

SPECIFICATION

Method of making packing seals

Packing seals are well-known and are used to prevent leakage around various movable machine parts, such as those in hydraulic pumps and the like.

The basic prior art packing seal consists of a series of individual rings which fit on top of one another when they are in place around the part to be sealed. Other prior art seals are of the spiral type, such as those shown in U.S. Patent No. 567,233. These spiral seals are made of one continuous coiled piece and compress to seal the machine parts. In both cases, the inner diameter of the seal must be close to the outer diameter of the shaft or other machine part to be sealed in order to assure a tight fit and prevent leakage. Accordingly, the principal drawback of the prior art seals is that they are expensive to manufacture because different seal moulds have to be made for seals of even slightly different diameter.

In an effort to overcome this drawback, some individual ring seals, i.e., the 8000 series from the A. W. Chesterton Company, the present applicant, can be cut down so as to fit around parts having diameters somewhat smaller than that of the original ring. However, the cut away portion of the ring is wasted, and in any event, the ring cannot be made to fit parts having even a slightly greater diameter than that of the original ring.

It is a principal object of this invention to provide an inexpensive method of fabricating a spiral packing seal which can be used to seal parts having diameters larger or smaller than that of the original seal.

The invention accordingly provides a method of making a packing seal, comprising compression moulding a thermo-setting plastic in a planar spiral mould under heat so as to form a partially-cured spiral seal, removing the partially-cured spiral seal from the mould and winding it to a cylindrical configuration and then applying further heat to the partially-cured seal so as to completely cure the seal.

In a preferred embodiment, a heated, homogeneous thermo-setting liquid urethane elastomer is poured into the female portion of a planar spiral mould. The male portion of the mould is compressed into the female mould, and heat is applied so that the liquid plastic turns into a plastic gum-like substance. The resulting partially-cured spiral seal is then wrapped around a cylindrical mandrel of a selected diameter and further cured by heating. After removal from the mandrel, the seal is placed in an oven for final curing. When finally cured, the seal is resilient and can be wrapped around and effectively seal machine parts of different diameters. This is done by cutting the spiral at selected points so that a series of identical rings are obtained, the rings having the diameter of the part to be sealed. Adaptors are similarly cut and placed on the top and bottom of the stack of rings, and the stack is then slipped around the machine part. The seal is

a good one because the hardened elastomer resists wear and extrusion and is not absorbent. If more rings are needed, a longer spiral seal can be made by using a splicing machine to bond one end of a spiral seal to an end of another seal.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a compression mould;

Fig. 2 is a partial cross-sectional view of a mandrel;

Fig. 3 is a perspective view of a spiral seal;

Fig. 4 is a cross-sectional view of a compressed seal in place around a machine part; and

Fig. 5 is a perspective view of a splicer.

Fig. 1 shows a mould 10 which comprises a female lower portion 12 and a male top portion 20. The female portion 12 has a spiral groove 14 with a V-shaped bottom 16. The male top portion 20 has a rounded spiral 22 protruding from its surface. The spiral 22 fits into the groove 14 when the male portion 20 of the mould 10 is in place.

A liquid thermo-setting urethane elastomer, is made by mixing a liquid resin such as L167 from Du Pont with a catalyst such as 4,4-methylene-bis(2-chloroaniline) available from the Polyester Corporation of New York. The catalyst is in pellet form, and it is melted prior to mixing with the liquid resin. The resulting liquid plastic is then heated to 180°—220°F (82.2°—104.4°C) and poured into the spiral groove 14 of the mould 10. The groove 14 is not completely filled with the liquid plastic.

At this point, the top portion 20 of the mould 10 is closed over the bottom portion 12 so that the rounded spiral 22 pushes into the liquid plastic in the groove 14. The portions of the mould are then pressed together by hydraulic presses (not shown). The presses exert a pressure of 1000 psi for the smaller moulds, but less pressure may be used. At the same time, the mould is heated to 80° and 220°F (82.2°—104.4°C). The compression moulding is continued for 4 to 6 minutes.

