

AUSTRALIA  
PATENTS ACT 1990  
NOTICE OF ENTITLEMENT

We, Laboratoire Perouse Implant AND Thierry RICHARD AND Eric  
PEROUSE, the applicants/Nominated Persons in respect of Application No.  
16685/92 state the following:-

The Nominated Persons Thierry RICHARD and Eric PEROUSE are  
entitled to the grant of the patent because they are two of the  
inventors; and the Nominated Person Laboratoire Perouse Implant  
would, on the grant of a patent for the invention to the other  
inventor, Yves Arnissolle, be entitled to have the patent assigned to  
it.

The Nominated Persons Thierry RICHARD and Eric PEROUSE are  
entitled to claim priority from the application listed in the  
declaration under Article 8 of the PCT because these Nominated  
Persons made the application listed in the declaration under Article  
8 of the PCT; the Nominated Person Laboratoire Perouse Implant  
has the consent of the applicants in respect of the application  
listed in the declaration under Article 8 of the PCT to make a  
Convention application based on that application; and because that  
application was the first application made in a Convention country  
in respect of the invention.

DATED this ELEVENTH day of FEBRUARY 1993



.....  
a member of the firm of  
DAVIES COLLISON  
CAVE for and on behalf  
of the applicant(s)

(DCC ref: 1551651)



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- (57) Claim

1. A surgical staple inserter for joining two ducts consisting of a vessel and a tubular vessel prosthesis, of the type including an internal part intended to be received inside the ducts, and an external part remaining outside the ducts, one of the internal or external parts of the staple inserter comprising a stable holder which contains a series of staples, each staple comprising two points joined together by a crosspiece, the staples being disposed in at least one ring with their points oriented radially, and means for ejecting the staples, the other of the internal or external parts of the staple inserter comprising an anvil, the staple inserter comprising means for radially spacing apart the anvil and the staple holder with respect to their relative working positions, and wherein the tubular vessel prosthesis is placed over a portion of the internal part of the staple inserter and in that points for holding the tubular vessel prosthesis in place project on the internal part and penetrate into a wall of the prosthesis.



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<p>(21) Numéro de la demande internationale: PCT/FR92/00287</p> <p>(22) Date de dépôt international: 30 mars 1992 (30.03.92)</p> <p>(30) Données relatives à la priorité: 91/03913 29 mars 1991 (29.03.91) FR</p> <p>(71) Déposant (pour tous les Etats désignés sauf US): LABORATOIRE PEROUSE IMPLANT [FR/FR]; B.P. 6, Z.A. d'Outreville, F-60540 Bornel (FR).</p> <p>(71)(72) Déposants et inventeurs: RICHARD, Thierry [FR/FR]; 71, boulevard Arago, F-75013 Paris (FR). PEROUSE, Eric [FR/FR]; 176, parc de Cassan, F-95290 L'Isle-Adam (FR).</p>	<p>(72) Inventeur; et (75) Inventeur/Déposant (US seulement) : ARNISSOLLE, Yves [FR/FR]; 51, rue Guilloux, F-69230 Saint-Genis-Laval (FR).</p> <p>(74) Mandataire: JACOBSON, Claude; Cabinet Lavoix, 2, place d'Estienne-d'Orves, F-75441 Paris Cédex 09 (FR).</p> <p>(81) Etats désignés: AT (brevet européen), AU, BE (brevet européen), CA, CH (brevet européen), DE (brevet européen), DK (brevet européen), ES (brevet européen), FR (brevet européen), GB (brevet européen), GR (brevet européen), IT (brevet européen), JP, LU (brevet européen), MC (brevet européen), NL (brevet européen), SE (brevet européen), US.</p> <p>Publiée Avec rapport de recherche internationale.</p> <p style="text-align: center; font-size: 2em; font-weight: bold;">654549</p>	

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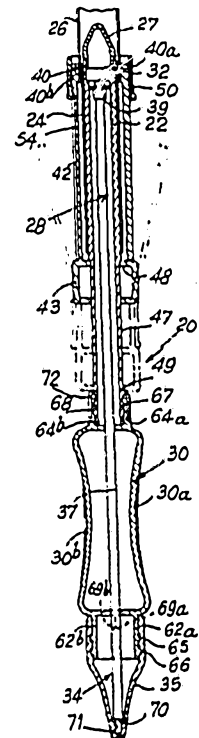
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(57) Abstract

A surgical staple inserter for joining two ducts consisting of a blood vessel (26) and a blood prosthesis (24). The staple inserter ejects staples (94) in a radial direction relative to the axis of the ducts (24, 26). In one embodiment, it includes a staple holder (32) surrounded by the prosthesis and containing a series of staples (94) arranged in at least one ring. All the staples (94) are ejected simultaneously. Said staple inserter also includes an anvil (40) outside the organic ducts, and a device for spacing apart the anvil and the staple holder in relation to their relative working position. Projections hold the prosthesis in place during the insertion of the staple holder into the ducts.

(57) Abrégé

L'invention concerne une agrafeuse chirurgicale pour réunir deux conduits constitués par un vaisseau sanguin (26) et une prothèse de vaisseau (24). Cette agrafeuse éjecte des agrafes (94) radialement par rapport à l'axe des conduits (24, 26). Dans un mode de réalisation, elle comprend un porte-agraves (32) entouré par la prothèse et contenant une série d'agrafes (94) disposées en au moins une couronne. Toutes les agrafes (94) sont éjectées simultanément. L'agrafeuse comprend également une enclume (40), située à l'extérieur des conduits organiques, et des moyens d'écartement relatifs de l'enclume et du porte-agraves par rapport à leur position relative de travail. Des pointes en saillie assurent la retenue anti-recul de la prothèse lors de l'introduction du porte-agraves dans les conduits.



Surgical Staple Inserter

The invention relates to a surgical staple inserter intended to join two ducts consisting of a vessel and a tubular vessel prosthesis.

5           The human body includes several types of organic ducts, such as for example the organs of the digestive system or of the circulatory system. During a surgical operation, there may be a need to suture two parts of section organic ducts together, for example following partial ablation of the duct.

10           In the case of vessels, which are difficult to suture, it is normal to join up a tubular prosthesis on the ends of the vessels. The wall of the prosthesis is more flexible than that of the vessel, which allows easier manipulations. It is thus possible to join the two parts of vessels by first joining up a vessel prosthesis end to each of their ends, then by subsequently joining up the two vessel prosthesis ends by known manual or mechanical means.

15           However, in the current art, suturing of the ends of the vessels must be performed manually by stitching.

A preferred object of the present invention is to allow mechanical sutures to be made in a convenient and secure manner by means of staples on relatively rigid organic ducts, such as blood vessels.

20           According to the present invention there is provided a surgical staple inserter for joining two ducts consisting of a vessel and a tubular vessel prosthesis, of the type including an internal part intended to be received inside the ducts, and an external part remaining outside the ducts, one of the internal or external parts of the staple inserter comprising a stable holder which contains a series of staples, each staple  
25           comprising two points joined together by a crosspiece, the staples being disposed in at least one ring with their points oriented radially, and means for ejecting the staples, the other of the internal or external parts of the staple inserter comprising an anvil, the staple inserter comprising means for radially spacing apart the anvil and the staple holder with respect to their relative working positions, and wherein the  
30           tubular vessel prosthesis is placed over a portion of the internal part of the staple inserter and in that points for holding the tubular vessel prosthesis in place project on the internal part and penetrate into a wall of the prosthesis.

It is to be noted that the prior art describes staple inserters with rings of staples which have points oriented radially (GB-A-2, 038, 226, FR-A-2, 171, 477), but that these staple inserters do not allow a vessel and a vessel prosthesis to be joined up conveniently inside the human body.

5           Embodiments of the invention will now be described by way of example only with reference to the attached drawings, in which:

          Figure 1 is a longitudinal section of a staple inserter according to an embodiment of the invention;

          Figure 2 is a general arrangement of the staple inserter;

10          Figure 3 is a partial perspective view of the protruding supports carrying the anvil;

          Figure 4 is half of a longitudinal section of the staple holder;

          Figure 5 is a view of half of an anvil sector along the arrow 5 in Figure 4;

15          Figure 6 is a partial perspective view of the internal part of the staple insert showing the arrangement of the staple ejection orifices;

          Figure 7 is a section along the line 7-7 in Figure 4;

          Figure 8 is a section along the line 8-8 in Figure 4;

          Figure 9 is half of a longitudinal section of a variant embodiment of the staple holder;

20          Figure 10 is a section along the line 10-10 in Figure 9;

          Figure 11 is a section along the line 11-11 in Figure 9;

- Figure 12 is a partial perspective view of the internal part of the staple inserter showing the arrangement of the staple ejection orifices according to a variant of the invention;

5           - Figure 13 is a front view of a staple ejection orifice according to this variant embodiment of the invention;

10           - Figure 14 is an exploded view of a second embodiment of the staple inserter according to the invention;

- Figures 15 to 18 illustrate the operation of the staple inserter in Figure 14;

15           - Figures 19 and 20 are half sections on a larger scale taken respectively along the lines 19-19 and 20-20 in Figure 18;

- Figure 21 represents the distal end part of the same staple inserter on an even larger scale, in axial section;

20           - Figure 22 is a longitudinal section of a third embodiment of the staple inserter according to the invention; and

- Figure 23 is a similar view, on a larger scale, of the distal end part of the staple inserter in Figure 22.

25           The staple inserter 20 of a generally elongate form is seen in Figures 1 and 2. It includes a tube 22 whose distal end is received in ducts, namely a prosthesis 24 and an organic duct 26. The prosthesis 24 is placed over the external surface of the tube 22 in order to be stapled to the organic duct 26, for example a vessel, partially covering the prosthesis 24 at the distal end of the tube 22. The distal end of the tube 22 includes a cap 27, pressed or glued into the tube, in the shape of a nose cone facilitating the penetration of the staple inserter 20 into the ducts. The cap 27 and the part of the tube 22 around which the prosthesis 24 and the vessel 26 are placed constitute a part which is

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internal with respect to the ducts 28 of the staple inserter. The rest of the staple inserter constitutes a part which is external with respect to the ducts 29 of the staple inserter. The proximal part of the tube 22 is  
5 carried by a staple inserter handle 30 consisting of two longitudinal half-handles 30a, 30b.

A staple holder 32, inside this tube, of a cylindrical general shape is arranged at the distal end of the same 22. It includes means for ejecting the  
10 staples radially, which means will be described subsequently and are represented in detail according to a first embodiment of the staple holder in Figure 4 and according to a second embodiment of the staple holder in Figure 9. The means for ejecting staples are controlled  
15 by the user by means of a stapling wing nut 34, mounted so as to rotate on the proximal end of the handle 30. The wing nut 34 includes a cap 35 fitted with two operating fins 36. It is connected to the means for ejecting the staples from the staple holder 32 by a linkage comprising  
20 a rod 37 connected to the staple holder 32 by a drive nut 39.

An anvil 40 is disposed outside the tube 22, at the stable holder 32, in order to deform the points of the staples which are ejected radially from the staple  
25 holder 32. The anvil 40 is shown in more detail in Figures 4 and 5 according to a first embodiment and in Figure 9 according to a second embodiment. In both embodiments, the anvil 40 consists of two anvil sectors 40a, 40b, each carried by a support 42 of generally semi-cylindrical shape, including a heel 43, forming a half-collared,  
30 carried by the tube 22. The two half-collars 43 are assembled together by means of connection members of a known type, for example screws, disposed in the holes 44 pierced in the radial fins 46 of each collar. These  
35 half-collars 43 can be displaced axially along the tube 22 by sliding over a portion of the external surface of this tube including a flat 47 extending longitudinally

and locking the half-collars 43 in rotation by interaction of their shapes. The longitudinal displacement of the half-collars 43 is limited by two shoulders 48, 49 constituting the longitudinal ends of each flat 47 and forming stops for positioning the supports 42 with respect to the staple holder 32.

The supports 42 are made for example of a relatively elastic metallic material in order to be able to space apart, approximately radially, their distal ends carrying the anvil sectors 40a, 40b in order to facilitate the placing of the prosthesis 24 and of the vessel 26 over the tube 22, between the latter and the supports 42. The supports 42, in the spaced-apart position, are shown in dot and dash lines in Figure 1.

