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Eibofner et al.

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[54] DENTAL INSTRUMENT

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[52] **U.S. Cl.** **32/26**
[51] **Int. Cl.** **A61c 1/08**
[58] **Field of Search** 32/26, 27; 279/102, 96, 23

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[57] **ABSTRACT**

The invention relates to dental instruments of the type having a tool-receiving hollow shank. A tool clamping sleeve is provided in the shank, the sleeve being radially expansible in at least one area thereof on insertion of a tool shank therein. Annular spaces are provided between the sleeve and the shank and, in some instances, between the sleeve and the tool shank, to permit such expansion with effective clamping action.

8 Claims, 9 Drawing Figures

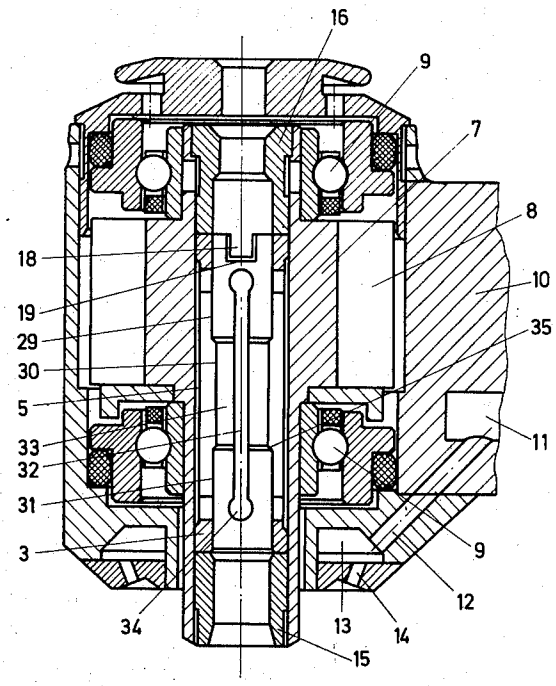

Fig. 1

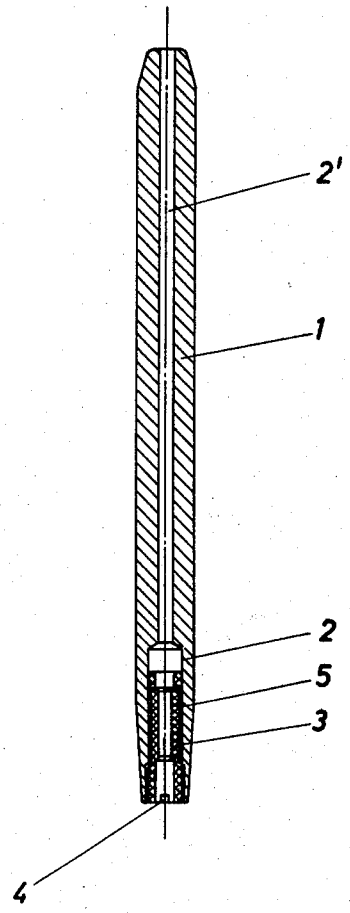

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Fig. 2

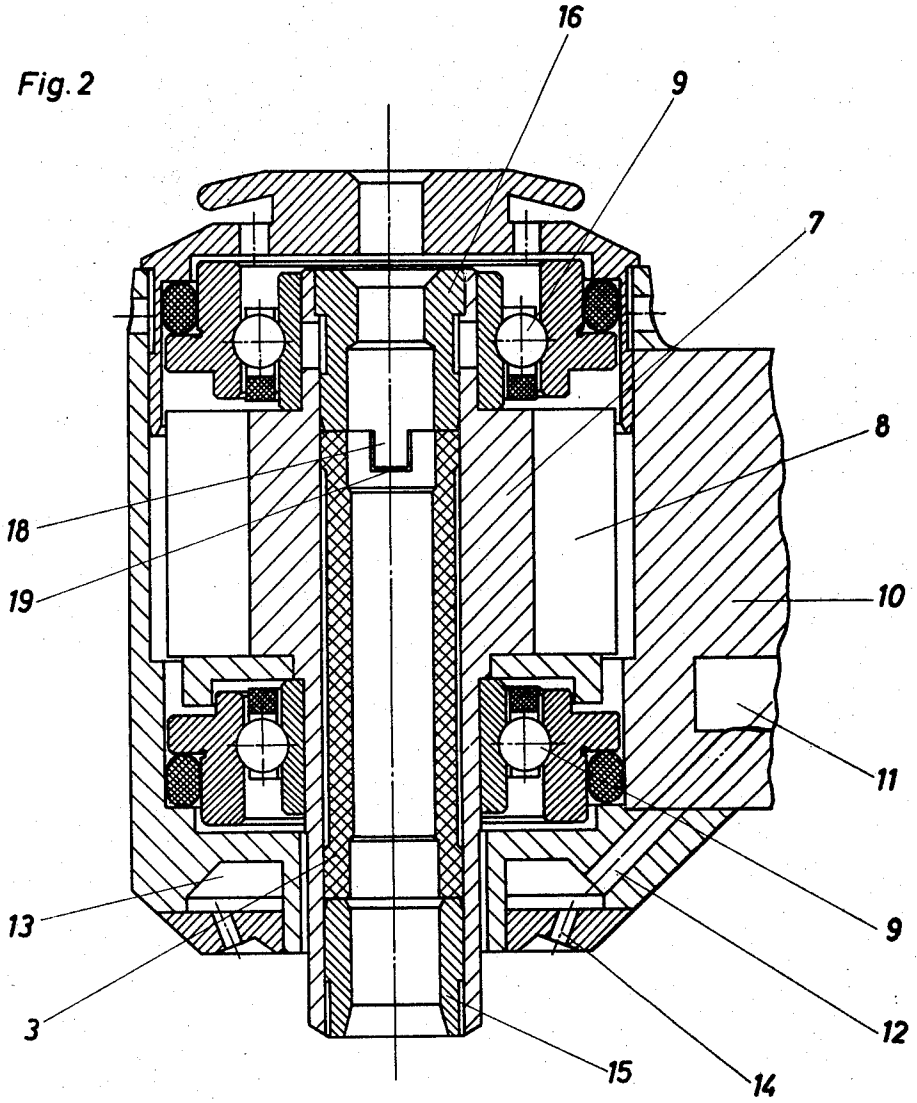

Fig. 3

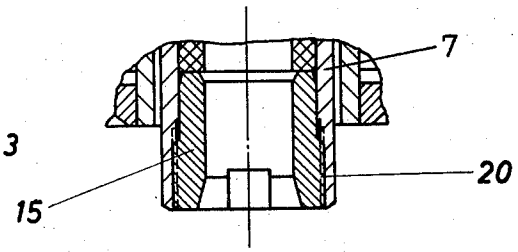

