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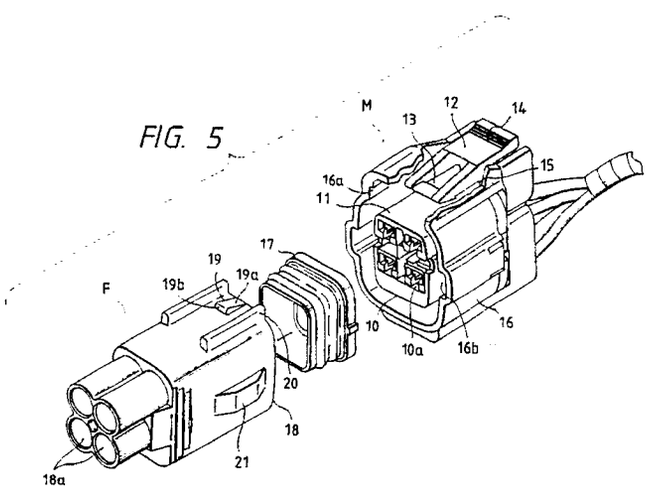
(54) Locking device for connectors.

(57) A locking device for a pair of connectors is disclosed which comprises a first connector having an outer wall provided with a protuberance having a rear engaging surface; a second connector having an outer wall provided with a cantilevered locking arm having a front inner surface engaging with the rear engaging surface of the protuberance; and a backlash preventing face for preventing any backlash from generating between the first and second components in engagement. The backlash preventing face is provided on the rear engaging surface and at least partially conforms with a rotational locus formed by the front inner surface of the locking arm when the locking arm pivotally moves.

FIG. 5



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LOCKING DEVICE FOR CONNECTORS

BACKGROUND OF THE INVENTION

The present invention relates to a locking apparatus for connectors that are used for connecting a wire harness and the like.

A locking means as shown in Fig. 1 has been proposed in Japanese Patent Application Laid-open No. 53-49695.

M and F stand for a male connector and a female connector, respectively. A cantilevered locking arm 3 having a locking hole 4 thereon is formed between two slits 2, 2 on a cylindrical outer surface 1 of the connector F. On the other hand, an engaging protuberance 6 is provided on an outer surface 5 of the connector M. A stop 7 is used for protecting the locking arm 3.

When both connectors M and F are being fitted or connected together, the leading edge of the locking arm 3 comes in contact with a slant surface 6a at the front part of the protuberance 6, as shown in Fig. 2A. As the arm 3 moves forward, it bends increasingly upward about its fulcrum 3a (Fig. 1). Then, when the locking hole 4 advances past the apex 6b of the protuberance 6, the locking arm 3 is resiliently restored to its natural or unbent state, as shown in Fig. 5B and the inner surface 4a at the front portion of the hole 4 is positioned, facing a rear surface 6c of the protuberance 6. In this state, the two connectors M and F become locked.

The letter P indicates the locus described by the inner surface 4a at the leading portion of the hole 4 as the locking arm 3 rotated about the fulcrum 3a and is resiliently restored to its initial state.

Fig. 3 is a graph showing the relationship between the locking load and the fitting depth (stokes) when the locking arm 3 is locked at the pretuberance 6. The locking load f increases with stroke 1 being increased, and reaches a maximum level at a point ℓ_1 where the hole 4 rides over the apex 6b of the protuberance 6, after which it decreases sharply and reaches zero. Because of inertia arising from their locked state, both connectors F and M stop when the stroke reaches a value ℓ_2.

In the locking apparatus according to the prior art, the inner surface 4a and the vertical rear surface 6c of the protuberance 6 come to face each other with the resilient restoration of the locking arm 3 as the hole 4 rides over the apex 6b of the protuberance 6. In this state the connectors are locked, but the existence of a flexion space or undesired idle overstroke for the hole 4 of the arm 3 as indicated by the locus P inevitably arises. In other words, this gives rise to an interval or a backlash X ($= \ell_2 - \ell_1$) between the inner surface 4a and the rear surface 6c.

Therefore, in the prior art, even if the two connectors F and M are connected together, the interval of X space remains. The connectors F and M are shifted due to vibration of the vehicle and the like, which in turn brings about the generation of undesired noise. In the case of connectors used as terminals, such movement causes wear of the connectors and impairs its conductive capabilities.

