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(12) # EUROPEAN PATENT APPLICATION

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(54) **Apparatus for severing a wellhead.**

(57) Apparatus 1 for severing a wellhead of a sub-sea well system using an explosive charge 2, shown in dashed lines in Figure 1. The apparatus 1 comprises two fuse devices 3 and 4 connected to a casing or housing for the charge 2.

Housing the charge 2 within the casing 5 means that a standard weight of explosive can be used for different thicknesses of wellhead to be severed, which providing a minimum thickness of explosive to detonate at a maximum explosive effect.

The fuse devices 3 and 4 are each made of fibreglass and are secured one at each end to a respective ring 6 of the casing 5 using suitable securing means such as bolts through aligned holes 7.

Each fuse device 3 is a hollow fibreglass shell containing an explosive fuse and a generally conical fibreglass former or insert 8 which acts as a plane wave former 8 pointing away from the charge in the assembled apparatus 1.

The fuse devices 3 and 4 also contain a packing of a foam plastic material or a cementitious material, e.g. cement.

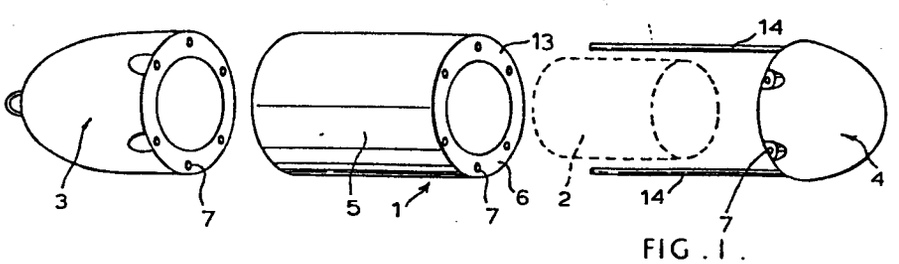

FIG. 1.

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APPARATUS FOR SEVERING A WELLHEAD

The invention relates to apparatus for severing a wellhead, or other parts of a well system such as a multi-string casing, by means of an explosive charge.

In the oil industry it is known to remove wellheads once a well is found to be dry or depleted of recoverable oil or gas reserves. The well is plugged, cemented and all structures above ten feet (3.05 M) beneath the mudline removed, as required by law. Conventional practice is either to mechanically cut the casings or lower an explosive charge.

Mechanical cutting is a timely and hence costly procedure. Explosive cutting charges currently are large, inefficient and unreliable resulting in a reluctance to use them.

It is accordingly an object of the present invention to provide apparatus that will reliably cut the casing, causing less peripheral damage to the casing, using smaller quantities of explosives, and reduce the problems of secondary blast effects, such as through water shock, damaging vessels in close vicinity to the charge.

According to the invention there is provided apparatus for severing a well system at for example a wellhead, comprising a casing having an inner and an outer sleeve and an explosive charge within the inner sleeve.

There may be a brittle medium in the space between the sleeves.

The brittle medium may comprise a plastic foam material.

The brittle medium may alternatively comprise concrete.

The respective sleeves may comprise concentric right cylinders whereby to provide an annular space therebetween.

The apparatus may comprise two fuse devices situated one at each end of the casing.

The apparatus may comprise means for detonating the charge substantially simultaneously at each end.

The means for providing substantial simultaneous detonation may comprise an explosive fuse in one fuse device and an explosive fuse running from the one fuse device to the other fuse device, both fuses being substantially of the same length.

The one fuse device may have guide means extending therefrom through the space between the sleeves to the other fuse device, the guide means receiving and guiding the explosive fuse between the fuse devices.

The guide means may comprise two substantially rigid tubes which extend from the one fuse device through the space between the sleeves to the other fuse device.

The other fuse device may have sockets for receiving the ends of the tubes.

Each fuse device may comprise a plane wave former.

Each fuse device may comprise a body having an inner and an outer shell, the space between the shells containing a brittle medium.

