

PATENT SPECIFICATION

(11) 1248 148

DRAWINGS ATTACHED

- (21) Application No. 43156 (22) Filed 29 Aug. 1969
 (45) Complete Specification published 29 Sept. 1971
 (51) International Classification F 16 b 2/20
 (52) Index at acceptance
 E2B 4A4 4A6B2 4A6B3
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(54) IMPROVEMENTS IN OR RELATING TO RETAINING RINGS AND ASSEMBLIES COMPRISING THE SAME

(71) We, WALDES KOHINOOR, INCORPORATION, 47—16 Austel Place, Long Island City 1, State of New York, United States of America, a corporation organized and existing under the laws of the State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to retaining rings and assemblies comprising the same.

According to one aspect of the present invention there is provided a retaining ring comprising an annular body portion, a first plurality of prongs extending at spaced intervals from the outer periphery of the annular body portion and a second plurality of prongs extending at spaced intervals from the inner periphery of the annular body portion, each of the first plurality of prongs progressively extending outwards in a radial direction from the outer periphery and each of the second plurality of prongs progressively extending inwards in a radial direction from the inner periphery, whereby the retaining ring is locatable on or in a first member which engages the projecting tips of either the first or the second plurality of prongs respectively in such a manner that one of the respective pluralities of prongs provide locating prongs which are radially compressed by contact with the body and the respective other of the respective pluralities of prongs provide retaining prongs for retaining a second member in a predetermined position relative to the first member.

According to a preferred embodiment of the invention, the retaining ring is provided with a plurality of fingers each extending from a respective one of said retaining prongs along an arc of a circle concentric with the annular body portion and inclined in a direction opposite to the inclination to said locating prongs.

According to another aspect of the present invention there is provided an assembly comprising a first member provided with a cylindrical surface and a retaining ring as defined above for locating a second member at an axial position along said cylindrical surface.

Advantageously, said retaining ring is provided with a plurality of fingers each connected to a respective one of said retaining prongs and extending therefrom along an arc of a circle concentric with said ring and inclined in a direction opposite to that of said locating prongs such that said retaining ring is secured at an axial position along said cylindrical surface which causes said spring fingers to resiliently bias an end face of said second member, and the length and stiffness of said spring fingers is such as to enable variation of the bias acting on said end face in a predetermined manner.

Embodiments of the invention will now be described with reference to the accompanying drawings, in which:—

Fig. 1 shows a front elevation of a retaining ring;

Fig. 2 shows a section taken on the line 2—2 of Fig. 1;

Fig. 3 shows in section an assembly including the self-locking ring of Figs. 1 and 2;

Fig. 4 shows in section another assembly including the ring of Figs. 1 and 3;

Fig. 5 shows in plan view a retaining ring for fitting on a shaft;

Fig. 6 shows in section a view taken on the line 6—6 in Fig. 5;

Fig. 7 shows in plan view a ring for fitting in an axial bore;

Fig. 8 shows in section a view taken on the line 8—8 of Fig. 7;

Fig. 9 shows an enlarged view of a modified part of Fig. 8;

Fig. 10 shows a perspective view of the ring of Fig. 5; and

Fig. 11 shows a perspective view of the ring of Fig. 7.

Figs. 1 and 2 show a retaining ring provided with retaining prongs which ring comprises a ring body 10 formed by an annular body portion. The ring body 10 is provided along its outer periphery with twelve integral, equally spaced and radially outwardly projecting spring prongs 12 and along its inner periphery with six integral, equally spaced, radially inwardly projecting prongs 14. From Fig. 2 it can be seen that the ring body 10 is formed with a frusto-conical transverse section. This construction provides a substantial increase in the resistance of the ring body to distortion when subject to compression forces applied thereto through its prongs 12. Alternatively, the ring body 10 is planar for those applications in which the risk of distortion is negligible.

The ring body 10 is also provided at its outer periphery with an integral annular flange 12a (extending normally to the ring axis), from which flange the outwardly projecting prongs 12 extend, being, slightly inclined thereto.

Similarly, the ring body 10 is also provided at its inner periphery with an integral annular flange 14a from which the radially inwardly projecting prongs 14 extend, being slightly inclined thereto. The annular flanges 12a, 14a are provided to facilitate production of the ring body 10, to enable simple regulation of prong length, and to allow easier calculation of the angle of inclination of both the outwardly and the inwardly projecting prongs 12, 14, respectively.

