a long service life.

Further features of the invention emerge from the further claims, the description and the drawings.

The invention will be explained in more detail with reference to an embodiment illustrated in the drawings, in which:

Fig. 1 shows, in diagrammatic illustration, a hydraulically pulsed wrench according to the invention,

Fig. 2 shows, in an enlarged illustration and in axial section, a striker of the hydraulically pulsed wrench according to Fig. 1 in a position in which a strike is exerted on the output shaft of the hydraulically pulsed wrench,

Fig. 3 shows, in an illustration corresponding to Fig. 2, the striker in the position in which no strike is exerted on the output shaft of the hydraulically pulsed wrench,

Fig. 4 shows an illustration corresponding to Fig. 2, but where the main plates of the striker are illustrated,

Fig. 5 shows a section along the line V-V in Fig. 2,

Fig. 6 shows a section along the line VI-VI in Fig. 3, and

Fig. 7 shows a functional illustration of the striker of the hydraulically pulsed wrench according to the invention.

The hydraulically pulsed wrench, which is illustrated only diagrammatically in Fig. 1, has a housing 1 in which a compressed-air motor 2 and the striker 3 are housed. The construction and mode of operation of the compressed-air motor 2 is known. The housing 1 of the hydraulically pulsed wrench can be of any suitable construction. The compressed-air motor 2 has a drive shaft 4, illustrated only diagrammatically in Fig. 1 and connected in driving manner to a housing 5 of the striker 3, in known manner (Fig. 2).

The housing 5 of the striker 3 has a cylindrical part 6 having a radially inwardly directed flange 7 on the output side. At the other end, the cylindrical part 6 is provided with a peripheral depression 8 into which there is inserted a striker cover 9. Placed on this is a closure cover 10, which is also inserted in

the depression 8 of the cylindrical part 6 and whereof the end side 11 remote from the striker cover 9 preferably lies flush with the end side 12 of the cylindrical part 6. The closure cover 10 is provided centrally with a coupling part 13, by means of which the housing 5 of the striker 3 is coupled to the drive shaft 4 of the compressed-air motor 2. The closure cover 10 lies flat on the striker cover 9, which is provided centrally with an axially extending annular collar 14. The latter projects into a depression 15, on the inner wall of which the annular collar 14 bears on the outside. The depression 15 is provided in the end side 16 of the closure cover 10 which bears against the striker cover 9.

In order to ensure simple assembly of the striker 3, the striker cover 9 is advantageously inserted loosely in the depression 8 of the cylindrical part 6. The striker cover 9 then bears by means of its corresponding end side 17 against a radially extending shoulder face 18 of the depression 8. So that the striker cover 9 can be aligned precisely with respect to the cylindrical part 6, at least one positioning pin 19 which projects into corresponding positioning openings 20 and 21 in the cylindrical part 6 in the striker cover 9 is provided. The striker cover 9 can as a result be assembled in particular in a precisely predetermined position. The closure cover 10 is advantageously screwed into the depression 8 of the cylindrical part 6.

The cylindrical part 6, with the flange 7, and the striker cover 9 delimit a cylindrical space 22 which is completely filled with pressurized medium, preferably pressurized oil. Through the cylindrical space 22 there passes an output shaft 23, which is mounted to be rotatable in the cylindrical part 6 and in the closure cover 10, (not illustrated). A receiver 24, for example a clamping chuck, for screwing tools is seated non-rotatably on the end of the output shaft 23 projecting out of the housing 5 on the output side.

The output shaft 23 is rotatable relative to the striker housing 5. In the region between the flange 7 of the cylindrical part 6 and the striker cover 9, the output shaft 23 has the cross-sectional shape illustrated in Fig. 7. However, it can also have an approximately circular cross-section in this region, as illustrated in Figs. 5 and 6. The flattened regions illustrated in Figs. 5 and 6 on the periphery of the output shaft 23 have only been drawn in to better illustrate the sealing position of the control plates, to be described below. In actuality, the output shaft 23 has a circular cross-section in this embodiment. This region of the output shaft 23 is enlarged in cross-section. Adjoining it are the end portions 25 and 26 of the output shaft 23, which are relatively small in external diameter. The output shaft 23 is mounted to be rotatable in the flange 7 of the cylindrical part 6 and in the striker cover 9 by means of these end portions 25, 26. The end portions 25, 26 are sealed with respect to the flange 7 and the striker cover 9 by means of seals 27 and 28. The thickened portion of the output shaft 23 lies in the cylindrical space 22 and has depressions 29 to 32 (Fig. 5) at angular spacings of 90° in its peripheral face. A control plate 33 and 34 is housed in each case in the mutually diametrically opposed depressions 29 and 31, while a main plate 35 and 36 is housed in each case in the other two mutually diametrically opposed depressions 32 and 30. As Fig. 2 shows, the control plates 33 and 34 extend between the flange 7 of the cylindrical part 6 and the striker cover 9. At their two mutually opposing ends, the control plates 33 and 34 are provided with cam-shaped lengthening portions 37, 38 and 39, 40 which form servo-type members by means of which the control plates are forcibly controlled. The servo-type members 37 and 38 of the control plate 33 are axially shorter than the servo-type members 39 and 40 of the diametrically opposed control plate 34. Correspondingly, the servo-type members 37, 38 are radially broader than the servo-type members 39, 40. The servo-type members 37 to 40 extend from the mutually facing longitudinal sides 41 and 42 of the control plates 33, 34. Each control plate 33 and 34 is biased radially outwards by at least one pressure