The brittle medium may comprise a foam plastics material or a cementitious material e.g. cement.

The inner sleeve of the casing and the inner shell of the or each fuse device may be substantially of the same diameter, and the outer sleeve of the casing and the outer shall of the or each fuse device may be substantially of the same diameter.

A fuse detonating cord may be connected to a central point at one

end of the explosive charge and to a central point at the opposite end of the charge.

The detonating cord may comprise four lengths running to two junction boxes at the base of the charge, a length of fuse detonating cord running from one fuse box to one end of the charge and from the other fuse box to the other end of the charge, the two lengths being substantially equal.

The four lengths may be substantially 90° apart.

Apparatus for severing a system, for example at a wellhead, is hereinafter described, by way of example, with reference to the accompanying drawings.

Figure 1 is an exploded perspective view of apparatus according to the invention;

Figures 2A-C show respective side elevational (partly in longitudinal section) top plan and bottom views of a top (in use) fuse device;

Figures 3 and A show respective side elevational (partly in longitudinal section) and bottom plan views of a bottom (in use) fuse device;

Figures 4 and 4A show similar views to Figures 3 and 3A, of a charge casing; and

Figures 5 and 5A show respective side elevational (partly in longitudinal section) and top plan views of an insert in each fuse device.

Referring to the drawings, there is shown apparatus 1 for severing a wellhead of a sub-sea well system using an explosive charge 2, shown in dashed lines in Figure 1. The apparatus 1 comprises two fuse devices 3 and 4 connected to a casing or housing 5 for the

charge 2.

Housing the charge 2 within the casing 5 means that a standard weight of explosive can be used for different thicknesses of wellhead to be severed, while providing a minimum thickness of explosive to detonate at a maximum explosive effect. This is in contrast to the prior art, where the explosive is wrapped round a central core. In that arrangement, twice as much explosive must be used for cutting a 40 cm diameter wellhead as a 20 cm one. Thus the present invention provides for a standarized charge.

The fuse devices 3 and 4 are each made of fibreglass and are secured one at each end to a respective ring 6 of the casing 5 using suitable securing means such as bolts through aligned holes 7.

Each fuse device 3 is a hollow fibreglass shell containing an explosive fuse and a generally conical fibreglass former or insert 8 which acts as a plane wave former 8, pointing away from the charge and having an apex 9, in the assembled apparatus 1, and the respective fuse devices 3 are supported on respective rings 10 of the casing 5.

The fuse devices 3 and 4 also contain a packing of a foam plastic material or a cementitious material, e.g. cement.

The casing 5 comprises two steel sleeves 11 and 12 which in the embodiment shown are coaxial, the charge being in the inner sleeve 11. The outer sleeve 12 is of a diameter to pass down the inner diameter of the well casing. The space 13 between the sleeves 11 and 12 is annular and contains a plastic foam filling, and there is means in the form of two tubes or columns 14 extending from the furse device 4 to the fuse device 3 for detonating the charge substantially simultaneously.

The foam filling in each case is one which has good shock transmitting properties, is brittle, and dense so as little energy

as possible is absorbed on detonation.

The upper (in use) fuse device 3 contains a coiled explosive fuse terminating at the charge 2. An explosive fuse of the same length as the coiled fuse extends along each column 14 in the space 13 to the bottom (in use) fuse device 4 where it contacts the charge 2, at a position opposite the point of contact of the other fuse.

In use, both explosive fuses are detonated simultaneously, and they explode at the same rate as they are the same length, so that they both detonate the charge 2 at opposite ends at the same time, or substantially so. The charge 2 is thus detonated at both ends and the inserts or plane wave formers 8 ensure that two plane waves pass to the centre of the device, where they coincide to provide an explosive force at right angles to the length of the apparatus 1, which severs the wellhead cleanly.