A locking hoop 50 allows the sectors of the anvil to be assembled together after having previously disposed the organic ducts to be stapled over the internal part of the staple inserter and having positioned the supports 42 opposite the staple holder (half-collars 43 abutting against the distal shoulder 48). The hoop 50 can be displaced axially along the external surface of the supports 42. A lug 52 disposed radially on the internal wall of the hoop 50 interacts with a longitudinal groove 54 in one of the supports 42 to guide the hoop 50 between the heels 43 forming the half-collars and the distal ends of the supports 42 carrying the anvil sectors 40a, 40b. The hoop 50 is made of a relatively elastic material, for example a plastic material, so as to make it possible to assemble the anvil sectors 40a, 40b by wedging the hoop around the supports 42 at the anvil sectors 40a, 40b.

Figure 3 shows a schematic view of the supports 42 allowing it to be understood how the hoop 50 is mounted on them. The supports 42 are first mounted on the staple inserter and assembled together by their heels 43 which form half-collars. The hoop 50 is then placed around them while engaging the lug 52, along the arrow F, in a longitudinal groove 58 common to the two supports

52. By displacing the hoop 50 towards the heels 43 of the supports 42, the lug is brought into longitudinal recesses 56 of the supports 42 which face each other. Finally, the lug 52 is brought to the level of a groove 5 60 communicating with the guide groove 54, which allows it to be engaged in the latter.

We shall now deal with the fixing and mounting of the handle 30 and the stapling wing nut 34.

10 The two half-handles 30a, 30b are extended at their ends on the one hand by half-sleeves 62a, 62b for supporting the wing nut 34, and on the other hand by half-sleeves 64a, 64b for fixing onto the tube 22. The two half-sleeves 62a, 62b of the handle 30 include two 15 annular ribs 65 which interact with annular channels 66 of complementary shape in the internal wall of the wing nut 34, while allowing free rotation of the wing nut 34 on the handle 30. The proximal end of the tube 22 which is fitted into the half-sleeves 64a, 64b of the handle 30 includes an annular projection 67 for axial positioning 20 of the handle 30 which interacts with an annular groove 68 of complementary shape made on the internal surfaces of the half-sleeves 64a, 64b.

In order to mount the handle 30, the stapling wing nut 34 is first dispersed on a support. The two 25 half-sleeves 62a, 62b for supporting the wing nut are then fitted into the cap 35 of the wing nut 34. This is done by juxtaposing the joining edges 69a, 69b of the half-sleeves 62a, 62b which are symmetrically truncated, the effect of which is to form an angle between the two 30 half-handles 30a, 30b. The proximal end 70 of the rod 37, with square cross-section, is engaged in a hole 71, of complementary shape, in the cap 35 of the wing nut 34. The proximal end of the tube 22, over which a sliding fastening hoop 72 has previously been placed, is disposed 35 between the two half-sleeves 64a, 64b of the handle 30. The half-handles 30a, 30b are closed onto each other and the fastening hoop 72 is slid over the external surface

of the two half-sleeves 64a, 64b, wedging it onto them.

5 Figures 4 to 8 show a first embodiment of the staple holder 32 and of the corresponding anvil 40. The staple holder 32 and the anvil 40 are disposed vertically in Figure 4. The staple holder 32 consists of two flanges 82, 84 firmly attached to the tube 22, carrying a rotating pin 85 onto which a disc 86 is fixed which can rotate between the flanges 82, 84. The disc 86 is pushed onto the median zone of the pin 85 which includes a portion 88  
10 with an irregular surface ensuring better connection between the disc 86 and the pin 85. The pin 85 is connected by one of its ends with square cross-section to the drive nut 39.

15 The flange 82 is positioned axially inside the tube 22 between the edge 90, delimiting the opening of the cap 27, and the disc 86. The flange 84 is positioned inside the tube 22 between a shoulder 91, corresponding to the increase in the internal space of the tube 22, and the disc 86. The flanges 82, 84 are positioned angularly  
20 with respect to the tube 22 by means of axial projections 92, 93 which interact with notches 92a, 93a of complementary shape and are respectively arranged on the edge delimiting the opening of the cap 27 and on the shoulder 91 of the tube 22.

25 Staples 94 are disposed flat between the opposite faces of the disc 86 and of a flange 82, 84, so as to constitute two superimposed rings of staples. Each ring of staples 94 includes ten staples distributed over the whole circumference of the tube 22. The staples 94 have  
30 their points, which project radially outside the tube 22, through orifices 95 in the latter. Figure 6 shows how the orifices 95 of the tube 22 are arranged in two superimposed rings, so that the orifices 95 of one ring are staggered with respect to the orifices 95 of the other  
35 ring.

Figure 5 shows an anvil sector 40b which includes cavities 96, of known shape, intended to receive the

points of the staples in order to hold them back during stapling.

The means for ejecting the staples 94 will now be described. In this connection, reference will be made to  
5 Figures 4, 7 and 8. Figures 4 and 7 show that each staple 94 is ejected by a hammer 98 of generally flat shape. The hammers 98 are disposed in rings between the opposite surfaces of the disc 86 and of a flange 82, 84. The flanges 82, 84 include, on the surface opposite the disc  
10 86, means for guiding the staples 94 and means for guiding the hammers 98. The means for guiding the staples 94 consist of radially extending recesses 100 in the surfaces of the flanges 82, 84, in which recesses the staples are housed. The means for guiding the hammers 98  
15 consist of radial grooves 102 arranged on the surface of the flanges, in the middle of the recesses 100, which interact with a guiding projection 102 disposed on one of the faces of the hammers 98. The disc 86 includes means for driving the hammers 98, which means consist of a  
20 spiral channel 106, at constant pitch, arranged symmetrically on each face of the disc. The spiral channels 106 interact with each of the drive projections 108 disposed on one of the faces of the hammers 98.

Figure 8 shows how the projections 108 for  
25 driving the hammers 98 are disposed in the spiral rib [sic] 106 of the disc 86. There are ten projections 108, corresponding to ten hammers 98, which simultaneously eject a ring of ten staples. The hammers 98 are set in their initial position, before stapling, at the centre of  
30 the disc 86. The position of the projection 108 on each hammer 98 depends on the angular position of the latter in the staple holder. As the spiral channel 106 has a constant pitch, the rotation of the disc in the clockwise direction, along the arrow H, simultaneously drives all  
35 the hammers 98, displacing them radially by an equal distance.

The mounting of the staple holder 32 according to

REPLACEMENT SHEET



this first embodiment will now be described. In a first step, the cap 27 is placed on a support. There are then successively assembled the first flange 82, on the cap 27, the disc 86 fixed on the pin 85, and the second flange 84. The hammers 98 are next introduced into the staple holder 32. Since the position of the drive projection 108 on each hammer 98 is a function of the angular position of the latter in the staple holder 32, it is expedient to dispose the various hammers 98 in the staple holder 32 in a well-defined order. For this purpose, the first step is introducing the first hammer 98 of the series into the staple holder by engaging the drive projection 108 in the spiral channel 106, through the periphery of the disc 86, at a recess 100 for guiding the staples. The same procedure is repeated with the other hammers 98 of the series, in the order in which they are disposed in the staple holder. All the hammers 98 are set in their initial position, at the centre of the disc 86, by rotating the disc 86 fully in the anti-clockwise direction. The cap 27/staple holder 32 assembly is then disposed in the distal end of the tube 22. The means for axial positioning and rotational positioning of the flanges 82, 84 which were described hereinabove ensure the correspondence between the orifices 95 for ejecting the staples from the tube 22 and the recesses 100 for guiding the staples 94. The staples 94 are introduced into the staple holder 32 through the orifices 95 while orienting their points outwards and while placing the crosspiece of each staple 94 in contact with the corresponding hammer 98. The length of the hammers 98 is such that, when they are in the initial position, the points of the staples extend slightly outside the tube 22. Thus, the points of the staples 94 press slightly into the wall of the prosthesis 24, without passing through it, so as to hold it on the tube 22.

Figures 9 to 11 show a staple holder 32 according to a second embodiment. In this case, the holder includes

a single ring of staples 94 whose crosspieces are oriented axially. In contrast to the previous embodiment, the staple holder 32 is disposed in a sleeve 110 which is pressed over the distal end of the tube 22, at a  
5 constriction 111 of the external wall of the tube. The sleeve 110 includes a collar piece 112, consisting of a single piece, which projects inside the sleeve, and which is used as a support for the various elements of the staple holder 32. As in the case of the first embodiment,  
10 the staple holder 32 has two flanges 114, 116 used as a support for a rotating pin 118 connected to the drive nut 39 by interaction of their shapes. In the second embodiment of the staple holder 32, the cap 27 is pressed into the sleeve 110 and the flanges 114, 116 are  
15 positioned axially and angularly with respect to the tube 22 in a similar manner to the first embodiment of the staple holder 32. Conversely to the first embodiment, two discs 120, 122 for driving the hammers 113, which discs are fixed onto the pin 118 by interaction of their shapes  
20 with axial ribbings 119 in the pin, are disposed on either side of the collar piece 112. They each carry on their face opposite one of the faces of the collar piece 112, a spiral channel 124, 126, of constant pitch, symmetrical to each other. These drive channels 124, 126  
25 interact with two drive projections 128, 129 of each hammer 113.

In Figure 9, the staple holder 32 is disposed vertically and the hammers 113 are in their initial position before stapling, at the centre of the staple  
30 holder 32. The anvil 40 is in this case adapted in order to be able to receive the staples 94 whose crosspieces are oriented axially with respect to the staple holder. It is fitted with cavities 130 of known shape, intended to fold the points of the staples 94 during the stapling.  
35 Figure 10 shows that the staple holder 32 includes ten hammers 113 each ejecting two staples 94 through orifices 131. Figure 12 shows how the orifices 131 for ejecting

the staples are disposed all around the sleeve 110. Figure 13 shows an orifice 131 in more detail. This has a general cross shape. The two lateral branches of the cross-shaped orifice 131 have T-shaped ends, through each of which one staple 94 is ejected. Similarly, each hammer 113 has a general cross shape when viewed facing an orifice 131 for ejecting the staples. It consists of a central body 132 represented vertically in Figures 9 and 13. The central body 132 is guided in a radial guide hole 134 in the collar piece 112. The central body 132 is fitted at its middle with two lateral branches 136 whose ends are T-shaped like the contour of the orifices 131. The ends of the branches 136 of each hammer are engaged in slideways 138 made in the collar piece 112 of the sleeve 110 and extending radially parallel to the holes 134 for guiding the central body 132 of the hammers 113. The staples 94 are disposed in the slideways 138 such that their crosspiece is in contact with the ends of the branches 136 of the hammers 94.

Figure 11 shows the spiral channel 126 in which the drive projections 129 of the hammers 113 are received. It is seen that the position of the projections 128, 129 on the central body 132 of the hammers 113 depends on the angular position of the hammer 113 in the staple holder, as in the case of the first embodiment of the staple holder.

The staple holder 32 is mounted in accordance with the general principles previously described in the first exemplary embodiment. The cap 27 is disposed in a support, then there are successively assembled the flange 114, the pin 118 with ribbings, a first drive disc 120, the sleeve 110, a second drive disc 122 and finally the second flange 116. The sleeve 110 and the staple holder 32 are disposed on the distal end of the tube 22, and whilst rotating the discs 120, 122 in the anticlockwise sense, the hammers are introduced through the orifices 130 in order. Finally, the staples 94 are disposed in the

slideways 138 on either side of the hammer guide holes 134 in the sleeve 110.

As in the first embodiment of the staple holder, the points of the staples 94 project outside the internal  
5 part 28 of the staple inserter so as to press into the wall of the prosthesis 24 without passing through it, in order to hold it axially on the staple inserter.