The outwardly projecting prongs 12 function as spring retaining prongs enabling the ring to fasten itself to the bore-defining surface of a cylindrical housing or similar ring enclosure to which it is connected by simply being inserted in the bore to a predetermined axial position therealong. Accordingly, said prongs 12 are inclined by a small angle to the general plane of the ring body 10. The direction of inclination is in a direction opposite to that in which the ring is moved during the course of its assembly. The free end edges of the prongs 12 when unstressed (i.e. prior to ring assembly) lie on a circle or somewhat greater diameter than that of the cylindrical housing bore, with the result that the inclination of the prongs increase during and following insertion of the ring in the bore.

It will be understood that the holding power of such a ring in the assembled state against thrusts exerted by the part retained thereby depends on several factors which are independent of one another. One such factor is the shear strength of the material of the part retained thereby, assuming of course that this material is not so hard as to make the prongs wholly ineffective. Another factor is the strength of the annular flange 12a or the ring body 10 on which depends its resis-

tance to distortion when subject to compression forces applied through the prongs 12 in the direction of inclination of the latter. A third factor is the resistance of the prongs to buckling under load. All of these factors will be taken into consideration when constructing a ring for each particular application or assembly in which it is to be used.

The inclination of the inwardly projecting prongs 14 is calculated to be such that the prongs will resist deflection when brought to their part-abutting position if there is to be no end play of said part, or to enable said prongs to serve as loading prongs which at all times impart a yielding force on the part to be retained, for example, when the ring is employed as the spring of a ball check valve.

Fig. 2 shows that the length of the radially inwardly projecting prongs 14 (i.e. the extent of their projection from the inner periphery of the ring body 10) is such that their free end edges lie on a circle having a substantially smaller diameter than the diameter of the spherical or part-spherical part to be retained. The inwardly directed part-retaining prongs 14 are inclined in the same direction to the general plane of the ring body 10 as are the outwardly projecting prongs 12.

By way of example, Figs. 3 and 4 show assemblies comprising the retaining ring described with reference to Figs. 1 and 2. Fig. 3 shows a ball joint comprising a part spherical ball 20 carried by a non-rotating spindle 22, and a ball-enclosing member 24 of said joint. A surface portion of the ball is seated against an inner surface of a truncated-conical shaped extension 26 provided on an end wall of said ball-enclosing member 24. The ball 20 is held against the extension 26, biased by a retaining ring 10. The outwardly projecting prongs 12 of said ring serve to secure the ring to the inner surface of a cylindrical portion 24a of the enclosing member 24. The ring is positioned such that the inner free ends of the inwardly projecting prongs 14 engage against a curved surface portion of the part spherical ball 20.

With the assembly shown in Fig. 3, relative movement is possible between the prongs 14 and the curved surface portion of the ball 20, i.e. the ball 20 may move so that the spindle 22 is inclined with respect to its position shown in Fig. 3, or the ball may rotate to a limited degree, so as to compensate for any misalignment in the assembly as a whole. Such adjustment of the ball may take place without end play in the event that the stiffness of the prongs 14 is such as to prevent end play, or with end play in case of the prongs having the calculated stiffness as permits limited end play.

From the above, it will be seen that the ring body 10 with its outwardly directed prongs 12 and its inwardly directed retain-

ing prongs 14 combines the capability of the ring to retain itself in place when assembled in a housing bore with the capability of a ring-type spring having prongs extending radially inwardly from the inner perimeter of a generally circular ring body to retain a body or part against which said prongs bear.

Fig. 4 shows an assembly comprising a retaining ring forming part of a ball check valve (i.e. a one-way valve). An inlet sleeve 30a and an outlet sleeve 30b form a valve body having a through bore and suitable means therein defining a valve seat 32. A ball-type check valve 34 is normally held seated against said seat by the inwardly projecting prongs 14 of a retaining ring 10. To enable said ring to retain itself in ball-loading position, the bore of the sleeve part 30b includes a smooth cylindrical bore portion 36 of larger internal diameter than the ball or seat. The ball projects into the portion 36 and is engaged by the radially outwardly projecting prongs 12.