To effect a smooth locking of the locking arm 3 with the protuberance 6, and to prevent the two connectors F and M from being insufficiently locked, the apex of the protuberance 6 is rounded as indicated by R in Fig. 4. Nevertheless, an interval X′ still remains as before, which could not solve the problem of backlash.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to eliminate the occurrence of backlash between the pair of connectors, due to the existence of an interval between the locking arm and the engaging protuberance, and to provide a locking device for connectors whose conductive capability is not impaired when used as terminals.

In order to achieve this and other objects, there is provided a locking device for a pair of components, comprising:

a first component having an outer wall provided with a protuberance having a rear engaging surface;

a second component having an outer wall provided with a cantilevered locking arm having a front inner surface engaging with said rear engaging surface of said protuberance; and

a backlash preventing means for preventing any backlash from generating between said first and second components in engagement, said backlash preventing means being provided on said rear engaging surface and including a substantially arcuate face which at least partially conforms with a rotational locus formed by said front inner surface of said locking arm when said locking arm pivotally moves.

According to the present invention, the locking arm and the engaging protuberance may lock together so that the inner surface of the locking hole (or depression) is always in contact with or in close proximity to the arcuate surface of the anti-backlash section. As a result, the occurrence of backlash between the pair of components during lock is

prevented, and the generation of unwanted noise, wear of the terminals, and the impairment of the conductive capabilities caused by the movement of the connectors can be eliminated.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view of male and female connectors according to a prior art;

Figs. 2A and 2B are partially enlarged cross-sectional views showing a locking operation between a locking arm and an engaging protuberance in the connectors shown in Fig. 1;

Fig. 3 is a graph showing a relationship between a fitting stroke and a locking load in the connectors shown in Fig. 1;

Fig. 4 is a partially enlarged cross-sectional view showing a locking operation between a locking arm and an engaging protuberance according to the prior art;

Fig. 5 is an exploded perspective view of female and male connectors according to an embodiment of the invention;

Fig. 6 is a partially enlarged cross-sectional view showing the locked state of a locking arm and an engaging protuberance in the connectors shown in Fig. 1;

Figs. 7A to 7C are cross-sectional views showing the pertinent parts of respective variations of the anti-backlash section of the engaging protuberance;

Fig. 8 is a partially perspective view showing a cover and box structure with a locking device according to the invention; and

Fig. 9 is a partially enlarged sectional view showing an example of a locking device according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will now be described with reference to Figs. 5 to 7.

Fig. 5 shows a male connector M and a female connector F. A locking arm 12 is provided on the outer wall 11 of a main body 10 of the male connector M. The locking arm 12 has a locking hole 13 at its front end portion, and an operating knob 14 at is rear end portion. Both intermediate legs of the iocking arm 12 are connected to the outer wall 11 through a base 15. The locking arm 12 is resiliently rotatable upward or downward about the base 15 which serves as a fulcrum.

The female connector F has a hood 18 for receiving the main 5 body 10 of the male connector M. An engaging protuberance 19 protrudes from the outer wall of the hood 18.

As shown on an enlarged scale in Fig. 6, the front porion of the engaging protuberance 19 has a gentle slant surface 19a, and an anti-backlash section 19b is integrally formed on its rear surface. This anti-backlash section 19b is shaped to have an arcuate surface Q' that corresponds to the locus Q formed by the inner surface 13a at the front part of the locking hole 13 when the locking arm 12 is rotated and displaced in vertical direction about the base 15.

The male connector M and female connector F are further made to be waterproof. The front half portion of the locking arm 12 and the main body 10 are encased together in a waterproof hood 16 which also serves as a receptacle for the hood 18. A guide wall 16a and a guide groove 16b are formed on the waterproof hood 16 so as to mate with flanges 20 and 21 to prevent a reverse connector engagement, respectively. The connectors F and M are connected together through a gasket 17.

A terminal chamber 10a of the male connector M and a terminal chamber 18a of the female connector F house the female terminal and male terminal, respectively. Each of the terminals is connected to a wire W, which is not shown in the illustration.

