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(54) **COUPLING DEVICE BETWEEN THE DRIVE SHAFT OF A SURGICAL INSTRUMENT AND A TOOL**

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(57) **ABSTRACT**

Coupling device between a drive shaft (**26**) of a surgical instrument (**28**) and a tool (**34**; **106**), characterized in that the coupling device (**20**) includes a fluid feed element fed from outside the coupling device (**20**) and communicating with a channel (**78**; **110**) arranged in the tool (**34**; **106**) and which emerges at a location along the length of the tool (**34**; **106**).

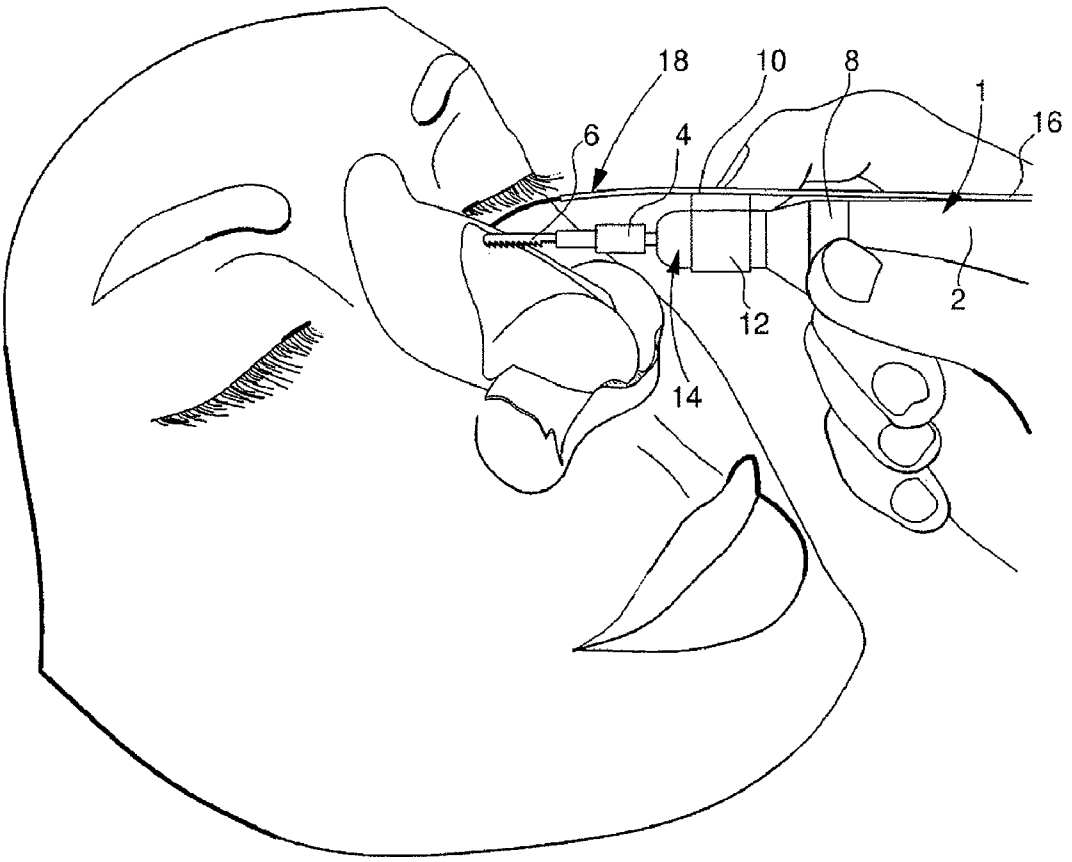
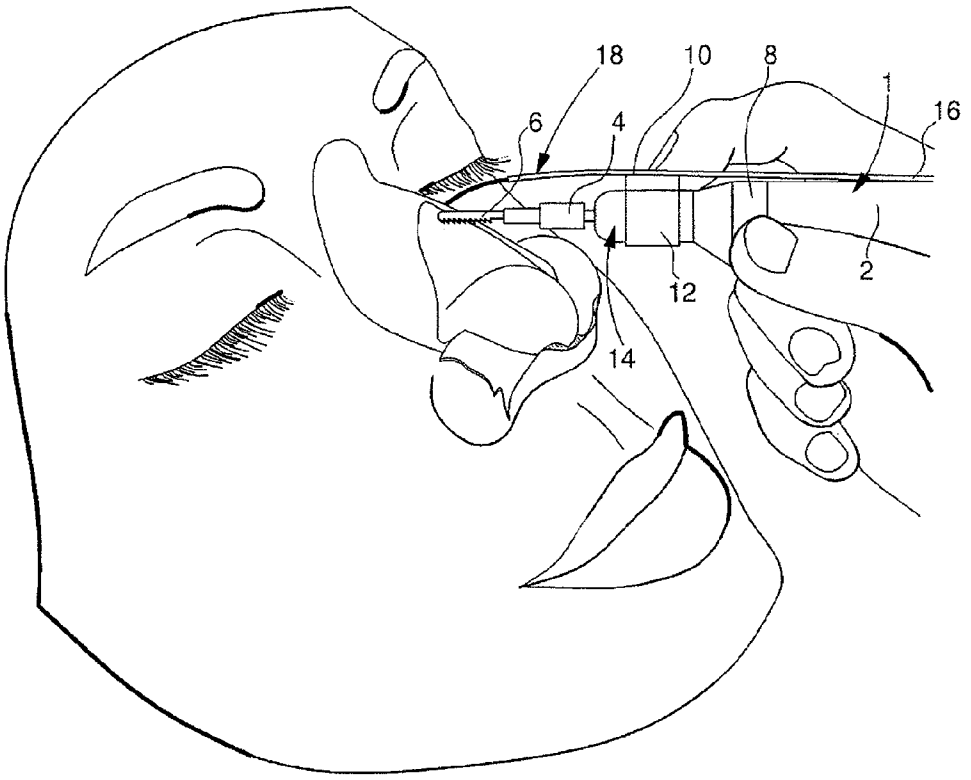