In both embodiments of the staple holder 32, the staple inserter is intended to be used with a prosthesis  
10 24 previously positioned over the tube 22 approximately between the heels 43 of the supports 42 and the anvil 40. In order to position the staple inserter in the vessel 26, the anvil supports 42 are spaced apart in order to dispose the vessel 26 between the anvil 40 and the end of  
15 the prosthesis 24, at the staple holder 32. The supports 42 are then positioned axially and the anvil sectors are assembled together by means of the locking hoop 50. For the stapling, the operator grips the staple inserter by the handle 30 and rotates the stapling wing nut 34. The  
20 rod 37 drives the pin 85, 118 in rotation via the drive nut 39. The hammers 98, 113 are then driven radially towards the periphery of the tube 22 and eject the staples 94 against the anvil 40.

The staple inserter represented in Figures 14 to  
25 21 with its axis X-X assumed to be horizontal, consists of the following pieces, represented in exploded form in Figure 14:

- a handle 201, consisting of two halves assembled along the plane of symmetry of the staple  
30 inserter by screws 202;
- a trigger 203 and its safety catch 204;
- a hollow central rod 205 and its annular operating button 206;
- a retention hoop 207 and an annular nose 208;
- 35 - a mounting hoop 209;
- a flexible tubular prosthesis 210 made of a biocompatible synthetic material, slightly pleated in



concertina fashion;

- six jaws or sectors 211;
- in each jaw; two staples 212 and a staple pusher 213 common to these two staples;

5           - a hoop 214 for closing the jaws and an arming lever 215.

Each half of the handle 201 comprises internally, at the rear, an elastic clip 216 surrounding an orifice 217 and, in its front part, a guiding slot 218, an arc-shaped window 219 and vertical positioning ribs 220. The slot 218 includes, from the rear to the front, a slightly descending part, a sharply descending part and a horizontal part.

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The trigger 203 is hinged on the handle around a spindle 221. It has at its upper part a T-shape whose branches 222 project through the windows 219. The catch 204 is hinged on the handle around a spindle 223 between an approximately horizontal active position (Figures 15 to 17) in which it penetrates a notch 224 in the trigger in order to lock it in the inactive position, and an approximately vertical (Figure 18) retracted position which allows actuation of the trigger.

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The rod 205 has an external diameter which is uniform over approximately its whole length, except in its front or distal part 225 whose diameter is enlarged. This rod includes, in its rear or proximal part, two circular channels 226, 227 situated at a small distance from each other, and it terminates at the rear in a tip 228 on which the button 206 is fixed. A cylindrical stud 229 is half inserted into an orifice 230 in the rod 205 which includes, over the whole of its length, an axial passage 231. The front end of the part 225 constitutes an anvil and has two rings of recesses 232 oriented axially.

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As Figure 21 shows more clearly, the retention hoop 207 is a flat band fixed to the distal end of the rod 205 by means of the nose 208. The latter is frustoconical on the outside, converging towards the

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front, while the hoop 207 includes a ring of points 233 oriented obliquely forwards and projecting radially with respect to the anvil 225.

5 The mounting hoop 209 is fixed into the handle by means of the ribs 220. It includes an axial bore 234 through which the rod 205 passes. The wall of this bore includes an axial groove 235 in which the stud 229 slides (Figure 19), which ensures angular positioning of the rod 205 with respect to the handle. This rod may be put  
10 axially, by means of the button 206, either in an advanced position (Figure 15), in which the button is adjacent to the handle, or in a pushed-back position (Figures 16 to 18). Both of these positions are precisely defined by the elastic entry of the clip 216 in the  
15 channel 226 or in the channel 227.

The hoop 209 is provided externally in its front part with six axial ribs 236 (Figures 14 and 19).

Each jaw 211, made of a plastic material, extends over an angle of 60°, has the general shape of a  
20 cylindrical sector and includes three moulded parts:

- a rear part 237 delimited between two internal radial shoulders and including a median axial groove 238 (Figures 14 and 19), in order to ensure its axial and angular positioning on the mounting hoop 209;  
25 - an intermediate part 239 protruding forward;  
and

- a front part 240 connected to the previous part by a hinge 241 which is deformable and, at rest, slightly divergent towards the front.

30 A radial slit 242 is made in the front part 240 of each jaw, in which slit a staple pusher 213 is guided so as to slide radially, the interior end of this slit receiving two parallel staples 212. The staples all have an axially oriented crosspiece and two points directed  
35 approximately towards the axis X-X. The pushers include an inclined external surface 243 forming a cam slope.

Each jaw furthermore has, along the parts 239 and

240, an axial groove 244 which cuts the slit 242. In this part 239, this groove is broken, approximately half way along its length, by a transverse rib 245.

5 Inside the hoop 214, there are six axial ribs 246 sliding in respective grooves 244. In the front part of this hoop, the ribs have a height which decreases so as to define six cam slopes 247 of the same inclination as the surfaces 243 of the staple pushers.

10 The arming lever 215 has an elongate shape with a U-shaped cross-section (Figure 19). At its front part, it includes two internal stubs 248 (Figures 14 and 19) received in diametrically opposite recesses 249 provided in the hoop 214. In its rear part, the lever 215 includes two other stubs 250 guided in slots 218 in the handle, 15 and, at its rear part, each branch of the U has a deep cutout 251.

The use for this staple inserter includes four steps, respectively illustrated in Figures 15 to 18.

20 First, the lever 215 is pushed back so as to lead the hoop 214 over that part 239 of the six jaws 211 abutting against the ribs 245 at the back. In this position, because the shape of the slots 218 is inclined towards the front, the rear of the lever 215 is raised. In addition, the button 206 is driven in towards the 25 handle, with the clip 216 engaged in the rear channel 226 of the rod 205, so that the anvil 225 projects far towards the front beyond the jaws, which are open. The surgeon may thus easily observe the introduction of the anvil into one extremity of the blood vessel 252 (Figure 30 21) to be connected to the prosthesis 210, which is placed over the anvil 225. This introduction is facilitated by the frustoconical shape of the nose 208, whose maximum diameter is substantially equal to that defined by the points 233. Preferably, to the same end, 35 the front end part of the prosthesis is smooth, that is to say not pleated. During this introduction, the points 233, which penetrate into the thickness of the front end

of the prosthesis without passing through it, prevent any backward movement of this prosthesis.

When the anvil has penetrated the vessel 252 sufficiently in order for it to cover the zone of the two  
5 rings of recesses 232, the surgeon, holding the button 206, pushes the handle, and therefore the rest of the staple inserter, forwards, until the clip 216 engages in the front channel 227 of the rod 205. He therefore achieves the situation in Figure 16, which only differs  
10 from that in Figure 15 in that the recesses 232 of the anvil are situated exactly in line with the points of the twelve staples 212 ready in the six jaws 211.

The following step (Figure 17) consists in pushing the arming lever 215 forwards, which pushes the  
15 hoop 214 in order to close the six jaws. This being done, the inclined parts of the slots 218 of the handle force the lever 215 to fold down progressively, until the two cutouts 251 cover the projecting arms 222 of the trigger 203. The front end of the hoop 215 is then situated at a  
20 distance behind that of the jaws 211, with the slopes 247 situated exactly opposite the slopes 243 of the staple pushers.

It then only remains to disengage the catch 204 and to press the trigger. The arms 222 then push the  
25 lever 215, and therefore the hoop 214, forwards, the two stubs 250 then being guided along the horizontal front part of the slots 218. The interaction of the slopes 247 and 243 causes the radial displacement inwards of the six pushers 243, and therefore the simultaneous centripetal  
30 ejection of the twelve staples. These staples pass through the vessel and the prosthesis and are bent in the recesses 232. The final position is that represented in Figure 21.

In order to retract the staple inserter, the  
35 arming lever 215 is pulled back. The consecutive backward motion of the hoop 214 frees the six jaws, which reopen by simple elasticity, the inclination towards the front

of the points 233 then allows the anvil to leave the stapled zone and then the prosthesis towards the rear, simply by pulling the handle 201.

5 The embodiment in Figures 22 and 23, which also uses cams sliding axially for ejecting the staples, but which is of a "centrifugal" type as in the case of Figures 1 to 13, will now be described.

10 A handle 301/trigger 303/catch 304 assembly is still present, but the openings 218 and 219, the ribs 220 and the clip 216 of the preceding embodiment have been removed. The handle has, in the axis X-X, a rear orifice 305 and a front duct 306 of larger diameter in which the rear end, of reduced diameter, of the main tubular body 307 is fixed. At the front end of this, a front tubular body 308 of larger diameter is fixed by means of a screw nut 307A. A hollow rod 309 slides in the assembly 307-308 and is pushed back by a helicoidal spring 310. It rear end, inside the handle, has a step 311 which bears on the upper, forked, end of the trigger 303.

20 The front end of the body 308 has six radial slits 312 for guiding a staple pusher 313 and for receiving two parallel staples 314 with crosspieces oriented axially and with points directed approximately radially outwards. An ejector 315 slides in the body 308, which ejector has a cylindrical rear part and a frusto-conical front part. This front part defines a cam slope 316 of the same gradient as the radially internal surface 317 of the staple pushers. The ejector 315 includes a central passage 318.

30 A hoop 319 for retention of the prosthesis 320 is fixed at the front end of the body 308, and its rear face defines the front face of the slits 312. This hoop includes a ring of points 321 inclined forwards. The prosthesis is placed over the body 308, and its smooth front end covers the slits 312 and the points 321, which penetrate into its thickness without passing through it.

35 A nose 322 is mounted so as to slide with respect

to the hoop 319 by means of several axial screws 323  
screwed in the latter. This nose includes a peripheral  
skirt with axial slots defining a series of flexible  
tongues 324 directed towards the back. In the ready  
5 position of the stapler, illustrated in the lower half of  
Figures 22 and 23, the nose is pressed flat against the  
hoop 319, and its central bore 325, converging towards  
the front along the same gradient as the cone 316,  
extends that 326, with the same gradient, of the hoop  
10 319, while the rear end of the tongues 324 covers the  
front end of the prosthesis.

The staple inserter also includes six jaws 327  
each fitted at their front end with an anvil sector 328  
provided with two axially oriented recesses 329. Each jaw  
15 is a protruding cylindrical sector connected by a thin  
hinge 330 to a common rear tubular support 331 which  
slides over the main body 307. Each sector is pushed into  
an open position by a leaf spring 332.

The support 331 is extended towards the back by  
20 an appendage 333 from which a lug 334 leads towards the  
axis X-X. An L-shaped security brake 335 is hinged on  
this lug and includes a branch 336 which is pushed by a  
spring towards a horizontal position, and a radial branch  
337. The latter passes through the outside of a slit in  
25 the appendage 333 and terminates in an oblique surface  
inclined downwards and forwards.

A closure hoop 338 may slide on the set of jaws  
327, on the support 331 and on the appendage 333.

When the support is in a rear position which is  
30 not represented, with the hoop 338 ready on the support  
331, the surgeon sees the prosthesis and the nose 322 and  
may force this into the vessel 339 whose extremity easily  
passes over the front part of the prosthesis by virtue of  
the tongues 324. The surgeon then presses the support 331  
35 forwards. When this reaches a front stop, which is not  
represented, the recesses 329 of the anvil are situated  
exactly in the planes of the staples 314, and the brake

335 catches in front of the front face of the handle 301 (Figure 22). The situation is then that represented in the lower half of Figures 22 and 23.

5 The surgeon then pushes the hoop 338 as far as its extreme front position, defined by an end stop 340 of the jaws, which closes them.

10 Finally, the surgeon frees the catch 304 and presses the trigger 303. The front end of this pushes the rod 309 forwards, compressing the spring 310, and this rod pushes the ejector 315. The cone 316, which was exactly opposite the surfaces 317 of the six pushers, displaces the latter radially outwards by a cam effect, which produces simultaneous stapling of the prosthesis and the vessel by the twelve staples.

15 Simultaneously, the front end of the cone 316 comes into contact with the conical bore 325 in the nose 322 and pushes the latter backwards until the cone abuts against the conical bore 326 of the hoop 319. As the upper halves of Figures 22 and 23 show, this displacement of the nose frees the tongues 324 which elastically return to a position parallel to the axis X-X.

