

SEAMING ROLLS

This invention relates to seaming rolls for a can closing machine and similarly acting machines, and more particularly but not exclusively to rolls having improved bearings and work surfaces for use in a can closing
5 machine.

Can closing machines are well known in which a flanged can body is supported with the flange uppermost while a can end having a countersink wall terminating in a peripheral cover hook is placed on the flange to close the
10 body. In these machines a chuck entered in the countersink wall of the can end serves to hold the cover hook of the can end in engagement with the flange of the can body. Usually a first roll, having a first operation seaming groove in the roll surface, is brought
15 to bear on the periphery of the cover hook of the can end so that relative rotation as between the can and the first operation groove brings about inter folding of the free edge of the cover hook between the flange and the rest of the can body - this is called "first operation seaming".
20 Thereafter a second roll having a second operation groove is brought to bear on the first operation seam to flatten the interfolded layers of cover hook and flange into a double seam - this second rolling operation being called "second operation seaming".

25 One form of roll and chuck is described in British Patent 2,098,899. Hitherto it has been customary to mount seaming rolls on steel roller bearings as shown in GB.2,098,899. Such bearings are packed with lubricant which, if the bearing overheats, may cause lubricant to
30 seep past an oil seal at risk of the lubricant contaminating the interior of a can. One objective of this invention is to prevent risk of lubricant leakage by

use of ball bearings made of a ceramic which does not require as much lubrication. A further advantage arising is avoidance of a corrosion interface between the balls and races .

5 Hitherto the peripheral margins of can end and can body flange, interlocked to create a double seam, have been quite large so that the forces arising on the roll bearings are easily coped with by steel roller bearings. However, British Patent 2,047,144B describes the formation
10 of double seams from narrower peripheral margins of can end and can body to make a smaller seam length so that the margins are stiffer and require greater radial pressures during deformation. Another objective of this invention is to provide a profile of annular work surface for first
15 operation seaming rolls that can be satisfactorily used to manufacture smaller double seams.

Accordingly this invention provides a seaming roll assembly, for double seaming a can end to a flanged container body, of a kind having a roll mounted on an
20 outer race in rolling engagement with rolling members supported by an inner race mounted on one end of a shaft, characterised in that the rolling members are ceramic balls and the races are metallic; the roll is mounted on a pair of axially aligned outer races mounted back-to-back; each
25 outer race comprising a first annular surface extending tangential to the balls, a second annular surface smaller in diameter than said first annular surface, and an arcuate portion joining said annular surfaces and conforming to the curvature of the balls; the said second
30 annular surfaces abutting each side of a circlip fitted in a recess in the interior of the roll; and a complementary inner race cooperates with each outer race to confine the

balls during rotation of the roll; each said inner races having a first annular surface extending tangential to the balls, a second annular surface of greater diameter, and an arcuate portion to hold the balls in contact with the
5 respective outer race, said first annular surface of each inner race being axially aligned and in contact with a spacer surrounding the shaft.

The roll assembly may be provided with a first operation seaming profile or alternatively a second
10 operation seaming profile located in a peripheral surface of the roll. In both cases it is desirable to locate the profile substantially in the same plane as the balls nearer said one end of the shaft.

The seaming profile may be a first operation profile
15 as shown in Figs. 4 or preferably the improved profile shown in Fig.8. This profile is particularly suitable for manufacture of double seams of short seam length.

Various embodiments will now be described by way of example and with reference to the accompanying drawings in
20 which:-

Fig.1 is a diagrammatic sketch of a known double seaming machine having a first operation roll and a second operation roll.

Fig.2(a) is an enlarged fragmentary section of a can
25 end and can body at the start of a first operation.

Fig.2(b) is an enlarged fragmentary section of the configuration of can end and side wall after application of the first operation roll.

Fig.2(c) is an enlarged fragmentary section of the
30 configuration of can end and side wall after application of the second operation roll.

Fig.3 is a side view of a prior art first operation seaming roll cut away to show roller bearings.

Fig.4 is a diagram showing a prior art first operation groove, for making small seams.

Fig.5 is a diagram showing a side view of a first operation roll according to the invention.