Fig. 1



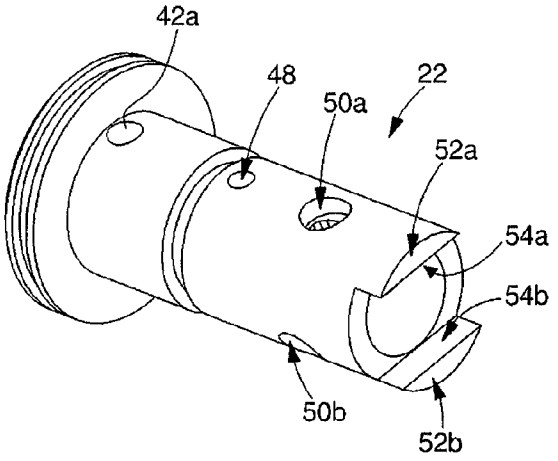


Fig. 3

Fig. 2

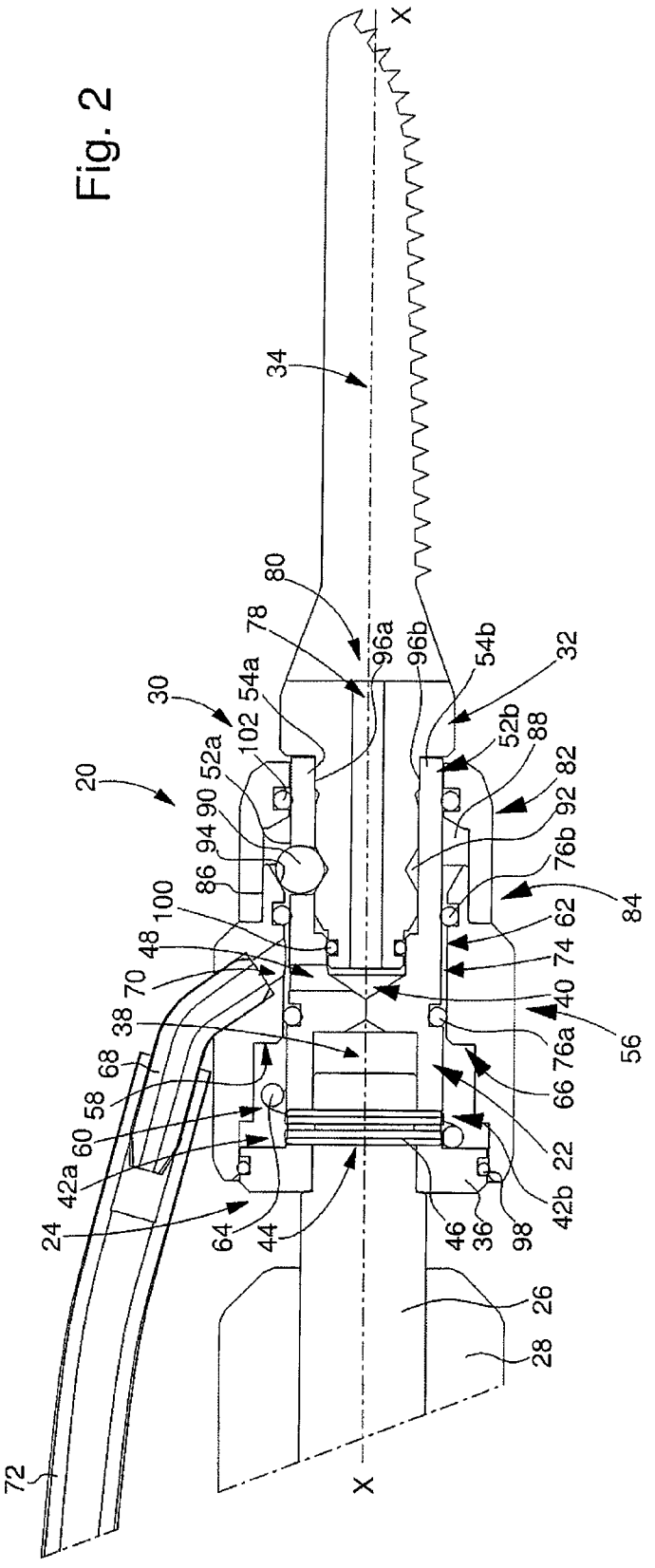

X
34
80
78
96a
96b
54b
32
30
54a
102
52a
52b
88
20
90
82
94
92
86
76b
84
100
62
48
74
70
40
38
56
76a
68
66
58
60
22
42a
42b
24
64
44
46
36
98
26
28
72
X

