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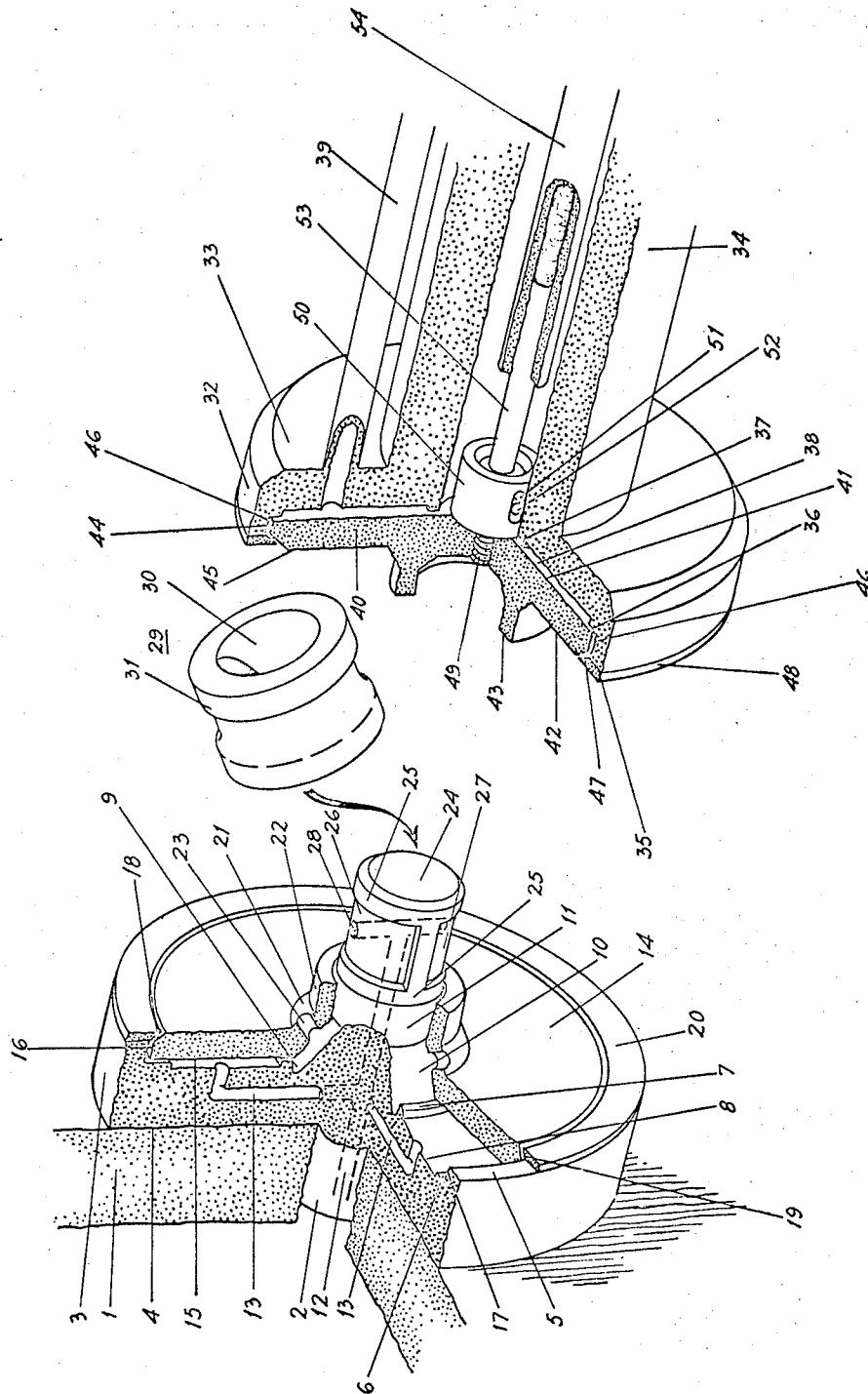
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DEVICE FOR HOLDING A RING-FORMED WORKPIECE