In Fig. 4 as in the previously described Fig. 3, the inner free edges of the inwardly projecting retaining prongs 14 contact a surface portion of the ball 34 which engages the valve seat 32. The ring is designed so that said prongs 14 bias the ball into a position such that the ball check valve is normally closed but also allow the ball to move a precalculated distance away from said seat 32 when pressure of fluid on the inlet side exceeds a predetermined value.

While the ring described with reference to Figs. 1 to 4 is designed for fitting in an axial bore, it is possible to incorporate the part-retaining features thereof into a ring for fitting to a shaft. In this latter ring, the retaining prongs project radially inwardly from the inner perimeter and the part-retaining prongs project radially outwardly from the outer perimeter of the ring body.

Figs. 5 to 11 of the drawings illustrate rings similar to those shown in Figs. 1 to 4 in which additional means are provided for exerting a resilient force on the machine part to be retained thereby, thus in effect providing a resilient shoulder.

In Figs. 5, 6 and 10, the ring comprises a ring body 100, with outwardly projecting retaining prongs 116a and inwardly projecting prongs 112. The outwardly projecting-retaining prongs 116a are provided with integral, circumferentially extending spring fingers 116 which incline away from the plane of the ring body in the direction opposite to that of the prongs 112.

In Fig. 6 the ring of Fig. 5 is shown fitted to a shaft S. This is effected by pushing the ring over an end of the shaft by an amount such as to bring the free ends of the circumferentially extending spring fingers 116 into engagement with an adjacent end

face of a machine part P such as a gear, bearing race or the like required to be mounted on said shaft. The term "circumferentially extending" is used herein to mean that said spring fingers extend along arcs of a circle which is concentric with that of the ring body 100. The ring ensures that the prongs 112 frictionally secure the ring to the shaft S, and that the circumferentially extending inclined spring fingers apply a resilient force to the machine part P.

The shaft S is provided with means for establishing a fixed ring-stop position beyond which the ring cannot be further pushed along the shaft, which position in turn determines the reaction plane of the ring from which the spring fingers will start to impose this resilient loading and/or positioning force on said machine part. Such means comprise an axially directed shoulder 118 on the shaft. This is effected by forming the end portion of the shaft, which receives and mounts the ring, as a section of reduced diameter so that a shoulder is formed which is engageable by the ring body 100. Thus, when the ring body 100 is pushed tight against the shoulder 118 and secured in place by the gripping effect of the prongs 112, it provides a fixed annulus against which the circumferentially extending spring fingers 116 react.

The spring fingers 116 are constructed to allow the retained part P to move a limited distance towards the fixedly held ring body 100. Thus the spring fingers are capable of cushioning the ring against sudden shock loads likely to be applied thereagainst by the retained machine part. By making the circumferentially extending spring fingers 116 longer or shorter, the cushioning power thereof can be varied in a predetermined manner. Furthermore, by varying the length and/or stiffness of the fingers 116, they can be made to function as a means for holding the machine part P at different axial locations along the shaft which locations are related to different loads applied thereto. Thus, a unitary retaining ring having fingers 116 is capable of locating the axial position of a machine part on a shaft in accordance with its loading simply by setting the spring bias exerted by the fingers so that the machine part retained thereby will assume one position for one load, a second position for another load, and so on, which in certain electrical and/or mechanical constructions is highly desirable.

Figs. 7, 8 and 11, show a ring fitting in an axial bore. This ring comprises a closed circular ring body 120 formed with integral prongs 122. Circumferentially extending spring fingers 124 project as shown in Figs. 7 and 11 from respective ones of the inner prongs 124a (Fig. 11). Comparing this ring body 120 to the ring body 100 shown in

Fig. 5, the circumferentially extending spring fingers 124 are interchanged so as to project from the outer prongs in Fig. 5 and from the inner prongs in Fig. 11. Thus, the outer prongs 122 project progressively radially outwards from the outer edge of the ring body 120 so as to grip the bore surface, the inner prongs project progressively inwards in a radial direction from the inner edge of the ring body 120, and the circumferentially extending spring fingers 124 project from the inner prongs and extend circumferentially along the inner edge of said ring body.

