PATENT SPECIFICATION

Application Date: Dec. 9, 1939. No. 31868/39. **537,863**

Complete Specification Left: Nov. 27, 1940.

Complete Specification Accepted: July 10, 1941.

PROVISIONAL SPECIFICATION

Improvements in or relating to the Lubrication of Rotary Valves

I, FRANK METCALF ASPIN, a British subject, of Walmer Place, 149, Walmersley Road, Bury, Lancashire, do hereby declare the nature of this invention to be as follows:—

This invention relates to the lubrication of rotary valves and is particularly applicable to rotary valves for internal combustion engines of the kind described in Patent Specification No. 463,412 though not limited to such application.

One of the main problems with rotary valves is their lubrication to obtain at the same time efficient and economical lubrication. This problem is inherent in the design of any rotary valve because a substantial portion of the valve surface which has to be lubricated to provide a bearing surface or gas seal, also has to pass the port or ports where loss of lubricant may occur.

The object of the invention is an improved method of and means for lubricating a rotary valve both efficiently and economically.

The invention comprises the method of lubrication wherein an oil film is maintained between the co-acting bearing or gas sealing surfaces of the valve member and its seating and wherein part, at least, or a substantial part of such oil film is diverted from the surface of the rotary valve member as it passes the port or ports.

According to the invention, means are provided for establishing an oil film at the co-acting bearing or gas sealing surfaces of the rotary valve member and its seating in combination with means, adjacent to the port or ports in the valve seating, for removing at least a substantial part of the oil film from the surface of the rotary valve member as it approaches the port and for re-establishing the coil film thereon after passing the port.

In one example of the invention, a rotary valve member and its housing constructed in accordance with Patent No. 463,412 has a conical peripheral face seating directly in a conical face in the housing. These coacting faces may, if of suitable material and proportions, form the bearing taking the whole of the thrust load on the valve member. On the other hand, supplementary anti-friction thrust bearings may be provided in accordance with the Specification of my Patent No. 511,208.

The rotary valve member, at its smaller conical end, merges into a cylindrical shaft or extension in which are formed the piston ring grooves, the duty of which rings is to retain any oil film on the conical surfaces and to prevent such oil from escaping up the valve stem. The tapered face of the valve member is longer than the depth of the port by a suitable amount necessary to provide a bearing and gas seal, and in the particular example herein described is in all approximately $3\frac{5}{8}$ inches long measured down its sloping face, whilst the port is of such depth as to leave a conical portion of about $\frac{1}{2}$ inch length above the port and of $^{9}/_{16}$th inch length below the port, i.e. at the larger diameter of the valve member.

A wavy oil groove is formed in the centre of these conical portions, the amplitude of the wave being approximately half the length of the conical space. The pitch of the upper wavy groove is about $\frac{3}{4}$ inch, whilst that of the lower wavy groove is about $1\frac{1}{2}$ inches. These grooves are only shallow and may conveniently be formed by a cam-grinder.

The valve housing has two ports, one for the inlet and the other for the outlet. Oil grooves are formed in the conical face of the seating on each side of the ports and extending into the vicinity of the region supplied by the wavy oil grooves in the rotary member. These grooves are spaced a short distance away from the port side say about $\frac{1}{8}$ inch, and are shaped so that their edges immediately adjacent to the ports are sharp and radial or normal to the surface whilst their other edges away from the ports are sloped or bevelled.

Oil ducts are provided in the wall of the housing in the vicinity of the wavy grooves on the rotary member, and to which oil is fed under low pressure to

reach the said wavy grooves.

In operation, the oil supplied under low pressure to the ducts in the housing is picked up by the wavy grooves and distributed effectively over the conical portions above and below the port. The oil also spreads from such area into the grooves on each side of the ports and is particularly carried to the groove on the far side of the port. The oil fills the full length of the groove and spreads therefrom to the intervening conical portion of the co-acting conical surfaces assisted by the " Michel " shaping or inclining of the back edge of the groove. When such oil film reaches the next groove in front of the next port a substantial part of the film is " scraped " from the rotary member by the combined action of the reverse " Michel " action and the sharp facing edge of such groove, and is led by such groove to the ends where it supplements the oil film and passes round the upper and lower ends of the port from where it enters the next groove beyond the port.