The connection between the male connector M and female connector F is effected in the same manner as shown in Fig. 2A. As the front end portion of the locking arm 12 gradually moves along the slant surface 19a on the front part of the engaging protuberance 19, the arm 12 is bent upward, while rotating about the base 15.

Then, as soon as the surface 13a of the locking hole 13 ride over the apex 19c of the engaging protuberance 19, the looking arm 12 undergoes elastic restoration and snaps downward. This condition is shown in Fig. 6. The surface 13a comes into contact with the base $Q_{O'}$ of the arcuate surface O' of the anti-backlash section 19B, and the connectors F and M become locked.

Since the base $Q_{O'}$ of the arcuate surface Q' is identified with the locus Q, there is no existence of an interval between the locking hole 13 and the engaging protuberance 19, as shown. Therefore, any backlash between the connectors F and M does not occur. Also, a line tangent to the base $Q_{O'}$ is perpendicular to the outer wall 11 and parallel to the inner surface 13a. As a result, the connectors F and M do not get unlocked even if a force that tends to draw the connectors apart is applied thereto. The connectors become unlocked only when the knob 14 of the arm 12 is pressed downward.

Figs. 7A to 7C show respective variations of the anti-backlash section 19b of the engaging pro-

tuberance 19. Fig. 7A shows an anti-backlash section 19b formed with a notch 19d on the lower half portion of the anti-backlash section, while Fig. 7B shows the same anti-backlash section 19b with a notch 19d, formed on the upper half portion. Fig. 7C shows the anti-backlash section 19b provided at a position a little distance away from the rear surface of the engaging protuberance 19. In any of the examples, as long as the arcuate surface Q′ of the anti-backlash section 19b is formed to match the aforementioned locus Q, the same locking effect exhibited by the example shown in Fig. 2 is realized.

As described above, in the present invention, the interval between the lccking hole or depression of the locking arm and the engaging protuberance is eliminated. Consequently, the problem of backlash when connecting and locking the pair of connectors is solved. In turn, the problems of wear of the terminals, impairment of the conductive capability, and generation of unwanted noise are also solved. Further, in waterproof connectors wherein a waterproofing gasket is placed between the pair of connectors, the impairment of the water-resistant property due to vibration can also be prevented.

Although the invention has been described in the case of connecting two connectors, it is apparent that the invention is not limited thereto or thereby. More specifically, as shown in Fig. 8, the similar locking device as described in conjunction with Figs. 5 to 7B may be applied to a box 31 with cover 30. The locking device similarly includes a locking arm 12′ having a locking hole 13′ and an associated protuberance 19′ to be engaged with the locking hole 13′.

Also, in the foregoing embodiments, the engaging curved surface of the protuberance 13 is arcuate. It is however apparent that a substantially arcuate surface may be used. Fig. 9 shows this example in which a locking arm 12″ has an engaging surface 13a′ may be engaged at point Q″ with the protuberance 13″. As shown in Fig. 9, the engaging surface Q″ of the protuberance is not exactly arcuate but substantially arcuate.

Claims

1. A locking device for a pair of components, comprising:
a first component having an outer wall provided with a protuberance having an engaging surface;
a second component having an outer wall provided with a cantilevered locking arm having an inner surface engaging with said rear engaging surface of said protuberance; and
a backlash preventing means for preventing any backlash from generating between said first and second components in engagement, said backlash preventing means being provided on said rear engaging surface and including a substantially arcuate face which at least partially conforms with a rotational locus formed by said front inner surface of said locking arm when said locking arm pivotally moves.

2. The device according to claim 1, wherein said locking arm has a through hole in which said front inner surface is formed.

3. The device according to claim 1, wherein said substantially arcuate face fully conforms with said locus formed by said front inner surface of said locking arm.

