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(54) A COMBINED MOULD ELEMENT AND SEALING RING

(71) We, RIEBER & SØN A/S, a Norwegian Company of Nøstegt. 58, 5000 Bergen, Norway, 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 a combined mould element and sealing ring, and is concerned with a reinforced combined forming element and sealing ring for sealing pipe socket joints which may be exposed to high internal pressures as well as low pressure and vacuum.

In this Specification, the expressions "mould element" and "sealing ring" are used hereinafter to clarify distinct effects in each case. It will, however, be understood that both expressions refer to one and the same construction unit. For example, the sealing ring is used for sealing off a joint between a socket end and an insert end of two co-operating pipes which are formed from thermoplastic material. The mould or forming element is used as a portion of a body of a mould for both fabricating the socket end of one pipe and simultaneously inserting the ring in an internal groove or race-way in the socket end produced thereby. Usually, the mould element is mounted on a drift for this purpose and is made of an elastically yieldable material such as rubber.

Generally, during assembling and joining of the spigot and socket ends, the sealing ring will be compressed in a manner corresponding substantially to the compression which the mould element is exposed to during the disassembling of the mould element from the drift. Usually, the drift has an external form corresponding essentially to the internal form of the pipe socket to be produced. The internal form of the pipe to be produced, is thus, substantially cylindrical with a sealing ring extending somewhat radially inwards so as to provide a seal against a spigot end of a

pipe which is to be inserted in the socket. However, when the spigot is inserted into the socket, it is of importance that the sealing ring is not dislocated or pushed out of the groove even if the spigot is not properly chamfered.

Further, it is known that the expansion of the grooved portion of the socket end, wherein the sealing ring is supported, stretches this portion into a relatively thin and thus weakened pipe wall. During storage and transportation, therefore, the pipes usually rest on the most stretched out parts of the pipe ends. Unintentional earth loading, traffic load, stones and the like will also be more easily transferred to these most outwardly projecting parts of the socket end. Hence, a support of these parts is advantageous to prevent unintended deformations, and even breakages, as a consequence of blows as may readily occur during transportation and handling of the pipes as well as during installation of the pipelines. In connection with heat strains in the pipe, such as can occur on storage (slacking of the pipes) in hot summer weather, and by use close to sources of heat (steam pipes in the same ditch) etc., there is an advantage in bracing the annular groove by use of a stiffened sealing ring to avoid deformation and the like which may lead to loss of compression and leakages.

According to the present invention there is provided a combined mould element and sealing ring comprising an annular body of uniform cross-section of elastically yieldable material disposed circumferentially about an axis and including a rigid reinforcing ring member positioned in said annular body, said cross-section comprising a rearward nose portion opposed to a forward leading edge portion, a radially inwardly protruding sealing portion located between said opposed portions and a radially outwardly directed portion extending from the rearward end of a generator line for a frustoconi-

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cal outer surface extending outwardly from said leading edge portion, the rigid reinforcing ring member being positioned between said generator line and a line joining the rearmost point on the nose portion and the foremost point on the leading edge portion, and the centroid of the cross-section of the rigid reinforcing ring member lying on a line perpendicular to the axis of the combined mould element and sealing ring which passes through a part of or through the adjacent areas of the inwardly protruding sealing portion.

The combined mould element and sealing ring, may be used to form a groove with a locked in sealing ring during the socketing operation of a hot end of a pipe. By locating the rigid reinforcing element of the combined element in the outer radial portion, the anchoring effect of the element within the socket of the pipe is facilitated.

The hot pipe can be formed with rather steep angles and small curves in the most stretched portions of the groove. Also, by allowing the hot pipe end to be sucked down with a steep angle in front of the outer radial portion of the combined element, the anchoring effect is improved. A steep angle is achieved by making a step in the outer radial portion of the mould for manufacturing the combined elements and, at the same time, the positioning of the rigid member may be facilitated during the moulding operation by positioning the ring member at the step in the mould. In order to anchor the sealing ring against being pressed out in the annular gap between spigot and socket by internal pressure in the pipeline, it is advantageous to position the rigid ring member close to the rear of the combined element. In order to anchor the sealing ring against being dislocated or pushed out of the groove by the spigot during assembling of the pipes, it is, however, advantageous to place the rigid ring member close to the front, that is, close to a leading edge.

