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ANODIZING RIVET

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Fig. 1

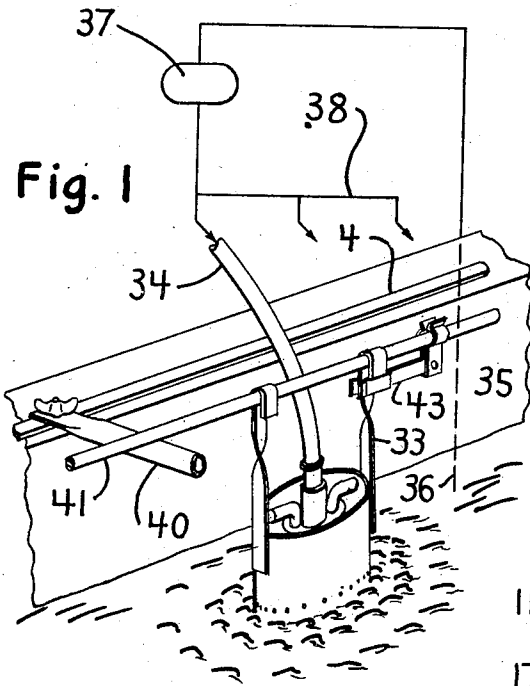


Fig. 3

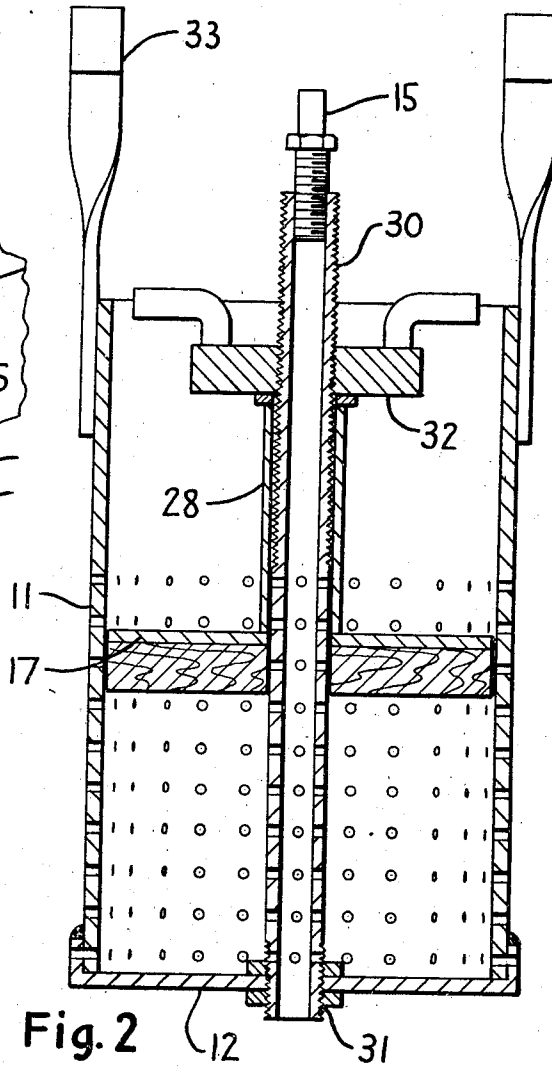
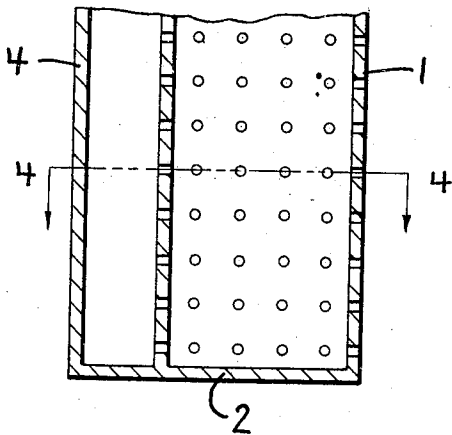
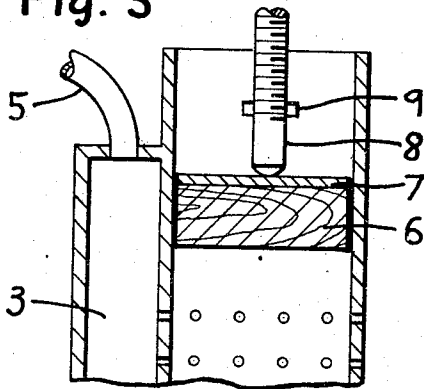
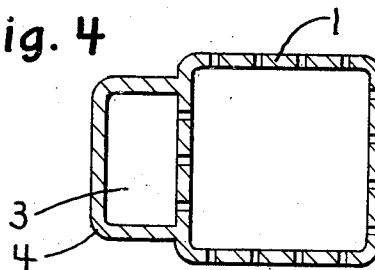