Fig. 4

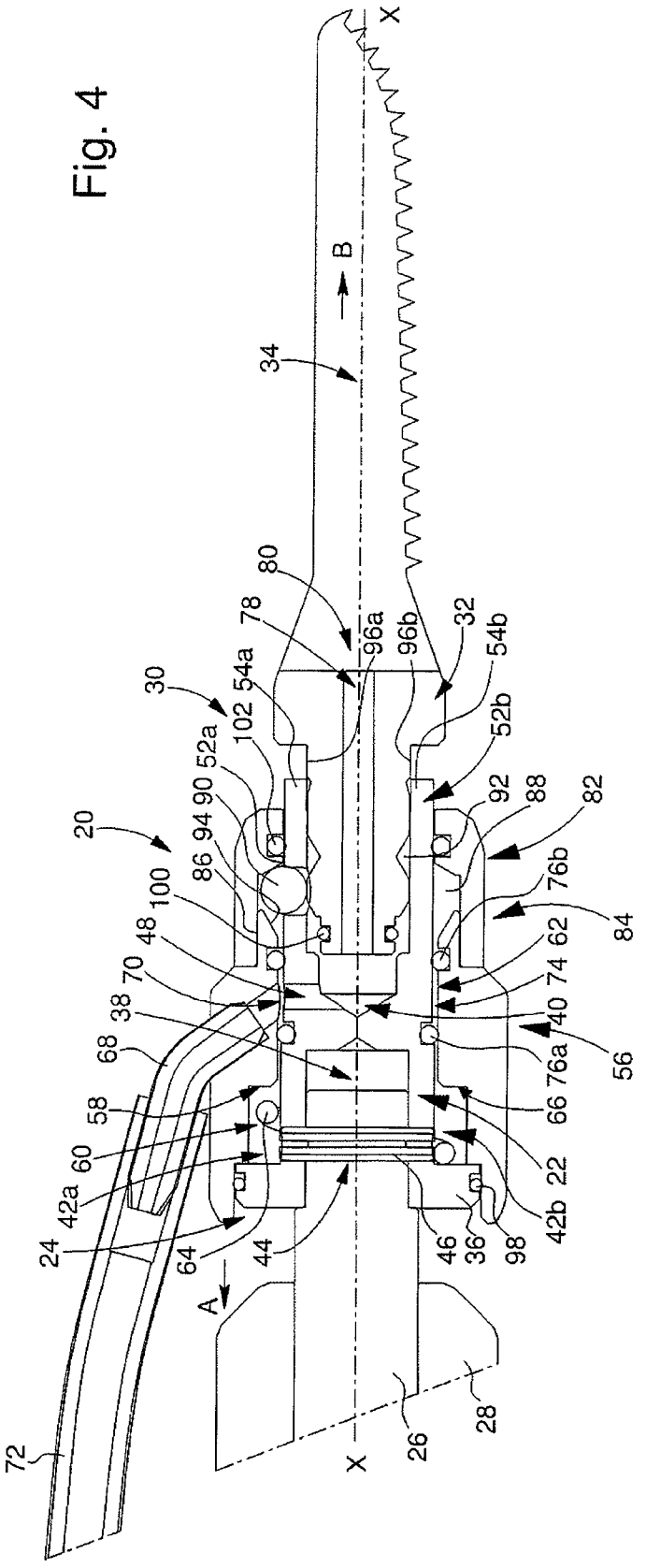

X
B
34
80
78
96a
96b
32
54b
30
54a
102
52a
52b
90
92
88
82
20
94
86
76b
100
48
62
84
70
74
38
40
68