In one embodiment, the inner peripheral surface of the annular body has a frusto-conically shaped portion extending from the sealing portion to define a leading edge with the outer surface portion. In another embodiment, the inner peripheral surface has a second portion spaced from the sealing portion and defining a leading edge with the outer peripheral surface.

The reinforcing member may either be completely or partially embedded within the annular body and may be of any suitable cross-sectional shape to obtain the specific advantages desired in each case. For example, the reinforcing member may be a ring of annular or curvilinear cross-section or may be made of a pair of annular rings with a plurality of webs connecting the rings together.

The inner peripheral sealing portion of the annular body may be rounded or flat or may be formed as a sealing lip. Similarly, the annular body may have a rounded or flattened outer radial portion.

The combined mould element and sealing ring may be positioned in a pipe joint comprised of two pipes. For example, where the pipes are made of PVC, the mould element is mounted on a drift of a mould apparatus and one pipe end is heated and forced over the mould element. This causes the pipe end to form a socket with an internal annular groove or race-way about the mould element as described in the specification of our United Kingdom Patent Serial No. 1511274. Thereafter, the mould element and pipe socket are removed from the mould apparatus, and the end of another pipe is inserted as a spigot into the socket end.

The sealing elements can be manufactured economically and with very close tolerances. This is achieved by making the sealing element with very little elastically yieldable material, i.e. very little rubber bulk and by anchoring the rubber bulk to a rigid ring member in a portion radially opposite the sealing portion. In the case of ordinary rubber-sealing rings there are limitations in how small the rings can be made because rings with little rubber bulk are easily dislocated or pressed out of the race-way by joining of a pipeline or pressed out into the annular gap between a spigot end and socket end by internal pressure in a pipeline.

It is a general tendency that sealing rings and especially unreinforced sealing rings may be squeezed out of the gap spacing the spigot end from the socket end when exposed to high internal pressure. This may also be the case with sealing rings reinforced with rigid ring members of minor thickness. However, in the present case, this problem can be solved by using a reinforcing member provided with a minimum cross-sectional dimension, i.e. a cross-section diameter, greater than the annular space separating the outer surface of the spigot end from the inner surface of the socket end.

Other limitations of ordinary sealing rings reside in the need for relatively large production tolerances which demand relatively much rubber volume to assure the sealing effect between socket and spigot. By locating the rigid ring member close to or in the same radial plane as the sealing area of the sealing ring, it is possible to produce sealing rings with very close diameter tolerances in the sealing area. This allows the rubber bulk to be reduced without influencing the sealing property of the sealing ring and at the same time eliminates the possibility of dislocating or pushing out the rubber ring with the spigot end during assembling or by internal pressure in the pipeline.

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Further, because the bulk of the sealing ring can be reduced, it is also possible to reduce the height of the race-way. This reduces the stretching and the thinning of the race-way and thus gives great advantages to the strength of the pipeline.

The invention will now be described by way of example with reference to the figures of the accompanying drawings, in which:-

Figure 1 illustrates a part cross-sectional view of a combined mould element and sealing ring in accordance with the invention;

Figure 2 illustrates a part cross-sectional view of a modified combined mould element and sealing ring having a second inner peripheral portion defining a leading edge with an outer surface portion in accordance with the invention;

Figure 3 illustrates a part cross-sectional view of a further modified combined mould element and sealing ring having a rounded leading edge in accordance with the invention;

Figure 4 illustrates a part cross-sectional view of a further modified combined mould element and sealing ring having a reinforcing member of curvilinear cross-section in accordance with the invention;

Figure 5 illustrates a part cross-sectional view of a further modified combined mould element and sealing ring having a reinforcing member composed of a pair of rings of circular cross-section;