20 This allows the staple inserter to be retracted backwards, but it is first of all necessary to push back the support 331, which is only possible when the jaws are in the open position by virtue of the presence of the brake 335. In fact, it is necessary initially to push back fully the hoop 338. When this arrives on the appendage 333, it retracts the radial branch 337 of the brake 335, and the latter tilts, along the arrow f. It is then, and only then, possible to push back the support 331, with the jaws consequently open, then to retract the staple inserter. This avoids the risk of the surgeon accidentally pushing the support 331 backwards when the jaws are closed, which could have the effect of tearing the stapled zone of the vessel 339.

35 It should be noted that in this embodiment, as in that in Figures 14 to 21, the staple inserter includes,

over its entire length, a continuously open duct, which allows a catheter or a fluid to pass.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or 5 "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A surgical staple inserter for joining two ducts consisting of a vessel and a tubular vessel prosthesis, of the type including an internal part intended to be received inside the ducts, and an external part remaining outside the ducts, one of the internal or external parts of the staple inserter comprising a stable holder which contains a series of staples, each staple comprising two points joined together by a crosspiece, the staples being disposed in at least one ring with their points oriented radially, and means for ejecting the staples, the other of the internal or external parts of the staple inserter comprising an anvil, the staple inserter comprising means for radially spacing apart the anvil and the staple holder with respect to their relative working positions, and wherein the tubular vessel prosthesis is placed over a portion of the internal part of the staple inserter and in that points for holding the tubular vessel prosthesis in place project on the internal part and penetrate into a wall of the prosthesis.

2. A surgical staple inserter according to claim 1, wherein the points penetrate into a distal end part of the tubular vessel prosthesis which end part is smooth.

3. A surgical staple inserter according to claim 1 or claim 2, wherein the staple holder is carried by the internal part, and the points of the staples are oriented radially towards the external part and form the points penetrating into the wall of the tubular vessel prosthesis.

4. A surgical staple inserter according to claim 1 or claim 2, wherein the points are firmly attached to the internal part of the staple inserter.

5. A surgical staple inserter according to claim 4, wherein the points are inclined towards the direction of introduction of the internal part into the tubular vessel.

6. A surgical staple inserter according to any one of the preceding claims, wherein the internal part of the staple inserter includes a nose whose proximal end has a diameter which is greater than the diameter of the tubular vessel prosthesis in a ready position of the nose and a diameter which is less than that of the tubular vessel prosthesis when the staples are ejected.

7. A surgical staple inserter according to claim 6, wherein the nose is mounted so as to slide axially at an end of the internal part of the staple inserter and includes a series of radially elastic tongues which cover a distal end of the prosthesis in the ready position of the nose, the internal part of the staple inserter comprising  
5 means for pushing the nose forwards approximately at the moment when the staples are ejected.

8. A surgical staple inserter according to any one of preceding claims wherein the external part comprises at least two sectors which can be displaced approximately radially, and means for assembling the sectors together, the staple  
10 inserter comprising means for displacing a support for the sectors axially with respect to the internal part of the staple inserter in the spaced-apart position of the sectors.

9. A surgical staple inserter according to claim 8 wherein the means for assembling the sectors together comprises a sliding hoop.

10. A surgical staple inserter according to claim 8 or claim 9, wherein the  
15 external part comprises stop means which define the frontmost position of the sectors.

11. A surgical staple inserter according to any one of claims 8 to 10, further comprising a brake for the sliding of the support for the sectors, and means for freeing this brake actuated by setting the assembly of the sectors in an inactive  
20 position.

12. A surgical staple inserter according to any one of the preceding claims, wherein the means for ejecting the staples comprises radially guided staple pushers or hammers, and means for driving the pushers or hammers comprising, for each  
pusher or hammer, an axially guided cam.

13. A surgical staple inserter according to any one of the preceding claims wherein the anvil is carried by the external part of the staple inserter.

14. A surgical staple inserter according to any one of the preceding claims wherein all of the staples are disposed in a ring of staples, the crosspiece of the staples being oriented axially.

15. A surgical staple inserter according to any one of the preceding claims  
30 further comprising a central passage which passes through it over its entire length.