56
76a
66
58
60
22
42a
42b
24
64
44
46
36
98
A
72
X
26
28

Fig. 5

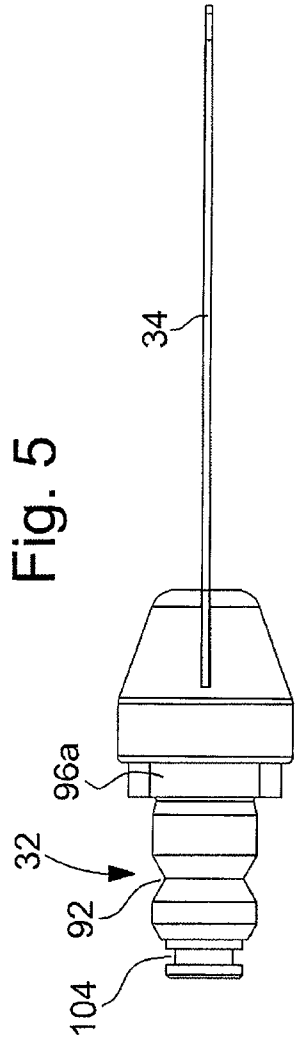
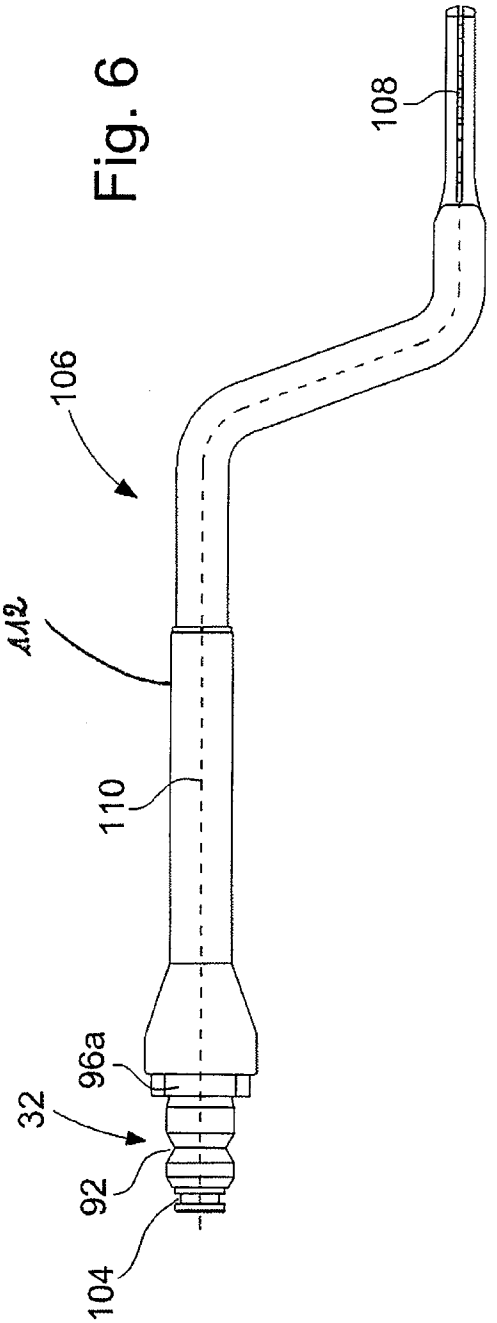