Figure 6 illustrates a part cross-sectional view of a modified mould element and sealing ring having a sealing lip on the inner periphery in accordance with the invention;

Figure 7 illustrates a part cross-sectional view of a combined mould element and sealing ring similar to that of Figure 2 on a drift of a mould apparatus;

Figure 8 illustrates a part cross-sectional view of a combined mould element and sealing ring similar to that of Figure 2 on a drift of a mould apparatus with a pipe socket formed thereover;

Figure 9 illustrates a part cross-sectional view of a combined mould element and sealing ring similar to that of Figure 2 in a pipe socket;

Figure 10 illustrates a part cross-sectional view of a pipe joint in a pipeline with internal pressure imposed on the combined mould element and sealing ring similar to that of Figure 2, and

Figure 11 illustrates a part sectional view of one embodiment of a die for manufacturing of a combined mould element and sealing ring in accordance with the invention.

In Figure 1, a combined mould element and sealing ring shown generally at 20 comprises an annular body 21 of elastically yieldable material, such as rubber, and a rigid reinforcing ring member 22. The annular body 21 is of a cross-section which is gener-

ally that of a liquid drop when its axis BB_1 is placed vertically. The body 21 has an inner peripheral surface that is to say in toward the axis AA_1 defining a radially inwardly protruding rounded sealing portion 23 and a plain frusto-conically shaped surface portion 24 extending from the rounded portion 23, an obliquely extending (i.e. frusto-conical) outer surface 25 that is to say out from the axis AA_1 on one side which forms a leading edge portion 26 with the plain frusto-conically shaped surface portion 24, an outer peripheral surface having a radially outwardly directed surface portion 27 adjacent the outer surface portion 25 and a portion 28 on the side opposite leading edge portion 26. The rigid reinforcing ring member 22 is in the form of a torus of circular cross-section and is embedded close to the rearward nose portion 28, i.e. at a position where the said nose portion 28, i.e. at a position where the said nose portion 28 and the radially outwardly directed surface portion 27 merge. The surface of the ring member 22 is thereby placed close to a transition portion between the rearward nose portion 28 and said surface portion 27.

A radial plane R_1R_2 passes through the sealing portion 23 and is between a radial plane R_3R_4 that passes through the centre of the ring member 22 and a leading side portion defined between the plain frusto-conically shaped surface portion 24 and the frusto-conical outer surface 25. Each radial plane is defined as a plane perpendicular to the centre line AA_1 of a pipe (not shown); see U.S. 4030872 (U.K. 1511274).

In Figure 2, wherein like reference characters but with a suffix 2 indicate like parts as in Figure 1 above, a combined mould and seal ring 30 has a plain or slightly frusto-conical inner portion 41 spaced from a sealing portion 23₂. This portion 41 tapers radially outwardly towards a frusto-conical leading surface portion 24₂ to form a leading edge 26₂. In addition, a recessed portion 42 of concave shape is formed between the sealing portion or rounded portion 23₂ and the portion 41. A radial plane R_3R_4 that passes through the centre of the member 22₂ is located between a radial plane R_1R_2 that passes through the mid-point of the sealing portion or rounded portion 23₂ and a radial plane G through the leading surface portion 25₂. The position of the ring member 22₂ is chosen at a level radially outside the leading edge 26₂ of the combined mould element and seal ring 40 in order, thereby, to ensure an intentional pressing down of the leading edge 26₂ during the pushing on of a hot pipe end (not shown) over the combined mould element and seal ring 40.

In Figure 3, wherein like reference characters but with a suffix 3 indicate like parts as above in Figures 1 and 2, a combined mould

and sealing ring shown generally at 50 is formed with an asymmetric shape having a rounded leading edge portion 51 on one side adjacent a frusto-conical portion 25. This leading portion 51 merges with an inner peripheral portion 23, to define a concave recess therebetween. The cross-section of the combined mould and sealing ring 50 is suitable for a mould apparatus as described in U.S. Patent Specification No. 3793427.