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Fig. 4

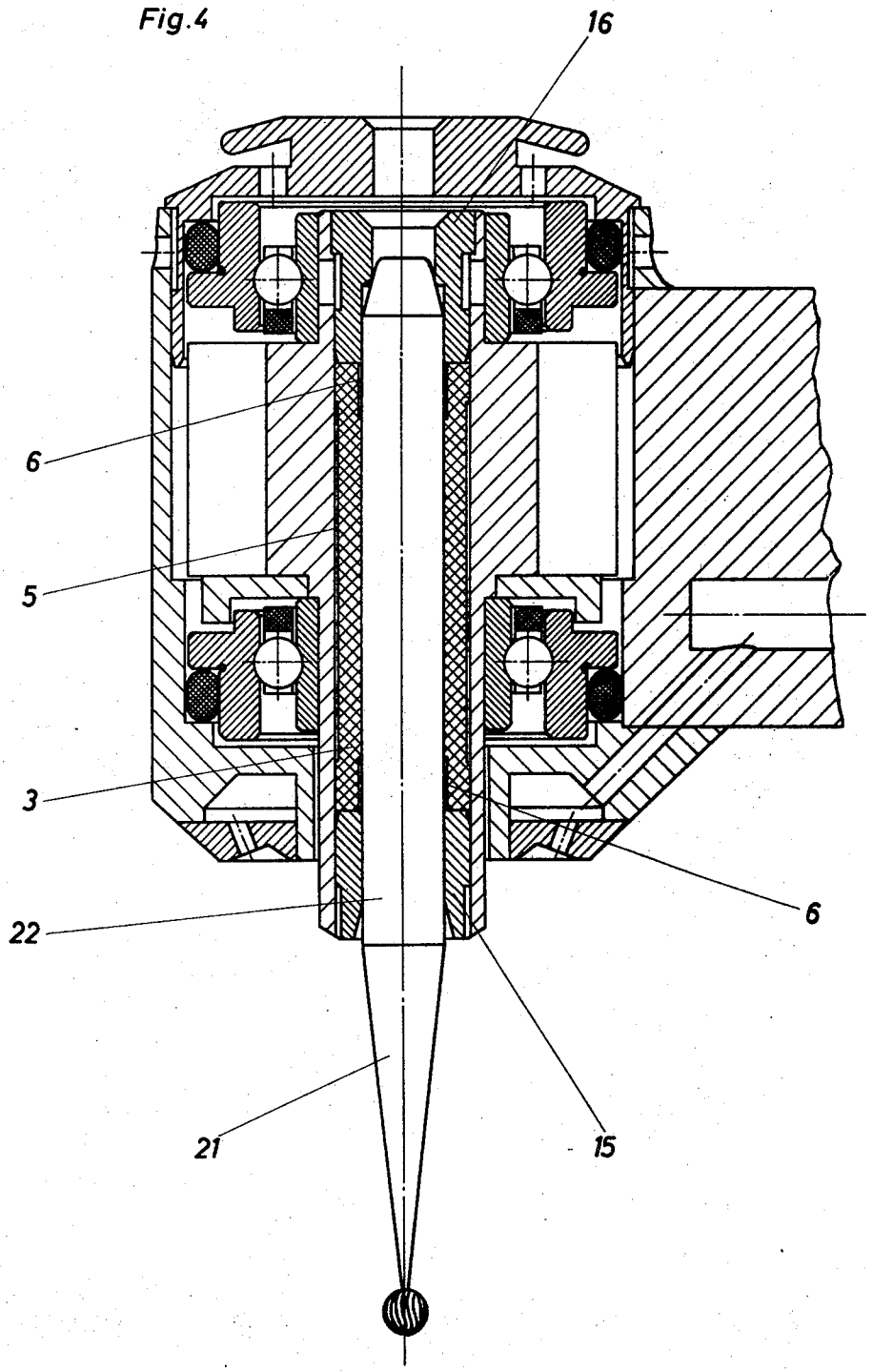

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Fig.5

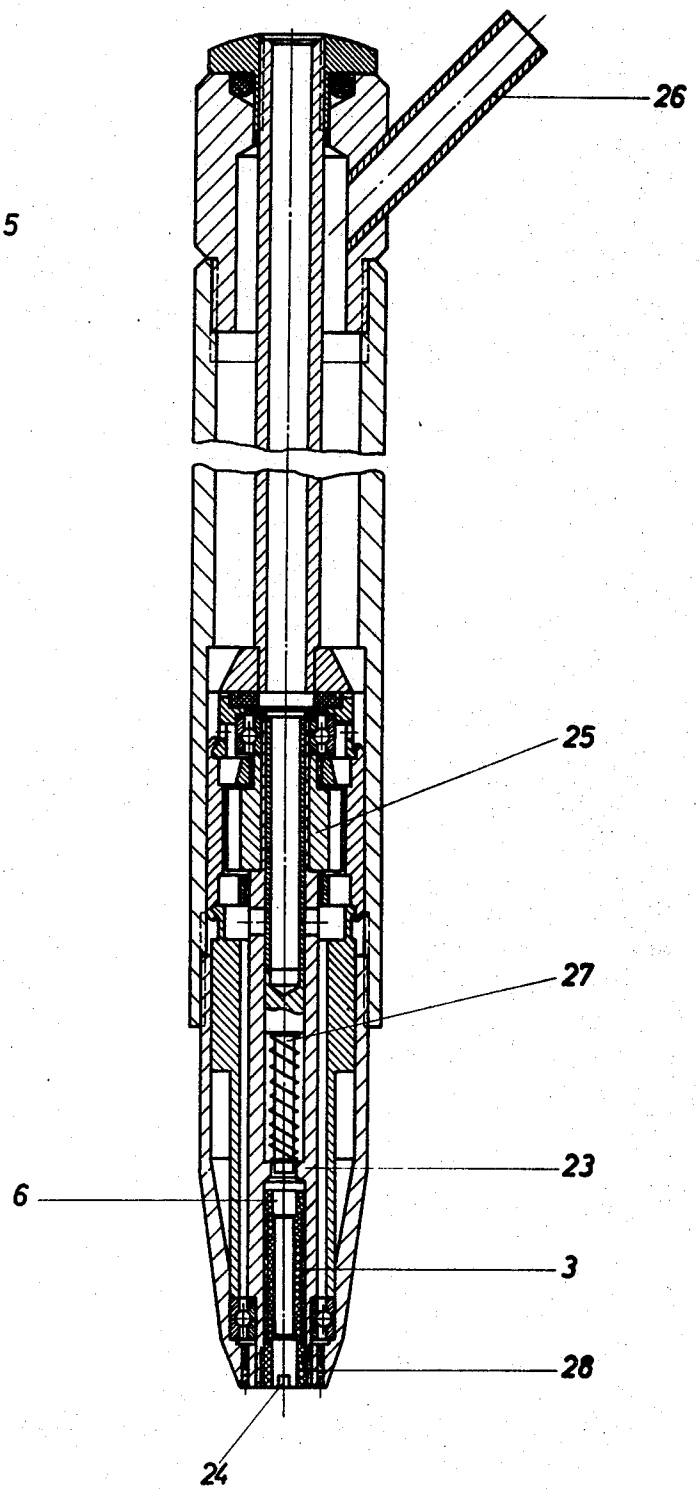

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Fig. 6

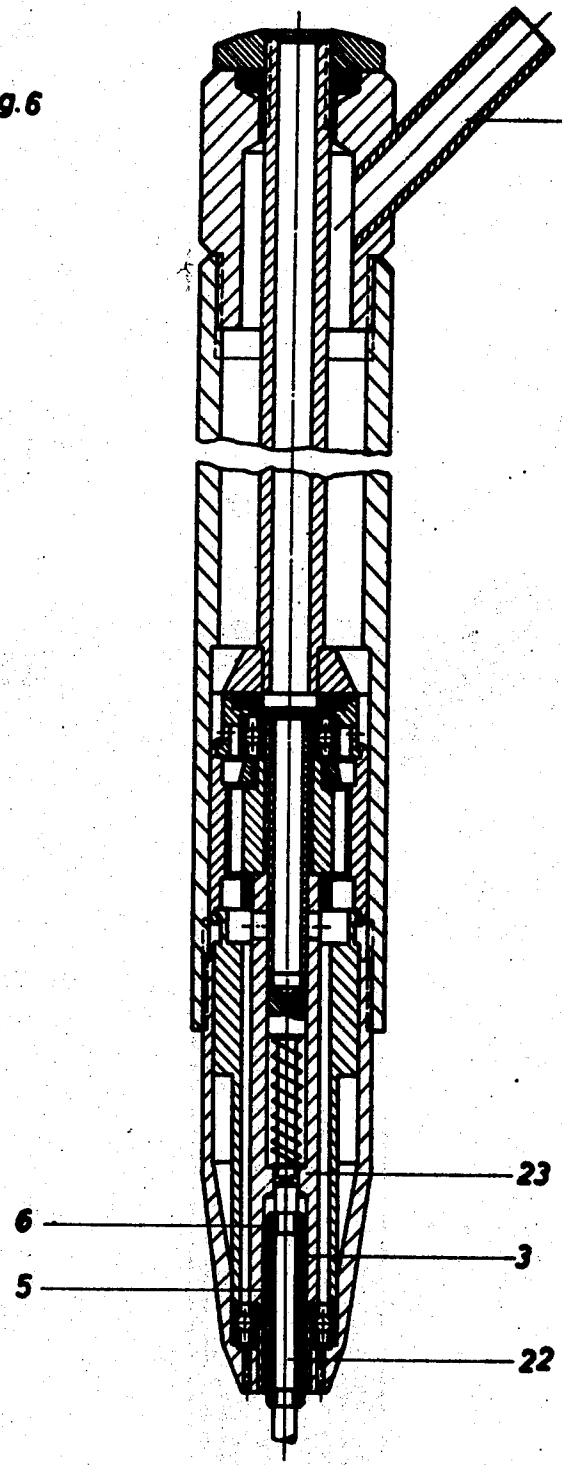

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Fig. 7

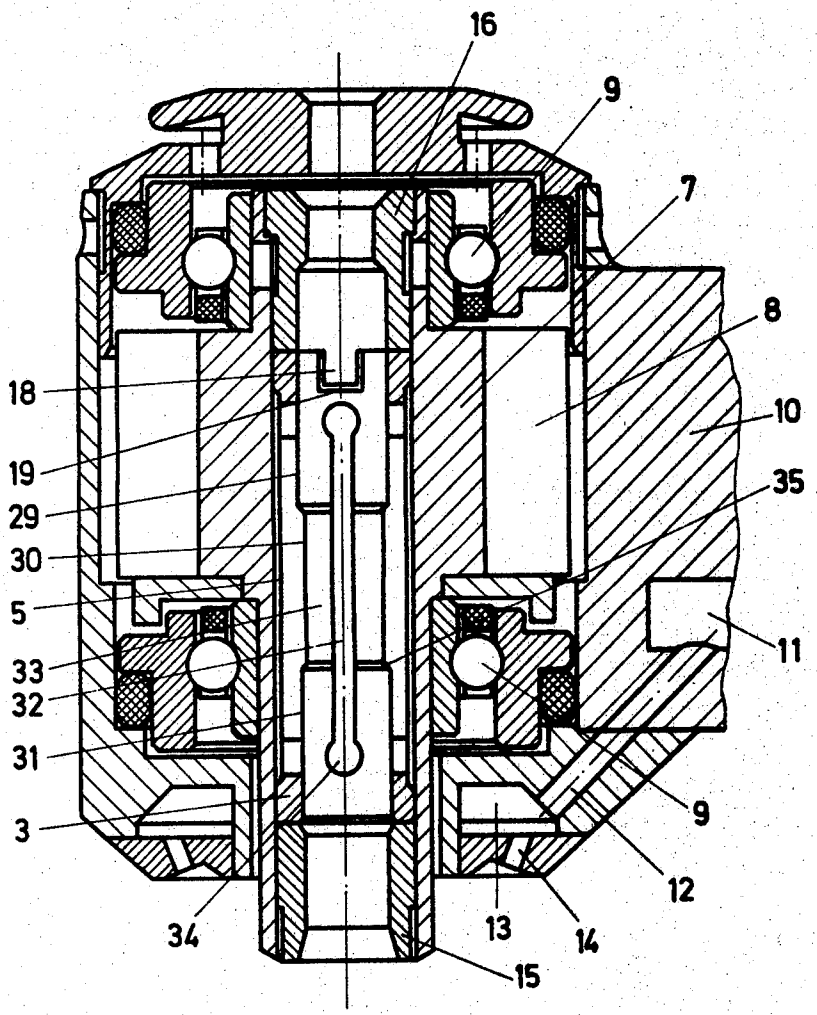

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Fig. 8

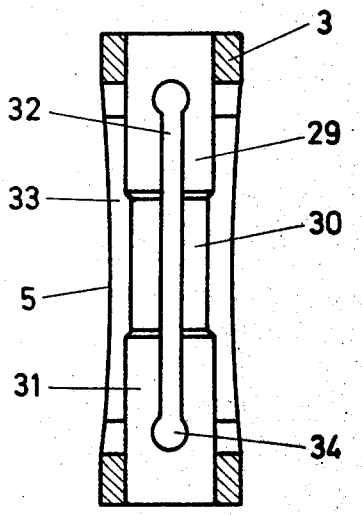
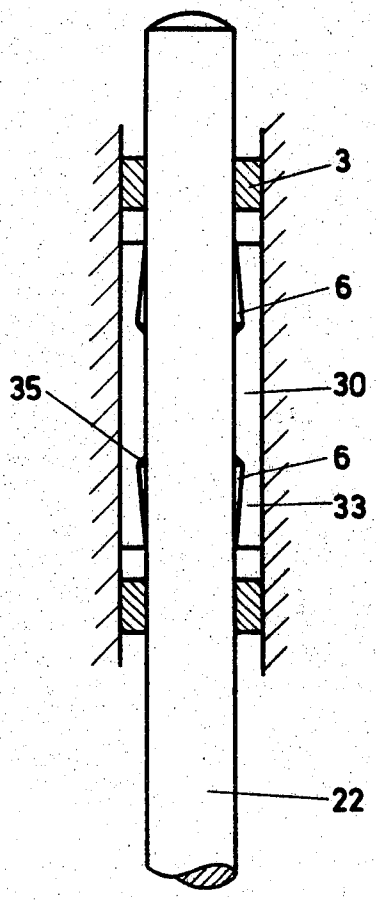


Fig. 9



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DENTAL INSTRUMENT

The invention relates to a dental instrument, more particularly a straight or angle handpiece, having a tool adapted to be inserted by means of a clamping sleeve made of elastic material in a hollow shank arranged in the instrument.

It is already known in the case of an instrument of this kind constructed as a dental turbine angle handpiece to screw the clamping sleeve made of elastic material into the hollow shank, and when inserting the tool