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(54) PIPE COUPLING

(71) I, GEOFFREY HARRISON, a British subject, of "Brymar", Manley Road, Ilkley, West Yorkshire, do hereby declare the invention, for which I pray that a patent may be granted to me, 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 pipe coupling comprising a coupling sleeve into which one end of a pipe can be received, a resilient annular pipe seal, and a locking ring co-operable with the pipe seal and with the coupling sleeve in order to hold the seal in position against one end of the coupling sleeve, the annular pipe seal having a radially outer portion which engages said one end of the coupling sleeve, and a radially inner portion which extends across the path of entry of a pipe to be received by the coupling sleeve.

A pipe coupling of the above type is particularly suitable for coupling together lengths of earthenware, concrete, plastics (or other materials) underground pipes, especially drainage pipes. In the coupling together of underground pipes in a coupling sleeve, it is essential as far as possible to provide a leak-proof coupling between the pipes, and especially to prevent leakage of any liquid matter from the coupling sleeve to the surrounding environment. Inevitably, there are variations in shape of pipes, especially earthenware pipes (within prescribed tolerances), and also there is a risk of improper coupling between two pipes in a coupling sleeve (e.g. due to unevenness in a trench in which the pipes are laid). Therefore, it is necessary to design the coupling sleeve, pipe seal and locking ring in such a way as to prevent or at least reduce the risk of escape of liquid matter from the sleeve, such matter having leaked into the annular space defined between the external surface of the pipe and the internal surface of the sleeve by reason of an improper fitting of the pipe in the

sleeve. There is also risk, even with properly assembled pipe couplings, that leakage will occur into the annular space due to movement of the component parts by traffic movements or tree roots.

There are two possible paths of escape from the coupling sleeve, for liquid matter in said annular space. The first path is axially outwardly along the external surface of the pipe, but the inner portion of the pipe seal is arranged to engage the external surface of the pipe in such a way as to resist leakage along this path. The second path is axially outwardly along the inner surface of the sleeve towards the end of the sleeve against which the seal is positioned, and then radially outwardly (or at least in an outward direction having a radial component) along the surface against which the pipe seal engages. The inner portion of the pipe seal is also arranged to act radially outwardly on the inner surface of the sleeve (when a pipe has entered the sleeve and thereby has deformed and displaced the inner portion of the pipe seal radially outwardly) so as to oppose migration of liquid matter along this second path.

While currently available seals are generally satisfactory in service, leakage problems are known to occur along the second path. In considering this problem, the intermittent nature of liquid discharges in a drainage system should be borne in mind. These liquid discharges often include small quantities of small particles of hard gritty material. Over a period of time, as a result of intermittent rushes of liquid through a drainage system, with an improperly fitting pipe liquid matter will migrate into the annular space referred to above and undergoes a shock pressure therein, tending to force material along the second path. Some of the small particles in the liquid material enter the annular space and tend to be driven partly along the second path whereby, in time, they exert a

kind of wedging action urging the inner portion of the seal radially inwardly and thereby diminishing the sealing effect. Evidently, once the seal begins to "lift-off", it becomes progressively easier for successive liquid discharges to further deteriorate the quality of the sealing effect with more and more solid particles being driven between the inner surface of the sleeve and the adjacent sealing surface of the pipe seal.

Some of the particles are hard and sand-like, and once there is a sufficient build-up of these particles, a leakage path is provided therethrough.

It is an object of the invention to provide improved resistance to leakage along said second path.

According to the invention there is provided a pipe coupling comprising a coupling sleeve into which one end of a pipe can be received; a resilient annular pipe seal; and a locking ring cooperable with the pipe seal and with the coupling sleeve in order to hold the seal in position against one end of the coupling sleeve, the annular pipe seal having a radially outer portion which engages said one end of the coupling sleeve, and a radially inner portion which extends across the path of entry of a pipe to be received by the coupling sleeve;

in which the radially inner portion of the annular pipe seal comprises (a) a radially inwardly extending curved lobe which is deflectable by the leading end of a pipe to allow entry of the pipe into the coupling sleeve and is subsequently, by its own inherent resilience, moveable into sealing engagement with the outer surface of the pipe, and (b) a generally axially extending curved lobe which has a radially outer surface which engages an annular portion of the inner surface of the coupling sleeve at or near said one end of the sleeve;

and in which said radially outer annular surface of the generally axially extending curved lobe is provided with at least one annular rib which projects generally radially outwardly of said surface.

