PATENT SPECIFICATION

Application Date: March 16, 1942. No. 3415/42. **556,740**

Complete Specification Left: Feb. 19, 1943.

Complete Specification Accepted: Oct. 20, 1943.

PROVISIONAL SPECIFICATION

Improvements in or relating to Bearing Surfaces for Tapered Rotary Valves of Engines and Pumps

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 bearing surfaces for tapered rotary valves such as are used for internal combustion engines, pumps and like machines, wherein the valves are heavily loaded and have continuous rotation or oscillation as distinct from mere plug cocks.

One of the problems in connection with the use of tapered rotary valves for internal combustion engines, pumps and like machines is the selection and use of suitable bearing metals for the rotary valve plug and its housing. On the one hand there are obvious advantages in the use of relatively light magnesium and aluminium alloys for the cylinder block or head, but such metals are unsuitable to provide the bearing surface of a rotary valve both as regards their surface and their strength. Such light metals also have a relatively high co-efficient of expansion, compared with the known metals which are classed as bearing metals, such as certain steels, cast irons and bronzes, and consequently and bearing lining is difficult to secure where there are changes of temperature which could expand the housing away from its liner. Again, in connection with the internal combustion engines or pumps it is very important that any bearing liner should have good contact with its housing for the dispersion of heat by conduction. Finally, the angle of taper presents a problem as regards securing a lining.

The object of the invention is an improved method of fitting construction of lining for the bearing surfaces of such rotary valves.

The invention comprises the method of fitting and securing a housing liner for a tapered rotary valve wherein the liner and housing are formed with complementary stepped peripheral surfaces providing a plurality of substantially cylindrical surfaces of which those on the liner are an interference fit in those of the housing, when both are at substantially equal temperatures, and wherein the liner is inserted in the housing without such interference by employing a temporary substantial temperature difference.

According to the invention a housing liner for a conical rotary valve is characterised in that it has a conical exterior formed of a plurality of substantially cylindrical surfaces in stepped arrangement.

According to one embodiment of the invention a lined housing for a conical rotary valve comprises a liner of suitable bearing metal having a conical exterior formed of a plurality of substantially cylindrical surfaces in stepped arrangement located in a recess in the housing of complementary shape, the complementary cylindrical surfaces of the liner and housing being an interference fit so that the liner is frictionally secured.

In the accompanying drawing,

Fig. 1 shows a liner for the rotary valve of an internal combustion engine of the kind described in my prior Patent No. 463,412.

Fig. 2 shows a modification of Fig. 1.

Fig. 3 shows a housing in a cylinder head adapted to receive the liner shown in Fig. 1 or 2.

Fig. 4 is an assembly drawing showing the housing of Fig. 3 fitted with the liner of Fig. 2 and a rotary valve therein.

Fig. 5 is a part sectional elevation of a rotary valve having an external cover.

Fig. 6 is an assembly drawing showing the housing of Fig. 3 fitted with the liner of Fig. 1 and the valve of Fig. 5.

As shown in Figs. 1 and 2, the liner, which may be of phosphor bronze, steel, cast iron or other suitable bearing metal is formed with an internal conical bearing surface *a* terminating at its narrower end in a cylindrical portion *b* whilst externally it is of stepped form having a plurality of cylindrical surfaces *c* which conform substantially to the conical

[Pr

shape of the inner surface *a* and cylindrical surface *b*. In the example shown in Fig. 2 where the liner has an inner surface *d* which may be of other metal such as lead, bronze, chrome or other suitable metal which may be deposited electrically or by spraying or may be cast in situ or brazed or otherwise suitably attached therein.

As shown in Fig. 3 the housing *e* is formed with internal stepped formation complementary to the external stepped shape of the liner and the cylindrical portions *f* are made of such dimensions as to be an interference fit at equal temperatures with the liner within the normal range of use. The external contour of the housing is shown of wavy form at *g* conforming to the ridges of the steps, the purpose of which is to provide thickness of metal without excess weight.

