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SWAGE-TYPE HOSE END FITTING
FOR NON-SKIVED HOSES

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This invention relates to a hose end fitting for attachment to a wire-braid reinforced flexible hose. More specifically, the invention relates to a swage-type hose end fitting for attachment to an unpared (i.e. non-skived) hose end.

5 Wire-braid reinforced flexible hoses are formed from a (synthetic) rubber with the braided metal reinforcing being located within the wall thickness of the hose. End fittings are attached to such hoses in one or other of two general ways. The first approach involves paring the outer rubber
10 layer from the hose to expose the reinforcing braid for a portion of the length of the end of the hose, and by clamping the pared end of the hose between a hollow stem and a surrounding ferrule, with a portion of the length of the ferrule being swaged or otherwise brought into direct contact
15 with the reinforcing braid. The second approach involves clamping an unpared end of the hose between the stem and ferrule.

 Clamping of a hose end between the stem and ferrule may be effected in one of two ways, depending upon whether the
20 fitting is to be reusable or non-reusable. In the case of reusable end fittings, the stem and ferrule are provided with mating thread portions and simply stated, the hose end is clamped between the stem and ferrule during the process of screwing them together. In the case of the non-reusable
25 end fittings, the stem is pushed into the bore of the hose and the ferrule is then swaged (i.e. clamped radially inwardly)

onto the hose end portion which surrounds the stem.

The present invention is concerned with a non reusable type of end fitting which is intended to be attached to an unpared end of a hose and which is clamped onto the hose by a swaging operation. Thus, for convenience, the present invention is herein referred to as a "swage-type hose end fitting for attachment to an unpared hose end".

To achieve positive connection between an end fitting and an unpared hose end, and to accommodate in-service tensile loadings, the hollow stem portion of a fitting is usually formed with external buttresses for engaging with the bore wall of the hose and the ferrule is usually furnished with internal buttresses for engaging with and biting into the outer rubber layer of the hose end. Ideally, the ferrule buttresses should bite right through contacted portions of the outer rubber layer of the hose end to contact the reinforcement and cause the braids to distort in an outward curve between adjacent buttresses. However, this latter requirement can and does lead to in-service problems with braid reinforced hoses. Thus, in biting into the outer covering of the hose, a moisture path to the metal braid is created and, with creeping of the outer rubber covering, such moisture path can be exposed to atmosphere. This can and does result in serious corrosion of the hose reinforcement and consequential reduction of the tensile or burst strength of the hose. Creeping of the hose rubber occurs during

attachment of the end fitting to the hose and/or as a result of in-service flexing of the hose.

Also, to permit positive locking-together of the stem and ferrule portions of a swaged type fitting, the ferrule is usually provided with an inwardly directed flange which locates in an annular groove of the stem. Then, when the ferrule is clamped onto the hose end, the ferrule flange locates in the stem groove so that a positive mechanical connection is achieved between the stem and the ferrule at the same time that clamping of the hose end is being effected. However, when it is required that a swaged type hose fitting be attached to an unpared hose end and the ferrule is to be swaged inwardly to a substantial extent, so that contact may be made with the reinforcement, the flange portion of the ferrule must be swaged inwardly by an equal amount. This can and does lead to problems. Thus, during initial stages of the swaging operation, compression of the hose wall causes longitudinal creeping of the rubber and this in turn causes longitudinal displacement of the stem relative to the ferrule. Therefore, displacement of the stem groove relative to the ferrule flange occurs during the swaging operation and interlocking of the two parts cannot be effected.

The present invention seeks to avoid the above stated problems which are associated with the attachment of a swaged type fitting to an unpared hose end.

Thus, the present invention provides a swage-type hose end fitting for attachment to a wire-braid reinforced hose without the outer covering of the hose being pared to reveal the wire-braid reinforcement; the end fitting comprising a hollow stem portion for engagement with the hose bore and a ferrule which is arranged to be swaged onto the hose end and the stem portion. The stem portion has a stem which is sized to fit into the hose bore, an annular recess spaced longitudinally from the stem and a shoulder separating the recess from the stem. The ferrule comprises an annular-form body which is formed with internal buttresses which are shaped and sized to bite into the outer covering of the hose and to extend to the hose reinforcement when the ferrule is swaged onto the hose end, an inwardly directed flange adjacent one end thereof for locating in the stem portion groove when the ferrule is swaged onto the hose end, and a nib adjacent the other end thereof, which when the ferrule is swaged onto the hose end, bites into the outer casing of the hose but does not extend to the reinforcement. The ferrule has first, second and third longitudinally spaced zones which respectively incorporate the buttresses, flange and nib, and the outside diameter of the ferrule is smaller in the second and third zones than that of the first zone so that, during a swaging operation, the second and third zones contract a smaller average radial distance toward the stem than the first zone.