The mould is then opened and the heat shut off. The compression moulding has partially cured the liquid plastic into a solid plastic gum stage. The resulting partially cured planar spiral seal is resilient but has not been cured enough to have a memory.

A mandrel 30, shown in Fig. 2, consists of an inner cylinder 32 with a lower lip 33 and a concentric outer cylinder 34. The cylinders are not attached, and their walls are separated by a distance approximately equal to the cross-sectional thickness of the spiral seal. The partially-cured seal which has been removed from the mould is fed into the space between the cylinders 32, 34 so that the seal is wrapped spirally around the cylinder 32 from the lip 33 to the opposite end of the cylinder 32. The outer cylinder 34 prevents the spiral seal from unravelling. The

mandrel 30 with the spiral seal wrapped thereon is then heated in an oven at 180°—220°F (82.2°—104.4°C) for 15 to 30 minutes. This further cures the seal to an extent that it has

5 dimensional integrity and stability as well as resilient memory. The inner diameter of the seal is that of the inner cylinder of the selected mandrel.

There are four available inner cylinders for the preferred embodiment, and they have diameters of 3.24, 4.25, 7.25, and 11.25 inches (respectively 8.25, 10.8, 18.4, and 28.6 cm). Four different moulds are used with the four different mandrels. The moulds only vary in size so that a

15 longer spiral seal is produced for use with the larger mandrels.

As a final step, the spiral seal 40 is tied in its compressed position and placed in an oven at 180°—220°F (82.2°—104.4°C) for 2 to 3 hours for a final curing. The spiral seal is resilient, and the hardened elastomer resists wear and extrusion and is non-absorbent.

A cured spiral seal 40 is shown in Fig. 3. It has a domed top 42, formed by the V-shaped bottom 16 in the groove 14 in the mould 10. The seal 40 also has a pair of downwardly extending peripheral ridges 44, formed when the rounded spiral 22 of the male portion 20 of the mould 10 was pressed into the liquid plastic in the spiral

30 groove 14 of the mould 10. When the spiral seal 40 is compressed, successive coils 50 fit together as the domed top 42 of one coil fits between the ridges 44 of the coil above.

The spiral seal is marked with measurement dimples, such as those shown in our U.S. Patent No. 4,157,833. These markings permit a purchaser to cut the spiral seal into a series of individual rings 60 having the same diameter as the part to be sealed without the need for difficult measurement or waste. The rings are then centre stacked as shown in Fig. 4. A top adaptor 62 and a bottom adaptor 64 are then added to the stack. The adaptors 62, 64 are made in the same manner as the spiral seal except the mould has a different shape. The resulting spiral adaptors are then cut into two rings which are placed above and below the stack of rings 60 as shown. The entire seal 70 is then placed around a shaft 72 or other machine part, and a gland 74 having a protruding collar 76 is tightened over the seal 70. The collar presses the seal 70 together, and the ridges 44 flare outwardly so that they press against the shaft 72, thereby sealing it.

Because of the resiliency of the spiral seal, the individual rings 60 can be cut to fit a machine part having a diameter approximately 20% larger or smaller than the diameter of the inner cylinder of the selected mandrel on which the spiral seal was cured. Therefore, with just the four inner cylinder

60 sizes, seal rings can be made for parts within a range of diameters from 2.75 inches (7 cm) to 13.75 inches (35 cm), and as the rings are cut from successive portions of the spiral seal, there is little wasted seal.