In the assembly drawing of Fig. 4 the liner of Fig. 2 is shown assembled in the housing of Fig. 3 and fitted with a rotary valve *h* of the kind described in my earlier Patent No. 463,412.

As shown in Fig. 5, the rotary valve *i* is made of metal which is not necessarily suitable as a bearing metal complementary to the metal of the liner shown in Fig. 1. It is therefore made with an external cover *j* of bearing metal, such as bronze, applied by spray or other suitable method so as to be intimately bonded to the base metal of the valve. The complete assembly of such valve with the housing of Fig. 3 and liner of Fig. 1 is shown in Fig. 6.

The invention provides an effective method of enabling metals to be used for the basic portions, such as the cylinder head and/or valve body whilst enabling suitable complementary bearing metals to be used. Thus in the assembly shown in Fig. 4 the housing *e* may be of magnesium of aluminium alloy, the liner may be of steel or cast iron and the inner surface *d* may be of lead bronze, chrome, or other metal suitable as a bearing but unsuitable for the construction of either the housing *e* or the liner. Again, in the assembly shown in Fig. 6, the housing and liner may be of the same metals as described for Fig. 4, whilst the bearing surface *j* may be of the same metal as suggested for the inner surface *d*. Furthermore, the liner shown in Fig. 1 or Fig. 6 may be of a suitable metal such as bronze or one of the special cast irons or steels to co-operate with a rotary valve of a suitable metal without an outer cover.

As a modification the complementary substantially cylindrical portions of the liner and/or housing may be slightly tapered either way, or both ways including barrel shaped or waisted so as to provide the required interference fit.

In use, to obtain assembly, it is convenient to heat the housing and freeze the liner until relative dimensions of the complementary substantially cylindrical portions are such that the liner can be freely inserted in the housing. Upon contact or otherwise as their relative difference of temperature is reduced, the liner expands and/or the housing shrinks until interference is established, when the complementary surfaces are pressed together. Any air trapped between is expelled initially from between the surfaces as they close or through the ports and any residue finally disperses through the pores of the metal. The degree of interference is such that, at normal low temperature, the difference is not such as to exceed the elastic limit of the material and cause fracture say of the housing, though compression of grain may occur, whilst at normal high temperature the difference of coefficient of expansion does not allow the housing to expand away from the liner. The normal pressure between the surfaces will be sufficient to prevent the liner from turning though locking pins may be inserted for such purpose, if desired.

In some cases, according to the metals used, the liner can be pressed into the housing without substantial difference of temperature.

Dated this 14th day of March, 1942.

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

COMPLETE SPECIFICATION.

Improvements in or relating to Bearing Surfaces for Tapered Rotary Valves of Engines and Pumps

I, FRANK METCALF ASPIN, a British subject, of Walmer Place, 149, Walmersley Road, Bury, Lancashire, do hereby declare the nature of this inven-

tion and in what manner the same is to performed, to be particularly described and ascertained in and by the following statement:—

This inventon relates to bearing surfaces for tapered rotary valves such as are used for internal combustion engines, pumps and like machines, wherein the valves are heavily loaded and have continuous rotation or oscillation as distinct from mere plug cocks.

One of the problems in connection with the use of tapered rotary valves for internal combustion engines, pumps and like machines is the selection and use of suitable bearing metals for the rotary valve plug and its housing. On the one hand there are obvious advantages in the use of relatively light magnesium and aluminium alloys for the cylinder block or head, but such metals are unsuitable to provide the bearing surface of a rotary valve both as regards their surface and their strength. Such light metals also have a relative high co-efficient of expansion, compared with the known metals which are classed as bearing metals, such as certain steels, cast irons and bronzes, and consequently any bearing lining is difficult to secure where there are changes of temperature which could expand the housing away from its liner. Again, in connection with internal combustion engines or pumps it is very important that any bearing liner should have good contact with its housing for the dispersion of heat by conduction. Finally, the angle of taper presents a problem as regards securing a lining.

