

Description

The present invention relates to a slitting cutter assembly according to the first part of claim 1 (JP-A-57/114 315). In this known assembly a fluid pressure is built up between the central arbor and a deformable sleeve and a screw is tightened axially on the arbor to perform clamping in axial and circumferential direction.

It is also known to clamp a tool on a shaft in axial direction only by means of an annular fluid operated piston (DE-B-1267 944). In circumferential direction the tool is secured on the shaft by means of a groove-feather-connection.

In order to apply a balanced pressure force on a plane, which is assumed to be not perfectly flat, it is further known to provide an assembly comprising a plurality of fluid operated pistons acting as a vice (DE-U-1842 788).

In another conventional slitting cutter assembly to cut a wide band steel plate into a plurality of narrow band steel plates, as shown in Fig. 1, two arbors 21, 22, are arranged in parallel on the vertical plane and each of the arbors 21, 22 is provided with a slipping-proof part 23 of large diameter at one end and a threaded part 24 of small diameter at other end. Annular or cylindrical spacers 25 and annular plate form cutters 26 are fitted to each of the arbors 21, 22 and a nut 27 threadably engaged with the threaded part 24 of each of the arbors 21, 22 is tightened, so that a plurality of the spacers 25 and a plurality of the cutters 26 are grasped between the nut 27 and slipping-proof part 23 of each of the arbors 21, 22 and a plurality of the cutters 26 are mounted on required positions of each of the arbors 21, 22 and bottom end of each cutter 26 of the arbor 21 on upper side and top end of each cutter 26 of the arbor 22 on lower side are spaced by a required gap.

In this constitution, however, since the cutter 26 are tightened by the nut 27 threadably engaged with the threaded part 24 of the arbor, if threads of the nut 27 and/or the threaded part 24 are not accurately finished or if spacer abutting surface of nut 27 and/or cutter abutting surface of the spacer 25 are not perpendicular to the arbor axial direction but slanted, the abutting surface of the cutter 26 with the spacer 25 is not uniformly pushed and the cutter 26 is not perpendicular to the arbor axial direction but slanted thereto. If the cutter 26 is slanted, the cutting line of the steel plate is not linear but meanders.

Since the nut 27 threadably engaged with the threaded part 24 of the arbor abuts on the spacer 25, a large force is required to tighten the nut 27 and therefore it is very difficult to increase the pushing force against the cutter 26 and much trouble is incurred to adjust the gap between the upper and lower cutters 26, 26. If the gap between the upper and lower cutters 26, 26 is not suitable, the cutting of the steel plate is not performed smoothly so that a burr may be produced at the cutting surface of the steel plate. Moreover, if pushing force or tightening force of the cutter 26

is small, the cutter 26 is loosened and trouble to adjust the gap is incurred again.

In view of above-mentioned difficulties met in the prior art, the problem underlying the invention is to provide a slitting cutter assembly of the kind mentioned in the first part of claim 1 which can easily and securely locate the cutters in an axial direction and retain them by frictional force in a circumferential direction on the arbor.

This problem is solved by the features of claim 1.

In the slitting cutter assembly of the invention, since each piston is supported by oil in the oil passage communicated with the bottom of each piston hole, even if a piston abutting surface of an object which abuts on the front end of each piston extending in front of the body is slanted or uneven, the pistons move forwardly or rearwardly and the position of each piston abutting on the object is adjusted whereby each piston abuts on the object uniformly so as to push the object uniformly. Moreover, as the threaded shaft is threadably advanced the piston is pushed by a force larger than the advancing force of the threaded shaft and therefore it is easy to increase the pushing force of the piston. In conclusion, the pusher of the invention using the pistons can easily push the object uniformly by a large force.

The invention is described in more detail in the following at hand of the drawings which represent a preferred embodiment of the invention.

Fig. 2 is a front view of a pusher according to an embodiment of the invention;

Fig. 3 is a sectional view taken along line III—III of Fig. 2;

Fig. 4 is a sectional view taken along line IV—IV of Fig. 2;

Fig. 5 is a sectional view taken along line V—V of Fig. 4; and

Fig. 6 is a front view partly in section of a steel plate splitter using the pusher of the embodiment shown in Figures 2 to 5.