In Figure 4, wherein like reference characters but with a suffix 4 indicate like parts as above in Figures 1, 2 and 3, a combined mould element and sealing ring shown generally at 60 is formed with an annular ring member 61 which is of curvilinear cross-section. As shown, the ring member 61 is in the form of a metal hoop ring member of especially rigid form, which is particularly favourable for the reception of external as well as internal radial loadings. The ring member 61 is disposed with an exposed surface between a nose portion 28, and outer peripheral portion 27, of an annular body 21. In this way, the ring member 61 is especially suitable for forming an internal support for the socket and the weakened stretched raceway. The ring member 61 will, in addition, form an effective support for the sealing ring and prevent the unit 60 from being pressed into the annular gap between spigot end and socket end by internal excess pressure in the pipe line (see Figure 10).

It is apparent that the ring member can be designed in various other ways and can be positioned in various ways other than those which are shown in order to be adapted according to existing support means of the mould apparatus or in order to satisfy other demands of the sealing ring. If desired, as shown in Figure 5, a combined mould element and sealing ring shown generally at 70 includes two or more ring members 62, 62₁ combined in one and the same construction and, moreover, such ring members 62, 62₁ can be connected to each other into coherent rigid member, for example with separate connecting webs 63 between the rings 62, 62₁.

Further, as shown in Figure 6, a combined mould element and sealing ring 80 may be formed with an internal peripheral portion 71 which defines a sealing lip (shown in an unloaded state). In this case, a recess 72 is formed between the sealing lip 71 and a plain portion 41. Thus, instead of forming a compression seal when in place, a lip seal is formed.

Referring to Figure 7, a mould apparatus 31 for forming a socket in an end of a thermoplastic pipe (not shown) to receive a combined mould element and sealing ring 40 (similar to Figure 2) includes a drift 32 with a recess 33 and a support ring 34. The recess 33 accommodates the annular body 21 of the

combined mould element and sealing ring 40 and the support ring 34 is shaped to mate with the rounded nose portion 28 and to force the said rounded nose portion 28 upwards to avoid any tilting of the mould element that could cause "fish mouthing" with the pipe end and mould element during pushing on the hot pipe end (Figure 8). The manner of forming a pipe end over the combined mould and sealing ring 40 in the mould apparatus 31 is similar to that as described in the specification of our United Kingdom Patent 1511274 and need not be further described here. As shown in Figure 8, a pipe 35 is bulged radially outwardly over the combined mould element and sealing ring 40 and has a groove or race-way 36 in which the combined mould element and sealing ring 40 is received. As shown in Figure 9, the inner diameter d of the combined mould element and sealing ring 40 is less than the inner diameter D of the socket end of the pipe 35. Also, as shown, the pipe 35 and combined mould element and sealing ring 40 mate against each other almost continuously from the rounded nose portion 28 to the leading edge portion 26 (depending somewhat on pipe thickness).

As shown in Figure 10, after positioning of a second pipe 37 having a chamfered spigot end 37A within the pipe 35, the combined mould element and sealing ring 40 forms a tight seal between the pipes 35, 37. As shown, the inner pipe 37 has an outer diameter greater than the inner diameter of the combined mould element and sealing ring 40. Thus, the body 21 of the combined mould element and sealing ring 40 is compressed and yieldably deformed. However, the ring member 22 is not deformed and remains in original shape. This serves positively to retain the combined mould element and sealing ring 40 in place against pressures imposed on it within the gaps between the pipes 35, 37.

In Figure 10, the sealing ring 40 is pressed into the annular gap between the socket end of pipe 35 and spigot end 37A by internal pressure in the pipe line but is anchored by the reinforcement of the ring member 22, e.g. a steel ring, moulded into the rubber of the annular body 21.