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Fig. 1



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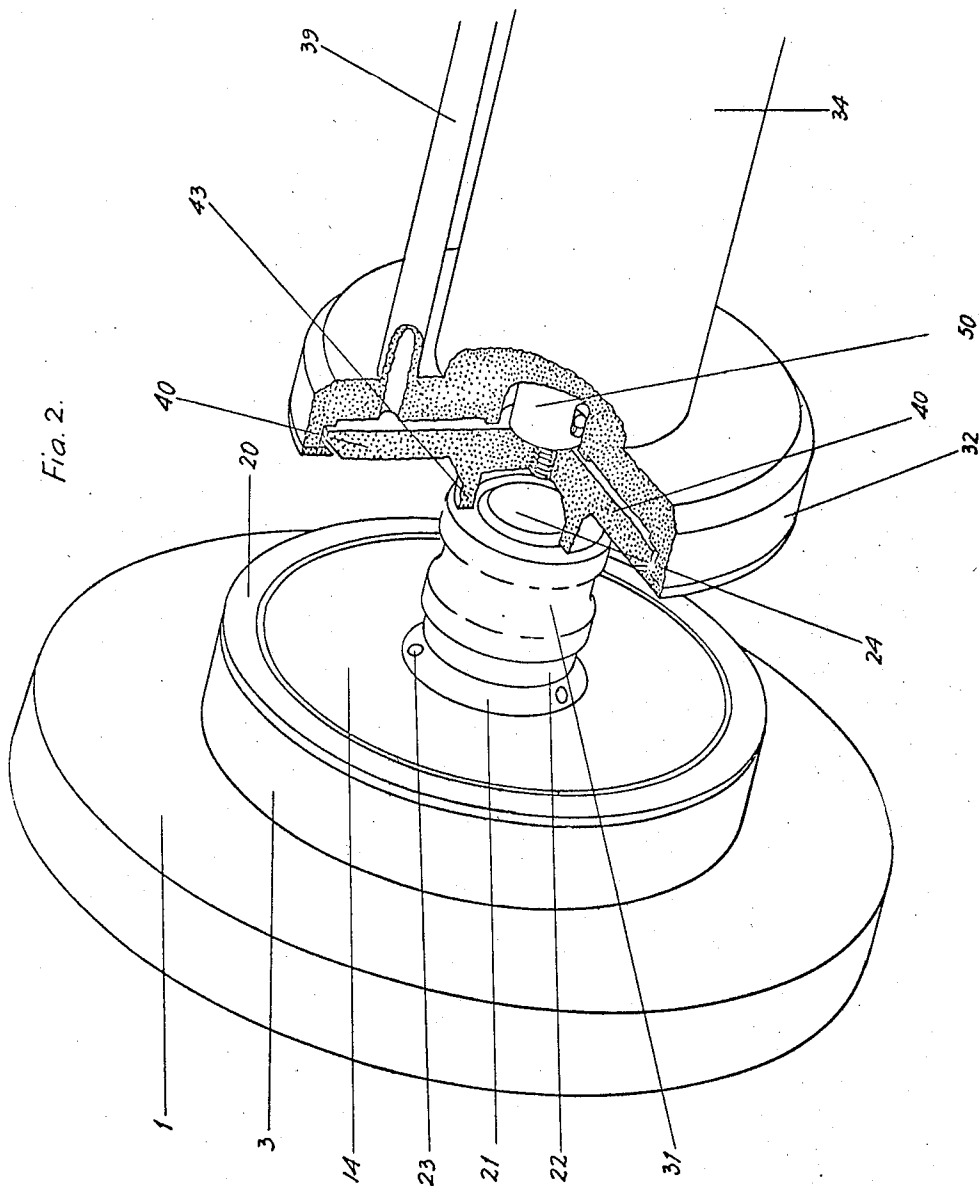
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