An assembly including an internal retaining ring is shown in Fig. 8, in which a housing H is provided with a cylindrical bore and P' is a machine part disposed within the bore and being located axially therealong by said internal ring. There is provided in the bore a ring-stop shoulder 128 comparing in function to the previously described ring-stop shoulder 118 provided on the shaft S. In the drawing, the shoulder 128 is formed by an annular bottom wall of a counterbore which opens into the main cylindrical bore. The ring 120, is inserted into the housing bore and shifted along the same until its annular body portion fits tightly against the shoulder 128.

In this position the ring body 120 defines a fixed axial plane with respect to the bore. The free ends of the circumferentially extending spring fingers 124 are disposed to press against the end face of the machine part P'. The assembly, is designed so that the fingers 124 exert a predetermined resilient pressure against said machine part P'. Thus, the retaining ring provides in effect a resilient shoulder which allows the retained machine part P' to move a limited distance towards the secured body 120 of the ring. This limited movement cushions the ring against suddenly applied shock loads likely to be transmitted thereto by said machine part. Furthermore, by varying the length and/or stiffness of the circumferentially extending spring fingers 124, the ring as a whole may be employed to position the machine part P' within the bore in different axial positions therealong which are related to different loads, just as the external ring may be so employed as earlier described.

While the ring body 120 of the internal form of retaining ring shown in Figs. 7, 8 and 11 has been shown to be planar, it may, for added strength or reinforcement as needed, have the truncated conical configuration shown in Fig. 9, wherein reference numerals 120x designate the ring body, 122x the retaining prongs, and 124x the circumferentially extending spring fingers which project from respective ones of the inner prongs. It is also possible to supply added strength or reinforcement as needed to the external form of retaining ring shown in

Figs. 4, 5, 6 and 10 by providing the ring body 100 thereof with truncated conical configuration corresponding to that shown in Fig. 9.

WHAT WE CLAIM IS:—

1. A retaining ring comprising an annular body portion, a first plurality of prongs extending at spaced intervals from the outer periphery of the annular body portion and a second plurality of prongs extending at spaced intervals from the inner periphery of the annular body portion, each of the first plurality of prongs progressively extending outwards in a radial direction from the outer periphery and each of the second plurality of prongs progressively extending inwards in a radial direction from the inner periphery, whereby the retaining ring is locatable on or in a first member which engages the projecting tips of either the first or the second plurality of prongs respectively in such a manner that one of the respective pluralities of prongs provide locating prongs which are radially compressed by contact with the body and the respective other of the respective pluralities of prongs provide retaining prongs for retaining a second member in a predetermined position relative to the first member.
2. A retaining ring as claimed in claim 1, wherein said retaining prongs project in a radial direction from the annular portion and are inclined to a general plane of the annular portion.
3. A retaining ring as claimed in claim 2, wherein said retaining prongs are inclined to a general plane of the annular portion in the same direction as said locating prongs.
4. A retaining ring as claimed in claim 3, wherein said retaining prongs have stiffness so as in use to prevent any substantial end play of the second member and to allow angular adjustment of the second member.
5. A retaining ring as claimed in claim 4, wherein said retaining prongs are formed with a stiffness which is such as to permit limited movement of the second member in the direction of the ring.
6. A retaining ring as claimed in any one of claims 1 to 3, comprising a plurality of fingers each extending from a respective one of said retaining prongs along an arc of a circle concentric with the annular body portion and inclined in a direction opposite to the inclination of said locating prongs.
7. A retaining ring as claimed in claim 4, wherein each of said fingers lies on an arc of the same circle.
8. A retaining ring as claimed in claim 4 or 5, wherein the length and stiffness of said fingers is such that said fingers in use apply a predetermined bias force to said second member.
9. A retaining ring as claimed in claim 6,



Fig. 5, the circumferentially extending spring fingers 124 are interchanged so as to project from the outer prongs in Fig. 5 and from the inner prongs in Fig. 11. Thus, the outer prongs 122 project progressively radially outwards from the outer edge of the ring body 120 so as to grip the bore surface, the inner prongs project progressively inwards in a radial direction from the inner edge of the ring body 120, and the circumferentially extending spring fingers 124 project from the inner prongs and extend circumferentially along the inner edge of said ring body.