Returning to Figure 7 it further illustrates how the reinforcing ring member 22 together with the supporting ring 34 securely holds the combined mould element and sealing ring 40 on the drift 32 by compressing the rubber against the drift 32. The dotted line shows the unloaded position of the rounded nose portion 28. The reinforcing ring member 22 allows the rubber to be pressed against the drift surface without allowing the outer portion of the combined mould element and sealing ring 40 to be stretched or dislocated and the supporting ring 34 avoids

any tilting of the combined mould element and sealing ring. This allows a hot pipe end to be pushed over the drift 32 and the combined mould element and sealing ring 40 while retaining the correct outer contours of the race-way when the pipe has been shrunk, sucked and cooled down according to U.S. Patent No. 3776682 as shown in Figure 8. In Figure 8, the dotted lines show the position of the rounded nose portion 28 before retraction of the supporting ring 34.

The drift 32 according to Figure 7 has longitudinal slots 38 to allow air to be sucked out on both sides of the combined mould element and sealing ring via vacuum bores (not shown). In order to avoid "fish mouthing" and to assure a good positioning of the combined mould element and sealing ring 40 on the drift 32, a small recess 33 for the combined mould element and sealing ring 40 is provided above the longitudinal slots 38. The section C, as marked with crossing lines, shows the compression of the combined mould element and sealing ring against the drift 32.

Referring again to Figure 2, by positioning the reinforcing ring member 22 over the sealing portion 23 or in a direction towards the leading edge 25, any tilting of the combined mould element and sealing ring is avoided during its movement axially on a drift, and no "fishing mouthing" occurs during the following pushing on the hot pipe end. In case the reinforcing ring member 22 is positioned more to the left, as viewed, the tilting and "fish mouthing" can be avoided by using a support ring 34, as shown in Figure 7, to lift up the nose section and force the leading edge portion 26 down on to the drift.

As shown in Figures 8 and 10, pressure areas E are initially formed in the sealing portion 23 of the combined mould element and sealing ring 40 when moving it into position on the drift as illustrated in Figure 7, and thereafter, are formed in the outer periphery after the hot pipe end is moved over the combined mould element and sealing ring 40, as illustrated in Figure 8, and hence cooled and shrunk radially towards the combined mould element and sealing ring 40 and the drift 32. In these manufacturing steps of the pipe socket end, the rigid reinforcing ring member 22 reinforces the combined mould element and sealing ring 40 in order to control the pressure effects involved in the internal as well as in the external parts of the combined mould element and sealing ring 40. Referring to Figure 9, after the socket end and the associated combined mould element and sealing ring 40 are removed from the drift, the pressured areas as illustrated in Figure 8 are substantially released. The remaining compression as illustrated in areas F assures a good bite and prevents dirt and the like from penetrating into the sealing

areas. When moving a spigot end into a socket end, the combined mould element and sealing ring 40 will be compressed similarly to the compression illustrated in the manufacturing step of Figure 8 and similar pressure areas will arise in the socket end and in the spigot end. Referring to Figure 10, when a pressure medium is transported through a pressure pipe line incorporating the illustrated pipe joint, the medium is allowed to penetrate into a gap formed between the combined mould element and sealing ring 40 and the socket end. In this latter case, the pressure areas E of the combined mould element and sealing ring 40 are located as indicated in Figure 10. The effect of the pressure areas provided by the resilient body 21 of the combined mould element and sealing ring 40 in co-operation with the reinforcing ring member 22 of the sealing unit provides an effective seal against leakage between the socket end and the spigot end of the illustrated pipe line joint.

Referring to Figure 11, a combined mould element and sealing ring 40 can be formed in a mould in a known manner. For example, the combined mould element and sealing ring 40 can be formed in a cavity 80 formed between three separate, cooperating die parts 81, 82, 83. The manufacturing of the combined mould element and sealing ring 40 is made by locating a prefabricated steel reinforcing ring member 22 in the cavity 80 on a set of pins 84 which might be withdrawable. Only one pin is illustrated in the drawing in dotted lines. These pins 84 protrude from the internal side of one part 82 of the die in mutually spaced relation along the internal side of the die part. By means of such pins, each ring is supported in a relatively accurate manner in the die to secure accurate reinforcing effects in the combined mould element and sealing ring 40 produced therein. Before the produced unit is removed from the die, the pins 84 are withdrawn from the unit and the associated die part. The elasticity of the rubber allows release of the combined mould element and sealing ring 40 from the mould and the pins, even if the pins are permanently connected to the mould surface and are not movable relative thereto.