5 Fig.6 is a second operation roll cut away to show the bearing.

Fig.7 is a diagram showing geometric relationship of a first operational profile to the original operation profile of Fig.4, and improved profile of Fig.8, and

10 Fig.8 is a diagram showing the complete work surface profile of the groove and part of the prior art groove shown dashed.

Figs. 1,2 3 and 4 permit discussion of problems arising during use of prior art seaming apparatus:

15 In Fig.1 the can closing machine comprises a base plate 1, an upright portion 2 upstanding from the base plate 1 and a top plate 3 extending from the upright portion 2 across the base plate 1. A lifter pad 4, supported on a pillar 5, is movable towards and away from
20 the base plate 1 to permit placement and lifting of a flanged can body 6 to engage with a can end 7.

In Fig.1 the can end 7 and can body 6 are depicted immediately before the start of first operation seaming. A driven rotatable chuck 8 is engaged with the can end 7
25 and about to rotate in the bearing 9 on the top plate 3. This bearing 9 permits adjustment of the height "H" of the chuck above the lifter pad 4: However, the lifter pad movement permits further adjustment. A first operation seaming roll 10 is mounted on an arm 11 having a shaft 12
30 which pivots in the top plate 3 so that a cam (not shown) may urge the arm 11 to bring the roll 10 to bear on the can end 7 against the support of the chuck 8. A second operation roll 13 is mounted on a pivotally mounted arm 14 operably engageable with a cam (not shown) which urges the

second operation roll to work against the interfolded metal created by the first operation roll 10.

Referring to Fig.2 it will be seen that, as the first operation roll 10 is moved towards the chuck 8 the periphery of the can end strikes an upper portion of the first operation groove 15 to experience a force "P" which may be resolved into an axial thrust and a radial thrust. At the start the axial component of thrust may be greater than the radial thrust but by the time the first operation 10 is nearing completion as shown in Fig.2(b), the radial thrust may exceed the axial thrust. Any first operation roll must be provided with bearings to support these varying thrusts. Similar thrust forces arise in the second operation as roll 13 flattens the seam to the 15 configuration shown in Fig.2(c) because the metal of the seam is held down by the top surface of the second operation groove.

Fig.3 shows a seaming roll assembly which is described fully in GB.2,098,899 to which the reader is 20 directed for detailed description. The roll assembly 10 comprises inclined roller bearings 16A, 16B to support the thrust forces "P" arising during formation of a double seam. Rolling motion of the inclined rolls 16A, 16B between an inner race 17A, 17B and an outer race 18A, 18B 25 disturbs lubricant in the bearing causing the lubricant to heat up and expand. In order to prevent loss of lubricant from the bearing a splash cover 19 spans the top of the bearing. A skirt of the splash cover makes sealing engagement with an annular oil seal 20 on the roll 30 surface. The bottom of the roll is closed by a disc 21, a skirt of which seals against an "O" ring 22 located in a recess in an interior wall of the roll. The disc is retained in the roll by a circlip. In spite of these lubricant control features, the problem of lubricant 35 leakage persists.

In Fig.3 the roll has a first operation seaming groove 15 which is defined in detail by Fig.4 which will be discussed hereinafter; however, the roller bearings and oil seals depicted in Fig.3 have also been used for rolls 5 having a second operation seaming groove.

The seaming roll assembly shown in Fig.5 overcomes the problem of lubricant leakage by use of ceramic ball bearings instead of the traditional steel roller bearings. The ceramic balls, running between inner and outer races 10 made of steel, do not require as much lubricant as did the steel rollers so that the problem of leakage of lubricant is abated.

The roll assembly depicted in Fig.5 comprises a first operation roll 24, a pair of outer races 25, 26 arranged 15 back-to-back within the roll and separated by a circlip 27, a plurality of ceramic balls (two of which are denoted 28, 29) arranged to roll between the outer races 25,26 and respective inner races 30,31, which are separated by a spacer 32, and a shaft 33 which supports the inner races 20 30, 31 and the spacer 32. The inner races are retained on the shaft 33 by washer 34 held in place by a stud 35 which is screwed into the end of the shaft. Any risk of loosening is prevented by a pin 36 passing through the washer 34 into the end of the shaft 33. The top roll assembly is 25 spanned by a splash cover 37 which is clamped between an end face of the top inner race 30 and a washer 38 on the shaft.