The invention will be more fully understood from the following description of a preferred embodiment thereof. The description is given with reference to the accompanying drawings wherein:

5 Figure 1 shows a half-sectional elevation view of a hose end fitting prior to attachment to a hose end and prior to swaging,

10 Figure 2 shows a view similar to Figure 1 but illustrating the fitting when finally assembled to the hose end, and

 Figures 3 to 6 show successive stages of assembly of stem and ferrule portions of the fitting to a hose end.

15 As is shown in Figure 1, the hose fitting comprises a stem portion 10, a ferrule portion 11 and an internally threaded female union 12. The union 12 is rotatable about a land 13 and is located between the stem and ferrule portions. In an alternative form of the fitting (not shown), the union 12 may
20 be replaced by a male union and, in such case, the union would be formed as an integral part of the stem portion. In fact, the union as such forms no part of the present invention, the invention relating to the interconnection of the stem and
25 ferrule portions and a hose end 14.

 The stem portion 10 comprises a hollow stem 15 which is intended to locate within the bore 16 of the hose 14, an

annular recess or groove 17 spaced longitudinally from the stem, and a shoulder 18 which separates the recess from the stem. The stem is tapered over a portion 19 of its length, to facilitate its insertion into the hose bore, and the stem is formed over a major portion of its length with a series of shallow annular buttresses or barbs 20 for gripping the bore of the hose.

The ferrule portion 11 comprises an annular-form body which, over its longitudinal length, includes three notionally separate zones. These are identified in Figure 1 as Zones 1, 2 and 3. Zone 1 of the ferrule is larger in diameter than the two other zones and it includes three longitudinally spaced internal annular-form buttresses 21.

Each of the buttresses 21 of the ferrule portion has the profile generally of a wedge, as shown in the enlarged detail view associated with Figure 1, so as to assist insertion of the hose end into the ferrule and to resist retraction thereof. Thus, each buttress has a leading flank 22 inclined at an angle $\alpha = 7^\circ$ to the vertical, a trailing flank 23 inclined at an angle $\beta = 15^\circ$ to the vertical, and a crest 24 which joins the leading and trailing flanks. The apex of the buttress is radiused, so that it does not act as a knife edge when engaging the outer casing 26 of the hose and the buttress has a depth D which is approximately equal to the thickness of the outer casing 26 of the hose. That is, the depth D corresponds approximately with the radial depth of the hose reinforcement 27 below the periphery of the hose.

Zone 2 of the ferrule portion has an average outside diameter that is smaller than the outside diameter of zone 1, and zone 2 includes a nose 28 of the ferrule portion. An inwardly directed annular flange 29 is provided at the forward end of the nose and this is sized to locate in the recess 17 of the stem portion when the ferrule portion is swaged onto the stem portion.

The remaining zone (Zone 3) of the ferrule portion also has a smaller average outside diameter than zone 1 and, at its trailing end, Zone 3 includes an annular form nib 30 which functions to seal against the outer casing 26 of the hose when clamped between the stem and ferrule portions. As shown in the enlarged detail view associated with Figure 1, the nib 30 includes a forward flank 31, a crest 32 and a rearward radiused surface 33. A small radius 34 blends the flank 31 and crest 32.

The nib has a depth $\underline{d}$ which is less than the depth $\underline{D}$ of the buttresses 21 and hence less than the depth of the reinforcement 21 below the outer periphery of the hose casing.

Within the ferrule portion, a recess 35 separates the nose from the leading buttress 21 recesses 36 separate the buttresses, and a recess 37 separates the nib 30 from the trailing buttress 21.

To attach the end fitting as above described to the hose, the unpared hose end 14 is first pushed into the

ferrule portion 11 until it abuts the internal wall 39 of the nose. Then, the stem portion is pushed through the nose 28 of the ferrule portion to locate in the bore 16 of the hose and, thereafter, the ferrule is swaged onto the hose end and stem portion by an encircling swaging die. Swaging (i.e. radial clamping) of the ferrule and hose end is effected in a single operation, although successive and progressive deforming functions are performed on the ferrule portion during the single swaging operation. This is described below in more detail, with reference to Figures 3 to 6 of the drawings.