shank, the diameter of which is greater than the internal diameter of the clamping sleeve, owing to the clamping sleeve abutting tightly on the screwthreading of the hollow shank it is not possible for the elastic material of the clamping sleeve to yield, so that the said elastic material is subjected to crushing. As a consequence of this, material fatigue and wear occur, which makes it necessary to interchange the clamping sleeve frequently.

It is also known in the case of a dental instrument likewise constructed as a turbine angle handpiece of the type mentioned hereinbefore to arrange elastic O-rings axially secured one above the other in the hollow shank. Although in that case the elastic material can yield into the space not filled by the cross-section of the rings, the elastic material is subjected to distortion and creep and thus here again there is a high rate of wear, which also makes frequent interchanging of the rings necessary in this case.

The invention has as its object to provide a dental instrument of the type mentioned initially wherein the clamping sleeve made of elastic material, without prejudicing its driving force exerted on the tool shank is subjected to the least possible stresses by the inserted tool shank.

This problem is solved in that between clamping sleeve and hollow shank, one or more annular spaces are formed at least when the tool is not inserted, the internal diameter of the clamping sleeve in the region of these annular spaces being smaller than the diameter of the tool shank.

Thus the advantages are afforded that the proposed annular spaces permit the elastic material of the clamping sleeve to yield in the radial direction when the tool shank is inserted. This obviates crushing and distortion of the material, and creep. In this way the wear on the clamping sleeve is greatly reduced.

According to a further feature of the invention it is proposed that one or more annular spaces are provided also between clamping sleeve and tool, the clamping sleeve abutting on the hollow shank wall in the region of the annular spaces between clamping sleeve and tool shank when the tool is inserted.

The advantage of this form of embodiment is that the elastic material of the clamping sleeve can yield still more easily, so that the wear is further reduced. The invention also proposes that the annular spaces between clamping sleeve and hollow shank and also between clamping sleeve and tool shank overlap somewhat. This construction makes it possible to completely obviate crushing effects.

According to a further form of embodiment of the invention an annular space is provided between clamping sleeve and tool shank at least at the drive-side end of the clamping sleeve.

According to a further form of embodiment of the invention, an annular space can also be arranged between clamping sleeve and hollow shank at least at the drive-side end of the clamping sleeve.

The invention proposes according to a further form of embodiment that the clamping sleeve is connected non-releasably to the tool shank. This affords the advantage that there is no need to secure the clamping sleeve against being pulled out, since the tool is pulled out with the clamping sleeve in any case when interchanging.