An assembly including an internal retaining ring is shown in Fig. 8, in which a housing H is provided with a cylindrical bore and P' is a machine part disposed within the bore and being located axially therealong by said internal ring. There is provided in the bore a ring-stop shoulder 128 comparing in function to the previously described ring-stop shoulder 118 provided on the shaft S. In the drawing, the shoulder 128 is formed by an annular bottom wall of a counterbore which opens into the main cylindrical bore. The ring 120, is inserted into the housing bore and shifted along the same until its annular body portion fits tightly against the shoulder 128.

In this position the ring body 120 defines a fixed axial plane with respect to the bore. The free ends of the circumferentially extending spring fingers 124 are disposed to press against the end face of the machine part P'. The assembly, is designed so that the fingers 124 exert a predetermined resilient pressure against said machine part P'. Thus, the retaining ring provides in effect a resilient shoulder which allows the retained machine part P' to move a limited distance towards the secured body 120 of the ring. This limited movement cushions the ring against suddenly applied shock loads likely to be transmitted thereto by said machine part. Furthermore, by varying the length and/or stiffness of the circumferentially extending spring fingers 124, the ring as a whole may be employed to position the machine part P' within the bore in different axial positions therealong which are related to different loads, just as the external ring may be so employed as earlier described.

While the ring body 120 of the internal form of retaining ring shown in Figs. 7, 8 and 11 has been shown to be planar, it may, for added strength or reinforcement as needed, have the truncated conical configuration shown in Fig. 9, wherein reference numerals 120x designate the ring body, 122x the retaining prongs, and 124x the circumferentially extending spring fingers which project from respective ones of the inner prongs. It is also possible to supply added strength or reinforcement as needed to the external form of retaining ring shown in

Figs. 4, 5, 6 and 10 by providing the ring body 100 thereof with truncated conical configuration corresponding to that shown in Fig. 9.

WHAT WE CLAIM IS:—

1. A retaining ring comprising an annular body portion, a first plurality of prongs extending at spaced intervals from the outer periphery of the annular body portion and a second plurality of prongs extending at spaced intervals from the inner periphery of the annular body portion, each of the first plurality of prongs progressively extending outwards in a radial direction from the outer periphery and each of the second plurality of prongs progressively extending inwards in a radial direction from the inner periphery, whereby the retaining ring is locatable on or in a first member which engages the projecting tips of either the first or the second plurality of prongs respectively in such a manner that one of the respective pluralities of prongs provide locating prongs which are radially compressed by contact with the body and the respective other of the respective pluralities of prongs provide retaining prongs for retaining a second member in a predetermined position relative to the first member.

2. A retaining ring as claimed in claim 1, wherein said retaining prongs project in a radial direction from the annular portion and are inclined to a general plane of the annular portion.

3. A retaining ring as claimed in claim 2, wherein said retaining prongs are inclined to a general plane of the annular portion in the same direction as said locating prongs.

4. A retaining ring as claimed in claim 3, wherein said retaining prongs have stiffness so as in use to prevent any substantial end play of the second member and to allow angular adjustment of the second member.

5. A retaining ring as claimed in claim 4, wherein said retaining prongs are formed with a stiffness which is such as to permit limited movement of the second member in the direction of the ring.

6. A retaining ring as claimed in any one of claims 1 to 3, comprising a plurality of fingers each extending from a respective one of said retaining prongs along an arc of a circle concentric with the annular body portion and inclined in a direction opposite to the inclination of said locating prongs.

7. A retaining ring as claimed in claim 4, wherein each of said fingers lies on an arc of the same circle.

8. A retaining ring as claimed in claim 4 or 5, wherein the length and stiffness of said fingers is such that said fingers in use apply a predetermined bias force to said second member.

9. A retaining ring as claimed in claim 6,



wherein said locating prongs correspond to said first plurality of prongs.

10. A retaining ring as claimed in claim 6, wherein said locating prongs correspond to said second plurality of prongs.

11. A retaining ring as claimed in any one of the preceding claims, wherein said annular body portion is frusto-conical.

12. A retaining ring as claimed in claim 9, wherein the outer periphery and the inner periphery of said annular body portion are each provided with a rim flange from which said first plurality and said second plurality of prongs project, respectively.

13. A retaining ring as claimed in any one of the preceding claims, wherein said retaining ring is formed as a unitary article.

