Oct. 31, 1939. K. KNUDSEN 2,177,928

HOLLOW METAL BALL AND METHOD OF MAKING SAME

Filed Dec. 9, 1936 3 Sheets-Sheet 1

Fig. 1.

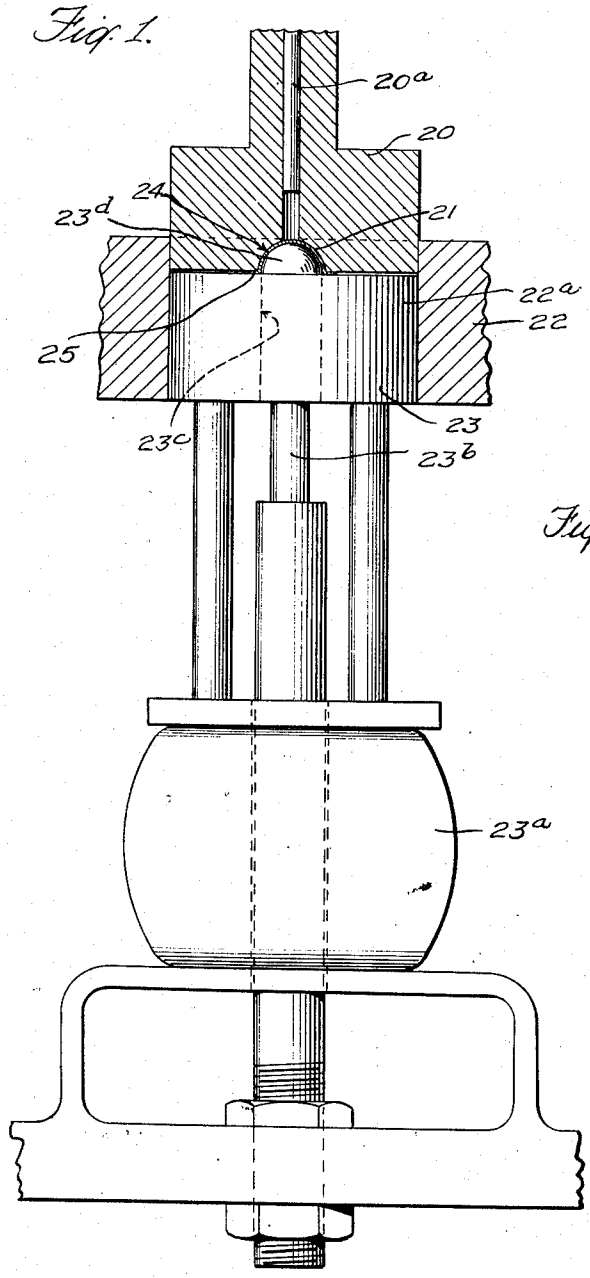


Fig. 2.

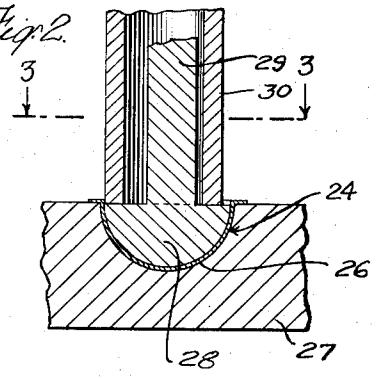
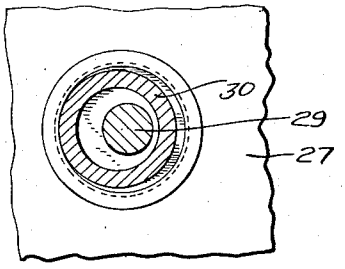


Fig. 3.



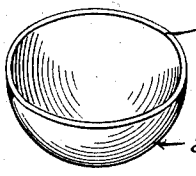


Fig. 4.

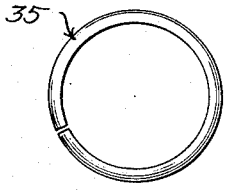


Fig. 5.

INVENTOR
KNUD KNUDSEN
BY William T. Kriesman
ATTORNEY

Oct. 31, 1939. K. KNUDSEN 2,177,928

HOLLOW METAL BALL AND METHOD OF MAKING SAME

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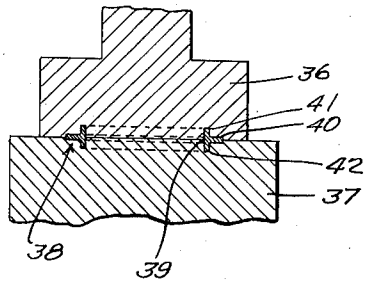


Fig. 6.