The object of the invention is an improved method of fitting and construction of a lining for the bearing surfaces of such rotary valves.

The invention comprises the method of fitting and securing a stationary housing liner for a tapered rotary valve wherein the liner and housing are formed with complementary stepped peripheral surfaces providing a plurality of substantially cylindrical surfaces of which those on the liner are an interference fit in those of the housing, when both are at substantially equal temperatures, and wherein the liner is inserted in the housing preferably by the temporary removal of such interference by employing a temporary change of temperature or temperature difference.

According to the invention a stationary housing liner for a conical rotary valve is characterised in that it has a conical exterior formed of a plurality of substantially cylindrical surfaces in stepped arrangement.

According to one embodiment of the invention a stationary lined housing for a conical rotary valve comprises a liner of suitable bearing metal having a conical exterior shape in which are formed a plurality of substantially cylindrical surfaces in stepped arrangement located in a recess in the housing of complementary shape, the complementary cylindrical surfaces of the liner and housing being an interference fit so that the liner is frictionally secured.

In the drawing filed with the Provisional Specification,

Fig. 1 shows a liner for the rotary valve of an internal combustion engine of the kind described in my prior British Patent No. 463,412.

Fig. 2 shows a modification of Fig. 1.

Fig. 3 shows a housing in a cylinder head adapted to receive the liner shown in Fig. 1 or 2.

Fig. 4 is an assembly drawing showing the housing of Fig. 3 fitted with the liner of Fig. 2 and a rotary valve therein.

Fig. 5 is a part sectional elevation of a rotary valve having an external cover.

Fig. 6 is an assembly drawing showing the housing of Fig. 3 fitted with the liner of Fig. 1 and the valve of Fig. 5.

As shown in Figs. 1 and 2, the liner, which may be of phosphor bronze, steel, cast iron or other suitable bearing metal is formed with an internal conical bearing surface *a* terminating at its narrower end in a cylindrical portion *b* whilst externally it is of stepped form having a plurality of cylindrical surfaces *c* which conform substantially to the conical shape of the inner surface *a* and cylindrical surface *b*. In the example shown in Fig. 2 the liner has an inner surface *d* which may be of other metal such as lead, bronze, chromium or other suitable metal which may be deposited electrically or by spraying or may be cast in situ or brazed or otherwise suitably attached therein.

As shown in Fig. 3 the housing *e* is formed with internal stepped formation complementary to the external stepped shape of the liner and the cylindrical portions *f* are made of such dimensions as to be an interference fit at equal temperatures with the liner within the normal range of use. The external contour of the housing is shown of wavy form at *g* conforming to the ridges of the steps, the purpose of which to provide thickness of metal without excess weight.

In the assembly drawing of Fig. 4 the liner of Fig. 2 is shown assembled in the housing of Fig. 3 and fitted with a rotary valve *h* of the kind described in my earlier British Patent No. 463,412.

As shown in Fig. 5, the rotary valve *i* is made of metal which is not necessarily

suitable as a bearing metal complementary to the metal of the liner shown in Fig. 1. It is therefore made with an external cover *j* of bearing metal, such as bronze, applied by spray or other suitable method so as to be intimately bonded to the base metal of the valve. The complete assembly of such valve with the housing of Fig. 3 and liner of Fig. 1 is shown in Fig. 6.

The invention provides an effective method of enabling metals to be used for the basic portions, such as the cylinder head and/or valve body whilst enabling suitable complementary bearing metals to be used. Thus in the assembly shown in Fig. 4 the housing *e* may be of magnesium or aluminium alloy, the liner may be of steel or cast iron and the inner surface *d* may be of lead-bronze, chromium, or other metal suitable as a bearing but unsuitable for the construction of either the housing *e* or the liner. Again, in the assembly shown in Fig. 6, the housing and liner may be of the same metals as described for Fig. 4, whilst the bearing surface *j* may be of the same metal as suggested for the inner surface *d*. Furthermore, the liner shown in Fig. 1 or Fig. 6 may be of a suitable metal such as bronze or one of the special cast irons or steels to co-operate with a rotary valve of a suitable metal without an outer cover.