Communicating grooves may be provided in the housing joining the ends of the side grooves adjacent the ports so as to help carry the oil round the ports as above described.

The side grooves in the housing may be straight down the inclined face parallel with the sides of the ports or may be curved or inclined and there may be two or more grooves as may be found to be desirable. The combination of the effectively lubricated zones above and below the ports and these distributing grooves at the sides of the ports can be used effectively to maintain lubrication for the whole co-acting conical bearing surfaces with very little loss at the ports, an effect hitherto unobtainable. Lubrication of the end portions of the conical bearing surfaces and particularly the lower portion which is a danger zone can always be effectively maintained at the same time. Incidentally, it has been found that the collection of carbon in the lubricating grooves does not prejudice or does not in practice occur to such an extent as to prejudice the efficient operation of the improved system of lubrication.

Dated this 29th day of November, 1939.

For the Applicant,
WILSON, GUNN & ELLIS,
Chartered Patent Agents,
54—56, Market Street, Manchester, 1.

COMPLETE SPECIFICATION

Improvements in or relating to the Lubrication of Rotary Valves

I, FRANK METCALF ASPIN, a British subject, of Walmer Place, 149, Walmersley Road, Bury, Lancashire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to the lubrication of rotary valves and is particularly applicable to rotary valves for internal combustion engines of the kind described in Patent Specification 463,412, though not limited to such application.

One of the main problems with rotary valves is their lubrication to obtain at the same time efficient and economical lubrication. This problem is inherent in the design of any rotary valve because a substantial portion of the valve surface which has to be lubricated to provide a bearing surface or gas seal, also has to pass the port or ports in the valve seating where loss of lubricant may occur.

The object of the invention is an improved method of and means for lubricating a rotary valve both efficiently and economically.

According to the invention, in the lubrication of a rotary valve member and its ported seating wherein lubricant is supplied to the bearing areas of the rotary valve member and its seating beyond the zone which sweeps over the port and is distributed over such areas by lubricant-holding formations in the surface of the rotary member and wherein the bearing surfaces in the said zone are lubricated by a lubricant-holding formation in the surface of the seating communicating with the said adjacent lubricated areas, there is provided the method of increasing the lubrication of the said areas and of reducing the loss of lubricant to the port wherein a lubricant-collecting formation is provided in the said zone of the seating adjacent to the leading edge of the port, formed and arranged to collect and lead the lubricant from such zone into the said adjacent areas.

The accompanying drawings illustrate one example of the invention, in which

Fig. 1 is a perspective axial section of the valve housing;

Fig. 2 is a perspective view of the lower part of the rotary valve member;

Fig. 3 is a cross section on line A—A of Fig. 2,

Fig. 4 is a cross section on line B—B of Fig. 1;

Fig. 5 is a part section on line C—C of Fig. 1;

Figs. 6 and 7 show modifications of the invention.

In the example of the invention illustrated in the drawings, a rotary valve member and its housing constructed in accordance with Patent No. 463,412, the valve member has a conical peripheral face 10 seating directly in a conical face 11 in the housing. These coacting faces may, if of suitable material and proportions, form the bearing taking the whole of the thrust load on the valve member. On the other hand, supplementary anti-friction thrust bearings may be provided in accordance with the Specification of my Patent No. 511,208.

The rotary valve member, at its smaller conical end, merges into a cylindrical shaft or extension 12 in which are formed two piston ring grooves 13, the duty of which rings is to retain any oil film on the conical surfaces and to prevent such oil from escaping up the valve shaft 12. The tapered face 10 of the valve member is longer than the depth of the port 14 of the valve by a suitable amount necessary to provide a bearing and gas seal, and in the particular example herewith described such face 10 is in all approximately $3\frac{5}{8}$ inches long measured down its sloping face, whilst the port 14 is of such depth as to leave a conical portion at 15 of about $\frac{1}{2}$ inch length above the port and of about 9/16th inch length at 16 below the port, i.e. at the larger diameter of the valve member.