The actual connection of the fuses can vary, but in one arrangement the fuse detonating cord starts at a central point at the top of the charge. There are four lengths, 90° apart runnig to two junction boxes 180° apart on the perimeter of the base. At the junction box, two lengths collide, and initiate a second run. One run travels back up into the charge. An equal length, contained in the bottom device, affixes in the opposite end. The end travelling back up into the top fuse unit meets the run from the opposite junction box at the apex of a plane wave former or generator centrally situated in the base of the top unit.

CLAIMS:

1. Apparatus for severing a well system at for example a wellhead, characterised by a casing (5) having an inner sleeve (11) and an outer sleeve (12) and by an explosive charge (2) within the inner sleeve (11).

2. Apparatus according to Claim 1, characterised by a brittle medium in the space (13) between the sleeves (11,12), preferably a concrete.

3. Apparatus according to either preceding claim, characterised by the respective sleeves (11,12) comprising concentric right cylinders.

4. Apparatus according to any preceding claim, characterised by two fuse devices (3,4) situated one at each end of the casing (5).

5. Apparatus according to any preceding claim, characterised by means for detonating the charge (2) substantially simultaneously at each end.

6. Apparatus according to Claim 5, characterised by means for providing substantial simultaneous denotation comprising an explosive fuse in one fuse (4) and an explosive fuse running from the one fuse device (4) to the other fuse device (3), both fuses being substantially of the same length.

7. Apparatus according to Claim 6, characterised by the one fuse device (4) having guide means (14) extending therefrom through the space (13) between the sleeves (11,12) to the other fuse device (3), and by the guide means (14) receiving and guiding the explosive fuse between the fuse devices (3,4).

8. Apparatus according to Claim 7, characterised by the guide means (14) comprising two substantially rigid tubes.

9. Apparatus according to Claim 8, characterised by the other fuse device (3) having sockets for receiving the ends of the columns (14).

10. Apparatus according to Claim 9, characterised by each fuse device (3,4) comprising a body having an inner and an outer shell, the space between the shells containing a brittle medium, preferably a foam material or a concrete or a cement.

11. Apparatus according to any of Claims 4-10,characterised by each fuse device comprising a plane wave former (8).

12. Apparatus according to any of Claims 4-11,characterised by the inner sleeve (11) of the casing (5) and the inner surface of the or each fuse device being substantially of the same diameter, and by the outer sleeve (12) of the casing (5) and the outer surface of the or each fuse (4) device being substantially of the same diameter.

13. Apparatus according to any of Claims 6-12,characterised by a fuse detonating cord being connected to a central point at one end of the explosive charge (2) and to a central point at the opposite end of the charge (2).

14. Apparatus according to Claim 13, characterised by the detonating cord comprising four lengths running to two junction boxes at the base of the charge (2), by a length of fuse detonating cord running from one fuse box to one end of the charge (2) and from the other fuse box to the other end of the charge (2), and by the two lengths being substantially equal.