spring 43 and 44.

A control track 45 and 46 is associated in each case with the servo-type members 37 and 38 of the control plate 33, in the flange 7 of the cylindrical part 6 and in the striker cover 9 respectively. A control track 47 and 48 is also associated with each of the servo-type members 39 and 40 of the control plate 34, in the flange 7 of the cylindrical part 6 and in the striker cover 9 respectively. All the control tracks 45 to 48 are formed by the side walls of depressions 49 and 50 in the mutually facing sides of the flange 7 of the cylindrical part 6 and of the striker cover 9. The control tracks 45 and 47 in the flange 7 and 46 and 48 in the striker cover 9 lie axially offset with respect to one another. As Fig. 2 shows, for the formation of these control tracks the respective depression 49 and 50 is constructed in stepped manner, with the control tracks 45 and 46 being provided on the mutually facing sides of the flange 7 and the striker cover 9, while the control tracks 47 and 48 are arranged on the mutually remote sides of the depressions and perpendicularly adjoin the base 51 and 52 respectively of the depressions 49 and 50. The control tracks 45 and 47, and 46 and 48, in the flange 7 and in the striker cover 9 each lie on the outer surface of an imaginary cylinder (Fig. 5). The generatrix of these cylindrical outer surfaces lies parallel to the axis of rotation of the output shaft 23. The control tracks 45 and 46 have a larger diameter than the control tracks 47 and 48. Moreover, the control tracks 45 and 47, and 46 and 48, are provided in such a way that they touch one another at one point 53 (Fig. 5).

As a result of the control tracks 45 to 48, the two mutually diametrically opposed control plates 33 and 34 are forcibly controlled when the hydraulically pulsed wrench is in operation in a way to be described below, such that they only come into sealing contact with associated sealing strips 54 and 55 at one position on a 360° rotation of the housing 5 (Fig. 5).

The two mutually diametrically opposed main plates 35, 36 are also under the force of at least one, in the embodiment in each case two, pressure springs 56 to 59 (Fig. 4), by means of which they are urged radially outwards against the inner wall 60 of the cylindrical space 22. The main plates 35, 36 are T-shaped (Fig. 4) and bear by means of the end sides of their limb against the mutually facing end sides 61 and 17 of the flange 7 of the cylindrical part 6 and of the striker cover 9 (Fig. 4). The depressions 32 and 33 are shorter than the axial length of the cylindrical space 22 and than the depressions 29 and 31 for the control plates 33 and 34. The depressions 29 and 31 extend over the entire axial length of the thickened central portion of the output shaft 23, while the depressions 32 and 30 are limited in the axial direction. The main plates 35, 36 engage by means of their base in these depressions, which are longer in the axial direction than the bases of the main plates. Moreover, the width of the depressions 30, 32 is greater than the thickness of the main plates 35, 36 (Fig. 5).

The inner wall 60 extends over an axial length section in the form of an ellipse (Fig. 5). Under the force of the pressure springs 56 to 59, the main plates 35 and 36 constantly bear against this elliptically extending inner wall 60 as the housing 5 rotates.

To start the hydraulically pulsed wrench, the compressed air motor 2 is started in known manner. The drive shaft 4 of the compressed-air motor 2 directly drives the housing 5 of the striker 3 by way of the coupling part 13. The closure cover 10, the striker cover 9 and the cylindrical part 6 with the flange 7 here form the housing 5. The output shaft 23 is entrained in rotation by way of the pressurized medium in the cylindrical space 22. As a result of this, the screwing tool inserted in the receiver 25 is rotated and a screw or a nut is screwed into the respective component. As long as the screwhead or the nut are not yet flush, the drive shaft 4 and the output shaft 23 rotate together. However, as soon as the screwhead or the nut is

seated, the output shaft 23 experiences a counter-force. To tighten the screw or the nut, it is now necessary for the output shaft 23 to apply a torque to the screw or the nut. Since the drive shaft 4, with the housing 5 of the striker 3, is rotatable with respect to the output shaft 23, the drive shaft 4 continues to be driven in rotation so that the housing 5 rotates relative to the output shaft 23.