Wavy oil grooves 17 and 18 are formed on the face 10 of the rotary member in the centre of these continuous conical portions, the amplitude of the wave being approximately half the length of the conical space. The pitch of the upper wavy groove 17 is about $\frac{3}{4}$ inch, whilst that of the lower wavy groove 18 is about $1\frac{1}{2}$ inches. These grooves are only shallow and may conveniently be formed by cam turning. The proportion of the groove is therefore such that it sweeps an area approximately half the complementary continuous bearing surface area of the housing beyond the ends of the port.

The valve housing has two ports, see Fig. 4, one 19 for the inlet and the other 20 for the outlet. Four oil grooves, 21*a*, 21*b*, 21*c* and 21*d* (see Figs. 1 and 4) are formed in the conical face of the seating on each side of the ports and extending into the vicinity of the region supplied by the wavy oil grooves 17 and 18 in the rotary member. These grooves 21*a*, 21*b*, 21*c* and 21*d* are spaced a short distance away from the port side say about $\frac{1}{8}$ inch, and are shaped so that their edges immediately adjacent to the ports are sharp and radial or normal to the surface whilst their other edges away from the ports are sloped or bevelled. The arrow shows the direction of rotation of the rotary member. The trailing edges 22 and 23 of the ports are rounded off (see Fig. 4) whilst the leading edges 24 and 25 are preferably angular as shown.

Oil ducts 26 (see Figs. 4 and 5) are provided in the wall of the housing in the vicinity of the wavy grooves on the rotary member, and to which oil is fed under low pressure to reach the said wavy grooves.

In operation, the oil supplied under low pressure to the ducts 26, in the housing is picked up by the wavy grooves and distributed effectively over the continuous conical portions 15 and 16 respectively above and below the port. The oil also spreads from such area into the grooves on each side of the ports and is particularly carried to the groove 21*a* on the far side of the port. The oil fills the full length of the groove and spreads therefrom to the intervening conical portion of the co-acting conical surfaces assisted by the "Michel" shaping or inclining of the back edge of the groove. When such oil film reaches the grooves 21*a* and 21*c* in front of the ports a substantial part of the film is "scraped" from the rotary member by the combined action of the reverse "Michel" action and the sharp facing edge of such groove, and is led by such groove to the ends where it supplements the oil film and passes round the upper and lower ends of the port from where it enters the ends of the next groove beyond the port and spreads along the same, filling it and spreading out therefrom by "Michel" groove action to cover the intervening conical portion of the rotary member.

Communicating grooves 27 (see Fig. 6) may be provided in the housing joining the ends of the side grooves 21*c* and 21*d* arranged above and below the port so as to help carry the oil round the port as above described.

As shown in Fig. 7 additional grooves 28 are provided in the housing as an extension of the ends of the leading side groove 21*d* to the areas above and below the port so that they fade out gradually in such areas and thus operate directly to increase the oil film supply pressure in such areas.

The side grooves 21*a*, 21*b*, 21*c* and 21*d* in the housing may be straight down the inclined face parallel with the sides of

the ports as shown in Fig. 1 or may be curved or inclined and there may be two or more grooves relatively close together as may be found to be desirable. The combination of the effectively lubricated zones above and below the ports and particularly below the ports and the distributing grooves at the sides of the ports can be used effectively to maintain lubrication for the whole co-acting conical bearing surfaces with very little loss at the ports, an effect hitherto unobtainable. Lubrication of the end portions of the conical bearing surfaces and particularly the lower portion which is a danger zone can always be effectively maintained at the same time. Incidentally, it has been found that the collection of carbon in the lubricating grooves does not prejudice or does not in practice occur to such an extent as to prejudice the efficient operation of the improved system of lubrication.

The invention is obviously not limited to all the details of construction of the example above described as the same may be modified without departing from the nature of the invention. For example, lubricant holding grooves may be provided in the valve housing instead of, or in addition to the grooves 17 and 18 in the rotary valve member and such grooves may be similarly wavy and continuous.

It is known from Patent No. 168,941 to provide a rotary valve having a series of short grooves in the peripheral bearing areas of its ends beyond the zone which sweeps over the port and to provide longitudinal channels in the wall of the seating, spaced in between the port openings, the ends of which grooves register momentarily with the ends of the channels, as the valve rotates, to supply the channels with lubricant from oil filled spaces at the ends of the valve.