Fig. 2

Fig. 4



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ANODIZING RIVET

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Anodic treatment for the formation upon sheets or articles formed of metal which is predominantly aluminum, for the protection of the surface thereof against corrosion, is a widely practiced and well recognized process, especially in airplane manufacture. It is a process which is readily applicable to structural elements, such as rib sections, skin sheets, struts, and the like. Each such element, connected electrically to the anode of an electric circuit, may readily be immersed within the anodic bath, and the conditions of treatment may be so controlled that when the current is passed and the bath liquid is brought into contact with it (and usually is moved relative to it by gentle movement or agitation), the article immersed is caused to be coated by a tough corrosion-resisting film, primarily an oxide of the metal.

It is not possible to treat such small parts as rivets, washers, bolts, nuts, and the like in the same manner, for obviously it is impracticable to effect and to maintain good electrical contact between each one of them individually and the anode of the current source, during its immersion, yet still it is desirable that such small parts be anodized. Such small parts, for convenience, will hereinafter be termed "rivets," which will be understood as a representative and inclusive term.

If it be attempted, as it has been in the past, to contain a multiplicity of such rivets loose in a metal basket, and to connect the metal basket to the anode, relying upon contact of each individual rivet with other rivets adjoining, and these with the basket, to conduct current to each individual rivet, it still is found that the coating is not uniform nor sufficient.

It has been considered by some that the failure to accomplish proper coating by the expedient above was due to failure to permit or to induce a sufficient penetration of the liquid bath throughout the mass, notwithstanding that the rivets were merely loosely placed within the basket. It was considered, then, that such circulation might be enhanced by joggling, shaking, or otherwise disturbing the position relationship of the rivets, but upon trying this it was found that there resulted failure of adequate and proper electrical contact, and that arcing and burning of the surface of the rivets resulted. It appears, then, that adequate contact must be maintained at all times for the passage of the electrical current to each rivet and to all surfaces of every rivet, which implies close and continuous contact of each individual rivet with all others adjoin-

ing it, and it appears that in addition there must be circulation of the anodizing bath liquid throughout the mass of rivets, yet in such a manner as will not disturb the position relationship of the rivets.

The difficulty of effecting full and complete anodization is particularly noticeable in parts such as countersunk rivets, which have appreciable flat areas which may come into face-to-face contact with each other, and it has been found in practice that the best attainable results heretofore have produced not to exceed about sixty per cent of properly anodized large size, round-head rivets, and a lower percentage of smaller or countersunk rivets. On the improperly anodized remainder the time and effort of the treatment have been wasted, and in order to avoid waste of time and effort in the further handling of such improperly anodized rivets, as for instance to avoid the heat treatment and refrigeration of such rivets which cannot in any event be used, and to prevent the necessity of careful inspection and selection of each individual one before it is put in place for riveting, it has been the practice to sort over such parts, and to pick out, by hand, those rivets which are not fully and completely anodized. Obviously this is a tedious task, one which cannot be performed with one hundred per cent of success, and one which is time consuming and costly. On the other hand, there has been known no method heretofore by which such hand picking could be avoided, for apparently if the electrical contact is not good and sufficient, the anodization is incomplete, and if, on the other hand, the physical contact between the parts is close enough to afford good electrical contact, then it is not feasible to effect circulation of the bath liquid through the mass without disturbance of the position relationship of the individual particles, and again disturbing the electrical contact and effecting burning.