As a modification the complementary cylindrical portions of the liner and/or housing may be slightly tapered either way or both ways, including barrel shaped or waisted so as to provide the required interference fit.

In use, to obtain assembly, it is convenient to heat the housing and freeze the liner until relative dimensions of the complementary substantially cylindrical portions are such that the liner can be freely inserted in the housing. Upon contact or otherwise as their relative difference of temperature is reduced, the liner expands and/or the housing shrinks until interference is established, when the complementary surfaces are pressed together. Any air trapped between is expelled initially from between the surfaces as they close or through the ports and any residue finally disperses through the pores of the metal. The degree of interference is such that, at normal low temperature, the difference is not such as to exceed the elastic limit of the material and cause fracture say of the housing, though compression of grain may occur, whilst at normal high temperature the difference of co-efficient of expansion does not allow the housing to expand away from the liner. The normal pressure between the surfaces will be sufficient to prevent the liner from turning though locking pins may be inserted for such purpose, if desired.

In some cases, according to the metals used, the liner can be pressed into the housing without substantial difference of temperature.

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. The method of fitting and securing a stationary housing liner for a tapered rotary valve wherein the liner and housing are formed with complementary stepped peripheral surfaces providing a plurality of substantially cylindrical surfaces of which those on the liner are an interference fit in those of the housing, when both are at substantially equal temperatures, and inserting the liner in its housing.

2. The method of fitting and securing a stationary housing liner for a tapered rotary valve according to Claim 1, wherein the liner is inserted in the housing without the said interference fit by employing a temporary substantial temperature difference.

3. A stationary housing liner for a conical rotary valve characterised in that it has a substantially conical exterior shape in which are formed a plurality of substantially cylindrical surfaces in stepped arrangement.

4. A lined housing for a conical rotary valve comprising a stationary liner of suitable bearing metal having a substantially conical exterior shape in which are formed a plurality of substantially cylindrical surfaces in stepped arrangement located in a recess in the housing of complementary shape, the complementary cylindrical surfaces of the liner and housing being an interference fit so that the liner is frictionally secured.

5. A stationary housing liner for a conical rotary valve comprising a liner of suitable metal having its inner conical bearing surface lined with a suitable bearing metal and its outer surface of substantially conical shape and formed of a plurality of substantially cylindrical surfaces in stepped arrangement.

6. A lined housing according to Claim 4 characterised in that the substantially cylindrical surfaces of the stationary liner and/or of the housing are slightly tapered.

7. A stationary housing liner according to Claim 3, characterised in that the substantially cylindrical surfaces are slightly tapered.

8. A lined housing according to Claim 6

or 7, characterised in that the housing is of metal of a higher coefficient of expansion than the stationary lining and the interference fit is such that it is greater than the difference of expansion within the normal temperature range of use.

9. In combination a lined housing according to any of the preceding Claims with a conical rotary valve of, or surfaced with, a bearing metal complementary to the liner bearing surface.

10. A stationary housing liner for a conical rotary valve constructed and arranged substantially as herein described with reference to and as illustrated in the several figures of the accompanying drawings.

11. A rotary valve housing having a stationary liner constructed and arranged substantially as herein described with reference to and as illustrated in the several figures of the accompanying drawings.

12. In combination, a rotary valve and lined housing constructed and arranged substantially as herein described with reference to and as illustrated in the several figures of the drawings filed with the Provisional Specification.

Dated this 16th day of February, 1943.

For the Applicant,
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.—1943.

FIG. 1.