A pusher 1 of the embodiment, as clearly seen in Fig. 2 and Fig. 3, comprises an annular body 2, and a number of piston holes 3 bored from a front surface of the body 2 at equally spaced positions along the axial direction of the body 2. In each piston hole 3 a piston 4 is slidably fitted with an O-ring 5 fitted to a circumferential groove on a circumferential surface thereof. An annular cover plate 7 provided with piston holes 8 of small diameter is overlaid on the front surface of the body 2 and fixed by a number of bolts 9. Each of the piston holes 8 of the cover plate 7 is in alignment with each piston hole 3 of the body 2. A front end portion 6 with small diameter of each piston 4 is inserted in the piston hole 8 of the cover plate 7, and a front end surface of spherical form of each piston 4 extends in front of the cover plate 7 (Fig. 6). An annular oil passage 10 communicating with a bottom portion of each piston hole 3 is formed within the body 2. As shown in Fig. 2 and Fig. 4, holes 11 are bored at two positions on other circumferential surface of the

body 2, and part of each hole 11 at bottom side is formed as a pressure chamber 12 and part of each hole 11 at opening side is formed as a threaded hole 13. A bottom portion of each pressure chamber 12 is communicated with the oil passage 10 through a small hole 14, and a piston 15 with an O-ring 16 fitted to a circumferential groove on a circumferential surface thereof is slidably fitted in each pressure chamber 12. A threaded shaft 17 is threadably fitted to each threaded hole 13, and a top end surface of spherical form of each threaded shaft 17 abuts on a base end surface of each piston 15. A stopper 19, as clearly seen in Fig. 4 and Fig. 5, is fixed to opening position of each threaded hole 13 using a bolt 20, and a base end surface with a hexagonal hole 18 of the threaded shaft 17 abuts on the stopper 19. Total cross-sectional area of all piston holes 3 is set to about 20 times as large as cross-sectional area of each pressure chamber 12, and oil is filled in the bottom portion of each piston hole 3, the oil passage 10, each small hole 14 and each pressure chamber 12. If any of the threaded shafts 17 is threadably advanced towards the pressure chamber 12 and the piston 15 is pushed by the threaded shaft 17 to bottom side of the pressure chamber 12, the piston 4 on the front surface of the body 2 is pushed forwards through the oil pressure by force of about 20 times as large as the advancing force of the threaded shaft 17 or the piston 15, respectively.

When a cutter 26 of a steel plate splitter is pushed and tightened using the pusher 1, as shown in Fig. 6, the pusher 1 is fitted between spacers 28, 29 of arbors 21, 22, and a rear surface of the pusher 1 abuts on the rear spacer 28 and the spherical front end surface of each piston 4 extending in front of the pusher 1 abuts on the front spacer 29. Further a rotation tool such as a torque wrench is engaged with the hexagon hole 18 of the threaded shaft 17 of the pusher 1, and the threaded shafts 17 is threadably advanced towards the pressure chamber 12 by the rotation of the tool and the piston 15 is pushed to bottom side of the pressure chamber 12. Then each piston 4 on the front surface of the pusher 1 is pushed forwards thereby urging the spacers 29, 25, 28, and the cutters 26, and each cutter 26 grasped between the spacers 25, 29 is pushed from both sides and tightened.

During the tightening, each piston 4 applies pressure to the oil in the oil passage 10 and the oil opposes against the pressure by reaction force being uniform in all directions. For example, even if the piston abutting surface of the spacers 29 or the cutter abutting surface of the spacer 25, 29 is not perpendicular to the arbor axial direction but slanted and therefore the pushing force of each piston 4 is different, the pistons 4 move forwards or rearwards and the position of each piston 4 abutting on the spacer 29 is adjusted, and all of the pistons 4 opposed by the oil at the uniform reaction force abut on the piston abutting surface of the spacer 29 uniformly, thereby tightening the

cutter 26 by uniform force directed exactly parallel to the arbors 21, 22.