I have discovered how the above difficulties may be obviated, and how, by apparently going contrary to the indicated procedure, namely, by effecting and retaining positive physical contact between the rivets, in conjunction with forced circulation of the bath liquid through the mass, the anodization of such rivets may be accomplished to such a high degree of perfection that the improperly anodized rivets are reduced to somewhere in the neighborhood of 1% or less, and never in excess of 2%.

The present invention concerns primarily the process of anodizing commercially and economi-

cally a multiplicity of such small articles as rivets, and secondarily, though it may be practiced with various forms of apparatus, with the apparatus which has been especially designed for the carrying out of the process in an economical and practical manner.

Figure 1 shows schematically the anodizing operation and one of the containers by the use of which the same may be performed, in accordance with the present invention.

Figure 2 is an axial section through a container and compressor which may be used in the carrying out of the process, and Figure 3 is a longitudinal section through a variant form of the container, Figure 4 being a transverse section through the container on the line 4-4 of Figure 3.

It may be debatable whether the difficulty in securing proper results according to previous methods was due to failure to secure good electrical contact throughout the entire mass, or to the failure to secure adequate penetration and movement of the bath liquid throughout the mass, or perhaps to the formation of voids from which gases or air are not forcibly expelled. Unless the individual rivets which compose the mass are held immobile within the mass, and each relative to all others, good electrical contact is not obtained, and arcing and discoloration result. Therefore attempts to secure proper penetration of the bath liquid, if carried far enough to accomplish effective penetration of a mass of rivets within a basket, resulted likewise in the displacement of rivets within and relative to the mass. At the same time it was considered necessary to leave the rivets sufficiently loose that penetration throughout the mass could be accomplished with the minimum of agitation and resulting disturbance of the individual rivets. In attempting to compromise, then, between sufficient looseness of the individual rivets within the mass for effective penetration with low rate of agitation, there resulted such looseness of the rivets within the mass that even with the gentle agitation normal in the anodizing bath, there was some displacement of rivets, and because the agitation must be gentle there resulted failure to penetrate effectively.

Since the anodizing process consumes an appreciable amount of time, perhaps 25 or 30 minutes, it is not practicable to spread the rivets upon a belt, trays or the like, with sufficient spacing to insure free access of the bath liquid to them at all sides, and, moreover, such an arrangement would not afford proper electrical contact to the individual rivets, accomplished merely by their own weight upon trays or the like, for the tray surfaces and the contacting surfaces of the rivets, upon becoming anodized, would lose effective electrical contact. Both effective electric contact and physical contact of the bath liquid with the surface of the rivets are required in conjunction, under anodizing conditions, to effect proper formation of the anodized film.

Bearing in mind the latter requirement, good electrical contact and immobility throughout the mass, and effective penetration of the bath liquid to all surfaces of the individual rivets within the mass, with expulsion of air or gas from all interstices, so that there will be contact of the bath liquid with all surfaces, the method consists, in effect, of first insuring that the rivets will be held immobile, and that they will be held positively pressed together in good electrical

contact with one another rather than, as heretofore considered necessary, that they be left loose for penetration of the bath liquid throughout the mass. As a matter of fact, to insure immobility of the individual rivets, and their compression into good electrical contact, the rivets are poured within, packed, jogged, and tamped down into, and finally are compressed tightly within and held compressed within a container which is perforated for the passage of the bath liquid. Thus preliminarily compressed and held immobile within such a container, which is preferably of the same metal as the rivets to afford good electrical contact, and which is itself electrically connected to the anode of the current source, the rivets and the container are immersed within the anodizing bath under conditions such as will produce an anodized film. These conditions, as to time, temperature, current strength, and the like, may be such as are present in any normal anodizing bath, and my invention contemplates no change in such conditions.