The provision of oil filled and sealed spaces at both ends of the valve in combination with the end grooves in the valve at each side of the port ensures that the channels, prior to and after the passage of the port are kept filled with oil so that none of the channels can act to lead the oil from the port zone to the end areas though obviously all the channels may provide passage of the oil from one end space and end bearing area to the other. The specification of such patent does not describe any particular shape or form for the grooves or channels which would provide a collecting and distributing effect comparable with that of the present invention.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In the lubrication of a rotary valve member and its ported seating wherein lubricant is supplied to the bearing areas of the rotary valve member and its seating beyond the zone which sweeps over the port and is distributed over such areas by lubricant-holding formations in the surface of the rotary member, and wherein the bearing surfaces in the said zone are lubricated by a lubricant-holding formation in the surface of the seating communicating with the said adjacent lubricated areas, the method of increasing the lubrication of said areas and of reducing the loss of lubricant to the port wherein a lubricant-collecting formation is provided in the said zone, of the seating adjacent to the leading edge of the port and is formed and arranged so as to collect and lead the lubricant from such zone into the said adjacent areas.

2. The method according to claim 1 of lubricating a rotary valve and its seating wherein lubricant is supplied to bearing areas of the rotary member outside of the areas which sweep over the port of its seating and is distributed over the full peripheral length of such areas by continuous distribution means in the surface of the rotary member.

3. The method according to claim 1 or 2 of lubricating a rotary valve and its seating wherein lubrication of the said zone is increased by the provision of lubricant-holding means adjacent the trailing edge of the port formed and arranged to collect lubricant from the said adjacent areas and to distribute it into the said zone.

4. Lubrication means for a rotary valve consisting of a rotary valve member mounted in a ported seating comprising lubricant holding and distributing grooves in the bearing areas of the rotary valve member beyond the zone which sweeps over the port and a lubricant collecting groove in the seating in the said zone and adjacent the leading edge of the port formed and arranged so as to collect and lead the lubricant from such zone into the said adjacent areas.

5. Lubrication means according to claim 4, characterised by a continuous wavy lubricant-holding and distributing groove in the bearing area of the rotary valve member.

6. Lubrication means according to either of the proceeding claim 4 or 5 characterised by a lubricant holding and distributing groove adjacent the trailing edge of the port.

7. Lubrication means according to claim 4, 5, or 6 characterised in that the lubricant collecting and/or distributing groove in the seating is formed with the edge farthest from the port relatively bevelled and the edge nearest the port relatively sharp or normal to the surface of the seating.

8. Lubrication means according to any of the preceding claims 4, 5, 6, or 7 characterised in that the lubricant collecting and/or distributing groove extends into the bearing areas beyond the zone of the port.

9. Lubrication means according to claim 8 characterised in that the groove is extended around the end of the port.

10. Lubrication means according to claim 8 or 9 characterised in that the groove fades out gradually in the said area.

11. Lubrication means for a rotary valve according to any of the preceding claims 2 to 10 characterised in that lubricant-retaining means such as a piston ring are provided between the stem of the rotary valve member and its housing.

12. Lubrication means for a rotary valve according to claims 4 to 11 characterised in that the lubricant-holding formation in the rotary member sweeps an area approximately half the complementary continuous bearing surface area of the housing beyond the end of the port.

13. A rotary valve and housing having lubricating means constructed according to any of the preceding claims 4 to 12.

14. A rotary valve and housing having lubricating means constructed and arranged substantially as herein described with reference to and as illustrated in Figs. 1 to 5 or as modified in Figs. 6 and 7 of the accompanying drawings.

Dated this 16th day of November, 1940.

For the Applicants,
WILSON, GUNN & ELLIS,
Chartered Patent Agents,
54/56, Market Street, Manchester, 1.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1941.