16. A surgical staple inserter substantially as hereinbefore described with reference to the accompanying drawings.

5

DATED this 14th day of September 1994

10 Laboratoire Perouse Implant AND  
Thierry Richard and Eric Perouse  
By Their Patent Attorneys  
DAVIES COLLISON CAVE

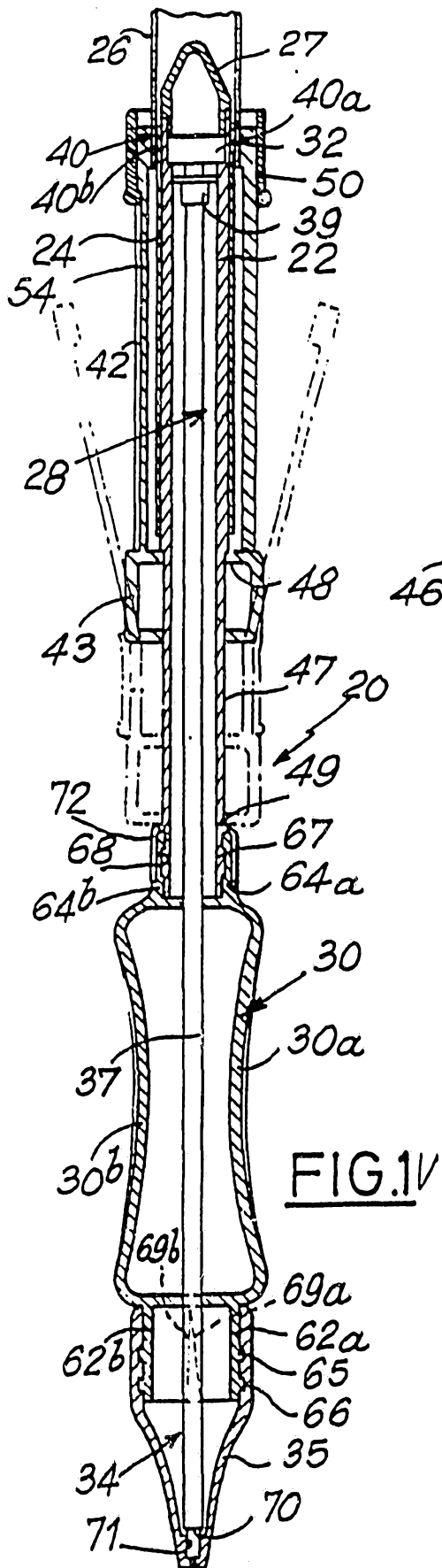


FIG. 1V

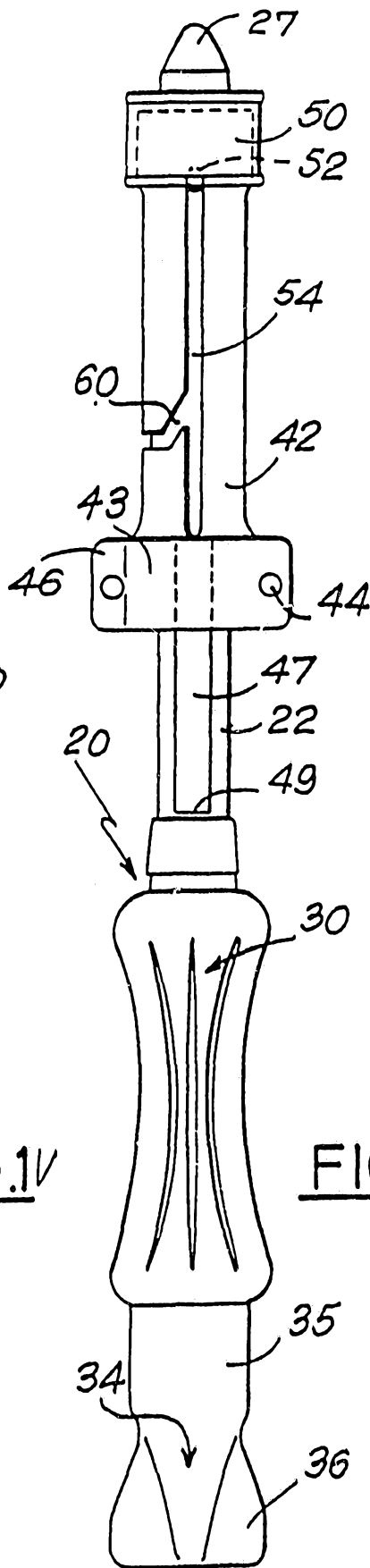


FIG. 2

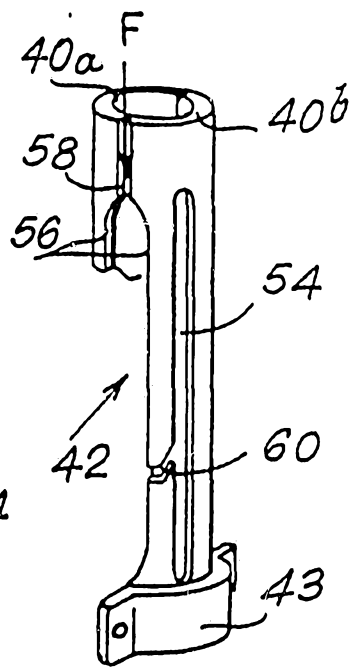


FIG. 3

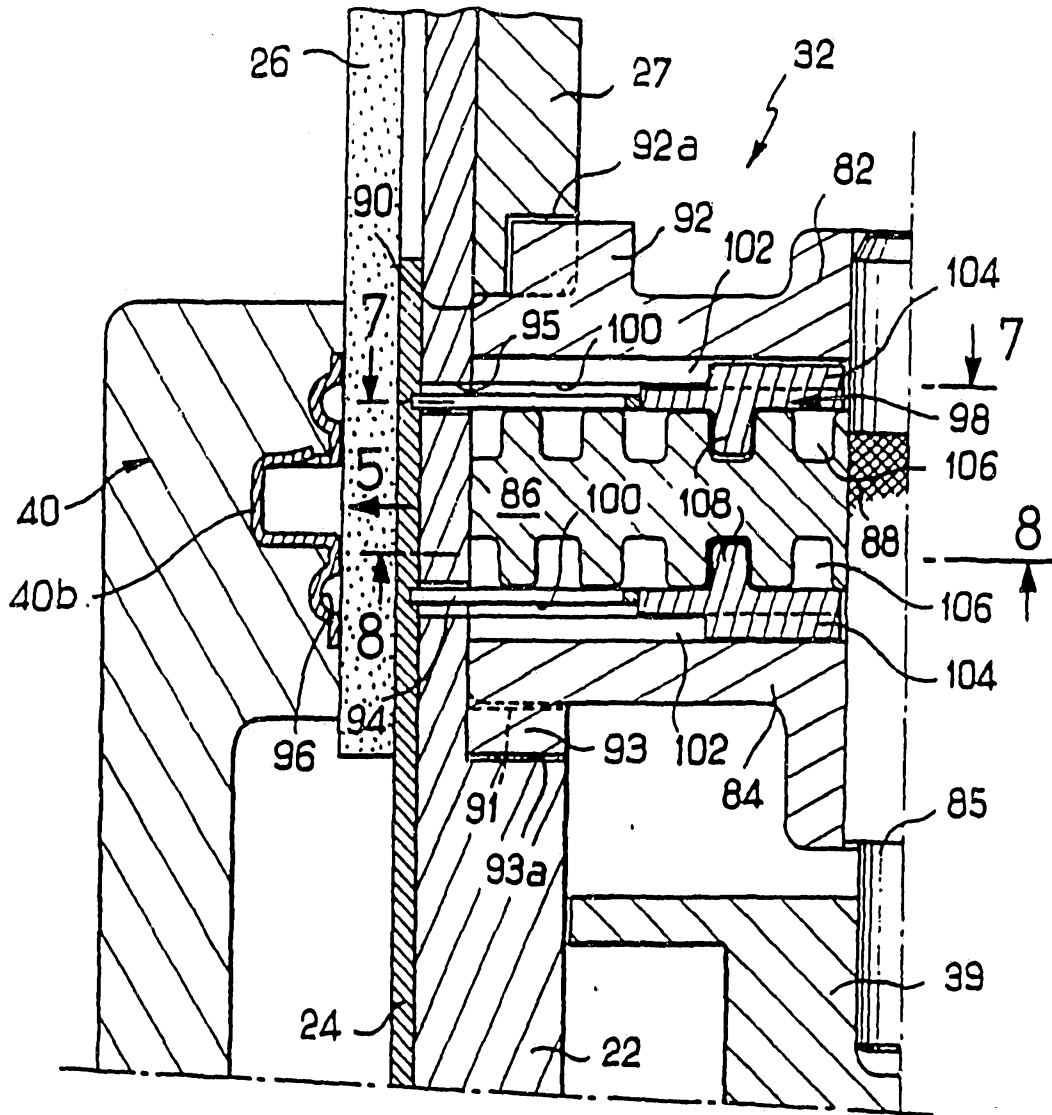


FIG. 4

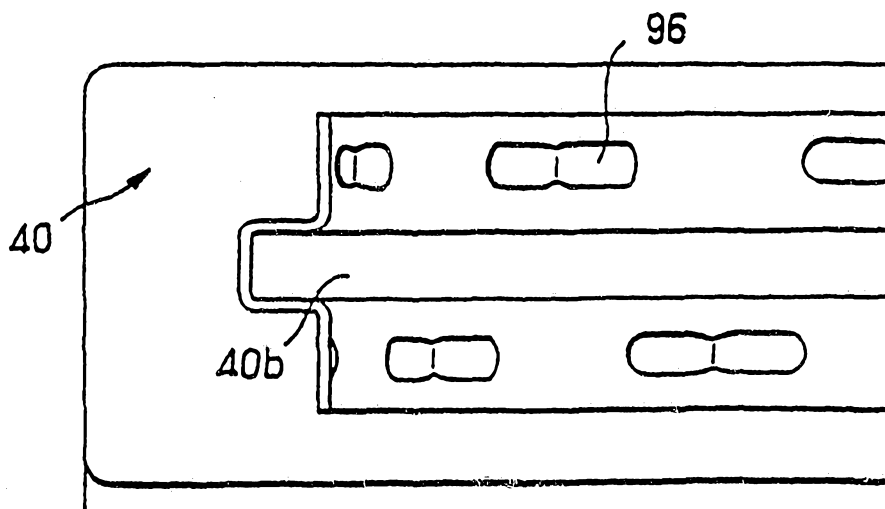


FIG. 5

REPLACEMENT SHEET

FIG. 6

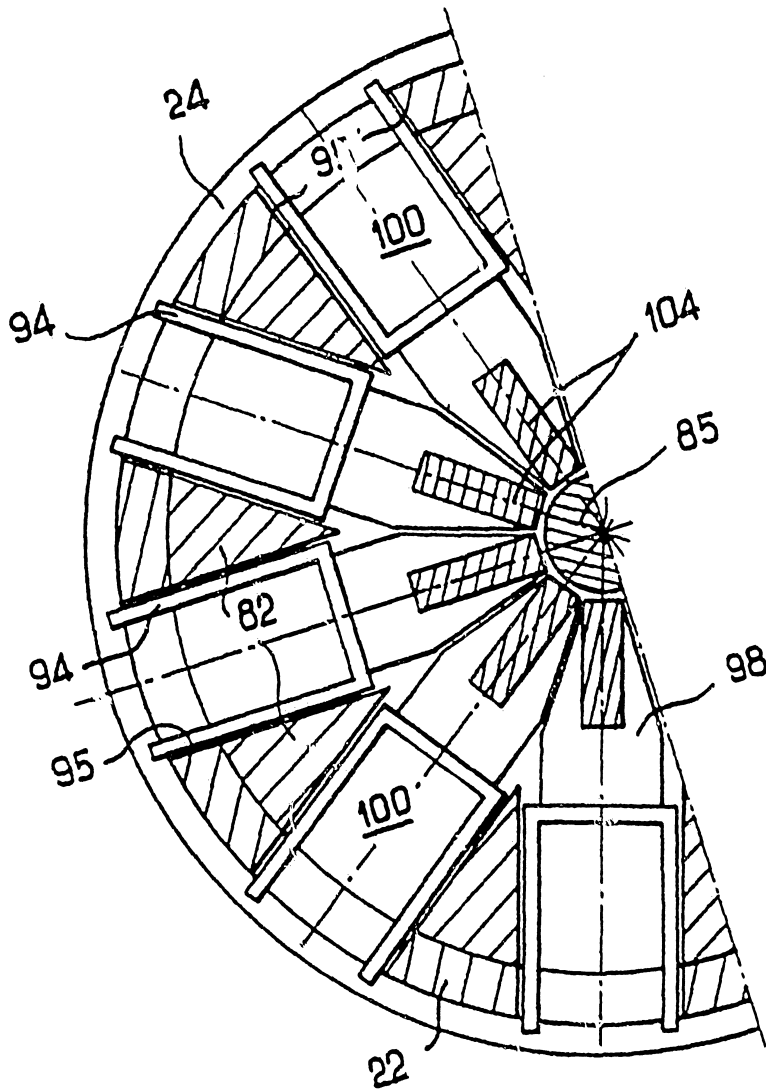
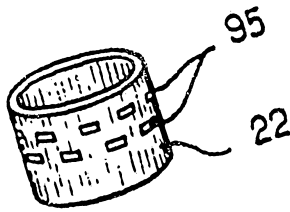