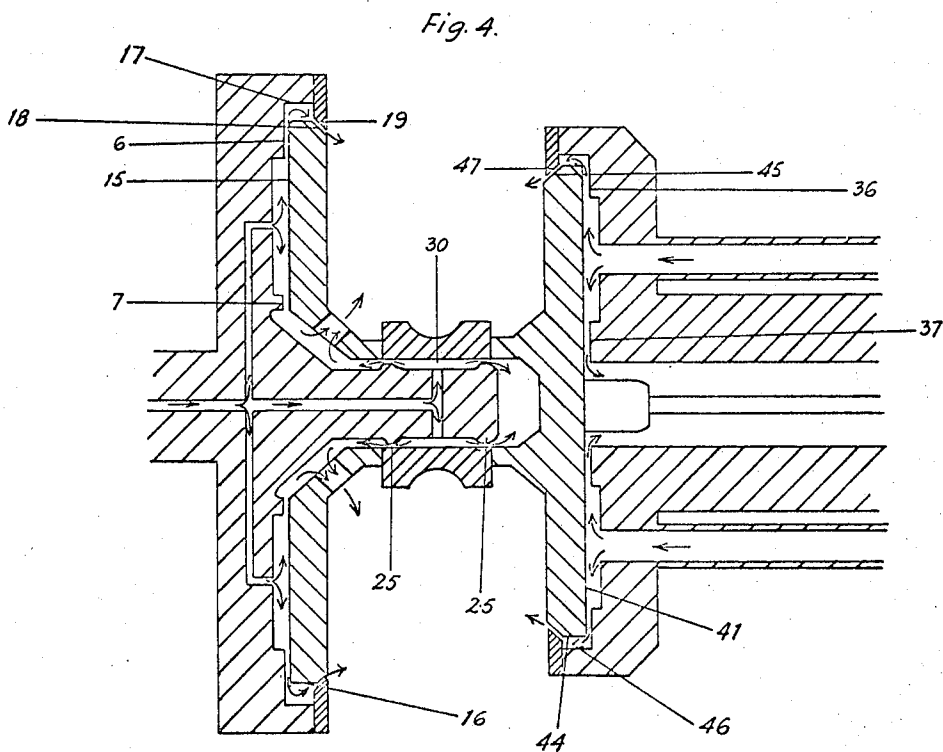
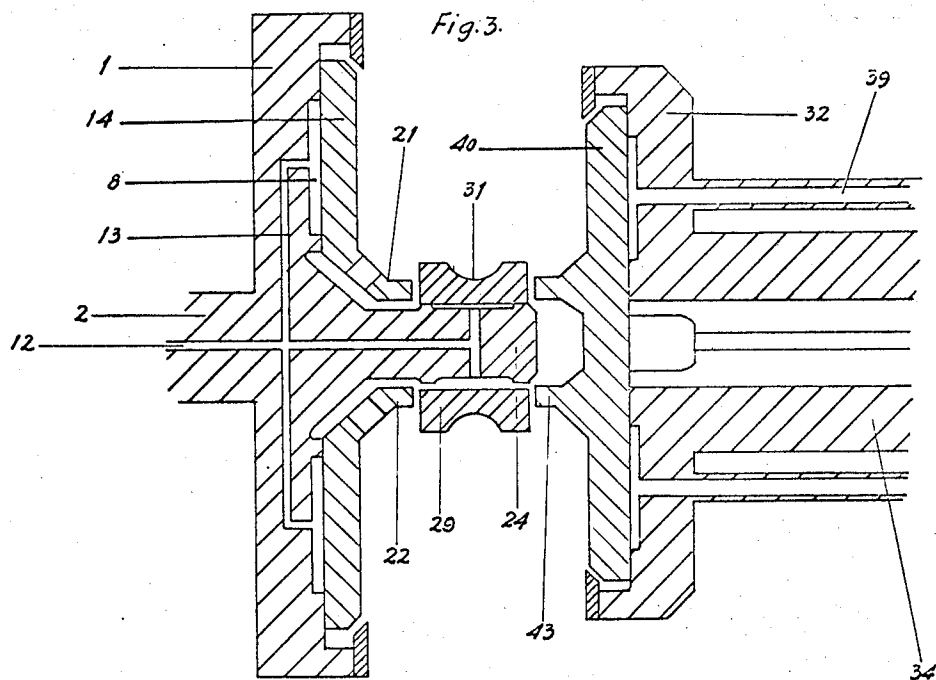
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## DEVICE FOR HOLDING A RING-FORMED WORKPIECE