Examining the upper races shown in Fig.5 it will be seen that the outer race 25 has an inner surface 30 comprising upper annular surface 39 extending tangentially to a ball 40, a lower annular surface 41 of diameter smaller than that of the upper annular surface 39, and an arcuate surface 42 conforming to an arcuate

surface portion of the ball 40 to join the upper and lower annular surfaces 39, 41. The arcuate surface 42 of the outer race 25 is therefore able to pass any axial component of pressure "P" arising at the roll groove 15 through the balls 28, 40 onto a complementary arcuate annulus 43 of the inner race 30. The shapes of inner and outer races are particularly easy to assemble because no press fitting is required. One suitable form of bearing is sold under the trade name SKF Ceramic bearing No. 7203 BECBP.

The lower races are identical in shapes to the upper races but arranged the other way up so that the lower outer races pass any downward thrust that arises at the end of the first operation, through the balls, such as that denoted 29, onto an arcuate portion of the inner race. It will be noted that the centre of each ball of the lower bearing is in substantially the same plane as the centre of the groove/work profile 15 so that during most of the seam forming loading, the bottom bearing is in a rolling mode with little axial thrust.

The roll 24, shown in Fig. 5, may be provided with the prior art first operation profile shown in Fig. 4 in order to manufacture small seams of length "L" approximately 0.081". (2.06mm). Preferably the roll 24 is provided with the new profile shown in Fig. 8 in order to permit manufacture of double seams of similar seam length.

Comparison of Figs. 4, 7 and 8 permits understanding of the differences in first operation profile depicted.

In Fig. 4 the prior art profile of groove, for making small seams, comprises an entry surface 44 which is inclined to the horizontal at an angle I which is between 1° and 2° (preferably $1\frac{1}{2}^\circ$). The entry surface blends tangentially into a first arcuate portion 45 of radius R_1 .

centred at a distance L_1 from a DATUM POINT where the entry surface 44 joins the first arcuate portion 45 on an angular displacement #1 outwards from a DATUM LINE extending vertically through the datum point.

- 5 The first arcuate portion 45 blends into a second arcuate portion 46 of radius R_2 centred at a distance L_2 from the datum point at an angular displacement #2 outwards from the datum line.

- 10 The second arcuate portion 45 blends into third arcuate portion 47 of radius R_3 centred at a distance L_3 from the datum point at an angular displacement #3 inwards from the datum line.

- 15 The third arcuate portion 47 blends tangentially with an exit surface 48 declining from the horizontal at an exit angle E in the range 2° to 3° from the horizontal.

A fourth arcuate portion 49 of radius R_4 connects the exit surface 48 to a cylindrical side wall extending in the datum line of the roll. Typical values of radii and centres of curvature are given in Fig.4 and table 1:-

- 20 TABLE 1: NB inch measurements are actual: millimetre conversions approximate:-

25	No.	Rad-R.	Length-L.	Angle #
	1	0.063 " (1.60mm)	0.063" (1.60mm)	7.837°
	2	0.0695" (1.77mm)	0.068" (1.73mm)	11.4
	3	0.018" (0.46mm)	0.072" (1.83mm)	31.304°
	4	0.006" (0.15mm)	0.087" (2.21mm)	3.934°

- 30 During experiments to manufacture double seams of relatively small length L, as denoted in Fig.2C, with 57mm (206) diameter can ends produced from aluminium alloy 0.245mm (approx. 0.009") thick, we have found it necessary to provide a modified first operation seaming groove profile.

Fig.7 shows that, in principle, the modification requires that the first second and third arcuate portions 45, 46, 47 swing through an angle of about $2\frac{1}{2}^\circ$ to be located nearer the axis of rotation of the roll 24.