FIG. 7

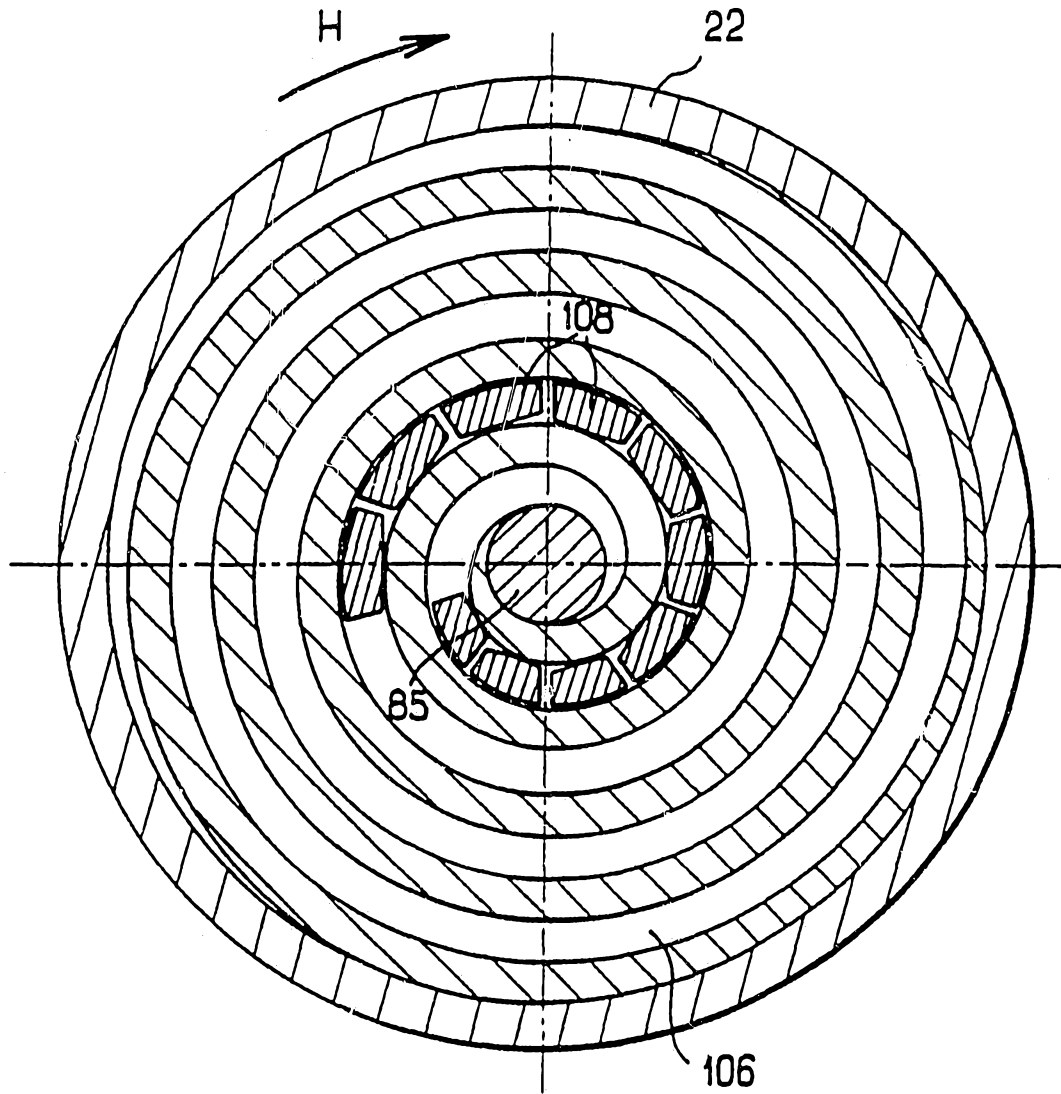


FIG. 8

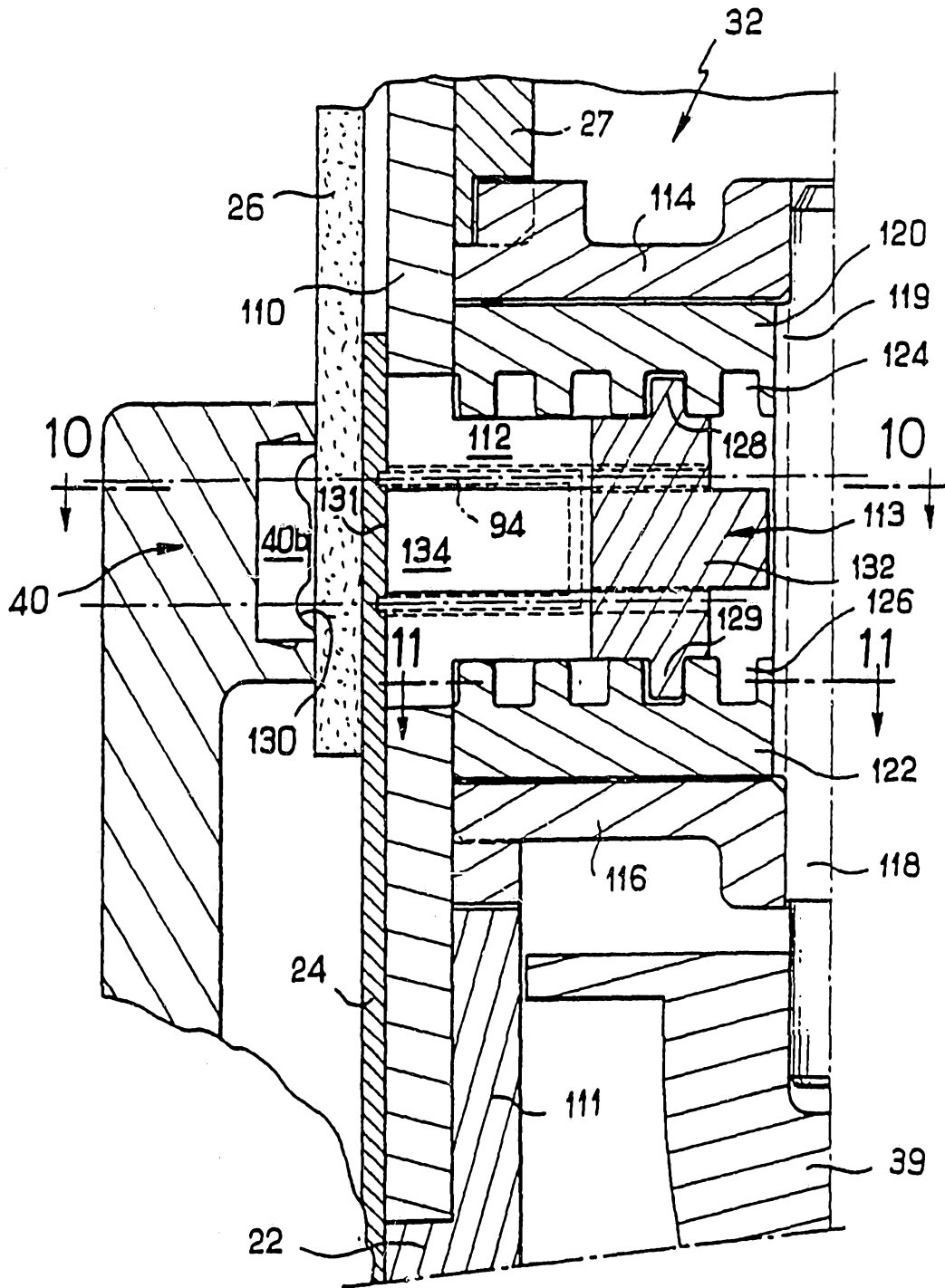


FIG. 9

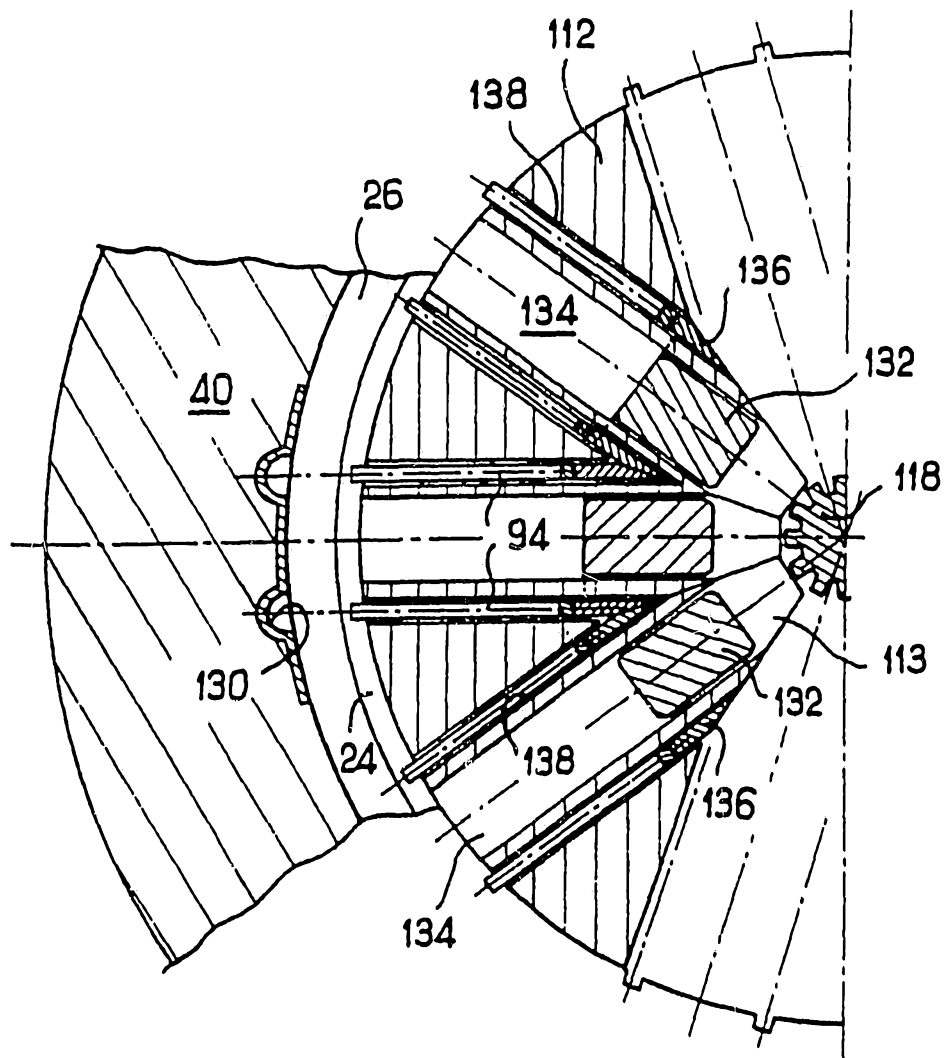


FIG.10

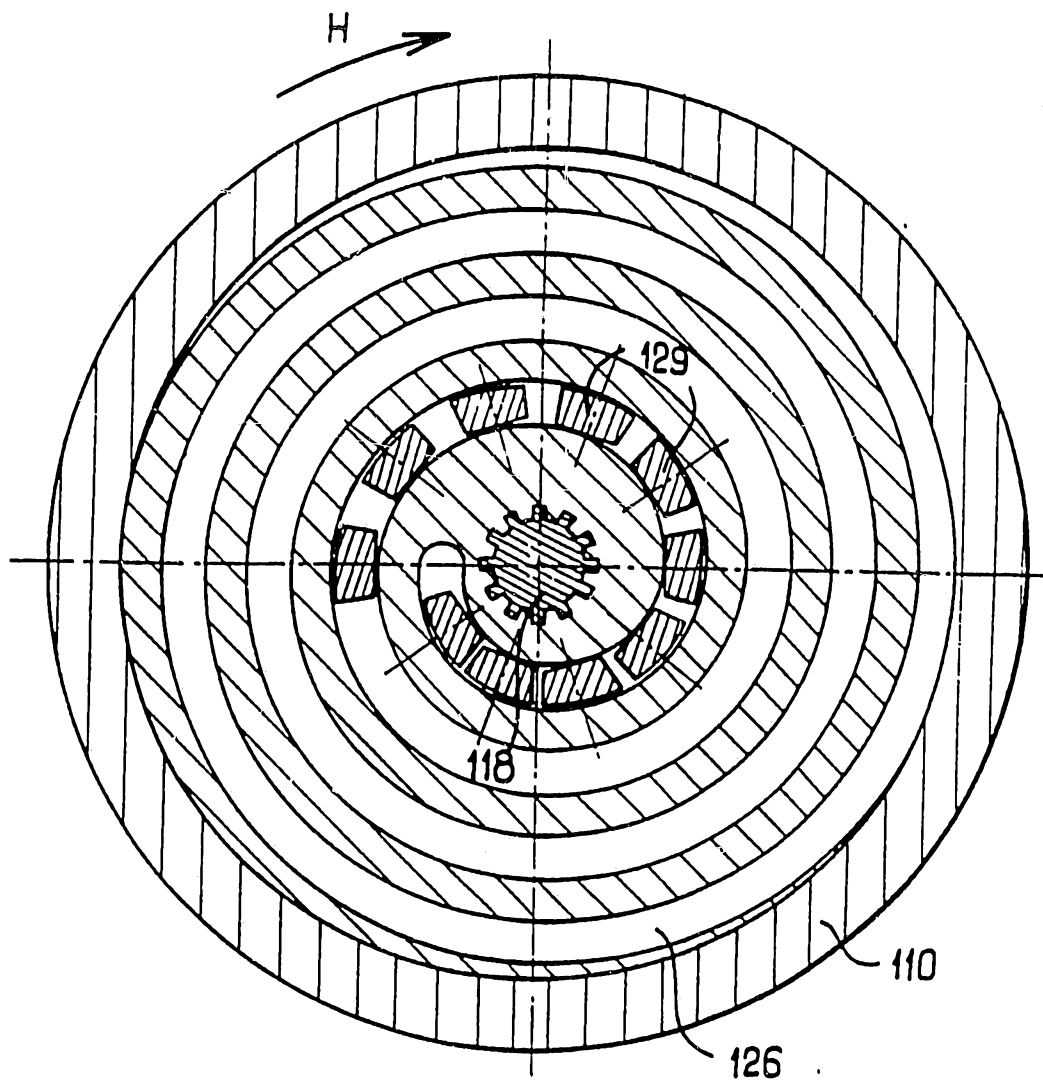


FIG. 11

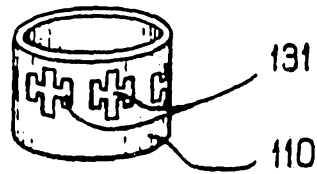


FIG. 12

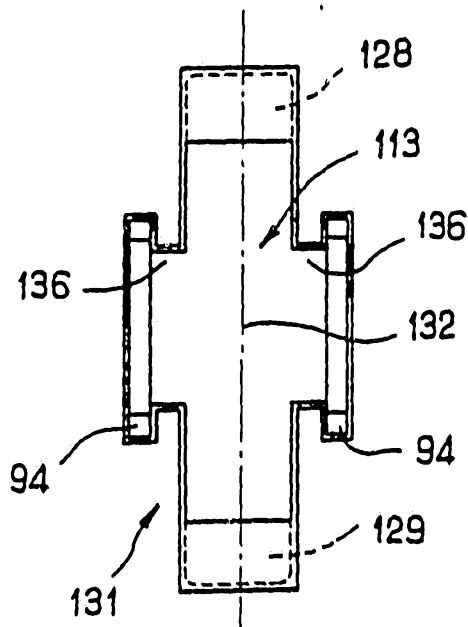
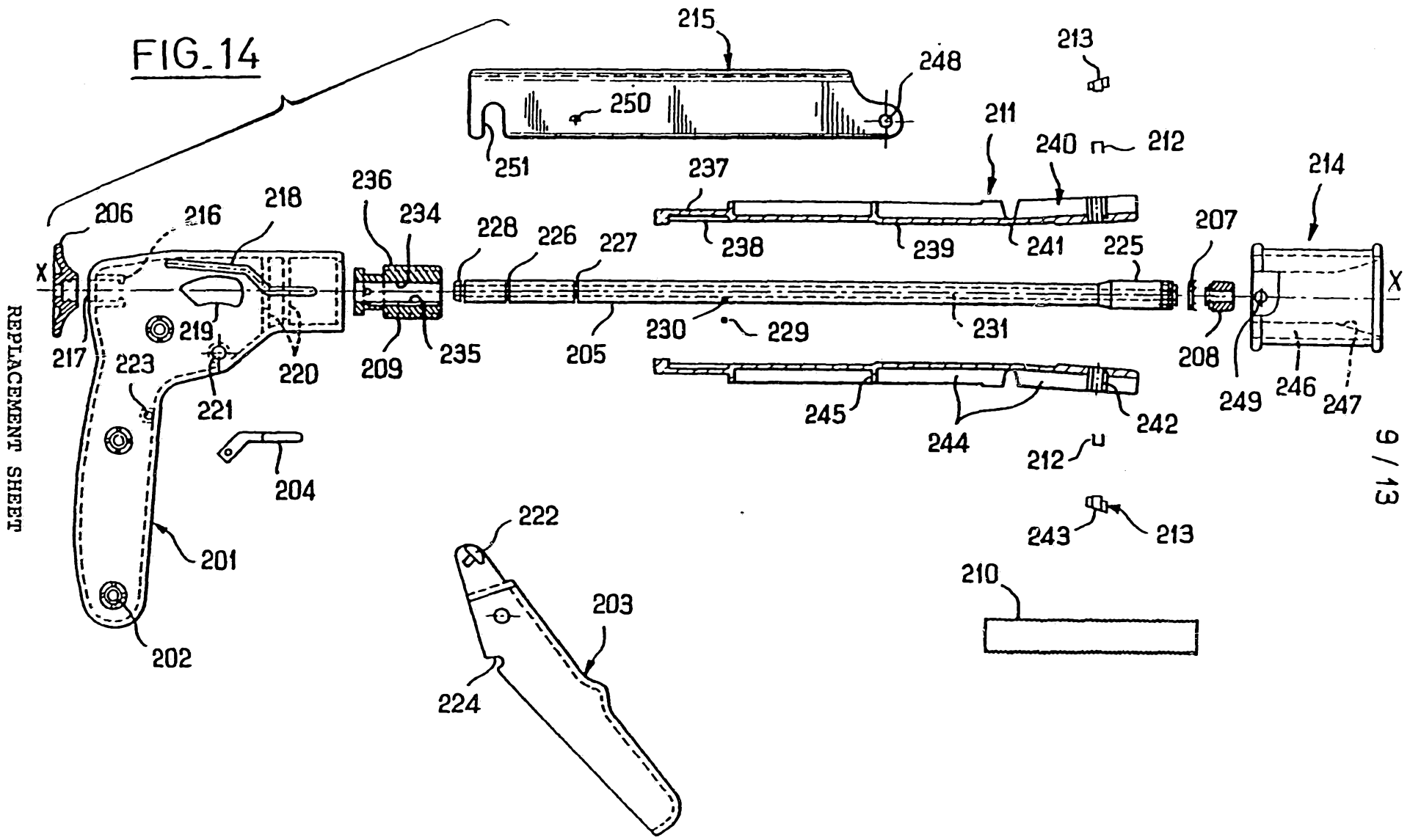