14. An assembly comprising a first member provided with a cylindrical surface and a retaining ring as claimed in claim 1 for locating a second member at an axial position along said cylindrical surface.

15. An assembly as claimed in claim 14, wherein said cylindrical surface is formed by the surface of a cylindrical bore and said second member is provided with a generally spherical part having a surface portion adapted to seat on a seating in bore, said retaining ring being operative to retain said surface portion normally seated on said seating by means of said second plurality of prongs forming the retaining prongs and having the free ends thereof arranged to lie on a circle of smaller diameter than said spherical part and engaging a spherical surface portion of said part spaced from that which seats on said seating means.

16. An assembly as claimed in claim 15, wherein said second plurality of prongs are the retaining prongs and are formed with a stiffness requisite to substantially prevent any end play of the second member retained thereby.

17. An assembly as claimed in claim 15, wherein said second plurality of prongs are the retaining prongs and are formed with a stiffness which permits limited movement of the second member in the direction of the ring axis.

18. An assembly as claimed in claim 15, wherein the first member comprises a housing having the cylindrical bore which houses a ball joint, said second member comprising the generally spherical part providing the ball of said joint, said first plurality of prongs are the locating prongs which secure said ring to the bore surface in a position such that said second plurality of prongs bear against and are effective to retain the ball against any substantial end play while permitting the ball to adjust its angular position with respect to the ring.

19. An assembly as claimed in claim 16, wherein said first member comprises a valve body having the cylindrical bore the seating

being for a ball valve and a smooth surface cylindrical bore portion of enlarged diameter disposed adjacent said seating, said second member comprising a ball check valve having a spherical surface portion adapted to seat on said seating, the remainder of said spherical surface portion extending into said smooth-surface cylindrical bore portion, said first plurality of prongs secure said ring to the cylindrical surface of said enlarged-diameter bore portion and in a position such that the free ends of said second set of prongs bear against a portion of the remainder of said spherical surface portion of said ball.

20. An assembly as claimed in claim 14, wherein said retaining ring is provided with a plurality of fingers each connected to a respective one of said retaining prongs and extending therefrom along an arc of a circle concentric with said said ring and inclined in a direction opposite to that of said locating prongs such that said retaining ring is secured at an axial position along said cylindrical surface which causes said spring fingers to resiliently bias an end face of said second member, and the length and stiffness of said spring fingers is such as to enable variation of the bias acting on said end face in a predetermined manner.

21. An assembly as claimed in claim 20, wherein said first member comprises a shaft said second plurality of prongs correspond to said locating prongs which engage the external surface of said shaft.

22. An assembly as claimed in claim 20, wherein said first member comprises a housing having a cylindrical bore in which said second member is disposed, and said first plurality of prongs are the locating prongs which secure said ring to the bore surface.

23. An assembly as claimed in any one of claims 20 to 22, wherein said first member is provided with ring-stop means for determining said secured position of the ring.

24. An assembly as claimed in claim 20, wherein said shaft is formed with an annular shoulder against which said ring is held by the locating prongs and which defines the secured position of said ring.

25. An assembly as claimed in claim 22, wherein said bore is formed with an annular shoulder against which said ring is held by the action of the locating prongs and which defines the secured position of the ring.

26. A retaining ring substantially as hereinbefore described with reference to Figs. 1 and 2 of the accompanying drawings.

27. A retaining ring substantially as hereinbefore described with reference to Figs. 5, 6 and 10 of the accompanying drawings.

28. A retaining ring substantially as hereinbefore described with reference to Figs. 7, 8 and 11 or Figs. 7, 8 and 11 as modified by Fig. 9 of the accompanying drawings.

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29. An assembly including a retaining ring as claimed in any one of claims 1 to 13 and 26 to 28.
- 5 30. An assembly including a retaining ring substantially as hereinbefore described with reference to Figs. 3 and 4 of the accompanying drawings.
- 10 31. An assembly including a retaining ring substantially as hereinbefore described with reference to Figs. 5, 6 and 10 of the accompanying drawings.

32. An assembly including a retaining ring substantially as hereinbefore described with reference to either Figs. 7, 8 and 11 or Figs. 7, 8 and 11 as modified by Fig. 9 of the accompanying drawings. 15

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75, Victoria Street,
London, S.W.1.
Chartered Patent Agents,
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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1971.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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