Fig. 6



COUPLING DEVICE BETWEEN THE DRIVE SHAFT OF A SURGICAL INSTRUMENT AND A TOOL

[0001] This application claims priority from European Patent Application No. 09174374.0 filed Oct. 28, 2009, the entire disclosure of which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention concerns a coupling device between the drive shaft of a surgical instrument and a tool. More specifically, the present invention concerns a coupling device between a motorised surgical instrument and a rhinoplasty tool.

BACKGROUND OF THE INVENTION

[0003] Rhinoplasty is a branch of cosmetic surgery that aims to redesign the profile of a patient's nose. One particular case is correction by bone ablation of the bump on the ridge of the nose that is more pronounced in some people than in others. In order to perform this ablation, the surgeon uses motorised handpieces that impart specific back and forth movements to saw, file or plane type tools. An example of this type of handpiece is illustrated in FIG. **1** annexed to this Patent Application. Designated as a whole by the general reference number **1**, the handpiece includes a generally cylindrical body **2** inside which are housed an electric motor and a shaft driven by the motor (not visible in the drawing). A coupling bushing **4** enables a tool **6**, such as a saw blade, to be removably mounted on the drive shaft. The surgeon holds handpiece **2** in his hand by body **2** thereof. For this purpose, a grooved surface **8** can be provided, which will define a non-slip gripping area.

[0004] The success of the operation depends partly upon the quality of the handpiece and the tools used. It also partly depends upon the irrigation of the work area with physiological saline solution. This saline solution maintains the cutting and abrasion qualities of the tools at an optimum level and gradually removes bone debris and blood. Thus, body **2** of handpiece **1** is provided with a fluid feed pipe **10** at the end thereof that carries tool **6**. In the example shown in FIG. **1**, pipe **10** is mounted on a ring **12** which is slidably engaged on the nose **14** of handpiece **1**. This pipe **10** is connected to a flexible tubing **16** through which the fluid arrives and which is used for directing a jet of fluid towards the operating field. However, the end **18** through which the jet of fluid emerges from pipe **10** cannot be arranged past coupling bushing **4**, since this would prevent tool **6** from being easily mounted/removed. Thus, when the tool **6** is long, as is the case of the saw blade shown in FIG. **1**, the physiological saline solution outlet point from the pipe **10** is far away from the working area of the tool. Irrigation of the working area is thus not precise and does not always occur in sufficient quantities.

SUMMARY OF THE INVENTION

[0005] It is an object of the present invention to overcome this problem by providing both a tool and a device for coupling the tool to a motorised handpiece allowing the operating field to be irrigated precisely and in sufficient quantity.

[0006] The present invention thus concerns a coupling device between a surgical instrument drive shaft and a tool shank, characterized in that the coupling device includes a fluid feed element, which is fed from outside the coupling device and which communicates with a channel arranged in the tool shank, said channel emerging at a place on the length of the tool shank.

[0007] In a complementary manner, the present invention also concerns a tool for assembly on a surgical instrument drive shaft, said tool having a shank connected to an active element either directly or via a body, characterized in that a channel arranged in the tool shank and, where appropriate, in the body of said tool, emerges at a place on the length of the tool.