As Fig. 5 shows, four sealing strips 54, 55, 62 and 63 which are constructed in one piece with the cylindrical part 6 and whereof the end sides act as sealing faces are provided on the inner wall of the cylindrical part 6, in each case at angular spacings of 90° .

Fig. 7 shows the movement sequence which is produced when the output shaft 23 continues to be turned in pulsed manner once the screwhead or the nut is seated. In the top illustration, the mutually diametrically opposed main plates 35, 36 and the also mutually diametrically opposed plates 33, 34 bear in sealing manner against the sealing strips 54, 55, 62, 63. As a result of this, four approximately sickle-shaped spaces 65 to 68 which are each enclosed are formed. With the direction of rotation 64 of the housing 5 illustrated, a high pressure builds up in the spaces 65 and 67, that is to say as seen in the direction of rotation 64 in each case behind the main plate 35 and 36, while a low pressure is formed in the two spaces 66 and 68 which are in front of the main plates 35 and 36, as seen in the direction of rotation 64. In this position, as a result of the sealed spaces, the pressure which builds up is transmitted to the output shaft 23, which is consequently rotated in abrupt or pulsed manner in the direction of rotation 64 of the housing 5. Since the depressions 30 and 32 in the output shaft 23 are broader than the main plates 35, 36, the latter can stand obliquely in this pulse position, as shown in Fig. 5 and in the top illustration of Fig. 7. As a result, there is sufficient space available to be able to displace the pressurized medium in the low-pressure spaces 66 and 68 adequately. This pressurized medium can be

displaced into the depressions 30 and 32.

As the housing 5 is rotated further, the sealing strips 54, 55, 62, 63 are freed of the main plates 35, 36 and the control plates 33, 34. The main plates 35, 36 are urged under spring force against the elliptical inner wall 60, so that they bear against this inner wall during rotation of the housing 5. The two control plates 33 and 34 are urged under spring force, with their servo-type members 37 to 40, against the associated control tracks 45 to 48, which each lie on a cylindrical surface and are arranged such that the control plates 33, 34 only bear against the sealing strips 54, 55 of the housing 5 in the pulse position (Fig. 5 and top illustration in Fig. 7). If the housing 5 has rotated by 180° with respect to the pulse phase, then a position in accordance with Fig. 6 and the bottom illustration in Fig. 7 is produced. The main plates 35, 36 in this position bear in sealing manner against the sealing strips 63 and 62, whereof the end sides lie on the elliptical inner wall 60. The control plates 33, 34, on the other hand, are spaced from the sealing strips 54 and 55 in this position. The control plates 33, 34 are forcibly controlled by their servo-type members 37 to 40 and the control tracks 45 to 48 such that after the 180° rotation of the housing 5 they do not bear in sealing manner against the corresponding sealing strips 54, 55 of the housing 5. As a result of this, no pressure is built up in the cylinder spaces in this position. The pulse generated by the main plates 35 and 36 passes without pressure. The output shaft 23 can thus be further accelerated. The housing 5 rotates further in the direction of rotation 64, with the main plates 35 and 36 bearing under spring force against the elliptical inner wall 60 and the control plates 33 and 34 being forcibly controlled by way of their servo-type members 37 to 40 by the control tracks 45 to 48. As a result of the eccentric position of the control tracks 45 to 48, the control plates 33, 34 move radially outwards again during the following 180° rotation of the housing 5 until, after a 360° rotation of the housing 5, they again bear in a sealing manner against the sealing strips 62, 63 (Fig. 5 and top

illustration in Fig. 7). Only now does the output shaft 23 receive a pulse again.