15. Apparatus according to Claim 14, characterised by the four lengths being 90° apart.

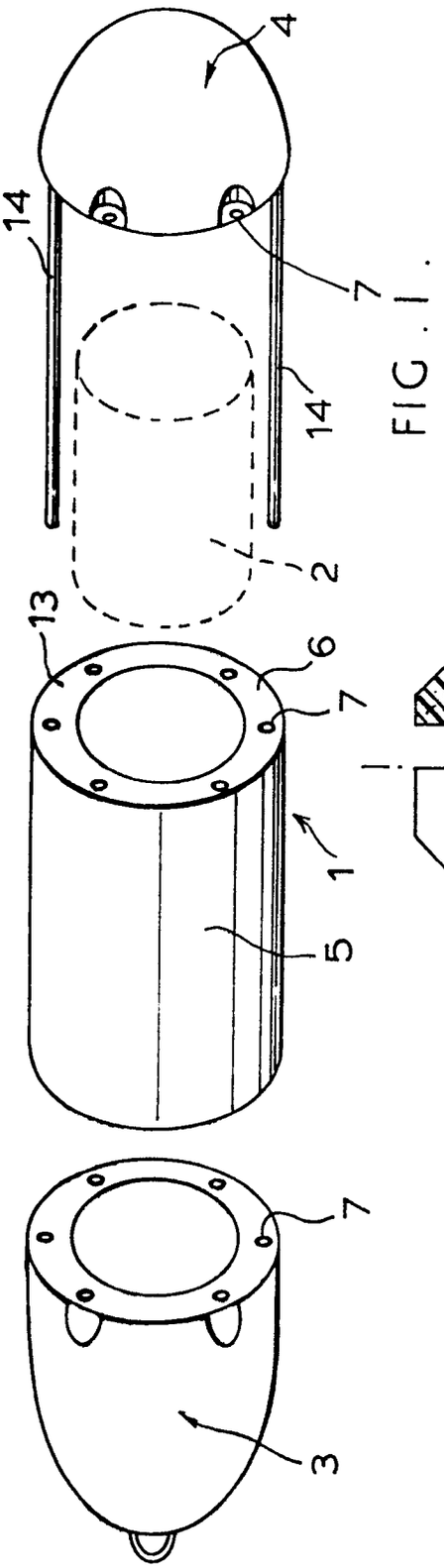

FIG. 1.

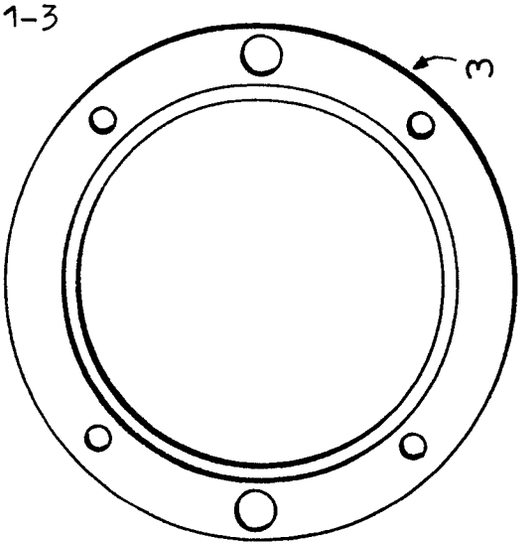

FIG. 2C.