According to a further form of embodiment of the invention, the clamping sleeve is arranged between two guide sleeves arranged in the hollow shank. This provides concentric guiding for the tool being inserted. A further proposal of the invention relates to a dental instrument for rotating tools, wherein the guide sleeve remote from the free tool end is

given a rotary movement and this guide sleeve is in engagement by means of a nose or the like with the clamping sleeve in order to transmit the rotary movement to the clamping sleeve. In this way the advantage is afforded that the clamping sleeve is relieved of load, since it does not have to transmit the rotary movement by means of friction. The clamping sleeve, therefore, can be fully used for the clamping of the tool within the elasticity limit of its material. This form of embodiment is particularly advantageous for angle handpiece heads, since in the case of these the clamping sleeve length is limited and, therefore, the frictional force for driving would possibly be too small. A further form of embodiment of the invention concerning a dental instrument for rotating tools is characterized in that the clamping sleeve is screwed to the hollow shank preferably at the sleeve end directed towards the free tool end.

The invention also proposes that the guide sleeve situated nearest the free tool end is inserted preferably releasably in the hollow shank. This gives the advantage that, when the guide sleeve is screwed out, the clamping sleeve can be taken out if necessary, insofar as it is not connected non-releasably to the tool shank.

In the aforesaid forms of embodiment, the clamping sleeve can be made from plastics material, e.g. polyamide. With chucks of this kind, generally satisfactory results are also obtained relatively to earlier known plastics material clamping sleeves, wherein yielding of the elastic material of the clamping sleeve is not possible, since, as mentioned, when the tool shank is inserted, the plastics material of the clamping sleeve can yield radially into the annular spaces provided, thus obviating crushing and rapid wear.

However, it has been found that the plastics material of the clamping sleeve is subjected to cold flow in the event of being subjected to continuous stressing happening exceptionally, i.e. if for example the tool has by oversight been inserted for a relatively long period of time, and this brings fatigue phenomena and reduces the clamping effect of the clamping sleeve.

According to a further form of embodiment, wherein one or more annular spaces are also provided between clamping sleeve and tool shank and the clamping sleeve abuts on the hollow shank wall when the tool is inserted in the region of the annular spaces situated between clamping sleeve and tool, and wherein furthermore the annular spaces between clamping sleeve and hollow shank and the annular spaces between clamping sleeve and tool shank overlap somewhat in the axial direction of the clamping sleeve, therefore, it is proposed that the clamping sleeve is made of metal and, to obtain the clamping force acting radially on the tool shank, is provided with clamping tongues formed by slots, which extend in the axial direction at least partly beyond both annular space regions.

The construction of the metal clamping sleeve with the resilient clamping tongues has the effect that cold flow is obviated, and therefore relaxation of the clamping force of the clamping sleeve cannot take place even with exceptionally occurring continuous stressing.

Per se a metal clamping sleeve is known which comprises in its central region a plurality of longitudinal slots distributed about the periphery, between which there are provided clamping tongues exerting a clamping force in the radial direction on the tool shank, the clamping tongues being bent inwardly. In the known clamping sleeves this has the result that in the clamping operation the clamping force is applied substantially only in punctiform manner to the tool shank, with the result that the clamping effect is relatively slight. In contrast thereto, in the case of the instrument according to the present invention, owing to the overlapping annular spaces between clamping sleeve and hollow shank on the one hand and between clamping sleeve and tool shank on the other hand, in conjunction with the clamping tongues extending axially beyond the two aforesaid annular space regions, the tool shank is subjected substantially to areal pressure. The clamping tongues are conveniently defined by longitudinal slots.

The invention also proposes that the clamping sleeve is made of a copper alloy, e.g. copper-beryllium, bronze or the like.

The construction of the clamping sleeve from a copper alloy has the advantage, over a steel construction, that the elasticity and therefore the spring travels are greater, which permits more frequent stressing and thus increases the working life of the clamping sleeve, since the clamping tongues are only subjected to fatigue much later than if they are made of steel. The greater spring travel relatively to steel means that e.g. for copper-beryllium a greater amount of wear on the clamping tongues on insertion and removal of tools can be permitted before the clamping force dropped below the minimum limit necessary for reliable fixing. With steel, the amount of wear which can be permitted is much smaller. In addition, for example copper-beryllium has better sliding properties than steel, which additionally reduces wear.

A further form of embodiment of the invention is characterized in that, when the tool is not inserted, the outer wall of the clamping sleeve in the region of the annular spaces situated between clamping sleeve and hollow shank follows an inwardly curved course — as viewed in longitudinal section. This permits particularly simple production of the aforesaid annular spaces, the procedure being that into the clamping sleeve which at first still has a cylindrical, smooth external wall, but already has the internal stepped-down wall portions for forming the annular spaces between clamping sleeve and tool shank, the tool shank or a push rod having the same diameter is pushed-in so that the external wall bulges outwards. In this state the bulging simply has to be removed again e.g. by grinding or turning, so that after the tool shank or push rod is removed the aforesaid inwardly curved outline is obtained.

The invention also proposes that when the tool is not inserted the internal wall of the clamping sleeve is of cylindrical shape and the transition from the wall portion forming the annular space between clamping sleeve and tool shank and the remainder of the wall portion is in the form of a bevelling permitting the complete insertion of the tool shank.

Finally, the invention proposes that the ends of the longitudinal slots are rounded, expediently in the form of a widening. This avoids or reduces the notching stresses which occur in the case of angularly shaped slot ends.