4. The device according to claim 1, wherein said substantially arcuate face has a cutaway portion.

FIG. 1

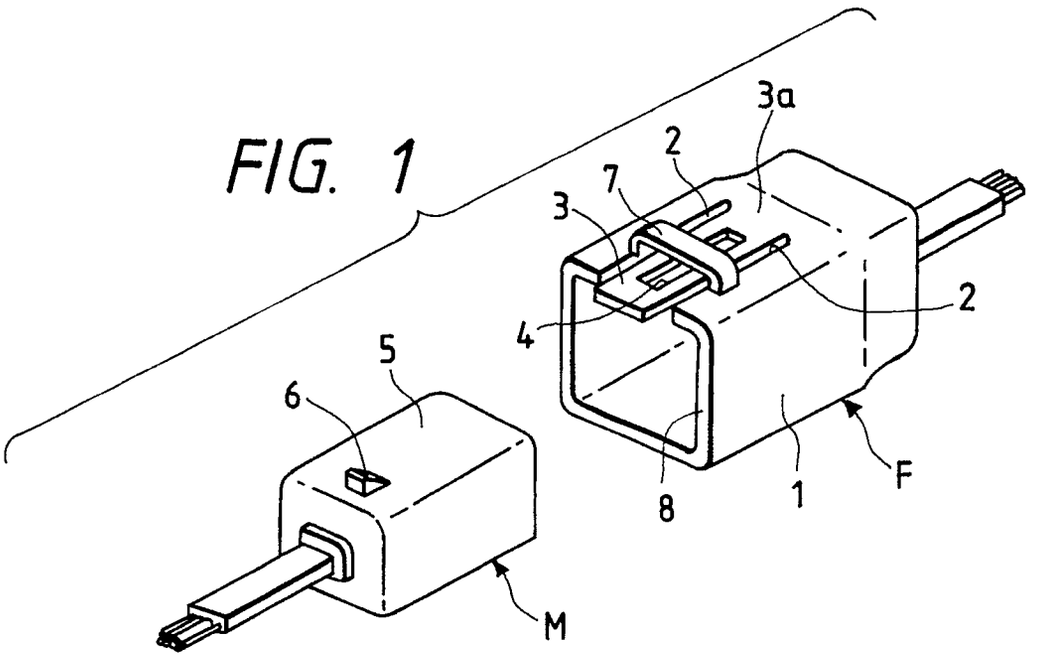


FIG. 2A

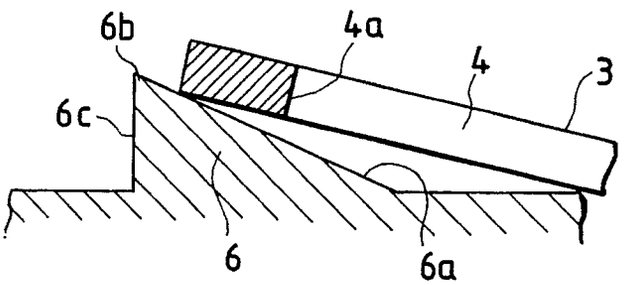


FIG. 2B

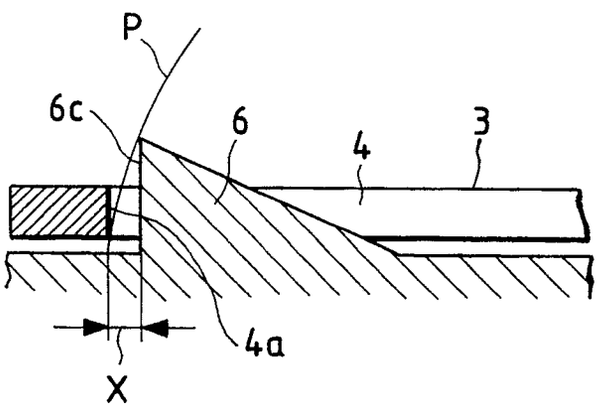


FIG. 3

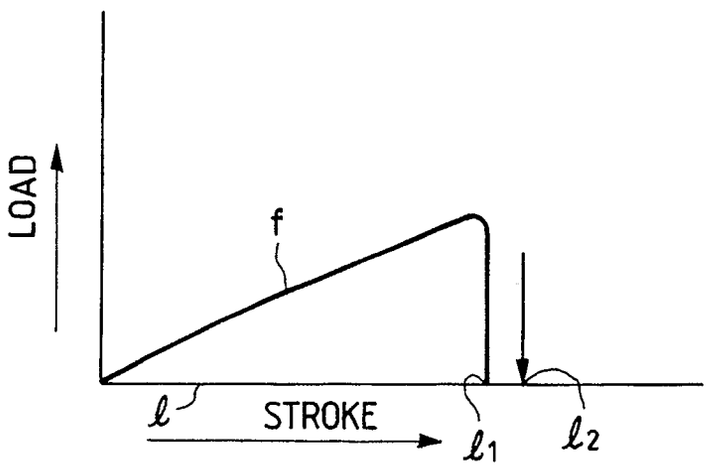
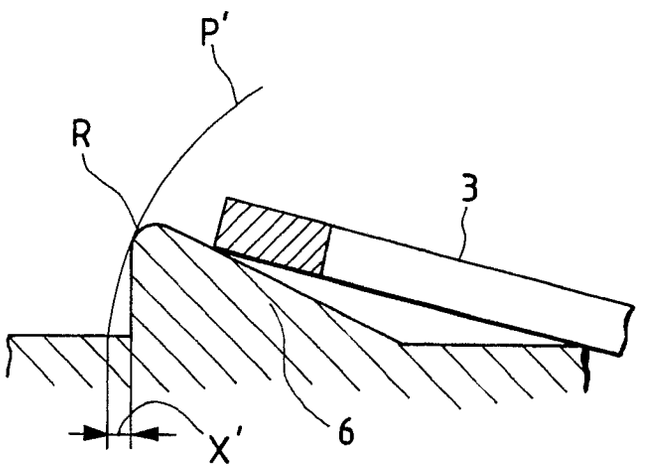