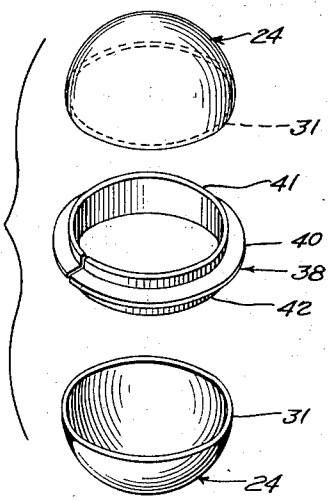


Fig. 7.

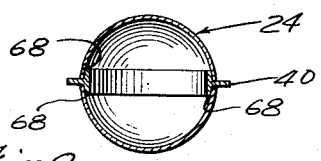


Fig. 8.

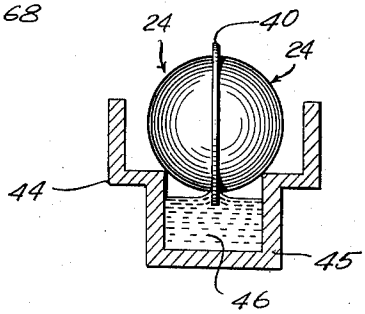


Fig. 9.

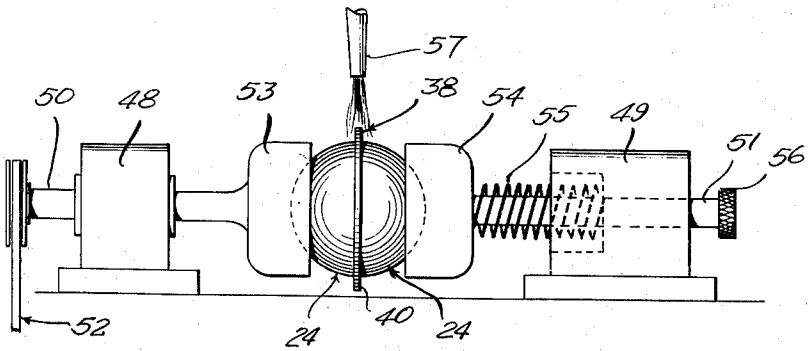


Fig. 10.

INVENTOR
KNUD KNUDSEN
BY William T. Kiesner
ATTORNEY

Oct. 31, 1939. K. KNUDSEN 2,177,928

HOLLOW METAL BALL AND METHOD OF MAKING SAME

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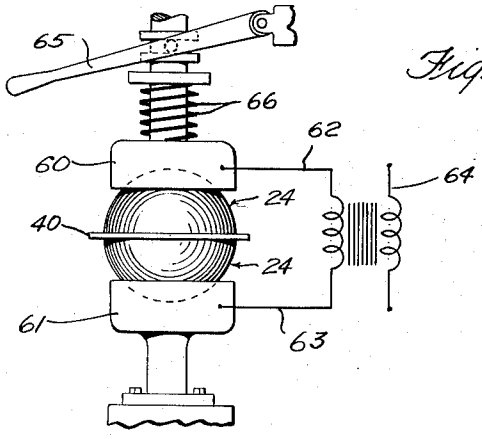


Fig. 11.

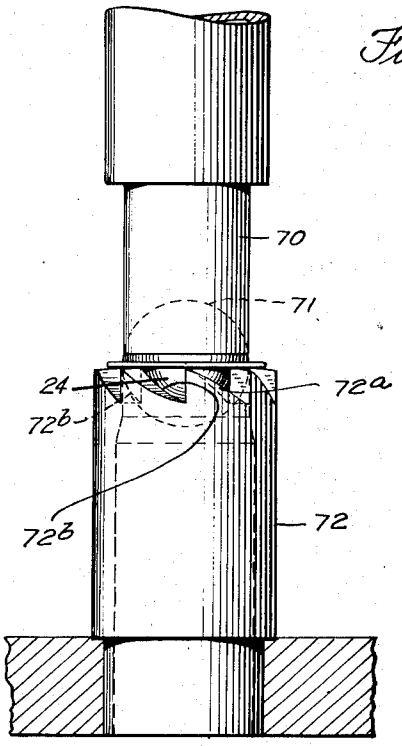


Fig. 12.