The invention will be explained in more detail with reference to the drawings wherein:

FIG. 1 is a sectional view showing a dental instrument, constructed as a tool holder e.g. for a mirror not shown here, with a clamping sleeve of elastic material,

FIG. 2 is a sectional view showing an angle handpiece head of a dental instrument, constructed as a turbine angle handpiece, with clamping sleeve of elastic material,

FIG. 3 is a sectional view showing a detail modified relatively to FIG. 2,

FIG. 4 shows the form of embodiment according to FIG. 2 with inserted tool constructed as a drill, in sectional view,

FIG. 5 is a sectional view showing a dental instrument constructed as a straight turbine handpiece, with clamping sleeve made of elastic material,

FIG. 6 shows the form of embodiment according to FIG. 5 with inserted tool shank,

FIG. 7 is a sectional view showing an angle handpiece head of a dental instrument constructed as a turbine angle handpiece, the clamping sleeve of elastic material being made of metal and provided with longitudinal slots,

FIG. 8 is a sectional view showing a form of embodiment of the clamping sleeve modified relatively to FIG. 7 and

FIG. 9 shows the clamping sleeve according to FIG. 8 with the tool shank inserted.

In FIG. 1, the dental instrument constructed as a tool holder is designated as 1. At its lower end the tool holder is constructed as a hollow shank. In the hollow shank 2 there is arranged a clamping sleeve 3 of elastic material into which there can be inserted the shank of a dental tool e.g. the shank of a mouth mirror. The elastic clamping sleeve 3 is inserted in the hollow shank 2. The screw slot 4 is provided for this purpose.

Between the clamping sleeve 3 and the wall of the hollow shank 2 there is situated an annular space 5. When the tool shank is inserted in the clamping sleeve, the elastic material of the clamping sleeve can yield into the annular space 5, so that a satisfactory fixing of the tool shank is possible without the risk of detrimentally affecting the elastic material.

The tool holder 1 is of hollow construction internally, starting from the hollow shank 2, so that the inserted tool can, if necessary, be pushed-out through the duct 2' thus formed by means of a thin rod or the like.

FIG. 2 shows an angle handpiece head of a dental instrument constructed as a turbine angle handpiece. The rotor 7, which is provided with a bore and is thus constructed as a hollow shaft is provided with turbine blades 8 and is mounted in the usual way by means of ball bearings 9 in the angle handpiece head. Of course it is also possible to mount it in any other suitable way. The air is supplied to the turbine through an air duct (not shown) passing through the shank 10 of the angle handpiece head, whereas the outgoing air can also be discharged in any desired manner. Also shown in the illustration is a water supply duct 11 from which a conduit 12 leads to a spray chamber 13 through which by means of small spray tubes 14 spray water can be discharged on to the region of the tooth being treated, or on to the tool point.

Inserted in the rotor 7, which is constructed as a hollow shaft, is the clamping sleeve 3 which is made of elastic material, and guide sleeves 15, 16 are situated at the two ends of the clamping sleeves 3 and are inserted in the rotor 7 so as to be rotationally rigid e.g. with a snug fit. The upper guide sleeve is provided with noses 18 which are in engagement with appropriate recesses 19 of the clamping sleeve 3, whereby the rotary movement of the rotor 7 is transmitted to the clamping sleeve.

According to the modified form of embodiment shown in FIG. 3, the lower guide sleeve 15 is screwed into the hollow of the rotor, for easier interchanging. The screwthread is designated as 20.

FIG. 4 shows the form of embodiment according to FIG. 2 with the inserted tool 21, which is constructed as a drill. The tool shank is designated as 22. It will be clearly seen that the central annular chamber 5 and also the annular chambers 6 situated at the two ends of the clamping sleeve 3 have become narrower, the cause of this being that the elastic material of the clamping sleeve 3 has yielded when the tool shank 22 was inserted. This prevents crushing, distortion or creep in the material and therefore obviates wear thereon. The drawing also shows that the annular spaces 5 and 6 overlap somewhat, thus further improving the aforesaid advantages.

In the form of embodiment according to FIG. 5, which shows a dental hand instrument constructed as a straight turbine handpiece, the clamping sleeve 3 is screwed into the hollow shaft 23 at its lower end at 28, as in the form of embodiment according to FIG. 1. For easier screwing-in, there is again provided a screw slot which is designated as 24. Suitable ball bearings or other bearings, which will not be described in detail here, are provided in known manner for mounting the shaft 23. 26 designates the connection for the driving air for the turbine rotor 25. A known ejecting device given the general reference numeral 27 is used for ejecting a tool (not shown) inserted in the clamping sleeve 3.

It should be mentioned that the screwing-in of the clamping sleeve 3 is in principle also possible in the case of the forms of embodiment shown in FIGS. 2 to 4. But this screwing-in is particularly appropriate in the form of embodiment according to FIG. 5 since in the case of a straight handpiece a considerable tool shank penetration depth is available, and therefore a considerable clamping length. Thus the clamping sleeve 3 inserted over a relatively considerable length has an adequate guide, so that there is no need for the guide sleeves provided according to FIGS. 2 to 4.

