June 11, 1935. Q. G. NOBLITT 2,004,535

PROCESS OF MAKING LOCK SEAMS

Filed Jan. 9, 1933

Fig. 1.

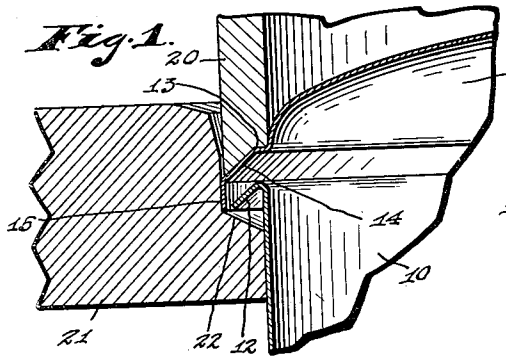


Fig. 2.

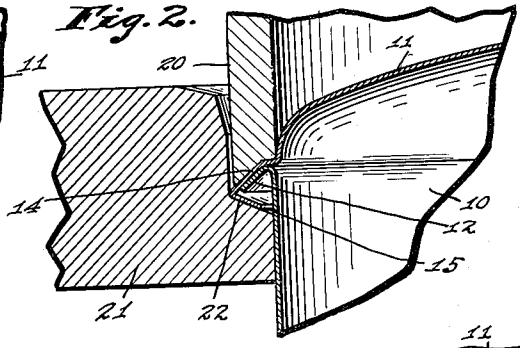


Fig. 3.

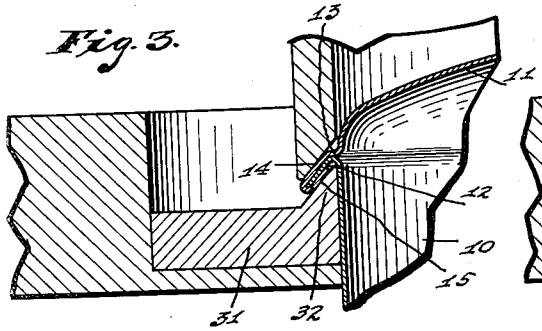


Fig. 4.

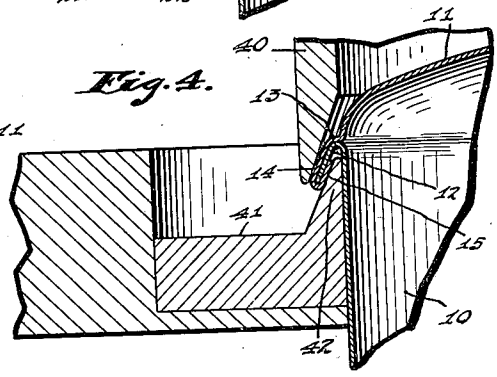


Fig. 5.

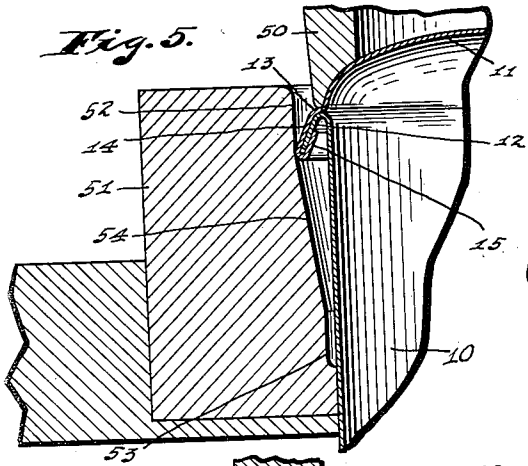


Fig. 6.

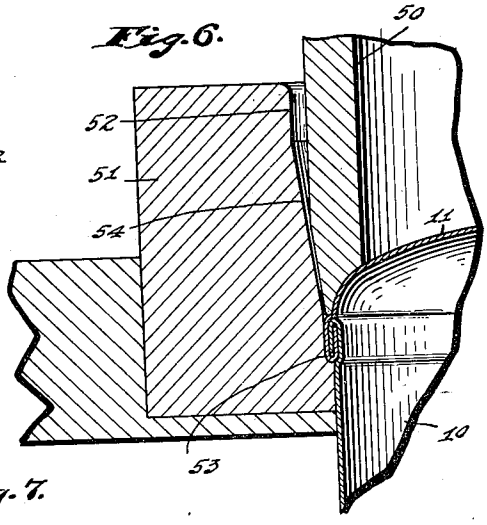
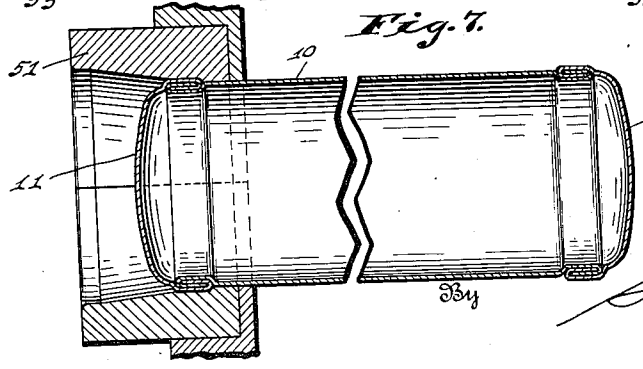


Fig. 7.