Thus, in use of the pipe coupling, the radially outer surface of the generally axially extending curved lobe will be pressed into firm sealing engagement with the inner surface of the sleeve upon the entry of the pipe into the coupling sleeve. The annular rib, projecting generally radially outwardly of the adjacent surface, will bear at least mainly the load transmitted to the radially inner portion of the seal by the pipe and, in view of the small surface area of the rib, this will create a very high localised pressure between the rib and the inner surface of the sleeve. Evidently, as compared with a seal not having the rib, the area of contact between the inner portion of the seal and the inner surface of the sleeve will be very much

smaller, with a corresponding multiplier effect on the sealing pressure produced.

This very high sealing pressure will be much more resistant to potential leakage and/or erosion by particulate matter in the liquid. Furthermore, even if particulate matter should be able to migrate axially outwardly of the rib, it would not be able to exert a wedging action as hitherto since the rib provides, at least mainly, the contact between the radially inner portion of the seal and the inner surface of the sleeve. Also, the particulate matter, being lodged axially outwardly of the rib, will not be able to provide a leakage path as hitherto.

Preferably, a number of ribs are provided which are of progressively diminishing radial extent (in an axially outwards direction) in their projection from the radially outer surface of the inner portion of the seal.

The radially outer portion of the seal preferably will be shaped to cooperate with the locking ring and with the end of the coupling sleeve so as to resist radial inward dislodgement. Thus, the outer portion may have a triangular shape in radial cross-section, and be arranged so as to diverge radially outwardly. Conveniently, the locking ring will have a radial portion engaging with the outer portion of the seal, and an axial portion engageable lockingly with an abutment on the external surface of the sleeve at or near the end of the sleeve.

One embodiment of pipe coupling according to the invention will now be described in more detail, by way of example only, with reference to the accompanying drawing in which:—

Figure 1 is a partial view, in axial section, of a pipe coupling as disclosed in the specification of application No. 55815/74 (Serial No. 1,490,530);

Figure 2 is a view, similar to Figure 1, showing a different construction of pipe coupling as disclosed in the aforesaid specification; and

Figure 3 is a partial view, in radial section, of a seal for use with a pipe coupling sleeve and locking ring as shown in Figure 2, to provide an embodiment of pipe coupling according to the invention.

Referring first of all to Figure 1 of the drawings, the coupling sleeve, locking ring and pipe seal illustrated therein will be described for the purposes of illustrating the general type of pipe coupling for which the pipe seal shown in Figure 3 has been designed. The pipe couplings shown in Figures 1 and 2 are described and illustrated in more detail in the aforesaid specification, so that only a brief description will be given herein.

In Figure 1, the pipe coupling is provided by a coupling sleeve 10, a locking ring 16 and a pipe seal 15. The coupling sleeve 10 has a socket portion 13 into which a pipe

can be received, the line of entry of the outer periphery of a pipe being shown by the dashed line 18. Also, the sleeve 10 includes a transverse annular wall 14 against which a pipe can abut.

The locking ring 16 comprises a radially extending portion 23 and an axially extending portion 26. At an end 17 of the socket 13, there is provided an integral radially outwardly extending annular bead 25 which provides an abutment over which portion 26 of the locking ring 16 can be taken as a snap-fit.

With regard to the seal 15, this is an annular seal comprising a radially outer portion which is located against the end surface 22 of the sleeve 10, and is held in position by means of the locking ring 16. The radially outer portion of the seal 15, the end surface 22, and the locking ring 16 are shaped so as to cooperate to prevent radial inward dislodgement of the seal. The seal 15 also has a radially inner portion which is located in the path of entry of a pipe, and serves to engage sealingly the external surface of the pipe. As shown, the radially inner portion comprises a radially inwardly extending curved lobe and a generally axially extending curved lobe.

Upon entry of a pipe along line 18, the radially inner end 27 of the seal will be displaced in an axially inwards direction, but by the inherent resilience of the seal will apply a radially inwards sealing action on the external surface of the pipe. In deforming and displacing the seal in this manner, a considerable load will be applied to the radially inner portion of the seal which results in generation of a substantial sealing pressure along interface 28 between the inner surface of socket 13 and the radially outer surface of the radially inner portion of seal 15.

As discussed in the introduction to the specification, the pipe coupling shown in Figure 1 is one example of a general type of pipe coupling which is susceptible to leakage problems, when circumstances provide an improperly fitting pipe. Inevitably, leakage of liquid matter can take place from a pipe or pipes received by the pipe coupling and into an annular space 29 defined between the external surface of the pipe and the internal wall of the socket 13. A first possible leakage path to the external environment from space 29 is in an axially outwards direction along the external surface of the pipe. However, by virtue of the special shape of the radially inner portion of the seal 15, a very efficient sealing action is provided which is generally adequate to prevent leakage along the first path. A possible second leakage path lies in an axially outward direction along the inner surface of socket 13 towards end 17, and then radi-

ally outwardly, or generally radially outwardly, along end surface 22 and thence to the surrounding environment. Leakage along this second path is opposed by the sealing action provided along interface 28.