65 The length of the seal can be increased by

connecting together two or more spiral seals by use of the splicer 80 of Fig. 5. Splicer 80 is essentially a pie-shaped portion of the mould 10. Splicer 80 has a series of grooves 82 (three shown) in a female portion 84, and the diameter of the grooves 82 correspond to the diameter of the spiral seals from the different mandrels. One end 86 of the spiral seal slides into the selected groove 82 from one side and an end 88 of

70 another seal slides into the groove from the opposite direction. Clamps 90 hold the ends 86, 88 in place. Heated thermo-setting plastic is poured between and over the ends 84, 86, and a male portion 92 having a series protruding rounded spirals 94 is closed. Compression moulding is applied to this interface at 180°—220°F (82.2°—104.4°C) for 5 to 10 minutes. At the end of that time, there is a solid joint connecting the two seals, and the joined seals are then placed into a curing oven for several hours.

85 Other thermo-setting materials, and different resins, and catalysts may be used with this invention. The mould may be made in different shapes, and the width of the seal may be varied. Also, much less pressure than 1000 psi may be used in compression moulding. It should also be understood that the inner cylinder of the mandrel may be of any desired diameter, and the four selected mandrel diameters referred to above are not critical. It is also possible to use the spiral seal without cutting it into individual rings. However, this may not be possible in some cases where there is limited accessibility to the machine part to be sealed.

100 Claims

1. A method of making a packing seal comprising: compression moulding a thermo-setting plastic in a planar spiral mould under heat so as to form a partially-cured planar spiral seal, removing the partially-cured planar spiral seal from the mould and winding it to a cylindrical configuration and then applying further heat to the partially-cured seal so as to completely cure the seal.

110 2. A method according to claim 1, wherein the further heat is applied to the seal first in a further curing step and then in a final curing step.

3. A method according to claim 2, wherein before the further curing step, the planar spiral seal is wound on a mandrel to form said cylindrical configuration, heat is applied to a seal on the mandrel in said further curing step, the seal is then removed from the mandrel and heat is applied to the seal after removal from the mandrel in the final curing step.

120 4. A method according to claim 2 or claim 3, wherein the further heat is from 180°—220°F (82.2°—104.4°C), the further curing step is carried out over a period of 15 to 30 minutes and the final curing is carried out over a period of 2 to 3 hours.

125 5. A method according to any one of the preceding claims, wherein the plastic is a urethane elastomer.



mandrel 30 with the spiral seal wrapped thereon is then heated in an oven at 180°—220°F (82.2°—104.4°C) for 15 to 30 minutes. This further cures the seal to an extent that it has dimensional integrity and stability as well as resilient memory. The inner diameter of the seal is that of the inner cylinder of the selected mandrel.

There are four available inner cylinders for the preferred embodiment, and they have diameters of 3.24, 4.25, 7.25, and 11.25 inches (respectively 8.25, 10.8, 18.4, and 28.6 cm). Four different moulds are used with the four different mandrels. The moulds only vary in size so that a longer spiral seal is produced for use with the larger mandrels.

As a final step, the spiral seal 40 is tied in its compressed position and placed in an oven at 180°—220°F (82.2°—104.4°C) for 2 to 3 hours for a final curing. The spiral seal is resilient, and the hardened elastomer resists wear and extrusion and is non-absorbent.

A cured spiral seal 40 is shown in Fig. 3. It has a domed top 42, formed by the V-shaped bottom 16 in the groove 14 in the mould 10. The seal 40 also has a pair of downwardly extending peripheral ridges 44, formed when the rounded spiral 22 of the male portion 20 of the mould 10 was pressed into the liquid plastic in the spiral groove 14 of the mould 10. When the spiral seal 40 is compressed, successive coils 50 fit together as the domed top 42 of one coil fits between the ridges 44 of the coil above.

The spiral seal is marked with measurement dimples, such as those shown in our U.S. Patent No. 4,157,833. These markings permit a purchaser to cut the spiral seal into a series of individual rings 60 having the same diameter as the part to be sealed without the need for difficult measurement or waste. The rings are then centre stacked as shown in Fig. 4. A top adaptor 62 and a bottom adaptor 64 are then added to the stack. The adaptors 62, 64 are made in the same manner as the spiral seal except the mould has a different shape. The resulting spiral adaptors are then cut into two rings which are placed above and below the stack of rings 60 as shown. The entire seal 70 is then placed around a shaft 72 or other machine part, and a gland 74 having a protruding collar 76 is tightened over the seal 70. The collar presses the seal 70 together, and the ridges 44 flare outwardly so that they press against the shaft 72, thereby sealing it.