Rotary movement is transmitted from the hollow shaft 23 to the clamping sleeve 3 by the aforesaid screwed connection 28.

The constructional form shown in FIG. 6 shows the same handpiece as in FIG. 5 but with the tool shank 22 inserted. In the form of embodiment shown in FIG. 6 there is no screwed connection between clamping sleeve 3 and hollow shaft 23. Rotary movement is transmitted from the hollow shaft 23 to the clamping sleeve 3 by friction. The clamping sleeve 3 is so opened-out on the tool shank 22 that the two ends of the clamping sleeve securely surround the portion of the tool shank 22 which at this region is slightly recessed. Long annular spaces 5 are situated in the central portion of the clamping sleeve. When the tool is removed, the clamping sleeve also comes out of the hollow shaft together with the tool shank 22.

In the forms of embodiment according to FIGS. 7 to 9, the internal wall of the metal clamping sleeve 3 is constituted by three cylindrical individual portions 29, 30 and 31, of which the outer portions 29 and 31 have a somewhat wider diameter than the internal portion 30. The external portions 29 and 31 serve to form annular spaces 6 between the clamping sleeve 3 and the tool shank 21 whereas, as FIG. 9 shows more particularly, the internal portion 30 having substantially areal contact with the tool shank 22 when the tool is inserted.

The clamping sleeve 3 is also so constructed that between the clamping sleeve and the rotor 7 there is formed a further annular space 5 (FIG. 7) which is present at least when the tool is not inserted. The internal diameter of the clamping sleeve 3 in the region of these annular spaces 5 is smaller than the diameter of the tool shank at least when the tool is not inserted.

As FIGS. 7 to 9 also show, the annular spaces 6 on the one hand and 5 on the other hand overlap here also.

The metal clamping sleeve 3 comprises clamping tongues 33 which are formed by slots 32, in order to obtain the clamping force acting in the radial direction, and which extend axially beyond the regions of both the annular spaces 6 and the annular space 5.

In the form of embodiment according to FIG. 8, the external wall of the clamping sleeve 3 when the tool is not inserted is curved inwards in the region of the annular space 5 as viewed in longitudinal section.

When a tool shank 22 is inserted in the clamping sleeve 3, the clamping tongues 33 take up a position shown in FIG. 9, whereby the central portion 30 achieves areal contact with the tool shank 22, and therefore there is a good clamping effect on the tool shank.

To avoid notching stresses at the ends of the slots 32, these are rounded in the form of a widening 34.

FIG. 7 shows that the internal wall of the clamping sleeve 3 is cylindrical in configuration when the tool is not inserted, the transition from the wall portions 29, 31 defining the annular spaces 6 between clamping sleeve 3 and tool shank to the other wall portion 30 being in the form of a bevelling 35. The bevelling 35 permits complete insertion of the tool shank 22 in a simple manner, i.e., without the transition forming an obstacle to the instrument side tool shank end, more particularly if the said end is not rounded or bevelled but is flat.

We claim:

1. A chuck device adapted to hold for rotation a dental tool and having a tool-receiving hollow shank, said shank having a tool-external end and an end remote therefrom, a tool clamping sleeve of elastic material fixed within said shank, said sleeve having at least one external circumferential surface area of less diameter than the internal diameter of the confronting surface area of said shank and at least one internal circumferential surface area (a) of diameter smaller with relation to the remaining internal circumferential surface thereof, (b) smaller than the diameter of an inserted tool and (c) of greater thickness than in said external circumferential surface area extending axially beyond said internal circumferential surface area to provide annular spaces formed by said surface areas into which said sleeve may expand in response to tool-applied pressure, said surface areas of said sleeve are in axially overlapping relation with said internal circumferential surface area being positioned axially wholely within the axial length of said external circumferential surface area.

2. A dental instrument as defined in claim 1, including driving means attached to said shank adjacent one end thereof, said internal surface area of said sleeve being located in radially opposite relation to said end of said shank.

3. A dental instrument as defined in claim 1, including a guide sleeve disposed within said shank at each said end, said clamping sleeve being disposed axially between said guide sleeves.

4. A dental instrument as defined in claim 3, said guide sleeve at said remote end having means for imparting rotary movement thereto, and means drivably connecting said remote end guide sleeve with said clamping sleeve for transmission of said rotary movement thereto.

5. A dental instrument as defined in claim 1, said clamping sleeve having a screw-threaded connection with said shank at said tool entrance end thereof.

6. A dental instrument as defined in claim 1, said clamping sleeve being formed of copper-beryllium alloy and having end portions, and a plurality of axially extending slots extending between and into said portions, said slots forming tool-clamping tongues in said clamping sleeve.

7. A dental instrument as defined in claim 6, the internal wall surface of each of said portions being of right cylindrical shape.

8. A dental instrument as defined in claim 6, each of said slots having end portions of greater width than the intermediate portions thereof.

* * * * *