As a result of the construction described, it is possible, with this hydraulically pulsed wrench, to accelerate the output shaft 23 over the entire range of angle of rotation of 360° of the housing 5 and to achieve the maximum speed for each individual pulse. Since all the plates 33 to 36 are urged under spring force against the associated control tracks 45 to 48 and 60, flexible adjustment of all the plates is ensured, as a result of which there is certain to be gap-free sealing and an improved pulse quality and accuracy of torque is achieved. As a result of this flexible adaptation, relatively large manufacturing tolerances can be permitted, so that the striker 3 and thus the entire hydraulically pulsed wrench can be manufactured at low cost and also assembled simply. In particular, the control tracks 45 to 48 do not have to be manufactured with high precision, but as a result of the resilient urging of the control plates 33 and 34 relatively large tolerances can readily be allowed. The external diameter of the striker 3 can be kept small as a result of the four movable plates 33 to 36. During the acceleration phase, which takes place over an angular range of 360°, the possibility of the housing 5 being contacted unintentionally by the control plates 33, 34 is eliminated.

In the pulse position (Fig. 5 and top illustration in Fig. 7), the various cylinder spaces 65 to 68 are not connected to one another, because the control plates 33, 35 lie in sealing manner on the end sides of the control tracks 45 to 48 pointing in the axial direction. The output shaft 23 is sealed by means of its end faces against the flange 7 and the striker cover 9, and in the pulse position it separates the spaces 65 and 67 which are under pressure from the spaces 66 and 68 which are relieved of pressure.

After tightening the screws or nuts, the hydraulically pulsed wrench can be switched off in conventional manner.

Claims

1. A hydraulically pulsed wrench having a striker (3) which is driven in rotation and has a housing (5) and an output shaft (23) for a screwing tool, where two mutually opposing main plates (35, 36) are mounted radially displaceably in the output shaft (23) and are constantly urged radially outwards towards the inner wall (60) of the housing (5) and where the striker (3) has two further mutually opposing plates (33, 34) which, together with the main plates (35, 36), bear in sealing manner against sealing strips (54, 55, 62, 63) of the striker housing (5) in a single rotary position of the housing (5) of the striker (3) for the generation of a rotary pulse acting on the output shaft (23), characterized in that the further plates (33, 34) are mounted displaceably in the output shaft (23) and have servo-type members (37 to 40) by means of which the further plates (33, 34) are moved radially inwards in cooperation with control tracks (45 to 48) in a forcibly controlled manner, in opposition to a constantly radially outwardly exerted pressure in the rotary positions of the housing (5) deviating from the rotary position region of the housing which generates the rotary pulse.

2. A pulsed wrench according to Claim 1, characterized in that the servo-type members (37 to 40) are cam-shaped attachments to the further plates (33, 34).

3. A pulsed wrench according to Claim 1 or 2, characterized in that all the plates (33 to 36) have an angular spacing of 90° from one another.

4. A pulsed wrench according to one of Claims 1 to 3, characterized in that the control tracks (45 to 48) are formed by the side walls of depressions (49, 50) of the housing (5) of the striker (3).

5. A pulsed wrench according to one of Claims 1 to 4,

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characterized in that the control tracks (45, 46) associated with the one further plate (33) are arranged axially offset with respect to the control tracks (47, 48) associated with the other further plate (34).

6. A pulsed wrench according to one of Claims 1 to 5, characterized in that the control tracks (45 to 48) each lie on cylindrical faces.

7. A pulsed wrench according to Claim 6, characterized in that the control tracks (45, 46) associated with the one further plate (33) have a larger diameter than the other control tracks (47, 48).

8. A pulsed wrench according to Claim 6 or 7, characterized in that the control tracks (47, 48) having the smaller diameter lie eccentrically with respect to the control tracks (45, 46) having the larger diameter.

9. A pulsed wrench according to one of Claims 6 to 8, characterized in that the control tracks (45 to 48) of different diameters touch one another.

10. A pulsed wrench according to one of Claims 1 to 9, characterized in that the further plates (33, 34) and the main plates (35, 36) are spring-loaded towards the associated control tracks (45 to 48) or the inner wall (60) of the housing (5).

11. A pulsed wrench according to one of Claims 1 to 10, characterized in that the main plates (35, 36) have a thickness which is less than the width of the associated depressions (30, 32) in the output shaft (23).

12. A pulsed wrench according to one of Claims 1 to 11, characterized in that all the plates (33 to 36) are arranged symmetrically with respect to the axis of the output shaft (23).

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13. A pulsed wrench according to one of Claims 1 to 12, characterized in that in the sealing position for generating the rotary pulse acting on the output shaft (23) the further plates (33, 34) lie in a sealing manner on the end sides of the associated control tracks (45 to 48).

14. A pulsed wrench according to one of Claims 1 to 13, characterized in that in the sealing position for generating the rotary pulse acting on the output shaft (23) the further plates (33, 34) bear against the side walls of the depressions (29, 31) of the output shaft (23) in a sealing manner, preferably in a plane-parallel manner.

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