Generally speaking, the sealing action against leakage along the second path is satisfactory for properly fitting pipes, but the combination of an adversely fitting pipe and intermittent discharge of liquid matter containing small solid particles, over a period of time can create deterioration in the quality of the sealing action provided along interface 28. Assuming that there has been a build-up of liquid matter in annular space 29, repeated intermittent discharges of liquid material through the pipe coupling will apply a shock pressure within the annular space 29. Furthermore, bearing in mind that liquid matter often includes small hard or gritty particles, there is a tendency for these small particles to be driven into or along interface 28. This is a very gradual process, but evidently once particles have started to become lodged, this will involve deterioration of the quality of the sealing action at a progressively faster rate, since the radially outer surface of the inner portion of the seal will tend to be gradually "lifted-off" thereby leaving access for further solid particles and also liquid matter. Therefore, over a period of time, it is possible to create a build-up of small solid particles throughout the axial extent of interface 28, thereby gradually creating the second leakage path. In this respect, it should be borne in mind that the small particles, although hard, will have voids therebetween so that a leakage path is provided therethrough in the same manner that liquid can pass through sand.

Figure 2 of the drawings shows a further construction of pipe coupling, in which the socket 13 is provided with a pair of peripheral abutment beads 27a and 28a, and the axial portion 26 of locking ring 16 is shaped to cooperate, in a snap-fit manner, with beads 27a and 28a. Also, the shape of the end surface at end 17 of the socket 13 is altered compared to end surface 22. Furthermore, the radially outer portion of the seal 15 is shaped to cooperate with the shaping provided at end 17. The pipe coupling shown in Figure 2 is also subject to the same problems discussed above in relation to Figure 1.

Referring now to Figure 3 of the drawings, there is shown one embodiment of seal of the type specified, which has been designed with a view to providing improved resistance to leakage along the second path. The seal in Figure 3 is designated generally by reference numeral 30 and comprises a radially outer portion 31 which is engageable with the end of a coupling sleeve, and a radially inner portion designated generally

by reference numeral 32. The inner portion 32 is intended to be located in the path of entry of a pipe, and to be deformable and displaceable to take up an axially inwards configuration in which it exerts a powerful radially inwards sealing action on the external surface of a pipe. The portion 32 is generally of curved T-shape having a radially inwardly extending curved lobe portion 33, a generally axially extending curved lobe portion 34 and an axially outer portion 35. In use, inner portion 32 of the seal provides a sealing action against leakage along the first path described above, generally along (initially) axially outer curved surface 36 adjacent the portion 33, whereas sealing action against leakage along the second path is provided by the radially outer annular surface 37 of seal portion 32. When assembled, the seal 30 will provide sealing action along interface 28 by means of surface 37.

However, by contrast with the seals shown in Figures 1 and 2, surface 37 is provided with at least one annular rib projecting generally radially outwardly of the surface. In the embodiment illustrated in Figure 3, a series of three ribs 38, 39 and 40 is provided. It will be noted that the ribs 38 to 40 are of progressively diminishing radial extent in a direction from the axially inner rib 38 to the axially outer rib 40. Also, as seen in Figure 3, annular surface 37 is a frustoconical surface, in that an angle of 5° is defined between surface 37 and a line 41 extending parallel to the axis (not shown) of the seal 30 and the pipe coupling. Also, it will be noted that the radially outer surface portions of ribs 38 to 40 generally lie on line 41.

By providing one or more ribs on surface 37, there is achieved a significantly higher, though localised, sealing pressure along interface 28. Upon entry of the pipe into the socket, the entire inner portion 32 of the seal undergoes a deformation whereby radially outer annular surface 37 is urged in a radially outwards direction towards interface 28. In the arrangements shown in Figures 1 and 2, the radial loading is transferred from the seal to the inner surface of the coupling sleeve 10 along a substantial area i.e. an area substantially similar to the area of surface 37. However, in the arrangement shown in Figure 3, the radial loading will be transmitted, at least mainly, through one or more of the ribs 38 to 40. Evidently, the area of contact provided by ribs 38 to 40 is very much smaller than that of the surface 37, with a corresponding multiplier effect on the sealing pressure created. Therefore, this provides a significantly increased resistance to leakage along the second path. Furthermore, even if liquid and/or solid particles should be able, in time, to migrate axi-

ally outwardly past the first rib 38, such matter will tend to be trapped in the annular gap defined between first rib 38 and the second rib 39, whereby the small solid particles will not be able to exert a wedging action as hitherto, or at least to a significantly reduced extent (depending on circumstances, there will be a tendency for at least some of the surfaces defined between the ribs 38 to 40 to be urged towards or into light sealing contact along interface).