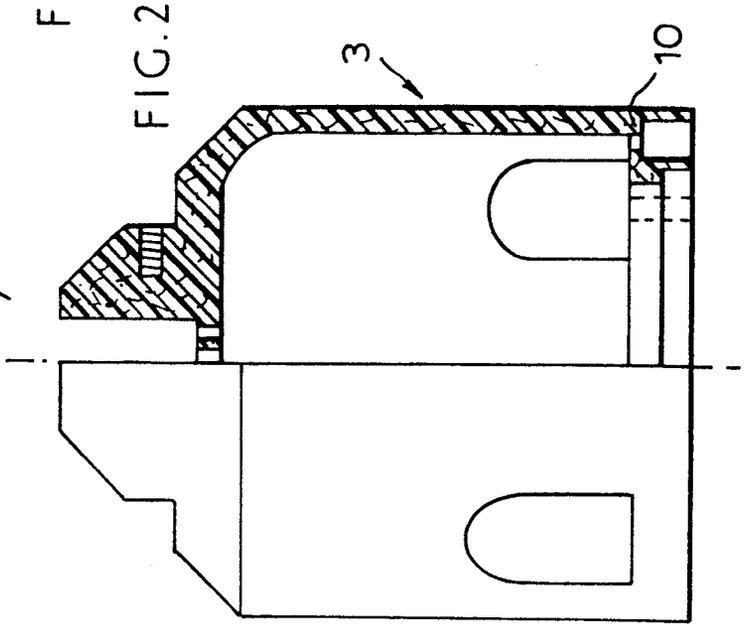

FIG. 2A

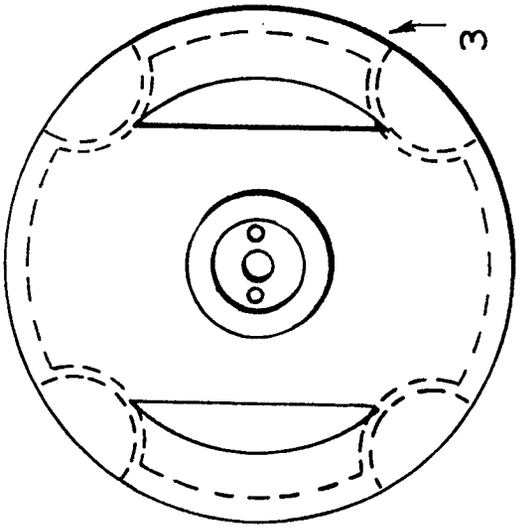

FIG. 2B

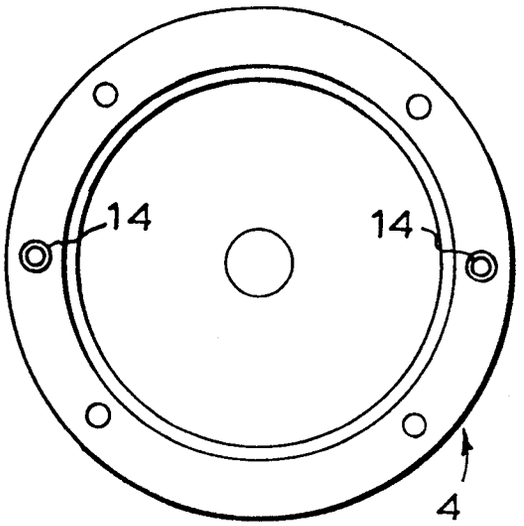

FIG. 3A