[0008] Owing to these features, the present invention provides a surgical tool and a device for coupling a tool of this type onto the drive shaft of a surgical instrument, which allow a fluid, such as a physiological saline solution, to be brought as close as possible to the working area of the tool. Indeed, instead of feeding the fluid to the working area by means of an external pipe whose fluid outlet end cannot extend beyond the coupling point between the tool and the handpiece drive shaft, the present invention teaches how to convey the fluid inside the tool and cause it to emerge as close as possible to the active area of said tool. Consequently, it is ensured that the operating field is irrigated precisely and in sufficient quantities to guarantee optimum operating conditions, which is very important, in particular for tools of a certain length.

[0009] According to a complementary feature of the invention, the coupling device comprises a support part, which assures the actual connection between the tool shank and the motorised shaft of the surgical instrument, a sleeve on which a bushing is rigidly coupled being arranged concentrically around the support part to define an inlet chamber for the physiological saline solution. The present invention thus provides a coupling device that comprises only three parts, and which is thus both simple to make and extremely compact, this latter aspect greatly facilitating handling of the surgical instrument by the practitioner. Moreover, the set of parts forming the coupling device according to the invention has general rotational symmetry, which removes asperities and other sharp corners which could cause injuries to patients.

[0010] According to another feature of the invention, the coupling device allows rigid axial locking between the tool shank and the drive shaft of the surgical instrument owing to a spring loaded ball lock system. As regards rotational locking, this is ensured by a flat portion provided on the tool shank and on which a corresponding flat portion provided on the coupling device abuts. Consequently, the tool is locked both axially and radially during working phases, yet can still be very easily mounted/removed owing to the spring ball lock system. This latter aspect is very important, since it considerably facilitates the task of the practitioner who is required to use several tools during the course of one operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Other features and advantages of the present invention will appear more clearly from the following detailed description of an embodiment of the coupling device according to the invention, this example being given purely by way of non-limiting illustration with reference to the annexed drawing, in which:

[0012] FIG. **1**, already cited, is a diagram of a surgical instrument including an operating field irrigation system according to the prior art;

[0013] FIG. **2** is a longitudinal cross-section of the coupling device according to the invention in the operating position;

[0014] FIG. **3** is a perspective view of the support part;

[0015] FIG. **4** is a similar view to that of FIG. **2**, the coupling device according to the invention being shown in the position where the tool shank is released;

[0016] FIG. **5** is a top view of the tool showing the flat surface that allows the tool to be locked radially, and

[0017] FIG. **6** is a bottom view of a second type of tool according to the invention, said tool including an elongated body, deformed locally into an S shape which extends between the tool shank and the active area thereof and through the entire length of which there runs a channel in which a fluid flows and which emerges in the active area.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] The present invention proceeds from the general inventive idea that consists in providing a coupling device and a tool for a motorised surgical instrument which allow in particular precise irrigation of the operating field in sufficient quantities by means of a fluid such as physiological saline solution. The coupling device therefore both allows the tool to be rigidly coupled to the surgical instrument drive shaft and allows a channel extending axially into the tool shank to be placed in communication with an external fluid source. Consequently, the fluid emerges from the tool shank at the active area thereof, i.e. as close as possible to the operating field, which concealed by tissue, is otherwise difficult to access particularly for tools of a certain length. Moreover, the coupling device has a limited number of parts, is compact and free from asperities, which makes the surgical instrument easier to handle. The practitioner becomes less tired and his movements are therefore more precise.

[0019] The present invention will now be described with reference to a motorised surgical instrument more particularly intended for operations within the field of rhinoplasty. It goes without saying, however, that the present invention is not limited to this type of operation and that it applies in an identical manner to any type of motorised surgical instrument driving a tool whose working area needs to be irrigated to ensure the best possible performance in terms of cutting, abrasion, drilling or suchlike and the removal of debris and blood.