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UNITED STATES PATENT OFFICE

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PROCESS OF MAKING LOCK-SEAMS

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Application January 9, 1933, Serial No. 650,761

5 Claims. (Cl. 113—121)

My invention is concerned with the application or attachment of a sheet-metal cap to the open end of a sheet-metal tube or casing in situations where it is undesirable to have on the finished assembly an outwardly projecting flange formed by the interlocked seam between the cap and the tube or casing. Where it is permissible to have the seam form an outwardly extending flange, it is comparatively easy to effect a tight joint since the seam can be compressed and locked by co-operating die-parts located on opposite sides of it. When it is desired, however, to secure a cap to a tube by interlocking the edges of such two parts and to avoid the presence of an outwardly projecting flange constituting the seam, difficulties are experienced in securing a tight joint. One method used in the past for interlocking the edges of a cap and tube while avoiding the existence of an outwardly projecting flange has been to form a lock-seam extending radially out from the tube, and then to fold this seam backwardly along the tube.

I have found it practically impossible to make an effective leak-proof seam by this method; for, no matter how tightly the seam is compressed to effect a seal while the seam projects outwardly, it is opened up at least slightly while it is being folded over the tube.

It is the object of my invention to produce a lock-seam between a tube or casing and an end-closure therefor in which the seam, while satisfactorily leak-proof, will lie closely along the wall of the tube or casing.

In carrying out my object I turn the edge of the tube or casing outwardly and backwardly to form a conical flange, and I form on the cap a flange having a conical portion complementary to the flange on the tube. The cap is placed over the end of the tube and the rim of the cap-flange turned inwardly back of the flange on the tube, thus loosely connecting the cap and tube together. In the next operation, the in-turned rim of the cap-flange is bent further inwardly to engage the back surface of the flange on the tube, and the seam thus formed is compressed. The seam thus provided is then bent backwardly as a whole into contact with the wall of the tube.

The accompanying drawing illustrates my invention: Fig. 1 is a fragmental axial section through the cap and tube and through the dies employed in effecting the first assembling operation, the dies being shown only partly closed; Fig. 2 is a view similar to Fig. 1, but showing the dies completely closed; Fig. 3 is a fragmental axial section showing the second set of dies and the operation performed thereby; Fig. 4 is a similar view illustrating a set of dies which, while bending the flange forming the lock-seam rearwardly, also compress the seam; Fig. 5 illustrates the final set of dies used in partially closed position; Fig. 6 is a view similar to Fig. 5, but showing the dies completely closed; and Fig. 7 is a complete axial section showing the assembled tube and cap in its final condition.

An article of the type with which my invention is concerned is illustrated in Fig. 7 and comprises a sheet-metal tube or casing 10 having sheet-metal end-closures or caps 11. It will be noted that the caps 11 are secured in place on the ends of the tube or casing 10 by interlocked seams which lie axially inwardly of the central portions of the caps and which do not project materially outwardly beyond the wall of the tube 10.

In producing a seam of the type illustrated in Fig. 7, the tube and caps are separately formed. The edge of the tube-wall at each end of the tube is bent outwardly and backwardly, as by rolling, to form a conical flange 12 which slopes radially outwardly and axially inwardly of the tube. Each cap 11 is formed with an annular flange having three portions: First, an inner and relatively narrow plane portion 13; second, an intermediate conical portion 14 which is tapered complementarily to the flange 12 on the tube 10; and third, an outer portion 15 which is substantially cylindrical and which extends axially outwardly from the body of the cap 11.

The dies used in the first assembling operation are illustrated in Figs. 1 and 2 and comprise an inner die 20 and an outer die 21. The former is shaped to engage the inner portion 13 and the intermediate portion 14 of the cap-flange. The outer die 21 has a central opening which receives the shell or casing 10. The upper end of the opening in the die 21 is counterbored to a diameter sufficient to receive the outer portion 15 of the cap-flange. The upper surface 22 of the shoulder forming the bottom of the counterbore slopes inwardly and downwardly, as is clear from Fig. 1.

When the tube 10 and cap 11 are to be assembled, the tube is placed in the lower die 21 with the flange 12 lying in the counterbored portion of the recess in the die 21, and the cap 11 is then dropped over the upper end of the tube. The parts are shown in this position in Fig. 1. The dies 20 and 21 are then brought together, the inclined surface 22 of the die 21 serving to force the outer portion 15 of the cap-flange inwardly

beneath the flange 12 on the tube 10. The first set of dies is illustrated in closed condition in Fig. 2 from which it is evident that at the completion of the first operation the tube and cap are loosely secured together by the radial overlapping of the flange 12 and the rim of the cap-flange.