The mould portions are withdrawn in directions x, y, relative to the combined mould element and sealing ring 40 in order to release it.

All the accompanying Figures of the combined sealing and forming element cross-section show the reinforcement placed near the rubber surface. However, the reinforcement can be located in spaced relation from the outer surface.

WHAT WE CLAIM IS:-

1. A combined mould element and sealing ring comprising an annular body of uniform cross-section of elastically yieldable



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any tilting of the combined mould element and sealing ring. This allows a hot pipe end to be pushed over the drift 32 and the combined mould element and sealing ring 40 while retaining the correct outer contours of the race-way when the pipe has been shrunk, sucked and cooled down according to U.S. Patent No. 3776682 as shown in Figure 8. In Figure 8, the dotted lines show the position of the rounded nose portion 28 before retraction of the supporting ring 34.

The drift 32 according to Figure 7 has longitudinal slots 38 to allow air to be sucked out on both sides of the combined mould element and sealing ring via vacuum bores (not shown). In order to avoid "fish mouthing" and to assure a good positioning of the combined mould element and sealing ring 40 on the drift 32, a small recess 33 for the combined mould element and sealing ring 40 is provided above the longitudinal slots 38. The section C, as marked with crossing lines, shows the compression of the combined mould element and sealing ring against the drift 32.

Referring again to Figure 2, by positioning the reinforcing ring member 22 over the sealing portion 23 or in a direction towards the leading edge 25, any tilting of the combined mould element and sealing ring is avoided during its movement axially on a drift, and no "fishing mouthing" occurs during the following pushing on the hot pipe end. In case the reinforcing ring member 22 is positioned more to the left, as viewed, the tilting and "fish mouthing" can be avoided by using a support ring 34, as shown in Figure 7, to lift up the nose section and force the leading edge portion 26 down on to the drift.

As shown in Figures 8 and 10, pressure areas E are initially formed in the sealing portion 23 of the combined mould element and sealing ring 40 when moving it into position on the drift as illustrated in Figure 7, and thereafter, are formed in the outer periphery after the hot pipe end is moved over the combined mould element and sealing ring 40, as illustrated in Figure 8, and hence cooled and shrunk radially towards the combined mould element and sealing ring 40 and the drift 32. In these manufacturing steps of the pipe socket end, the rigid reinforcing ring member 22 reinforces the combined mould element and sealing ring 40 in order to control the pressure effects involved in the internal as well as in the external parts of the combined mould element and sealing ring 40. Referring to Figure 9, after the socket end and the associated combined mould element and sealing ring 40 are removed from the drift, the pressured areas as illustrated in Figure 8 are substantially released. The remaining compression as illustrated in areas F assures a good bite and prevents dirt and the like from penetrating into the sealing

areas. When moving a spigot end into a socket end, the combined mould element and sealing ring 40 will be compressed similarly to the compression illustrated in the manufacturing step of Figure 8 and similar pressure areas will arise in the socket end and in the spigot end. Referring to Figure 10, when a pressure medium is transported through a pressure pipe line incorporating the illustrated pipe joint, the medium is allowed to penetrate into a gap formed between the combined mould element and sealing ring 40 and the socket end. In this latter case, the pressure areas E of the combined mould element and sealing ring 40 are located as indicated in Figure 10. The effect of the pressure areas provided by the resilient body 21 of the combined mould element and sealing ring 40 in co-operation with the reinforcing ring member 22 of the sealing unit provides an effective seal against leakage between the socket end and the spigot end of the illustrated pipe line joint.