Moreover, since a pressure multiplying circuit or booster circuit to advance the piston 4 by force of about 20 times as large as the advancing force of the threaded shaft 17 is constituted in the pusher 1, the threadable advancing of the threaded shaft 17 is easy without requiring large force, and the pushing force of each piston 4 hence the tightening force of the cutter 26 can be easily increased. Accordingly, since the tightening force of the cutter 26 can be increased uniformly it is not a great problem to adjust the gap between the upper and lower cutters 26, 26.

In Fig. 6, like parts to those in Fig. 1 are designated by the same reference numerals and the descriptions shall be omitted.

The pusher 1 of the embodiment can be used not only in the above case to tighten the cutter 26 of the steel plate splitter, parts of a machine, but also in other various cases, so that an object such as a work for a machine tool abutting on the front end of each piston 4 can be easily pushed uniformly at large force.

Claim

A slitting cutter assembly comprising annular cutters (26) and spacer rings (25) axially mounted on a central arbor (21, 22) by retaining means removably engageable with the central arbor and including a tightening device for axially clamping said annular cutters and spacer rings on the arbor, said tightening device having an annular body (2) retained on said arbor and provided with a plurality of piston holes (3) in a front surface of said annular body:

first pistons (4) slidably fitted into each of said piston holes and the front end (6) of each piston (4) extending in front of said body (2); and a passage (10), being provided in said body (2) to communicate with a bottom portion of each of said piston holes, both passage and piston holes containing hydraulic fluid;

characterized in that
a pressure chamber (12) is provided in said body (2) and communicates with said oil passage (10);

a second piston (15) is slidably fitted in the pressure chamber (12);

a threaded hole (13) is provided in the outer circumferential surface of said body (2) and communicates with said pressure chamber (12);

a threaded shaft (17) is threadably fitted to said threaded hole (13) and has a top end abutting said second piston (15) and a base end adapted to be engaged with a rotation tool;

a pressure multiplying circuit in which the total cross-sectional area of all of said piston holes (3) is set larger than the cross-sectional area of said pressure chamber (12);

whereby said second piston (15) is adapted to be pushed by said threaded shaft (17), and said first pistons (3) are adapted to be pushed forwardly out of said annular front surface of said

body 2, and part of each hole 11 at bottom side is formed as a pressure chamber 12 and part of each hole 11 at opening side is formed as a threaded hole 13. A bottom portion of each pressure chamber 12 is communicated with the oil passage 10 through a small hole 14, and a piston 15 with an O-ring 16 fitted to a circumferential groove on a circumferential surface thereof is slidably fitted in each pressure chamber 12. A threaded shaft 17 is threadably fitted to each threaded hole 13, and a top end surface of spherical form of each threaded shaft 17 abuts on a base end surface of each piston 15. A stopper 19, as clearly seen in Fig. 4 and Fig. 5, is fixed to opening position of each threaded hole 13 using a bolt 20, and a base end surface with a hexagonal hole 18 of the threaded shaft 17 abuts on the stopper 19. Total cross-sectional area of all piston holes 3 is set to about 20 times as large as cross-sectional area of each pressure chamber 12, and oil is filled in the bottom portion of each piston hole 3, the oil passage 10, each small hole 14 and each pressure chamber 12. If any of the threaded shafts 17 is threadably advanced towards the pressure chamber 12 and the piston 15 is pushed by the threaded shaft 17 to bottom side of the pressure chamber 12, the piston 4 on the front surface of the body 2 is pushed forwards through the oil pressure by force of about 20 times as large as the advancing force of the threaded shaft 17 or the piston 15, respectively.