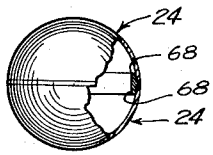


Fig. 13.

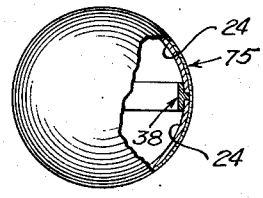


Fig. 14

INVENTOR
KNUD KNUDSEN
BY William T. Knueven
ATTORNEY

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UNITED STATES PATENT OFFICE

2,177,928

HOLLOW METAL BALL AND METHOD OF MAKING SAME

Knud Knudsen, Danbury, Conn., assignor to Danbury-Knudsen, Incorporated, a corporation of Connecticut

Application December 9, 1936, Serial No. 115,002

18 Claims. (Cl. 29—148.4)

This invention is in hollow metal balls and the method for making them.

One of the objects of this invention is to provide a low cost precision hollow metal ball having certain relatively precise or narrow limits of ratio of its weight to its volume particularly with respect to the specific gravities of alcoholic liquors of which whiskey, gin, and the like, may serve as examples, and having also adequate resistance to attack thereon by such liquors or constituents in or of the latter. Another object is to provide a ball of the above-mentioned character and capable of inexpensive and quantity-rate of production and yet maintain and provide a consistency or uniformity of roundness to insure dependable coaction with a ring-like or annular valve seat, usually of cork or like composition, for dependable passage-sealing action at all times and of a diminutiveness appropriate for incorporation into certain types of non-refillable so-called stoppers applicable to the necks of bottles. Another object is to provide a thoroughly practical method and apparatus for producing balls of the above-mentioned character, capable of achieving a cost of production so low as to make it possible to fit balls of this character and the bottle fitment or stopper with which the ball is to coact for non-refillable action, into the small margin of cost available therefor to the distiller or bottler of liquors and the like or to other producers and bottlers of liquids. Another object is to provide a method and apparatus for the production of balls of the above-mentioned character that will be efficient, reliable in operation, capable of high rate of production, and well adapted to meet the varying requirements of practical manufacture, and particularly the requirement of low cost of production. Another object is to provide a hollow ball construction meeting such requirements as those noted above and which, nevertheless, will be strong, durable, uniformly round, of adequately uniform distribution of weight, and of adequately uniform capacity or tendency to roll. Another object is to provide a method and apparatus for the quantity production of balls of the above-mentioned character and capable of achieving such uniformity of the above-mentioned characteristics of the ball as to minimize greatly, if not entirely eliminate, the need for testing of the balls, particularly for such qualities as leak-proofness, buoyancy, ratio of weight to volume, and the like. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, arrangements of parts and in the several steps and relation and order of each of the same to one or more of the others, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which are shown certain of the preferred forms or embodiments of certain mechanical features of my invention,

Figure 1 is a vertical sectional view of an apparatus for achieving a step in the earlier stages of making of the hollow ball;

Figure 2 is a similar view of another apparatus for achieving a succeeding step;

Figure 3 is a horizontal sectional view as seen along the line 3—3 of Figure 2;

Figure 4 is a perspective view of a half-ball resulting from such steps as those typified in Figures 1, 2 and 3;

Figure 5 is a plan view of a ring member in an early stage;

Figure 6 is a vertical sectional view of an apparatus for operating from the ring member of Figure 5;

Figure 7 is an exploded perspective view of three parts that go to make up the hollow ball structure as they appear just prior to preliminary assembly;

Figure 8 is a sectional view through the assemblage resulting from the parts shown in Figure 7, the section being taken through the axis of the above-mentioned ring member;

Figure 9 is a sectional view of an apparatus for applying soldering flux to certain parts of the hollow ball structure;

Figures 10 and 11 are front elevations, respectively, of possible forms of apparatus for accomplishing the step of actual soldering together of the several ball parts;

Figure 12 is a front elevation partly in section of an apparatus for forming a succeeding step in the ball production;

Figure 13 is a front elevation partly in section of the ball construction as it appears upon the conclusion of the step shown in Figure 12, and

Figure 14 is an elevation partly in section of the completed and final ball structure, after the conclusion of certain succeeding steps.

Similar reference characters refer to similar parts throughout the several views of the drawings.