FIG. 4



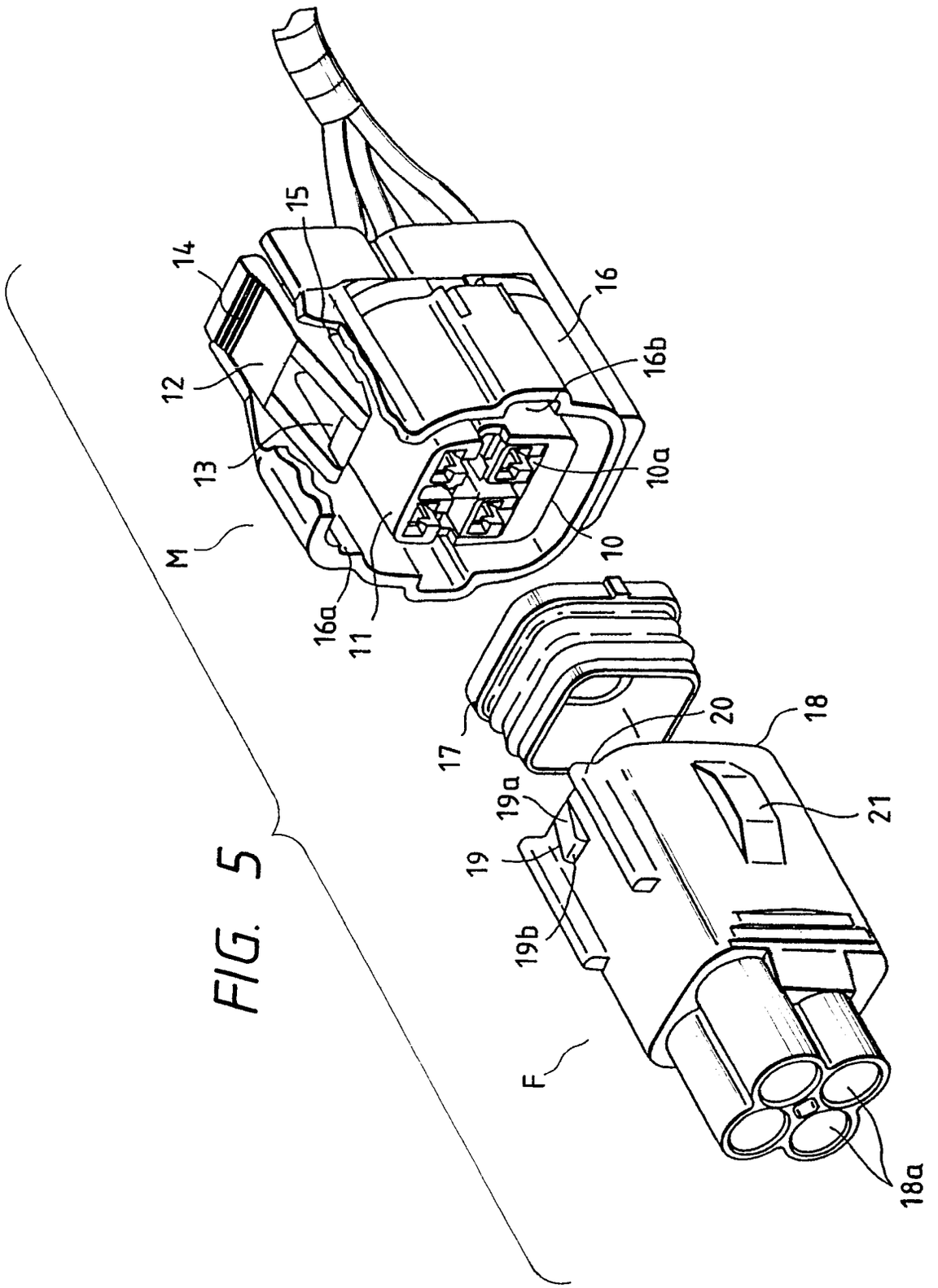


FIG. 5

FIG. 6

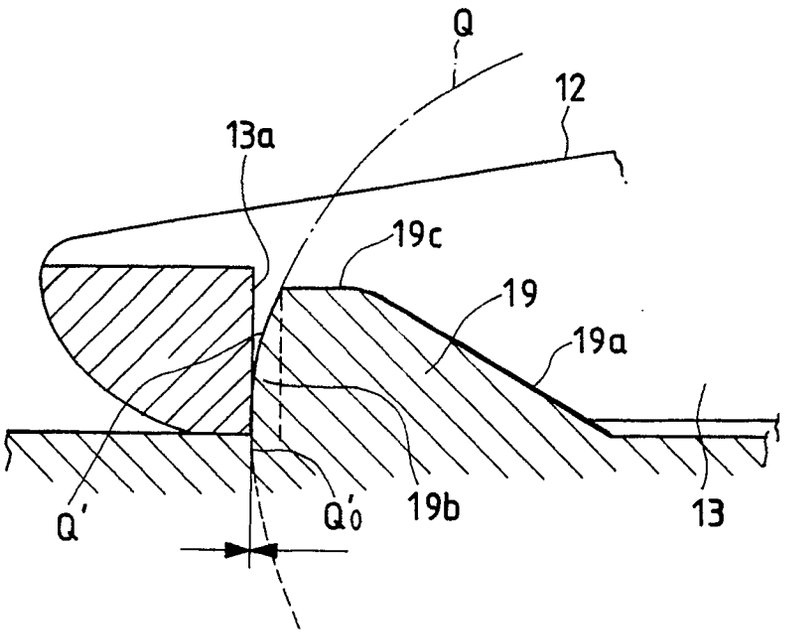


FIG. 7A

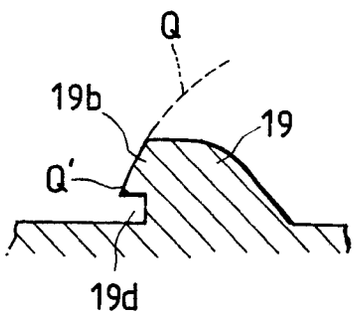


FIG. 7B

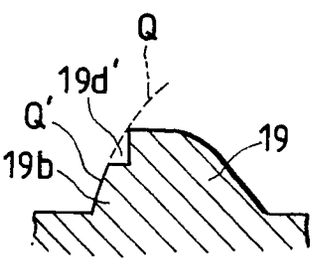


FIG. 7C

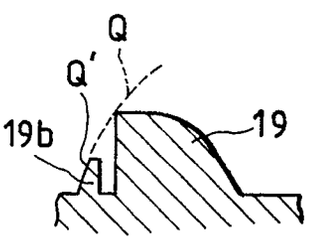


FIG. 8

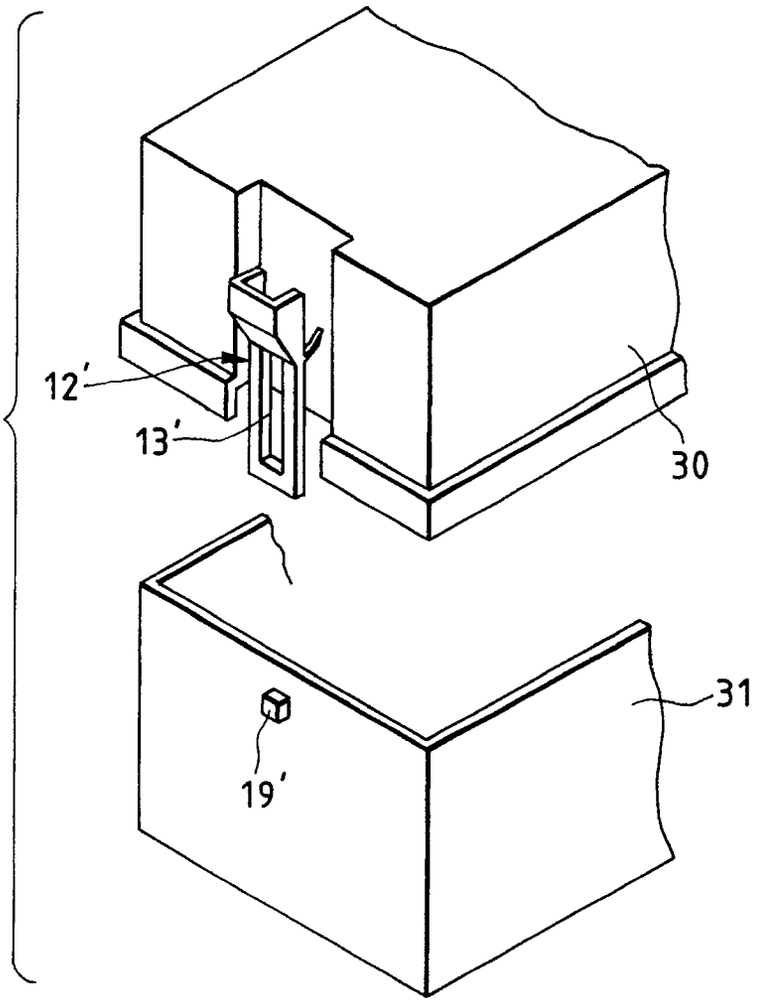