When a cutter 26 of a steel plate splitter is pushed and tightened using the pusher 1, as shown in Fig. 6, the pusher 1 is fitted between spacers 28, 29 of arbors 21, 22, and a rear surface of the pusher 1 abuts on the rear spacer 28 and the spherical front end surface of each piston 4 extending in front of the pusher 1 abuts on the front spacer 29. Further a rotation tool such as a torque wrench is engaged with the hexagon hole 18 of the threaded shaft 17 of the pusher 1, and the threaded shafts 17 is threadably advanced towards the pressure chamber 12 by the rotation of the tool and the piston 15 is pushed to bottom side of the pressure chamber 12. Then each piston 4 on the front surface of the pusher 1 is pushed forwards thereby urging the spacers 29, 25, 28, and the cutters 26, and each cutter 26 grasped between the spacers 25, 29 or between the spacers 25, 29 is pushed from both sides and tightened.

During the tightening, each piston 4 applies pressure to the oil in the oil passage 10 and the oil opposes against the pressure by reaction force being uniform in all directions. For example, even if the piston abutting surface of the spacers 29 or the cutter abutting surface of the spacer 25, 29 is not perpendicular to the arbor axial direction but slanted and therefore the pushing force of each piston 4 is different, the pistons 4 move forwards or rearwards and the position of each piston 4 abutting on the spacer 29 is adjusted, and all of the pistons 4 opposed by the oil at the uniform reaction force abut on the piston abutting surface of the spacer 29 uniformly, thereby tightening the

cutter 26 by uniform force directed exactly parallel to the arbors 21, 22.

Moreover, since a pressure multiplying circuit or booster circuit to advance the piston 4 by force of about 20 times as large as the advancing force of the threaded shaft 17 is constituted in the pusher 1, the threadable advancing of the threaded shaft 17 is easy without requiring large force, and the pushing force of each piston 4 hence the tightening force of the cutter 26 can be easily increased. Accordingly, since the tightening force of the cutter 26 can be increased uniformly it is not a great problem to adjust the gap between the upper and lower cutters 26, 26.

In Fig. 6, like parts to those in Fig. 1 are designated by the same reference numerals and the descriptions shall be omitted.

The pusher 1 of the embodiment can be used not only in the above case to tighten the cutter 26 of the steel plate splitter, parts of a machine, but also in other various cases, so that an object such as a work for a machine tool abutting on the front end of each piston 4 can be easily pushed uniformly at large force.

Claim

A slitting cutter assembly comprising annular cutters (26) and spacer rings (25) axially mounted on a central arbor (21, 22) by retaining means removably engageable with the central arbor and including a tightening device for axially clamping said annular cutters and spacer rings on the arbor, said tightening device having an annular body (2) retained on said arbor and provided with a plurality of piston holes (3) in a front surface of said annular body:

first pistons (4) slidably fitted into each of said piston holes and the front end (6) of each piston (4) extending in front of said body (2); and a passage (10), being provided in said body (2) to communicate with a bottom portion of each of said piston holes, both passage and piston holes containing hydraulic fluid;

characterized in that

a pressure chamber (12) is provided in said body (2) and communicates with said oil passage (10);

a second piston (15) is slidably fitted in the pressure chamber (12);

a threaded hole (13) is provided in the outer circumferential surface of said body (2) and communicates with said pressure chamber (12);

a threaded shaft (17) is threadably fitted to said threaded hole (13) and has a top end abutting said second piston (15) and a base end adapted to be engaged with a rotation tool;

a pressure multiplying circuit in which the total cross-sectional area of all of said piston holes (3) is set larger than the cross-sectional area of said pressure chamber (12);

whereby said second piston (15) is adapted to be pushed by said threaded shaft (17), and said first pistons (3) are adapted to be pushed forwardly out of said annular front surface of said



body (2) by the oil when threadably advancing said threaded shaft (17) with a force greater than the advancing force of the threaded shaft (17).