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4 Claims

### ABSTRACT OF THE DISCLOSURE

Apparatus for performing machining operations on a workpiece, a device for supporting the ring-formed workpiece having inner and outer envelope surfaces and transversely disposed substantially flat axial end surfaces comprising a pair of opposed workholding members confronting the axial end surfaces of the workpiece, each workholding member have an element for engaging the workpiece and mounted for floating movement in the workholding member, fluid pressure means for maintaining the element of each of said workholding members in pressure applying relation with the axial end surfaces of the workpiece, thereby providing a pressure medium cushion support at both axial ends of the workpiece, means for rotating one of said workholding members thereby to effect rotation of the workpiece, a mandrel engageable interiorly of the workpiece and spaced from the inner envelope surface to define an annular space therebetween and fluid medium connected to a suitable pressure source for pressurizing said annular space whereby inner envelope surface of the workpiece is completely out of engagement with said mandrel.

The present invention relates to a device for holding a ring-formed workpiece with an inner and an outer envelope surface and with transversal end surfaces. An example of such a workpiece is a ball race. The holding device is to have such properties that it can hold the ball race, or any other conventional type of ring in such a way that its outer envelope surface can be machined, for instance through grinding or polishing, while maintaining stringent requirements stipulated for the surface smoothness and geometrical accuracy of the envelope surface. A ball race has been illustrated in the drawings and described hereafter as an example of a ring-formed workpiece, and hereafter will simply be referred to as a "ring." At such machining of rings, the ring itself, during the course of the machining, has been subjected to certain reciprocal transverse movements, which is undesirable, as the requirements stipulated for surface smoothness and accurate geometrical form then cannot be completely fulfilled.

The purpose of the present invention is to achieve a substantial damping of the above-mentioned transverse movements, and this is achieved according to the present invention in that the ring, both transversely and axially, is set up in such a way that pressure-medium cushions or films limit the movements of the ring axially, and then in both directions, as well as transversely, also in all directions.

According to an appropriate embodiment, the ring is set up on a mandrel, a pressure medium then being applied between the outer envelope surface of the mandrel and the inner envelope surface of the ring.

Further, in accordance with the embodiment of the invention illustrated, the ring is adapted to be supported at opposite axial end faces by means of a pair of opposed workholding members of generally dislike form, each

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having an element of generally dislike form for engaging the workpiece and mounted for floating movement in the workholding member. Fluid pressure means is provided for maintaining the element of each workholding member in pressure applying relation with the axial end surfaces of the workpiece so that the ring is supported axially between two pressure medium cushions or films.

In view of the above-mentioned two clampings of the ring, this is thus clamped both transversely and axially between pressure-medium cushions, which have the capability of damping undesirable movements that are applied to the ring.

The characteristic properties of the present invention are specified in more detail in the following claims.

The present invention will be described in more detail in conjunction with the attached drawings, in which:

FIG. 1 shows a device for holding a ring for external machining in the working situation when the ring is to be set up, in which

FIG. 2 shows the ring in a clamped condition, in which

FIG. 3 shows the device in cross-section just before the ring is clamped and before the pressure medium has been applied, and in which

FIG. 4 shows the ring clamped and the pressure medium being applied.