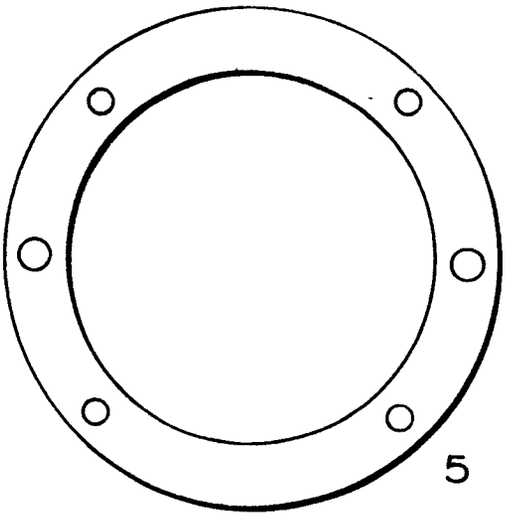

FIG.4A

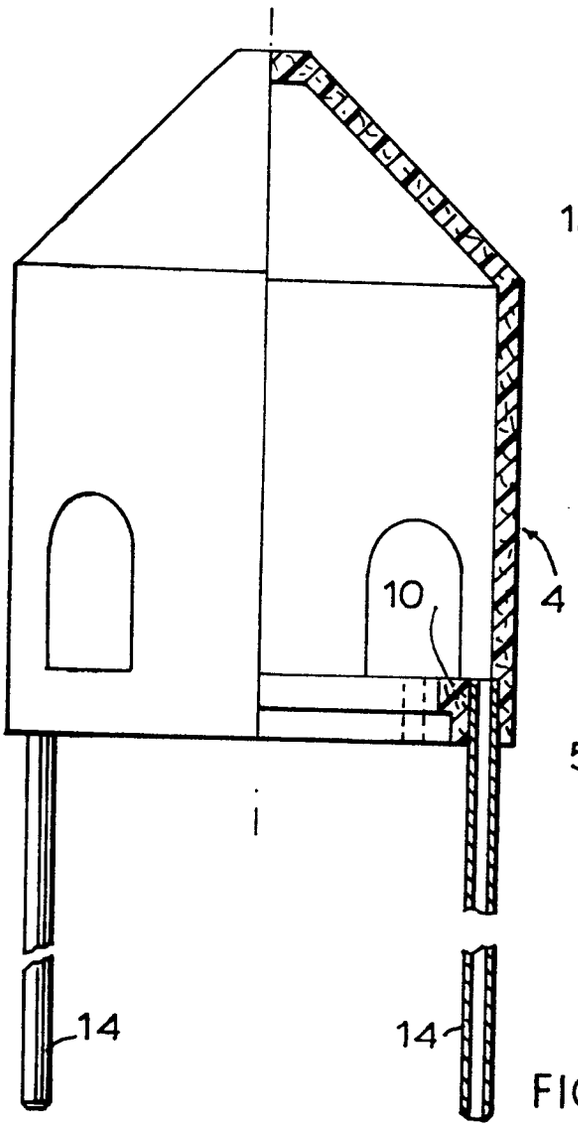

FIG. 3.

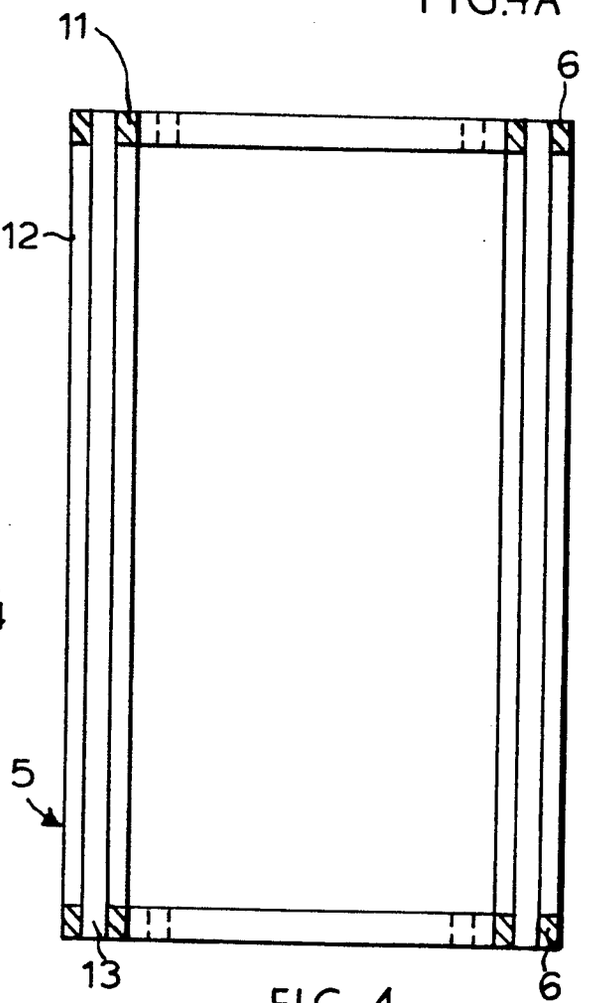

FIG. 4 .