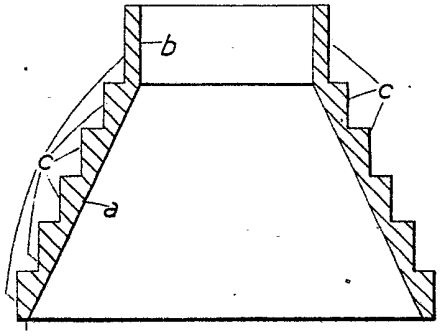


FIG. 3.

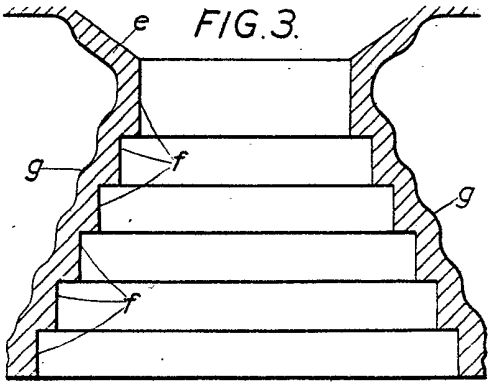


FIG. 2.

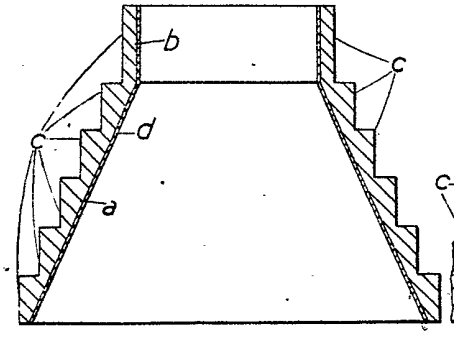


FIG. 4.

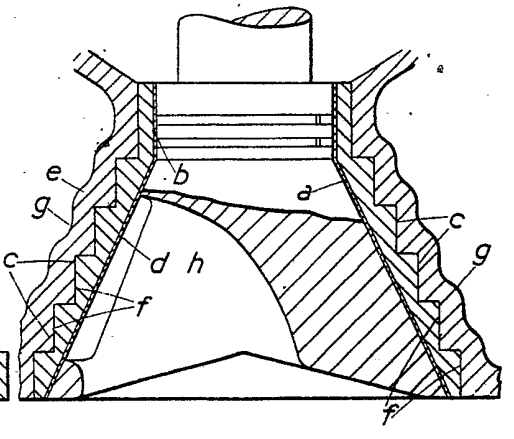


FIG. 5.

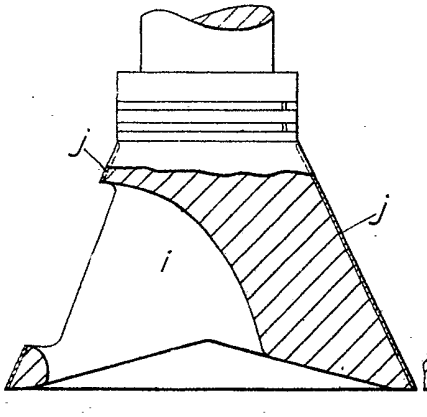
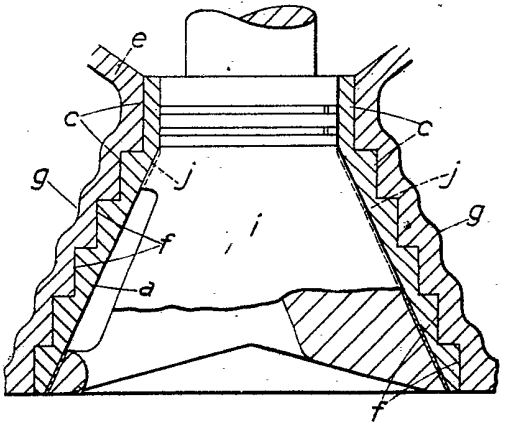


FIG. 6.



Malby & Sons, Photo-Litho.