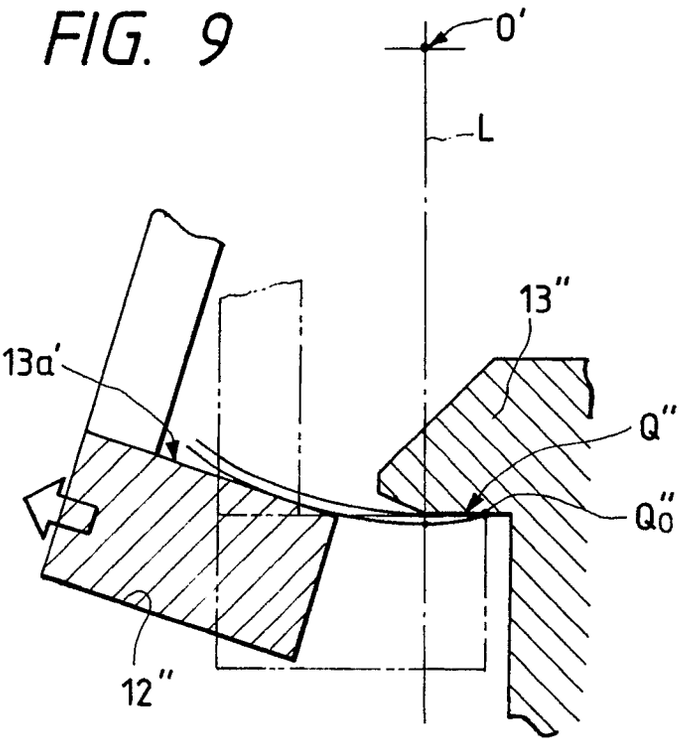


FIG. 9



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 11 8593

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-3 933 406 (CAMERON et al.) * Column 4, lines 44-49,55-61; figure 1 * ---	1,2	H 01 R 13/627
A	EP-A-0 028 120 (FORD MOTOR CO.) * Page 5, lines 31-36; figure 1 * -----	1,4	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 R
F 16 B
E 05 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-11-1990	BOLDER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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