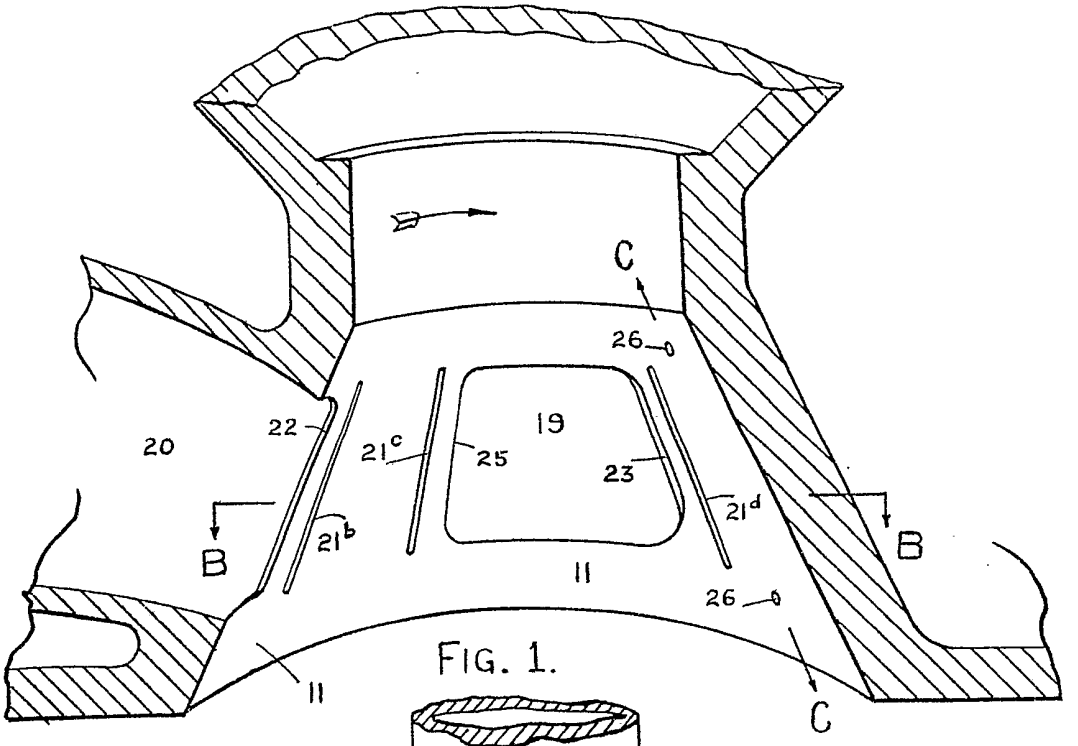

FIG. 1.

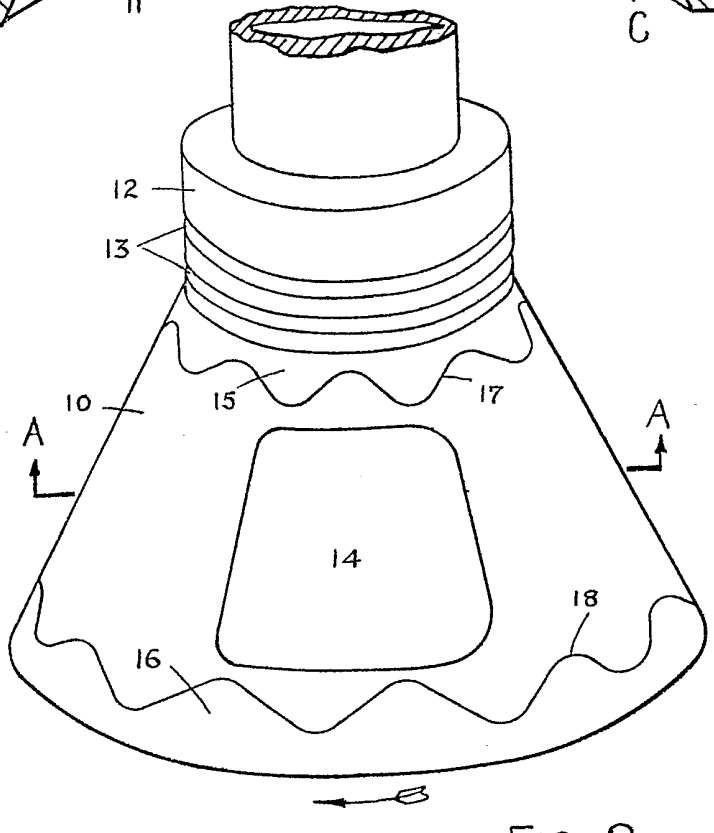

FIG. 2.