In the figures, 1 is a base. In the base, an axle 2 is suspended or fastened. A disc-formed flange 3 with two flat surfaces 4 and 5 is fixed to the axle. In the side surface 5, a groove with a flat bottom surface has been made. The outer peripheral surface of the groove has been given the reference designation 6, and the inner peripheral surface of the groove has been given the reference designation 7. Between these surfaces a channel 8 has been made, which is intended for a pressure medium. The channel is arranged concentrically in relation to the actual disc-formed flange 3. Inside the inner peripheral surface 7 a channel 9 has been made, and this channel, which also is concentric, is adjacent to a conical hub 10, which goes over to a cylindrical hub 11. In the shaft 2, there is an axially drilled hole 12. From this hole, a number of transverse holes 13 run, which emanate in the channel 8. A disc-formed holding member has its inner side surface 15 in contact with the contact surface, consisting of the parts 6 and 7. The disc-formed member 14 has a peripheral surface 16, which is entirely cylindrical, and which is opposite a wall 17 of a groove, of which the contact surfaces 6 and 7 form the bottom. The right side of the peripheral surface 16 is chamfered, as shown in the figure. The chamfer has been given the reference designation 18, and this is opposite a chamfered surface 19 of a ring 20. The ring 20 limits the axial movement of the holding member 14 towards the right, and moreover, together with the wall 17 constitutes the limit for the radial movement of the disc-formed member 14. The disc-formed member 14 has a conical hub 21, which goes over to a cylindrical hub 22. Said two hubs are tubular and are arranged concentrically in relation to the hubs 10 and 11. The conical hub 21 is provided with a number of outlet holes 23 for pressure medium fluid.

At the right end, the cylindrical hub 11 goes over to a cylindrical mandrel 24 with an envelope surface 25, in the periphery of which a number of recesses 26 and 27 have been made. A transverse hole 28, which is connected with the axial hole 12, leads to each of the transverse holes 28. The mandrel 24 has a diameter which is smaller than the diameter of the hole 30 of the ring 29, which is provided with an outer envelope surface 31.

Opposite the disc-formed flange 3 there is a disc-formed flange 32, which has a rear, flat surface 33, at which a tubular axle 34 is fastened. The flange 32 has a front flat surface 35. In said side surface a contact surface has

been milled, the outer and inner parts of which have been given the reference designations 36 and 37. Between said parts a groove 38 has been milled, which is in connection with a number of tubes 39 for the supply of pressure medium to the channel, which is a peripheral channel or pockets. A flat side surface 41 of a disc-formed holding member 40 is in contact with the contact surface formed by the parts 36 and 37. On its other surface 42, the holding member is provided with a cylindrical, tubular hub 43, the free edge surface of which is intended to be in contact with the right side surface of the ring 29. The disc-formed holding member 40 has a peripheral surface 44, which is entirely cylindrical and is provided with a chamfer 45. The peripheral surface 44 is opposite a wall 46 of the milled recess which contains the bottom surface 36, 37. The chamfer 45 is opposite a chamfer 47 of a ring 48. Because of the ring 48 and the wall 46, the movement of the disc-formed holding member is limited both axially and radially. In the center of the disc 40 there is a hole, into which a screw 49 is threaded. At the right end of the screw a tubular part 50 is fastened, which has two side holes 51 for a driving stud 52, which is fastened on a shaft 53 which, in turn, is fastened to the shaft 54. When the shaft 54 is rotated, the disc-formed holding member 40 is caused to rotate.