During immersion of the compacted rivets within the anodizing bath, the second requirement of my invention is fulfilled, namely, there is effected forcible penetration of the bath liquid into and throughout the entire mass displacing any gas or air which might tend to collect in pockets. This might be effected in various ways. It will be remembered that the invention is applicable to many forms of loose articles, such as rivets, washers, bolts, nuts, and the like, and that each of these may vary widely in size, in contour or form, and in the absence or presence of rounded or flat surfaces, and that all such conditions will affect the freedom of passage of the bath liquid through the mass. For instance, large rivets, especially if they be of the normal round-head type, will present large interstices for the relatively free passage of the bath liquid, whereas small rivets, especially if they be of the countersunk type, will tend to pack very tightly together, and if two flat-head surfaces are pressed together it will require considerable force to effect movement of the bath liquid between such surfaces, so pressed together. It becomes apparent, then, that no rule may be laid down as to the amount of force, or the nature of its application, which may be required to effect the desired penetration and circulation through the mass of the bath liquid, but these considerations will vary in accordance with the nature of the rivets being treated.

If the rivets are sufficiently large and of such individual contour that the interstices between them are relatively large, the agitation to effect penetration of the bath liquid may take only the form of rapid and violent agitation of the fluid within the bath, or violent bubbling of the liquid up into the bath or tank. In other instances, and usually, it will be necessary to project streams of the bath liquid within the mass, to pass through it, or to pass from its interior outwardly.

I have found that several pounds of very small countersunk rivets, of aluminum or of metal predominantly aluminum, when compacted into a container of the type shown in Figures 3 and 4, for instance, may be afforded sufficiently intimate contact with the bath liquid, when the latter is projected into one side of the container, under a pressure in the neighborhood of 12½ pounds per square inch, thus to force it through a mass which is somewhat in excess of two inch-

es in thickness. However, I do not desire the above to be considered as restrictive, but purely as illustrative of conditions which have been found suitable in a typical instance.

The container 1 shown in Figures 3 and 4 is rectangular in cross section, and closed at its bottom 2. Its four walls are perforated with a multiplicity of perforations, which are sufficiently small that the rivets may not catch therein, but sufficiently large and numerous that the interstices of the mass of rivets constitute the primary resistance to fluid flow, and not the perforations. Along one side there is provided a conduit 3, by means of a closed channel 4 which is welded in place, and which is of slightly less width than the width of the container 1, and of somewhat less length. At one end of the conduit 3 there is provided a connection 5 for a hose leading from a suitable pressure pump. The open upper end of the container 1 is closed, first by a wooden block 6, and then by a disk 7, conforming to the cross section of the container 1, which block and disk are forced down upon the rivets within the container by means of a jack screw 8, reacting from the container 1 by means not shown, but which may be anchored in the holes illustrated at 9.

Another form of container of somewhat greater capacity is illustrated in detail in Figure 2. This comprises a cylindrical container 11, closed at the bottom as indicated at 12, and open at its top, except when it is filled with rivets, when the top is closed by a disk 17, having a sleeve 28 fitted upon the externally threaded conduit 30, which is anchored at 31 in the bottom 12. A washer 32, threaded upon the screw 30, forces down on the end of the sleeve 28, and thence upon the disk 17. One container such as this has a capacity of thirty pounds of rivets.

The screw 30 is hollow, and is provided with a multiplicity of perforations, and the sleeve 28 closes those perforations which are above the level of the disk 17. At the upper end there is a connection 15 provided for the connection of a hose to the hollow screw 30. The entire container is suitably supported, as by hooks 33, by which it may be hung from a rod electrically connected to the current source.