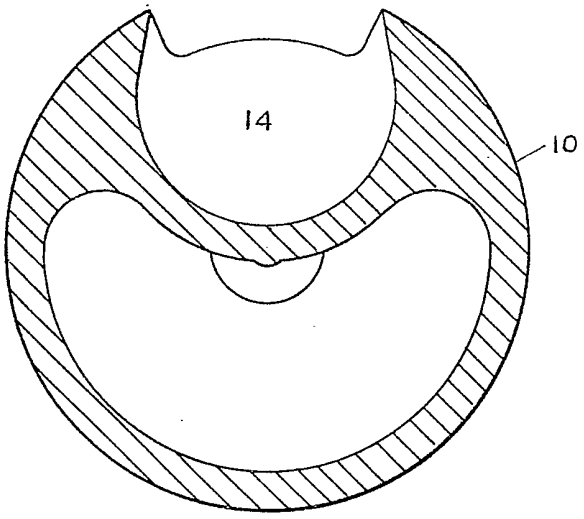

FIG. 3.

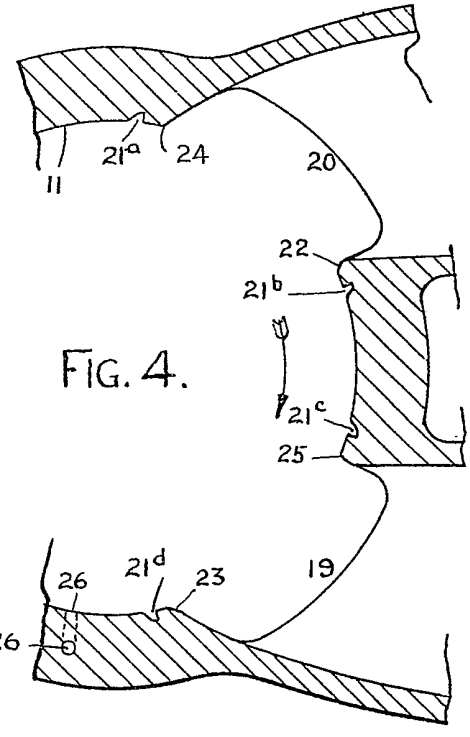

FIG. 4.

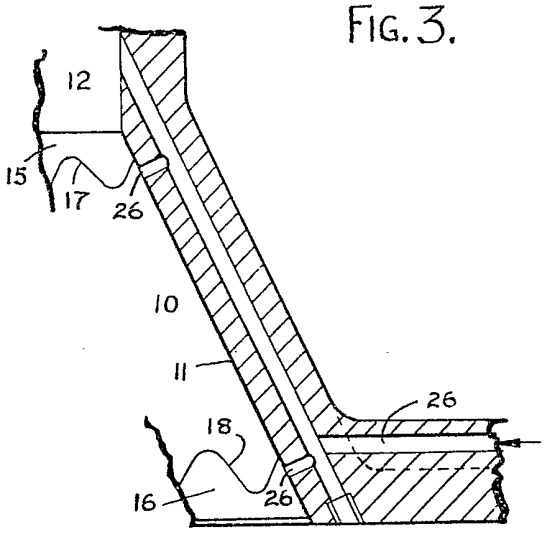

FIG. 5.

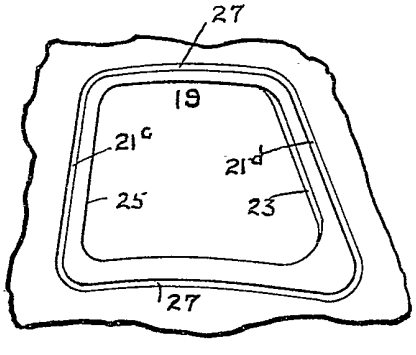

FIG. 6.