Patentanspruch

Rundmessereinheit mit ringförmigen Messern (26) und Abstandsringen (25), welche axial auf einer zentralen Welle (21, 22) mittels lösbar mit der zentralen Welle verbindbaren Rückhaltevorrichtungen angeordnet sind und eine Spanneinrichtung zum axialen Verspannen der ringförmigen Messer und der Abstandsringe auf der Welle umfassen, wobei die Spanneinrichtung

einen Ringkörper (2), der auf der Welle gesichert ist und mehrere Kolbenöffnungen (3) in seiner Stirnfläche aufweist;

erste Kolben (4), die jeweils gleitbar in die Kolbenöffnungen eingepaßt sind und deren vorderer Endabschnitt (6) jeweils in den vorderen Abschnitt des Ringkörpers (2) hineinragt; und

einen Kanal (10) im Ringkörper (2) zur Verbindung mit dem unteren Abschnitt jeder Kolbenöffnung aufweist und sowohl der Kanal als auch die Kolbenöffnungen eine hydraulische Flüssigkeit enthalten, dadurch

gekennzeichnet, daß

eine Druckkammer (12) in dem Ringkörper (2) vorgesehen ist, die mit dem Kanal (10) kommuniziert;

ein zweiter Kolben (15) gleitbar in die Druckkammer (12) eingepaßt ist;

eine Gewindebohrung (13) in der äußeren Umfangsfläche des Ringkörpers (2) vorgesehen ist, die mit der Druckkammer (12) kommuniziert;

ein Gewindebolzen (17) in die Gewindebohrung (13) eingeschraubt ist, deren Wirkende in den zweiten Kolben (15) stößt und deren unteres Ende zum Zusammenwirken mit einem drehbaren Werkzeug gestaltet ist; ein druckmultiplizierender Kreis vorgesehen ist, bei dem die Gesamtquerschnittsfläche aller Kolbenöffnungen (3) größer als die Querschnittsfläche der Druckkammer (12) gemacht ist;

so daß der zweite Kolben (15) mittels des Gewindebolzens (17) verschoben werden kann, und die ersten Kolben (3) über die Stirnfläche des Ringkörpers (2) hinaus nach außen bewegt werden können mittels des Öles, wenn der Gewindebolzen (17) durch Verschrauben vorgeschoben wird, und zwar mit einer Kraft, die größer als diejenige Kraft ist, welche der Gewindebolzen (17) beim Vorschieben ausübt.

Revendication

Un ensemble de cisailles de découpage comprenant des cisailles annulaires (26) et des bagues d'entretoisement (25) montées dans une direction axiale sur un mandrin central (21, 22) par des moyens de retenue pouvant venir en prise de façon amovible avec le mandrin central et qui comportent un dispositif de serrage pour bloquer dans une direction axiale lesdites cisailles annulaires et lesdites bagues d'entretoisement sur le mandrin, ledit dispositif de serrage comportant un corps annulaire (2) retenu sur ledit mandrin et comprenant un certain nombre d'alésages de pistons (3) dans une surface frontale dudit corps annulaire; des premiers pistons (4) montés coulissants dans chacun desdits alésages de pistons, l'extrémité frontale (6) de chaque piston (4) étant située à l'avant dudit corps (2); et un passage (10) étant aménagé dans ledit corps (2) pour communiquer avec une section de fond desdits alésages de pistons, le passage et les alésages de pistons contenant tous un fluide hydraulique,

caractérisé en ce que

une chambre de pression (12) est aménagée dans ledit corps (2) et communique avec ledit passage d'huile (10); un second piston (15) est monté coulissant dans la chambre de pression (12); un orifice taraudé (13) est aménagé dans la surface circonférentielle extérieure dudit corps (2) et communique avec ladite chambre de pression (12);

un arbre fileté (17) est vissé dans l'orifice taraudé (13) et comporte une extrémité supérieure butant sur ledit second piston (15) et une extrémité de base adaptée pour être en prise avec un outil de rotation;

un circuit multiplicateur de pression dans lequel la surface de section droite totale de tous lesdits alésages de pistons (3) est fixée pour être supérieure à la surface de section droite de ladite chambre de pression (12);

de telle force que ledit second piston (15) est adapté pour être poussé par ledit arbre fileté (17) et lesdits premiers pistons (3) sont adaptés pour être poussés en avant vers l'extérieur de ladite surface frontale annulaire dudit corps (2) par l'huile lorsque l'on fait avancer par vissage ledit arbre fileté (17) avec une force supérieure à la force d'avancement de l'arbre fileté (17).



* C L M S *

55

60

65

4