The device described above functions in the following way. In FIG. 1, the device is in the working situation where it is prepared to receive a ring 29 which is to be set up. The ring is set up on the mandrel 24 in the way shown in FIG. 3. When this has been done, the flange 32 with the axle 34 is moved towards the flange 3 so far that the ring 29 will be located between the ends of the hubs 22 and 43, i.e. the situation shown in FIG. 2 or in FIG. 3, but in the last-mentioned figure a further movement together must take place. Thereafter, if pressure medium of a suitable kind is applied, for instance water, coolant, air or the like, to the axle 2 and to the tubes 39, the pressure medium will flow as shown in FIG. 4. This involves, when regarding the last-mentioned figure, that the ring 29 will have a pressure-medium cushion or a pressure-medium film located between the mandrel 24 and the envelope surface of the hole 30. Through the supply of pressure medium to the channel 8, a pressure-medium cushion or film will be formed between the surfaces 15, 6 and 7, which is concentric in relation to the flange 3. Further, a pressure-medium cushion or film will also be formed between the envelope surface of the conical hub 10 and the inner envelope surface of the conical hub 21, as well as between the envelope surface of the cylindrical hub 11 and the inner envelope surface of the cylindrical hub 22. A ring-formed pressure-medium cushion or film will also be formed between the surfaces 16, 17 and 18, 19.

When pressure medium is supplied to the channel 38 through the tubes 39, also the disc-formed member 40 will be in contact with the surfaces 36 and 37 via a pressure-medium cushion of film, which is circular and concentric in relation to the flange 32. A pressure medium cushion or flange will also be formed between the surfaces 44 and 46, and 45 and 47.

From the description given in the foregoing, it should be entirely obvious that the ring is completely suspended in pressure medium cushions or films, which involves that no matter what movement is imparted to the ring, this will be dampened very rapidly. Thus, the ring is not rigidly mechanically clamped in any way. If the ring is thus given a movement in either of the axial directions, the movement of the ring will be dampened by the air cushions which are formed through the channels 8 and 38. If the ring is given a radial movement, this will be dampened by

the pressure-medium cushion or film between the inner envelope surface of the ring and the mandrel and by the pressure-medium cushions or films at the peripheries of the holding member 14 and 40.

It should be obvious that all or some of the pressure-medium conductors can be provided with valve controls, so that manual or automatic setting of an inserted ring is possible. It is then advisable to have said peripheral channels divided up so that a number of pockets will be formed which have a separate supply of pressure medium. If fluid is used as a pressure medium, the laws of hydrostatic suspension and thereby for self-centering will then of course be applicable.

If fluid is used in the device described, the suspension will act hydrostatically. But it should also be obvious that the suspension can be converted in a known way to hydrodynamic suspension.

Under certain circumstances, one or several of the slots 18, 19; 16, 17; 10, 21; 11, 22; 44, 46 and 45, 47 can have such a width that pressure medium cushions or films will not be formed.

I claim:

1. Apparatus for performing machining operations on a workpiece, a device for supporting the ring-formed workpiece having inner and outer envelope surfaces and transversely disposed substantially flat axial end surfaces comprising a pair of opposed workholding members confronting the axial end surfaces of the workpiece, each workholding member having an element for engaging the workpiece and mounted for floating movement in the workholding member, fluid pressure means for maintaining the element of each of said workholding members in pressure applying relation with the axial end surfaces of the workpiece, thereby providing a pressure medium cushion support at both axial ends of the workpiece, means for rotating one of said workholding members thereby to effect rotation of the workpiece, a mandrel engageable interiorly of the workpiece and spaced from the inner envelope surface to define an annular space therebetween and fluid medium connected to a suitable pressure source for pressurizing said annular space whereby inner envelope surface of the workpiece is completely out of engagement with said mandrel.

2. Apparatus as claimed in claim 1 wherein said elements are in the form of a disc engageable in a pocket in the holding member, the disc terminating adjacent its central portion in a cylindrical hub engageable with the axial end face of the workpiece, said pocket confining said disc and permitting limited movement therein.

3. Apparatus as claimed in claim 2 wherein said disc is formed with a chamfer at its outer peripheral edge, and said pocket includes a peripheral flange having a chamfered surface confronting the chamfer on the disc and spaced therefrom a predetermined distance to provide a controlled pressure medium outlet.

4. Apparatus as claimed in claim 1 wherein said mandrel is provided with at least one recess in its outer peripheral surface, the surface of the recess being spaced further from the envelope surface of the workpiece than other portions of the mandrel and including channel means communicating with said recess and said fluid pressure means.

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