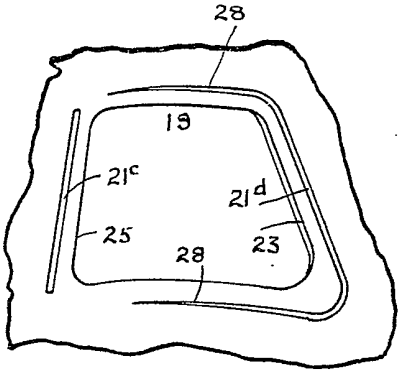

FIG. 7.

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2 SHEETS

SHEET 1

SHEET 2

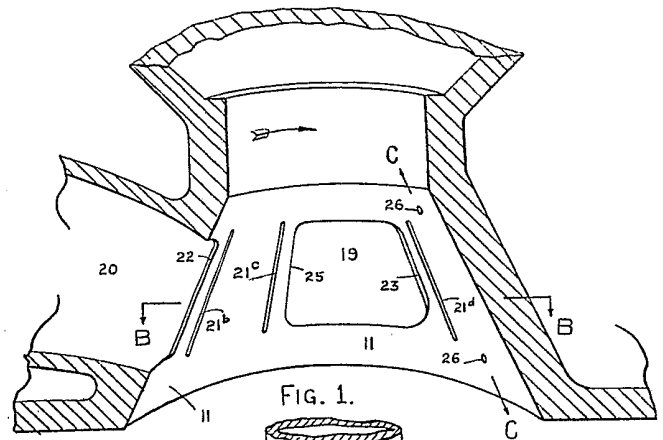

FIG. 1.

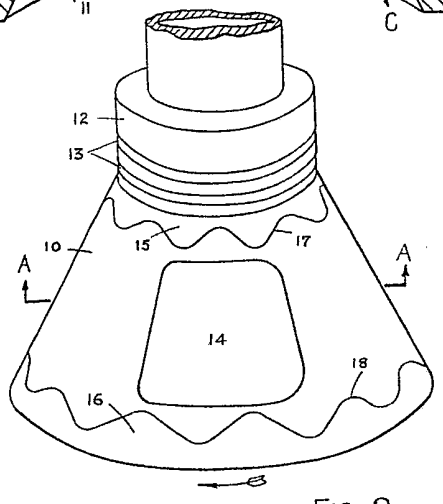

FIG. 2.

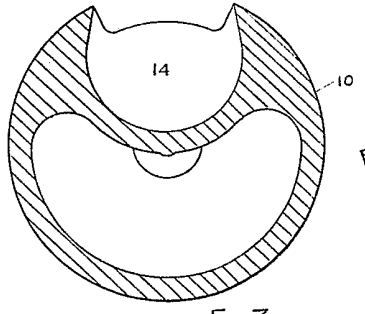

FIG. 3.

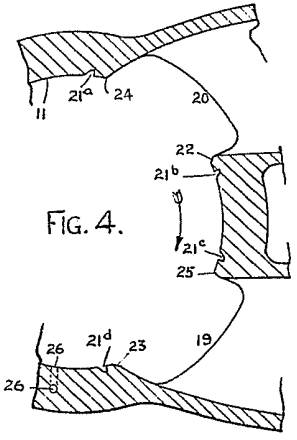

FIG. 4.

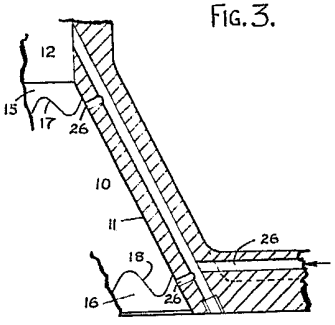

FIG. 5.

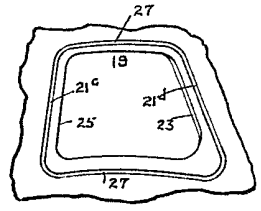

FIG. 6.

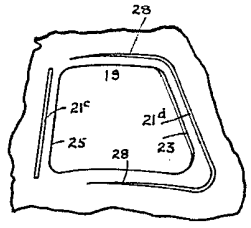

FIG. 7.

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