Because of the resiliency of the spiral seal, the individual rings 60 can be cut to fit a machine part having a diameter approximately 20% larger or smaller than the diameter of the inner cylinder of the selected mandrel on which the spiral seal was cured. Therefore, with just the four inner cylinder sizes, seal rings can be made for parts within a range of diameters from 2.75 inches (7 cm) to 13.75 inches (35 cm), and as the rings are cut from successive portions of the spiral seal, there is little wasted seal.

The length of the seal can be increased by

connecting together two or more spiral seals by use of the splicer 80 of Fig. 5. Splicer 80 is essentially a pie-shaped portion of the mould 10. Splicer 80 has a series of grooves 82 (three shown) in a female portion 84, and the diameter of the grooves 82 correspond to the diameter of the spiral seals from the different mandrels. One end 86 of the spiral seal slides into the selected groove 82 from one side and an end 88 of another seal slides into the groove from the opposite direction. Clamps 90 hold the ends 86, 88 in place. Heated thermo-setting plastic is poured between and over the ends 84, 86, and a male portion 92 having a series protruding rounded spirals 94 is closed. Compression moulding is applied to this interface at 180°—220°F (82.2°—104.4°C) for 5 to 10 minutes. At the end of that time, there is a solid joint connecting the two seals, and the joined seals are then placed into a curing oven for several hours.

Other thermo-setting materials, and different resins, and catalysts may be used with this invention. The mould may be made in different shapes, and the width of the seal may be varied. Also, much less pressure than 1000 psi may be used in compression moulding. It should also be understood that the inner cylinder of the mandrel may be of any desired diameter, and the four selected mandrel diameters referred to above are not critical. It is also possible to use the spiral seal without cutting it into individual rings. However, this may not be possible in some cases where there is limited accessibility to the machine part to be sealed.

100 Claims

1. A method of making a packing seal comprising: compression moulding a thermo-setting plastic in a planar spiral mould under heat so as to form a partially-cured planar spiral seal, removing the partially-cured planar spiral seal from the mould and winding it to a cylindrical configuration and then applying further heat to the partially-cured seal so as to completely cure the seal.

2. A method according to claim 1, wherein the further heat is applied to the seal first in a further curing step and then in a final curing step.

3. A method according to claim 2, wherein before the further curing step, the planar spiral seal is wound on a mandrel to form said cylindrical configuration, heat is applied to a seal on the mandrel in said further curing step, the seal is then removed from the mandrel and heat is applied to the seal after removal from the mandrel in the final curing step.

4. A method according to claim 2 or claim 3, wherein the further heat is from 180°—220°F (82.2°—104.4°C), the further curing step is carried out over a period of 15 to 30 minutes and the final curing is carried out over a period of 2 to 3 hours.

5. A method according to any one of the preceding claims, wherein the plastic is a urethane elastomer.



6. A method according to any one of the preceding claims, wherein the compression moulding is effected by pouring a heated, liquid plastic into the female portion of the spiral mould,
- 5 covering the female portion with the male portion of the spiral mould and applying pressure thereto for a period of four to six minutes at 180°—220°F (82.2°—104.4°C).
7. A method according to claim 6, wherein the
- 10 pressure is 1000 psi.
8. A method according to any one of the preceding claims, wherein the spiral seal is cut into a series of individual ring seals after it is removed from the mandrel.
- 15 9. A method of making a packing seal substantially as described herein with reference to the accompanying drawings.
10. A packing seal made in accordance with a method as claimed in any one of the preceding
- 20 claims.