Referring to Figure 11, a combined mould element and sealing ring 40 can be formed in a mould in a known manner. For example, the combined mould element and sealing ring 40 can be formed in a cavity 80 formed between three separate, cooperating die parts 81, 82, 83. The manufacturing of the combined mould element and sealing ring 40 is made by locating a prefabricated steel reinforcing ring member 22 in the cavity 80 on a set of pins 84 which might be withdrawable. Only one pin is illustrated in the drawing in dotted lines. These pins 84 protrude from the internal side of one part 82 of the die in mutually spaced relation along the internal side of the die part. By means of such pins, each ring is supported in a relatively accurate manner in the die to secure accurate reinforcing effects in the combined mould element and sealing ring 40 produced therein. Before the produced unit is removed from the die, the pins 84 are withdrawn from the unit and the associated die part. The elasticity of the rubber allows release of the combined mould element and sealing ring 40 from the mould and the pins, even if the pins are permanently connected to the mould surface and are not movable relative thereto.

The mould portions are withdrawn in directions x, y, relative to the combined mould element and sealing ring 40 in order to release it.

All the accompanying Figures of the combined sealing and forming element cross-section show the reinforcement placed near the rubber surface. However, the reinforcement can be located in spaced relation from the outer surface.

WHAT WE CLAIM IS:-

1. A combined mould element and sealing ring comprising an annular body of uniform cross-section of elastically yieldable

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material disposed circumferentially about an axis and including a rigid reinforcing ring member positioned in said annular body, said cross-section comprising a rearward nose portion opposed to a forward leading edge portion, a radially inwardly protruding sealing portion located between said opposed portions, and a radially outwardly directed portion extending from the rearward end of a generator line for a frusto-conical outer surface extending outwardly from said leading edge portion, the rigid reinforcing ring member being positioned between said generator line and a line joining the rearmost point on the nose portion and the foremost point on the leading edge portion, and the centroid of the cross-section of the rigid reinforcing ring member lying on a line perpendicular to the axis of the combined mould element and sealing ring which passes through a part of or through the adjacent areas of the inwardly protruding sealing portion.

2. The combined mould element and sealing ring according to claim 1, wherein said radially inwardly protruding sealing portion has a plain surface portion extending from said portion to define the forward leading edge portion with said frusto-conical outer surface.

3. The combined mould element and sealing ring according to claim 1, wherein said radially inwardly protruding sealing portion has a second plain surface portion spaced from said portion and defining a forward leading edge portion with said frusto-conical outer surface.

4. The combined mould element and sealing ring according to claim 1, wherein a radial plane through said reinforcing ring member is positioned between a first radial plane through said rearward nose portion and a second radial plane through the radially inwardly protruding sealing portion.

5. The combined mould element and sealing ring according to Claim 1 wherein said reinforcing member is a torus of circular cross-section.

6. The combined mould element and sealing ring according to Claim 1 wherein said reinforcing member is an annular ring member having a curvilinear cross-section.

7. The combined mould element and sealing ring according to Claim 1 wherein said reinforcing member comprises a pair of annular rings and a plurality of webs connecting said annular rings together.

8. The combined mould element and sealing ring according to Claim 1 wherein said reinforcing member is completely embedded with said annular body.

9. The combined mould element and sealing ring according to Claim 1 wherein said annular body has a rounded leading edge portion opposite said rearward nose

portion.

10. A combined mould element and sealing ring, constructed and arranged substantially as herein described and as shown in Figures 1, 7, 8, 9, 10, 11, and 12 of the accompanying drawings.

11. A combined mould element and sealing ring, constructed and arranged substantially as herein described and as shown in Figures 2, 7, 8, 9, 10, 11 and 12 of the accompanying drawings.

12. A combined mould element and sealing ring, constructed and arranged substantially as herein described and as shown in Figure 3 of the accompanying drawings.

13. A combined mould element and sealing ring, constructed and arranged substantially as herein described and as shown in Figure 4 of the accompanying drawings.

14. A combined mould element and sealing ring, constructed and arranged substantially as herein described and as shown in Figure 5 of the accompanying drawings.

15. A combined mould element and sealing ring, constructed and arranged substantially as herein described and as shown in Figure 6 of the accompanying drawings.

For the Applicants

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