The containers 1 or 11 having been filled and tamped down and jogged and packed as tightly as possible with the rivets or whatever other loose parts are to be anodized, they are finally held, thus compacted and immobilized, by the disk 7 or 17. Preferably they are so tightly compacted that when shaken not a single rivet rattles or moves relative to any other rivet. Thus compacted, the container, full of rivets, is immersed within the anodizing bath, as shown in Figure 1, and a hose 34 is connected to the connection 5 or 15. Anodizing liquid is taken from the tank 35 by means of the line diagrammatically indicated in Figure 1 at 36, and is delivered by a pump represented at 37 to a header 38, and thence by one of several hoses 34 to the interior of the conduit 3 or 28. It emerges through the perforations distributed in the wall of such conduit within the mass of rivets, and forces its way outward by the pressure of the pump quite uniformly through the interstices in the mass, and comes into intimate contact with all surfaces of every rivet. It escapes from the container through the perforations in the walls 1 or 11 thereof, and thus back to the bath. In the meantime the container and its rivets are subjected to anodizing conditions, including the sup-

ply of current by way of the bus bar 4, the electrically connected cross bar 40, and the longitudinals 41 electrically connected between cross bars 40 above the surface of the liquid in the tank. The hooks 33 are hung upon these longitudinals 41 or upon the cross bars 40, and effective electrical contact is established between the container (hence also the rivets) and the current-carrying bar 41, by suitable means, such as the electrical clamp 43. If the container were of other than a conductive material, special electrical leads into the interior of the mass of rivets might be provided, but since the container itself is a good conductor, and is of the same material as the rivets being treated, the container itself may constitute the electrical connection.

What I claim as my invention is:

1. For use in anodic treatment of rivets and like small parts, a perforated container open at one end only, positively acting, unyielding means to close the open end, and to compress within the container a multiplicity of the rivets, a conduit leading from end to end of the container, and having a multiplicity of orifices discharging within the mass of rivets within the container, and means to supply anodic bath liquid under pressure to said conduit.

2. For use in anodic treatment of rivets and like small parts, a perforated container of the same metal as the rivets, open at its top only, a hollow conduit extending along one side of the container, and communicating with its interior through the perforations thereof, a top closure disk fitting closely within the container, screw means to compress within the container a multiplicity of rivets, and means to supply anodic bath liquid under pressure to said conduit, for discharge within the compacted mass of rivets, and through all the interstices of said mass, and outwardly through the container's perforations.

3. A process for anodizing a multiplicity of aluminum rivets and like parts, which comprises packing them sufficiently tightly within a perforated aluminum container to effectively immobilize the individual rivets during subsequent treatment, positively holding the rivets in such condition, connecting the container to the anode of a normal anodic treatment bath, immersing the rivets, within the container, within such bath, under film-forming conditions, and forcing bath liquid under pressure into the mass at a multiplicity of points within the mass, the liquid pressure being sufficient to force the liquid through the interstices and through the perforations of the container, and between the pressed-together surfaces of the rivets, against the resistance offered by the tightly packed rivets, and the immobilizing pressure upon the rivets being sufficient to maintain them immobile under the separating influence of the liquid pressure.

4. The process of anodizing a mass of small separate aluminum objects which comprises placing the mass of objects in a perforated container, positively pressing together the objects under a pressure sufficient to hold them immobilized and in firm electrical contacting relationship with each other within the container, establishing an electrical connection between the anode of an anodic treatment bath and the mass of objects within the container immersed in the anodizing bath under film-forming conditions, and directing beneath the surface of the bath in proximity to the mass of objects and through such mass while thus held in the container bath liquid under

sufficient pressure to penetrate between the pressed-together surfaces of the objects.

5. The process of anodizing a mass of small separate aluminum objects which comprises placing the mass of objects in a perforated container, subjecting the objects to a positive pressure sufficient to hold them immobilized and pressed together in firm electrical contacting relationship with each other within the container, immersing the container with the mass of objects therein 10

in an anodizing bath under film-forming conditions, establishing an electrical connection between the anode of the bath and the mass of objects, and directing beneath the surface of the bath in proximity to the container and through the latter into the mass of objects contained therein jets of the bath liquid under sufficient pressure to penetrate between the pressed-together surfaces of the objects.

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