As has already been indicated above, the hollow ball, to function in certain types of non-refillable stoppers, particularly for liquor bottles, has to meet certain peculiar requirements

not the least of which is low cost of materials employed and low cost of production; at the same time it must expose to the liquor or liquid a constituent which is not soluble in liquid or in constituents of the latter and is not attacked thereby, and in certain instances it must meet, within a relatively narrow margin, a certain requirement as to ratio of its weight to its volume. In these latter instances, such ratio is important as it bears upon the degree of presence or absence of buoyancy of the hollow ball and in some instances also the ball has to coact with or is acted upon by a movable or weighted member, the relationship of whose weight, at various angles of tilting of the bottle, to the weight and degree of buoyancy of the hollow ball are sometimes of major significance in the functioning of that type of non-refillable stopper. For illustrative purposes, it will suffice to state that, even in the most exacting of such instances such as those last-mentioned, this ratio is met if the final ball is of an outside diameter of 0.500 inch, with a tolerance of 0.001 inch, and its weight is between 13.5 and 15.0 grains; a ball meeting these last-mentioned numerical specifications functions satisfactorily in a non-refillable stopper for use with alcoholic liquors, such as whiskey, gin, or the like, and causes co-acting parts, such as a tiltable or movable weight, in the stopper mechanism also to coact satisfactorily. If the exposed surface of the ball is tin of suitable depth, the requirements of avoiding contamination of the liquor or liquid are satisfactorily met with.

However, a major factor in the provision of a hollow ball of this character is the item of cost to the distiller or bottler of liquor and in this item of cost the two principal factors are cost of materials and cost of production. While the parts of the non-refillable stopper or bottle fitment, other than the ball, may be capable of commercial construction within a satisfactory price or cost range to permit of economical adaptation of non-refillable stopper into liquor bottles, yet the cost of commercially producing a hollow metal ball has heretofore been so high as to make prohibitive the adoption commercially of such non-refillable stoppers by distillers and bottlers of alcoholic liquors. One of the dominant aims of this invention is to overcome this obstacle or prohibition and to provide a hollow metal ball construction and a method and apparatus for making it of such low cost as to bring not only the hollow ball itself but the entire non-refillable stopper or bottle fitment within the small or narrow range necessary for adoption in the liquor industry.

In the following description, it is assumed, for purposes of illustration, that the hollow ball to be produced meets all of the various requirements and characteristics, some of which have been noted above, if its outside diameter is 0.500 inch (with the tolerance above-mentioned) and its weight is between 13.5 and 15 grains, but it is to be understood that the ratio of weight to volume may and can be changed or departed from, depending upon the particular dimensions, characteristics of the liquor, and other factors, met with or required in a non-refillable stopper embodying a hollow metal ball. For the production of the ball illustratively dimensioned and weighted as above set forth, I prefer to start with a sheet metal such as phosphor bronze or drawn copper, having an initial thickness of 0.0075 inch. Other sheet metals may, of course, be employed, having due regard to their densities or specific gravities, but in the illustrative example I prefer phosphor bronze or drawn copper because these have sufficient ductility or workability and yet are hard enough to resist denting of the final ball in the course of the ordinary production handling thereof.

From the sheet metal a disk of appropriate diameter is first stamped out, the diameter being adequate for the subsequent drawing of the disk or blank into a hollow hemisphere. In Figure 1 is shown an illustrative step of so stamping and then drawing the circular blank.

An upper die member **20** has a recess **21** that is a true segment of a sphere having a radius of 0.500 inch but it is preferably of a depth that is a few thousandths of an inch less than that radius, for a purpose later described. The die recess **21** is, therefore, in volume, slightly less than a hemisphere. Member **20** is cylindrical, and enters a companion die member **22** having a cylindrical hole **22a**, thus cutting a disk out of sheet metal interposed therebetween, the disk being peripherally gripped between die **20** and an annular part **23** normally held with its upper face in the plane of the face of fixed member **22** by a yielding part such as a rubber collar **23a**. Parts **23** and **20**, with the disk gripped therebetween, now move downward as a unit.

Fixed against movement, as on a pillar **25b**, is a die part **23c** along which the member **23** slides downwardly and whose upper portion **23d** is truly hemispherical but of a radius less than that of the recess **21** by substantially the thickness of the sheet metal operated upon and whose uppermost point is in or just beneath the plane of the face of the fixed die part **22**. As parts **20** and **23**, with the disk or blank held therebetween move downward as a unit, fixed die part **23d** enters the die recess **21** and correspondingly and progressively trues and shapes the blank or disk into a substantially hemispherical part **24** having, however, a laterally and peripherally extending flange **25** about its upper or open end.