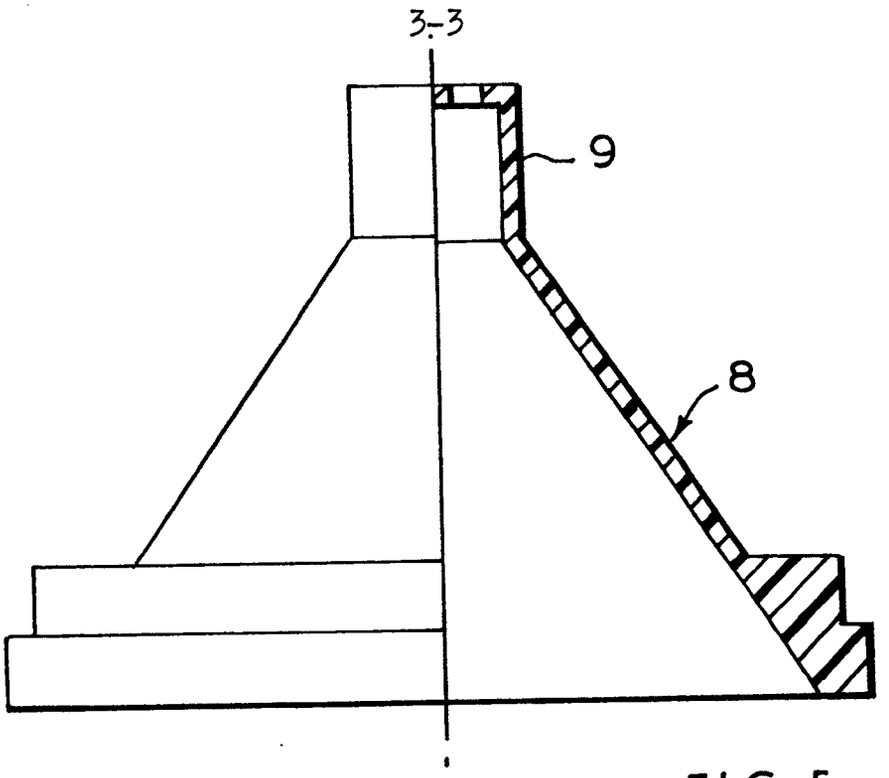

FIG.5.

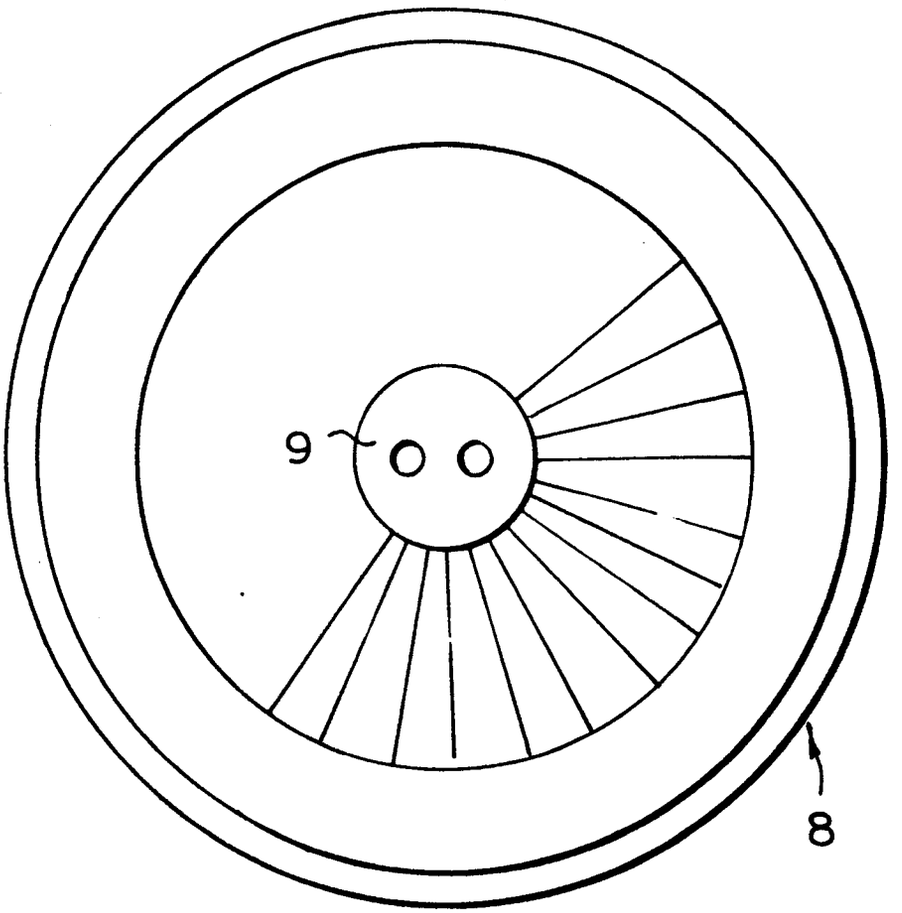

FIG.5A.