5 Table 2 records typical figures arising from this geometric rotation.

TABLE 2:

	No.	Rad-R.	Length-L.	Angle #
10	1	0.063 " (1.60mm)	0.063" (1.60mm)	5.340°
	2	0.0695" (1.77mm)	0.068" (1.73mm)	8.903°
	3	0.018 " (0.46mm)	0.072" (1.83mm)	33.802°
	4	0.006 " (0.15mm)	0.087" (2.21mm)	6.432°

15 However, this geometric rotation gives rises to an inadequate entry angle "H°" with respect to the horizontal in Fig.7. Accordingly the profile is modified to have a greater entry angle shown in Fig.8 as a preferred entry angle of 1.5° although angles between 1° and 2° will
20 suffice.

Returning to Fig.7 it will be noticed that the fourth arcuate portion 49 no longer reaches the cylindrical wall on the datum line. This is corrected by dropping the centre of the third arcuate portion 47, exit surface 48
25 the fourth arcuate portion 49 a distance of 0.0055" (0.14mm) to maintain the seam length and achieve a desired exit angle in the range between 2° and 3° .

Fig.8 shows the new first operation profile. The nomenclature of Figs. 4 and 7 is retained so that the
30 profile can be read in the same way to show that, in contrast to the profile of Fig.4, the new profile of groove is substantially deeper at the third and fourth arcuate portions and presents a less abrupt slope to the periphery of a can end during the commencement of double

seaming. Typical values of radii and location are tabulated in Table 3:-

TABLE 3:-

	No.	Rad-R.	Length-L.	Angle #
5	1	0.063 " (1.60mm)	0.063" (1.60mm)	5.338°
	2	0.0695" (1.77mm)	0.068" (1.73mm)	8.9°
	3	0.018" (0.46mm)	0.074" (1.88mm)	33.239°
	4	0.006" (0.15mm)	0.087" (2.21mm)	3.934°

10 Fig.6 shows a roll assembly identical to that
of Fig.4 except that the roll is a second operation roll
50 in which the operational groove 51 comprises a
substantially cylindrical root surface flanked by
substantially planar surfaces. The purpose of this second
15 operation groove is to impose a flattening force on the
preliminary seam made in the first operation as can be
understood from Figs. 2(b) and 2(c). Fig.2(c) shows an
alternative form of second operation groove which is
contoured to the anticipated curve of the desired final
20 seam.

CLAIMS:

1. A seaming roll assembly for double seaming a can end to a flanged container body, of a kind having a roll mounted on an outer race in rolling engagement with rolling members supported by an inner race mounted on one
5 end of a shaft, characterised in that the rolling members are ceramic balls and the races are metallic; the roll is mounted on a pair of axially aligned outer races mounted back-to-back; each outer race comprising a first annular surface extending tangential to the balls, a second
10 annular surface smaller in diameter than said first annular surface, and an arcuate portion joining said annular surfaces and conforming to the curvature of the balls; the said second annular surfaces abutting each side of a circlip fitted in a recess in the interior of the
15 roll; and a complementary inner race cooperates with each outer race to confine the balls during rotation of the roll; each of said inner races having a first annular surface extending tangential to the balls, a second annular surface of greater diameter, and an arcuate portion to hold
20 the balls in contact with the respective outer race, said first annular surface of each inner race being axially aligned and in contact with a spacer surrounding the shaft.
2. A seaming roll assembly according to any preceding claim characterised in that a peripheral surface of the
25 roll includes a first operation groove or alternatively a second operation groove located in the same plane as the balls nearest said one end of the shaft.
3. A seaming roll assembly according to claim 1 or claim 2, characterised in that a first operation groove
30 profile comprises a flared entry surface, a first arcuate surface, a second arcuate surface and a third arcuate



surface each blending with the next, and divergent exit surface, the centre of curvature of said third arcuate surface is located at a distance 0.074" (1.88mm) from a datum point where the entry surface joins the first arcuate surface portion at an angular displacement of 33.24° inboard of a vertical datum line passing through the datum point and extending parallel to the axis of rotation of the roll; and the radius R_3 of said third arcuate portion is about 0.018" (0.46mm).

- 10 4. A seaming roll assembly substantially as described and shown in Fig.5, or Fig.6 or Figs. 5 and 8 of the accompanying drawings.
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