FIG. 13



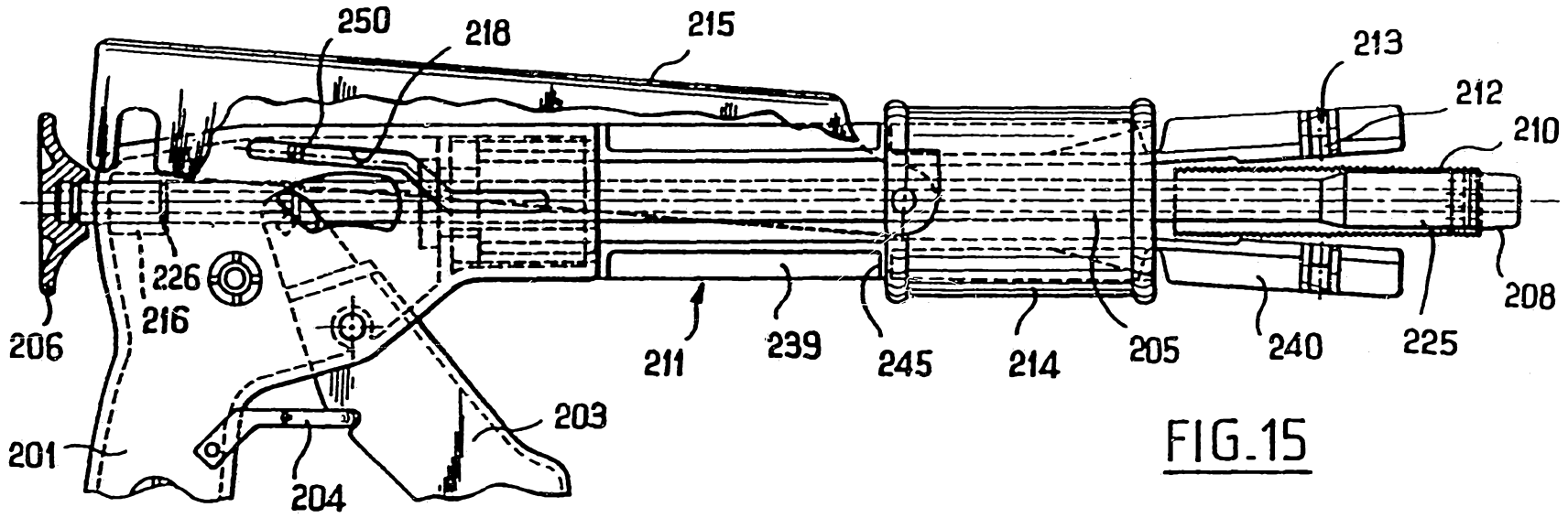


FIG. 15

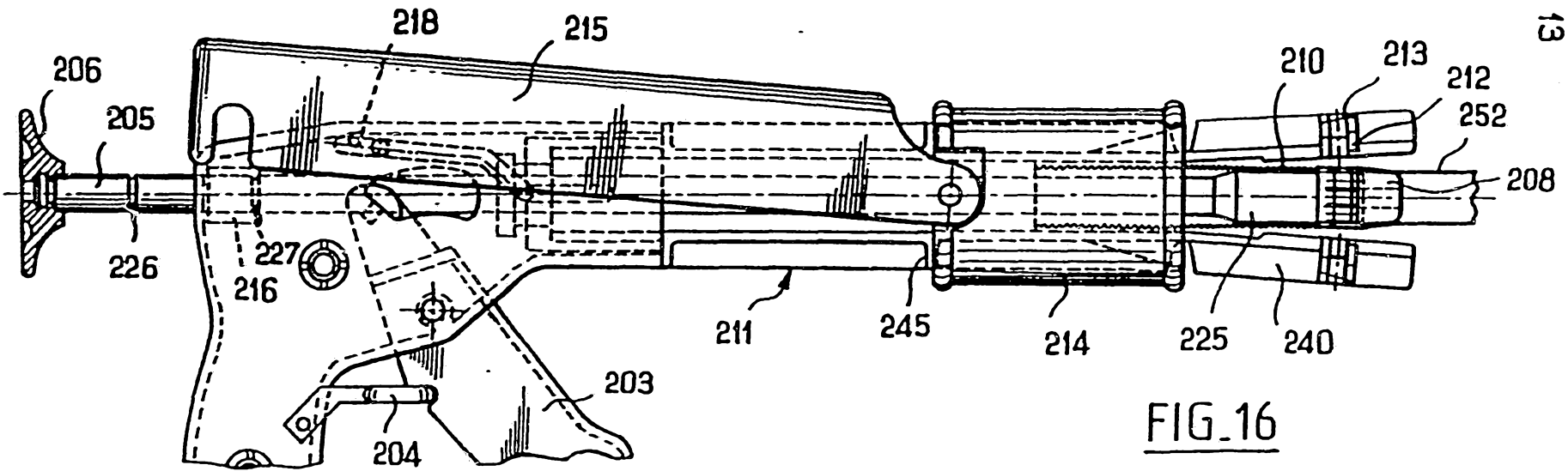


FIG. 16

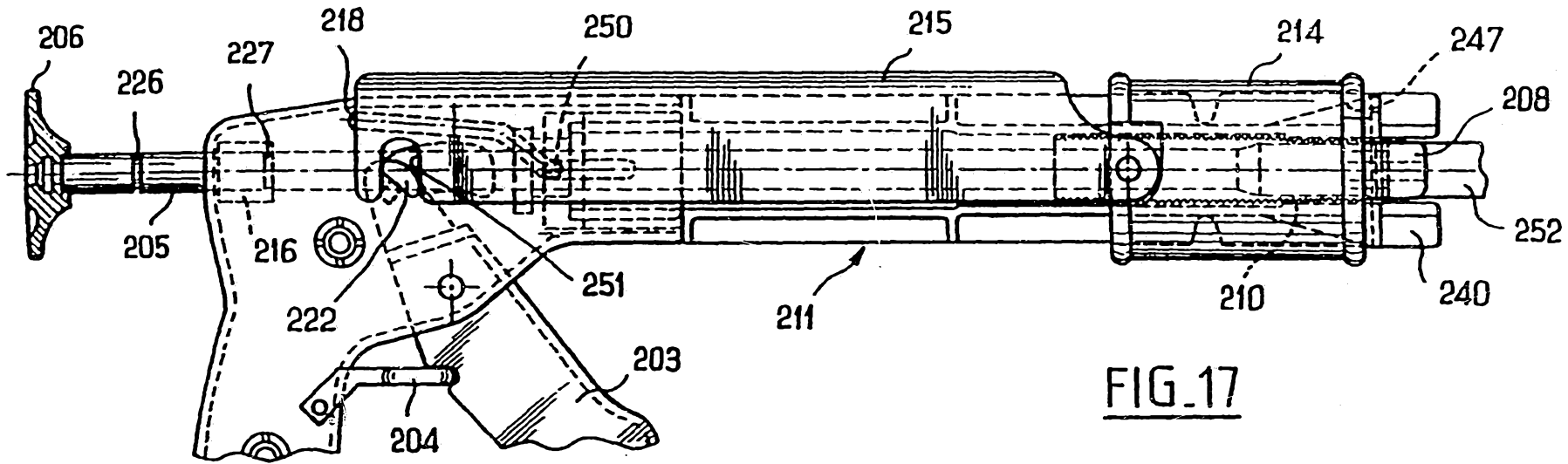


FIG. 17

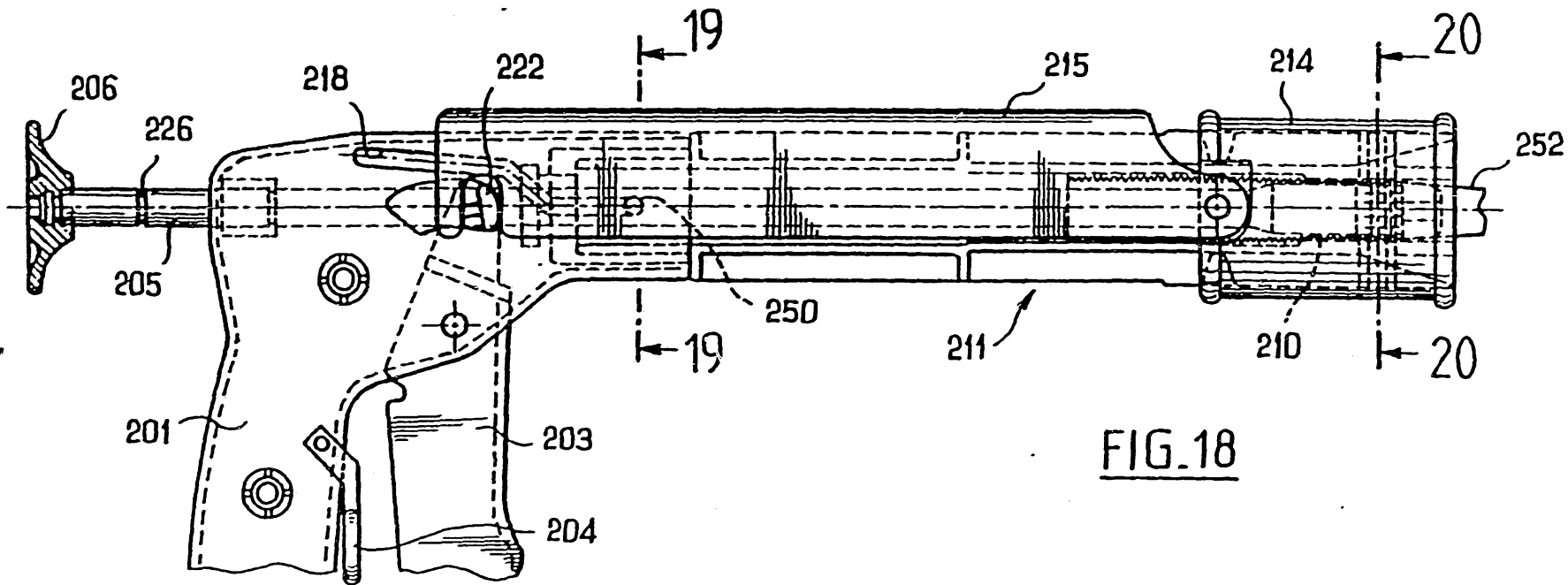


FIG. 18

REPLACEMENT SHEET

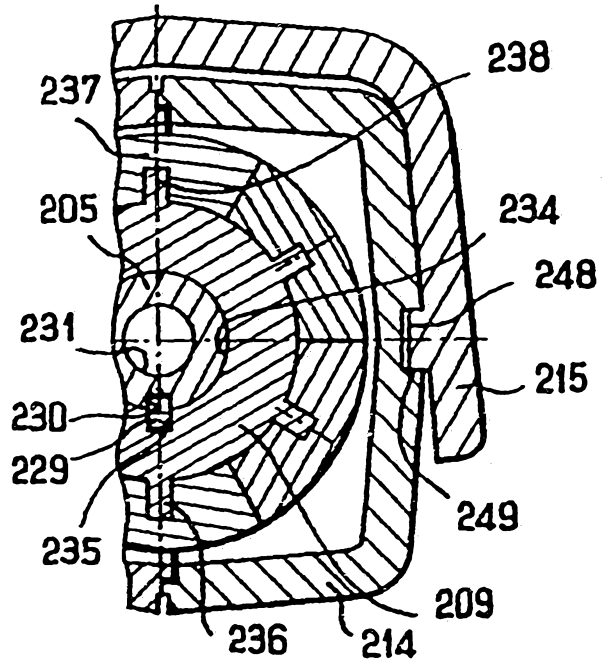


FIG. 19

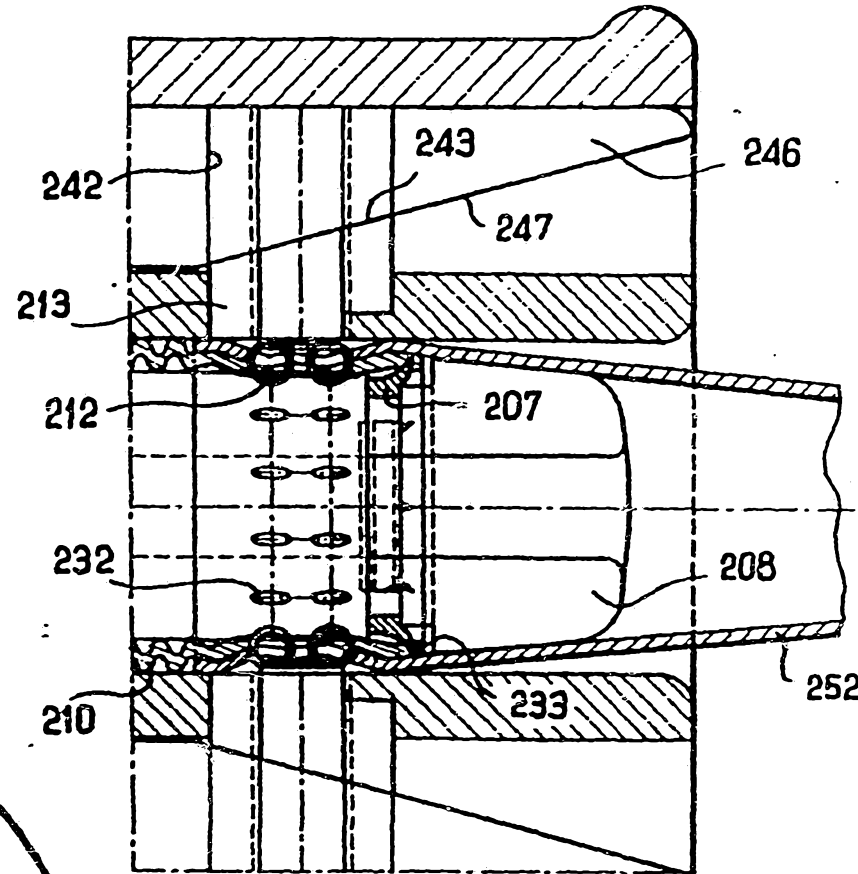


FIG. 21

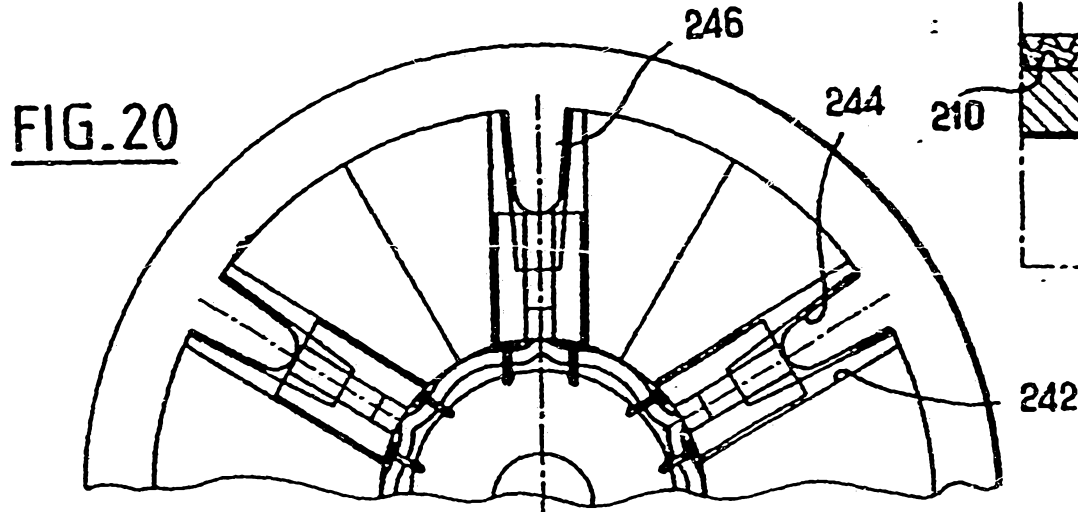


FIG. 20

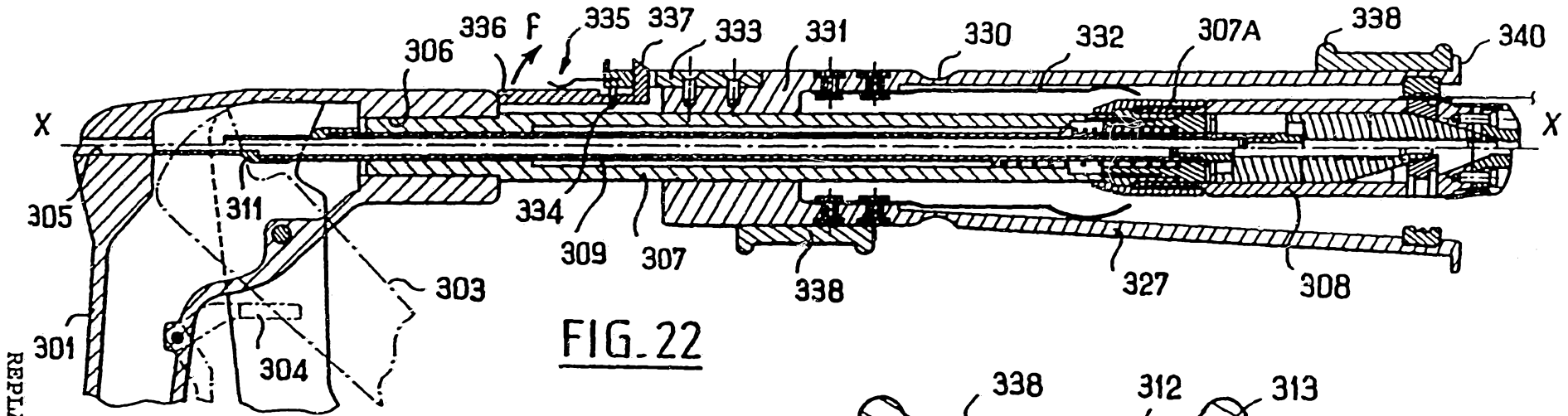


FIG. 22

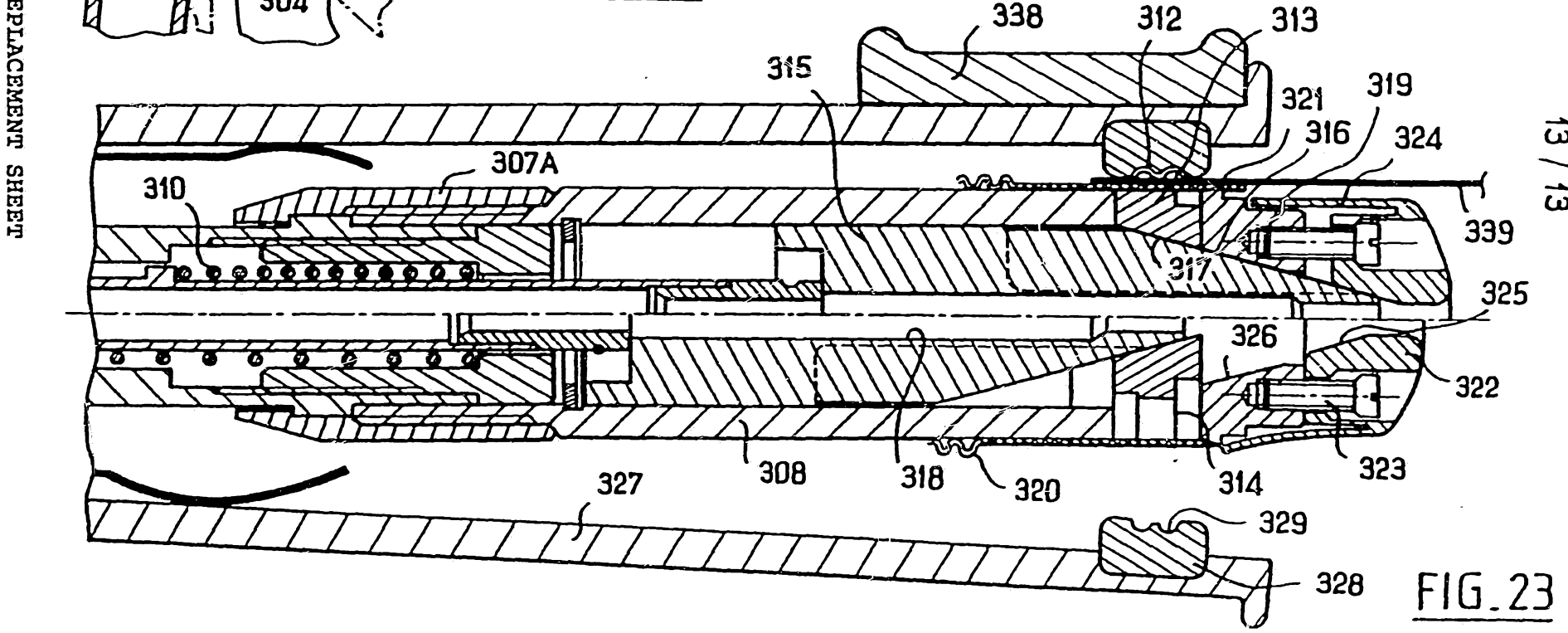


FIG. 23

REPLACEMENT SHEET

**INTERNATIONAL SEARCH REPORT**

PCT/FR 92/00287

International Application No

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>7</sup>				
According to International Patent Classification (IPC) or to both National Classification and IPC				
CIB 5 A61B17/115				
<b>II. FIELDS SEARCHED</b>				
Minimum Documentation Searched <sup>8</sup>				
Classification System	Classification Symbols			
CIB 5	A61B			
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>9</sup>				
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>10</sup>				
Category <sup>*</sup>	Citation of Document, with indication, where appropriate, <sup>11</sup> of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>14</sup>		
A	GB,A,2 038 226 (TAKASAGO) 23 July 1980 cited in the application see the entire document ---	1		
A	FR,A,2 171 477 (RASKULOV) 21 September 1973 cited in the application see page 8, line 21 - page 9, line 30; figure 4 ---	1		
A	US,A,4 872 874 (TAHERI) 10 October 1989 see abstract; figures 8-12 ---	1		
A	US,A,3 519 187 (KAPITANOV) 7 July 1970 ---	-		
A	US,A,4 304 236 (CONTA) 8 December 1981 ---	-		
<table style="width:100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <sup>*</sup> Special categories of cited documents: II                      "A" document defining the general state of the art which is not considered to be of particular relevance                      "E" earlier document but published on or after the International filing date                      "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)                      "O" document referring to an oral disclosure, use, exhibition or other means                      "P" document published prior to the international filing date but later than the priority date claimed                 </td> <td style="width: 50%; vertical-align: top;">                     "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention                      "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step                      "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.                      "Δ" document member of the same patent family                 </td> </tr> </table>			<sup>*</sup> Special categories of cited documents: II "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the International filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "Δ" document member of the same patent family
<sup>*</sup> Special categories of cited documents: II "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the International filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "Δ" document member of the same patent family			
<b>IV. CERTIFICATION</b>				
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report			
29 JUNE 1992	17.07.92			
International Searching Authority	Signature of Authorized Officer			
EUROPEAN PATENT OFFICE	J. STEENBAKKER (signature)			

ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO. FR 9200287  
SA 58805

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on the International Patent Application. The European Patent Office is in no way liable for those particulars which are merely given for the purpose of information. 29/06/92

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FR-A-2171477	21-09-73	None	
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