As a result of the swaging operation and as shown in Figure 2 of the drawings, a number of clamping/retaining operations are performed on the hose end.

15 Firstly, the inner and outer rubber casings of the hose are compressed and locked between the stem and ferrule portions, this resulting in interference between the stem barbs 20 and the bore 16 of the hose.

20 Secondly, the ferrule buttresses 21 penetrate the outer casing of the hose to lock it against axial displacement.

Thirdly, the ferrule buttresses 21 cause the metal reinforcement 27 of the hose to deform and assume a serpentine path, this further aiding tensile retention of the hose.

25 Fourthly, the outer casing of the hose is caused to flow into the recesses 35 to 37 of the ferrule and to be compressed in a longitudinal direction as well as in a

radial direction.

Fifthly, the nib 30 is forced to enter the outer casing of the hose to provide a weatherproof seal.

Reference is now made to Figures 3 to 6 of the drawings, which show successive operations that are performed progressively during the swaging operation.

Figure 3 shows the assembly of the stem 10, ferrule 11 and hose 14 just prior to application of a swaging force by an encircling die 40.

10 As the die 40 commences to close about the ferrule portion, as shown in Figure 4, it acts to compress Zone 1 of the ferrule in a radial direction and this in turn causes the buttresses 21 to commence penetration into the outer casing of the hose. At the same time, the ferrule is caused
15 effectively to elongate in the longitudinal direction, due to the absence of contact between the die 40 and Zones 2 and 3 of the ferrule, and the nose portion flange 29 of the ferrule is simultaneously moved into initial engagement with the recess 17 in the stem. This is an important step because,
20 if engagement of the flange and recess did not occur, elongation of the rubber hose might cause relative displacement of the stem and ferrule and, as a result, prevent the interlocking of the two parts.

Figure 5 shows a further transition in the swaging
25 process as further movement of the die 40 occurs. At this point in the operation the buttresses 40 are driven further

into the outer casing of the hose, and the die 40 engages with the nose 28 of the ferrule and more positively drives the flange 29 into the recess 17.

5 The final swaging stage is shown in Figure 6 when, with maximum displacement of the swaging die 40, the condition as described above with reference to Figure 2 is achieved. Thus, the three ferrule Zones 1, 2 and 3 have all been acted upon by the die and the outside periphery of the ferrule is thereby reduced to a diameter which is constant along the
10 length of the ferrule.

Thereafter, the die is opened and the assembled fitting is released.

CLAIMS

1. A swage-type hose end fitting for attachment to a wire braid reinforced hose without the outer covering of the hose being pared to reveal the wire braid reinforcement, the end fitting comprising:

5 a hollow stem portion for engagement with the hose bore and a ferrule which is arranged to be swaged onto the hose end and the stem portion,

the stem portion having a stem which is sized to fit into the hose bore, an annular recess spaced
10 longitudinally from the stem and a shoulder separating the recess from the stem,

the ferrule comprising an annular-form body which is formed with internal buttresses which are shaped and sized to bite into the outer covering
15 of the hose and to extend to the hose reinforcement when the ferrule is swaged onto the hose end, an inwardly directed flange adjacent one end thereof for locating in the stem portion groove when the ferrule is swaged onto the hose end and a nib adjacent
20 the other end thereof which, when the ferrule is swaged onto the hose end, bites into or grips the outer casing of the hose but does not extend to the reinforcement,

the ferrule having first, second and third
25 longitudinally spaced zones which respectively incorporate the buttresses, flange and nib, and the outside diameter of the ferrule being smaller in the second and third zones than in the first zone so that, during a swaging operation, the second

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and third zones contract a smaller average radial distance toward the stem than the first zone.

5 2. A fitting according to Claim 1 wherein each buttress has an inclined face facing radially inwardly and away from the flange, such as to assist insertion of the hose end into the ferrule and to resist retraction thereof.

10 3. A fitting according to either preceding Claim, wherein the stem is formed over a major portion of its length with a series of barbs for gripping the bore of the hose.

15 4. A swage-type hose end fitting substantially as described with reference to and as shown in the drawings.

20 5. The combination of the hose-end fitting of any preceding Claim and a wire-braid reinforced hose attached thereto, the outer covering of the hose being unpared.

25 6. The combination according to Claim 5, wherein the inside of the three zones of the swaged ferrule diameters surrounding the hose end are substantially the same.

30 7. The combination of a swage-type hose end fitting and a wire-braid reinforced hose substantially as described with reference to and as shown in the drawings.

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