[0020] Designated as a whole by the general reference number **20**, the coupling device according to the present invention is shown in longitudinal cross-section in its working position in FIG. **2**. This coupling device **20** includes first of all a support part **22**, which, at a rear or proximal end **24**, is carried by a drive shaft **26** of a surgical instrument **28**, and which, at a front or distal end **30**, carries a shank **32** of a tool **34**, in this case a saw. As examination of FIG. **2** reveals, support part **22** is a generally cylindrical part which ends at the rear end **24** in a circular collar or base **36** and in which first and second bores, respectively **38** and **40**, are machined. Drive shaft **26** of handpiece **28** is engaged in first bore **38** of support part **22**. Preferably, support part **22** is driven and pinned onto drive shaft **26**. However, according to a variant, support part **22** could be made integral with drive shaft **26**. If it is mounted on drive shaft **26**, support part **22** is pierced with two, diametrically opposite holes **42***a* and **42***b*, and drive shaft **26** also has a piercing **44**. These two holes **42***a* and **42***b* and piercing **44** are aligned to allow a pin **46** to pass therethrough. The support part **22** is thus rigidly coupled to drive shaft **26** of surgical instrument **28** while remaining removable for the purposes of maintenance and sterilisation. Shank **32** of tool **34** is engaged in second bore **40** of support part **22**. Tool **34** is axially and radially coupled to support part **22** in a way which will be described in detail below. Support part **22** is also pierced with a single hole **48**, which forms a pipe, opening out into the second bore **40** as well as with at least one, and preferably three, through holes **50***a*, **50***b* and **50***c* regularly spaced along the perimeter of support part **22** and which also open out into second bore **40**. Finally, support part **22** has at the front end **30** thereof, two projecting portions **52***a* and **52***b*, diametrically opposite each other, in the arc of a circle and whose opposite surfaces **54***a* and **54***b* are flat. The role of these various elements will also be described in detail below.

[0021] Secondly, coupling device **20** according to the invention includes a sleeve **56** arranged concentrically around support part **22**. This sleeve **56** has a generally cylindrical external shape and an inner space that is also cylindrical with a locally reduced diameter **58**. This reduced diameter **58** therefore splits the inner volume of sleeve **56** into a first housing **60**, whose diameter is fitted to that of base **36**, and a second housing **62**, whose diameter is fitted to the external diameter of support part **22**. A return spring **64** is arranged inside the first housing **60**, abutting, at a rear end, against base **36**, and at a front end, against the bottom **66** of said first housing **60**. A bent nozzle **68** made of stainless steel is inserted into a first pipe **70**, preferably made obliquely relative to the general axis of longitudinal symmetry X-X of coupling device **20**. A flexible feed tube **72** for a fluid such as a physiological liquid is connected to bent nozzle **68**.

[0022] Pipe **70** opens into an annular fluid inlet chamber **74**, defined by the gap left free between the wall of the second housing **62** of sleeve **56** and the external surface of support part **22**. Annular chamber **74** is sealed by means of two gaskets **76***a* and **76***b* placed approximately at the rear end and front end of second housing **62**. Annular chamber **74** communicates with the aforementioned pipe **48** which opens into the second bore **40** of support part **22**. A sealing gasket **100** must be assembled on the rear end of the shank **32** of the tool **34** to prevent the physiological fluid leaking towards the exterior. Thus, the physiological liquid fed from the exterior via flexible tube **72** and bent nozzle **68** will flow in succession into the first pipe **70**, then annular chamber **74** and second pipe **48** before filling the bottom of bore **40**. According to the invention, a channel **78** is machined into shank **32** of tool **34** and emerges at a location along the length of shank **32**, preferably in active area **80** of tool **34**, i.e. if tool **34** is a saw blade, by the teeth of said saw. Thus, the physiological fluid which has run into the bottom of bore **40** will escape by flowing through channel **78** and emerging in active area **80** of tool **34**. By forcing the physiological liquid to take a path that leads it from the exterior of coupling device **20** to the centre of shank **32** of tool **34**, the point where the physiological fluid emerges can be moved as close as possible to the active part of the tool. The operating field is therefore irrigated precisely and in sufficient quantities to guarantee optimum operating conditions.

[0023] We will now consider the locking/unlocking of the tool onto the surgical instrument drive shaft. The coupling device **20** according to the invention includes, thirdly and lastly, a bushing **82** arranged concentrically around support part **22** and rigidly coupled to sleeve **56** preferably by being driven thereon or by another securing technique. For assembly of bushing **82** onto sleeve **56**, on the front end side **84** of sleeve **56**, there is an annular edge **86** whose external diameter is adapted to the internal diameter of housing **88** defined by bushing **82**. As an examination of FIG. **2** reveals, one of the

three through holes **50***a* made in support part **22** and which opens into the second bore **40** is used as a base for a lock ball **90**. Lock ball **90** is retained in base **50***a*, which has, for this purpose, a slightly smaller diameter in the bottom thereof than the largest diameter of ball **90**.