The loose assembly effected by the first operation is then transferred to the second set of dies illustrated in Fig. 3. This second set of dies comprises an inner die 30 and an outer die 31. The former is provided with a conical face adapted to engage the back of the intermediate portion 14 of the cap-flange. The outer die 21 has a central opening to receive the shell or tube 10 and, surrounding such opening is an upwardly projecting annular rib 32 the outer surface of which is conical and tapered complementarily to the face of the inner die 30.

When the dies illustrated in Fig. 3 are brought together with a tube and cap assembly between them, the outer portion 15 of the cap-flange is bent upwardly into engagement with the back of the flange on the tube 10, and the intermediate and outer portions of the cap-flange are forced toward each other to grip the flange on the tube 10 between them.

A third set of dies employed is illustrated in Fig. 4 and comprises an inner die 40 and an outer die 41. Like the die 31, the die 41 has a central opening to receive the tube 10 and an upwardly projecting annular rib 42 surrounding such opening. The dies 40 and 41, however, differ from the dies 30 and 31 in that the conical operative faces of the die 40 and the rib 42 are more nearly cylindrical. As a result of the action of the dies 40 and 41, the seam formed by the interlocking of the tube 10 and cap 11 is bent backwardly more nearly into parallelism with the wall of the tube 10 and at the same time is compressed and tightened.

The final assembling operation is performed in the dies illustrated in Figs. 5 and 6. This set of dies comprises an inner die 50 and an outer die 51. The inner die 50 is annular in shape and is formed to engage the center portion of the cap 11 near the edge thereof and also to engage the inner portion 13 of the cap-flange. Like the other outer die described, the die 51 has a central opening adapted to receive the shell 10, the upper end of this opening being counterbored. The counterbored portion of the opening of the die 51 may be regarded as divided axially into three sections; first, an upper cylindrical section 52 having a diameter sufficient to receive the seam formed by the dies 40 and 41; second, a lower portion 53 which is also cylindrical but which has a diameter only slightly larger than the outer diameter of the tube 10; and third, an intermediate conical portion 54 which tapers from the larger-diameter portion 52 to the smaller diameter-portion 53.

As is clearly evident from Figs. 5 and 6, the tube and cap assembly, after the operation performed by the die illustrated in Fig. 4, is transferred to the dies illustrated in Figs. 5 and 6. As these dies are brought together the outer edge of the seam formed by the interlocking flanges of the tube and cap is forced inwardly by the conical wall 54 of the die 51. When the dies are completely closed, this seam has been brought into parallelism with the wall of the tube 10, as is clear from Fig. 6. Preferably, the diameter of the lower portion 53 of the die 51 is such as to displace the metal at the end of the tube 10 inward, thus reducing the outer diameter of the seam from what it otherwise would be.

The outer die in each set of dies is slit axially on a diameter, as shown for the die 51 in Fig. 7, in order to permit the application of the outer die to the tube.

I have found that the above described method of interlocking a tube and an associated end-closure provides a seam which is both neat in appearance and substantially leak-proof. The process is especially adapted for the application of end closures to the shells of mufflers used with internal combustion engines.

I claim as my invention:

1. The process of securing together a sheet-metal tube and a cap for one end thereof, which comprises separately forming on the end of the tube and at the edge of the cap complementary conical flanges, the flange on the cap being wider than the flange on the tube, bringing the cap and tube together with said flanges in engagement and the rim of the cap-flange projecting outwardly beyond the flange on the tube, folding the projecting rim of the cap-flange inwardly beneath the tube flange, compressing the seam thus formed, and then folding such seam inwardly into engagement with the wall of the tube and subjecting the exterior of the seam to inwardly directed radial pressure to cause a permanent reduction in the internal diameter of the tube in the plane of the seam.

2. The process of securing together a sheet-metal tube and a cap for one end thereof, which comprises separately forming on the end of the tube and at the edge of the cap complementary flanges, the flange on the cap being wider than the flange on the tube, bringing the cap and tube together with said flanges in engagement and the rim of the cap-flange projecting outwardly beyond the flange on the tube, folding the projecting rim of the cap-flange inwardly beneath the tube flange, compressing the seam thus formed, and then folding such seam inwardly into engagement with the wall of the tube and subjecting the exterior of the seam to inwardly directed radial pressure to cause a permanent reduction in the internal diameter of the tube in the plane of the seam.

3. The process set forth in claim 1 with the additions that the operation of folding the seam inwardly is performed in a plurality of steps and that the seam is compressed at the conclusion of each step.

4. The process set forth in claim 2 with the additions that the operation of folding the seam inwardly is performed in a plurality of steps and that the seam is compressed at the conclusion of each step.

5. The process of securing together a sheet-metal tube and a cap for one end thereof, which comprises separately forming on the end of the tube and at the edge of the cap complementary flanges, the flange on the cap being wider than the flange on the tube, bringing the cap and tube together with said flanges in engagement and the rim of the cap-flange projecting outwardly beyond the flange on the tube, folding the projecting rim of the cap-flange inwardly beneath the tube flange, compressing the seam thus formed, and then folding such seam inwardly into engagement with the wall of the tube while maintaining the cap and tube free from internal support at the seam.

QUINTIN G. NOBLITT.