The seal shown in Figure 3 would be particularly suitable for use in connection with a locking ring and coupling sleeve as shown in Figure 2. However, it will be evident that only small modification of the seal would be required for adaption to fit in the arrangement shown in Figure 1, in that appropriate alteration in shape of the radially outer portion 31 will be required. Therefore, it should be understood that the shape of the radially outer portion 31 is not critical, provided only that it should be designed to cooperate with the surface provided at the end (17) of a coupling sleeve and with a locking ring.

WHAT I CLAIM IS:

1. A pipe coupling comprising a coupling sleeve into which one end of a pipe can be received; a resilient annular pipe seal; and a locking ring cooperable with the pipe seal and with the coupling sleeve in order to hold the seal in position against one end of the coupling sleeve, the annular pipe seal having a radially outer portion which engages said one end of the coupling sleeve, and a radially inner portion which extends across the path of entry of a pipe to be received by the coupling sleeve;

in which the radially inner portion of the annular pipe seal comprises (a) a radially inwardly extending curved lobe which is deflectable by the leading end of a pipe to allow entry of the pipe into the coupling sleeve and is subsequently, by its own inherent resilience, moveable into sealing engagement with the outer surface of the pipe, and (b) a generally axially extending curved lobe which has a radially outer surface which engages an annular portion of the inner surface of the coupling sleeve at or near said one end of the sleeve;

and in which said radially outer annular surface of the generally axially extending curved lobe is provided with at least one annular rib which projects generally radially outwardly of said surface.

2. A pipe coupling according to claim 1, including a plurality of ribs provided on said radially outer annular surface.

3. A pipe coupling according to claim 2, in which said ribs are of progressively diminishing radial extent in their projection

from said annular surface, in a direction generally axially outwardly of the seal towards said one end of the sleeve.

4. A pipe coupling according to any one of the preceding claims, in which the radially outer portion of the seal is shaped to cooperate with the locking ring and with the end of the coupling sleeve so as to resist radial inward dislodgement.

5. A pipe coupling according to claim 4, in which said radially outer portion of the seal has a triangular shape in radial cross-section, and is arranged to diverge radially outwardly.

6. A pipe coupling according to claim 4 or 5, in which the locking ring has a radial portion engaging with the radially outer portion of the seal, and an axial portion engageable lockingly with an abutment on the external surface of the sleeve at or near the

end of the sleeve.

7. A pipe coupling according to claim 1 and including an annular pipe seal substantially as hereinbefore described with reference to, and as shown in Figure 3 of the accompanying drawing.

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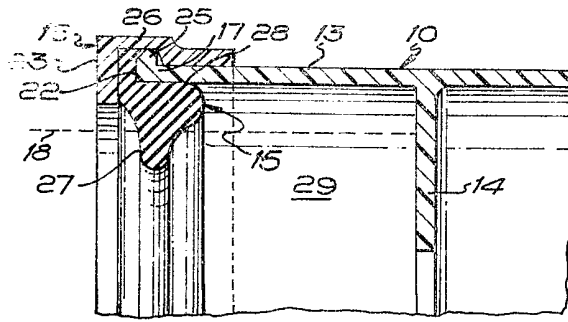


FIG. 1

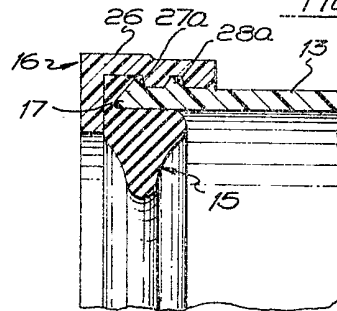


FIG. 2

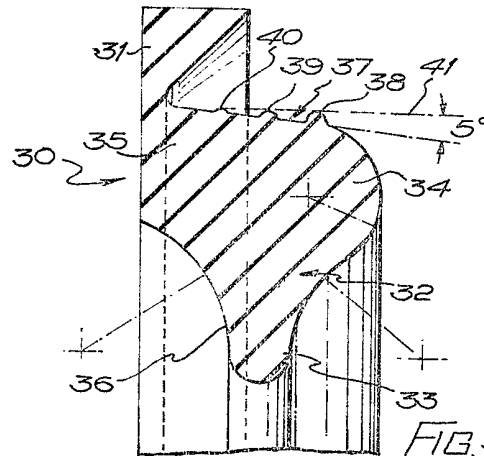


FIG. 3