[0024] Lock ball **90** projects on either side of support part **22**, on one side into bore **40** and on the other side into housing **88** defined by bushing **82**. More specifically, in the operating position of coupling device **20** as illustrated in FIG. **2**, lock ball **90** projects, on the side of second bore **40** into a groove **92** with a V shaped profile made in the external periphery of shank **32** of tool **34** and is held in said groove **92** by sleeve **56**, which is forced in the direction of the ball **90** by the elastic return force of spring **64**. It can be seen that sleeve **56** abuts against the lock ball **90** via a truncated surface **94** of the annular edge **86** on the inner perimeter thereof. Lock ball **90** thus ensures the axially coupling between tool **34** and drive shaft **26** of surgical instrument **28** via support part **22**. Tool **34** is locked in rotation onto drive shaft **26** by the actual support part **22** whose projecting portions **52***a* and **52***b* abut, via their opposite plane surfaces **54***a* and **54***b* on corresponding plane surfaces **96***a* and **96***b* arranged on tool shank **32**. In the working position, tool **34** is thus rigidly coupled to drive shaft **26**.

[0025] The operation of removing tool **34** will now be examined with reference to FIG. **4**. With this aim, the user exerts traction backwards against the return force of spring **64** on the assembly formed by sleeve **56** and bushing **82** (see arrow A). Simultaneously, the user exerts traction forwards on tool **34** (see arrow B). Under the effect of this traction, lock ball **90**, which is no longer held in place in groove **92** by truncated surface **94**, rolls onto the external perimeter of shank **32** of tool **34** and moves up into housing **88** defined by bushing **82**, which is just above ball **90**. At that moment, there is no longer any opposition to removal of shank **32** of tool **34**. As regards lock ball **90**, once shank **32** of tool **34** has been removed from bore **40**, it falls back into its base defined by hole **50***a*.

[0026] At the rear end of coupling device **20**, a sealing gasket **98** can be provided between base **36** and first housing **60**. A sealing gasket **102** can also be provided between bushing **82** and support part **22** to prevent any residue from the operation penetrating coupling device **20**.

[0027] FIG. **5** is a top view of tool **34** showing in particular the flat surface **96***a* on which projecting portion **52***a*, provided at the front end of support part **22**, abuts via the corresponding flat surface **54***a* thereof, to lock tool **34** in rotation. FIG. **5** also shows a circular groove **104** which houses sealing gasket **100**. V-shaped groove V **92** can also be seen, into which ball **90** projects to lock tool **34** axially.

[0028] FIG. **6** is a bottom view of another type of tool according to the invention. Designated as a whole by the general reference numeral **106**, this tool differs from that shown in FIGS. **2**, **4** and **5** only in that the shank **32** thereof, which is used to assemble the tool to the surgical instrument drive shaft via support part **22** according to the invention, is connected to the active part **108** thereof, in this case a semi-circular saw blade, via an elongated body **112**. According to the invention, a channel **110** (shown in dotted lines in FIG. **6**) extends through tool **106**, said channel **110** being machined in shank **32** and into body **112** of tool **106** and emerging at a location along the length of said body of tool **106**, preferably in proximity to the active are **108** thereof. After machining channel **110** in shank **32** and body **112** of tool **106**, tool **106** may be given the desired shape, for example it may be partially S shaped as shown in the drawing. It is clear that, thanks to the present invention, the physiological liquid can be made to emerge as close as possible to the active area of the tool according to the invention, even when the latter is of significant length.

1-23. (canceled)

24. A tool for assembly on the drive shaft of a surgical instrument, wherein the tool has a shank connected to an active element either directly, or via a body, wherein a channel arranged in the shank of the tool and, where appropriate, in the body of said tool emerges at a location along the length of the tool.

25. The tool according to claim **24**, wherein the channel emerges by the active element.

26. The tool according to claim **24**, wherein a groove is arranged on the periphery of the tool shank for receiving a lock ball.

27. The tool according to claim **25**, wherein a groove is arranged on the periphery of the tool shank for receiving a lock ball.

* * * * *