That step or operation completed, the part **24** is ejected, as by a knock-out member **20a** acting after the parts are returned to normal and die member **20** appropriately elevated, and is now inserted into a recess **26**, substantially like the recess **21**, of another lower die member **27**. Co-acting with the latter are two devices; one of these devices is a holding or center or alining member **28**, substantially hemispherical, and dimensioned snugly to enter the drawn sheet metal part **24**, and to press and bottom the latter, and securely hold it, in the die recess **26**. Member **28** may have a shank or stem **29** extending upwardly where it is connected to and operated by any suitable mechanism.

The other of the devices comprises a shearing tool **30**, in the form of an annulus, as shown in Figures 2 and 3; this cutting tool extends about the stem **29** (Figures 2 and 3) and any suitable means may be provided for mounting and moving it radially in an appropriate path or paths or steps.

Its lower and outer cutting edge or lower face is in the same horizontal plane that is coincident with the plane horizontal upper face of the lower die member **27** of Figure 2. It is shaped, moreover, to fall within that portion of the sheet metal part **24** (see Figure 2) that projects above the upper face of the die member **27** and it is caused to move radially outwardly just after the member **28** comes to rest to position and hold the sheet metal part **24** in proper position.

As it is made to move outwardly radially (see Figure 3) it shears off, along the above-mentioned horizontal plane, the excess metal of the sheet metal part 24, and, moreover, does so, due to the above actions, in a manner to leave a smooth, flat edge face 31 (see Figure 4) in what is now substantially a half-ball, the part 24. This edge face 31 is smooth and accurately falls within a single plane, due not only to the secure holding and alining of the sheet metal part 24 by the coacting parts 28 and 27 of Figure 3, but also due to the progressively and peripherally advancing shearing action as the shearing tool 34 is moved in appropriate steps or paths radially of the axis of the stem 29.

The half-ball 24 of Figure 4 is preferably a true segment of a sphere that is slightly less than a complete hemisphere, but hollow. For each ball to be made, two such hollow half-balls 24 are employed.

Next I make up a joining and alining ring member, one for each ultimate ball. This ring member is preferably made of wire, illustratively copper wire of a thickness of 0.040 inch, and I may make it by winding such wire in a close helix, and then severing or cutting the helix along a line to form as many split wire rings as there are turns in the helix. One such split ring is shown at 35 in Figure 5. It is of an inside diameter slightly less than the inside diameter of the half-balls 24, and it is shaped as by appropriately formed companion die members 36 and 37 (Figure 6) into what may be termed, as above noted, an alining and joining ring member 38. Illustratively, the die members 36, 37 are shaped to press or stamp the round wire split ring 35 of Figure 5 into this ring member 38 to give it a truly cylindrical inner part but which externally may be a spherical segment 39 and preferably it has projecting laterally from its middle portion a flange 40. The upper and lower parts 41 and 42 of the cylindrical part 39 are externally truly cylindrical or spherical and of a diameter, determined by the die members 36, 37, substantially equal to the inside diameter of the upper open ends of the half-balls 24, one of which is shown in Figure 4, and they are, moreover, truly concentric. Or the outer surfaces of the parts 41 and 42 may be made segments of a sphere whose radius is equal to that of the inside radius of the half-balls or shells. Preferably, also, the free portions, such as the upper and lower peripheral portions of the parts 41 and 42, as seen in Figure 6, may be made relatively yielding, as by making them of lesser thickness, to better and more easily conform, if necessary, to the curvatures of the inside faces of the half-balls. The laterally projecting flange 40 may be of a thickness of several thousandths of an inch, such as 0.002 or 0.005 inch, and it is by half of that amount, as will now be clear, that the half-balls 24 fall shy of being true hollow hemispheres.

The alining and securing ring 38 is now given a coating of tin, preferably by electro-deposition, in order thereby to better achieve a nicety or uniformity of distribution throughout its surfaces of the tin. This coating of the tin is of sufficient thickness to provide enough tin for ultimately soldering the two half-balls to the securing member 38.

In Figure 7 I have shown in exploded perspective two half-balls 24 with an interposed tin-coated flanged securing and alining ring 38, and these three parts are now mechanically assembled or interfitted in any suitable way. Thus, the upper cylindrical flange 41 is received snugly inside of the upper shell or half-ball 24 and the lower cylindrical flange 42 is snugly received into the open end of the lower shell or half-ball 24, any suitable means being employed to press the three parts together to make sure that the plane face edge faces 31 of the half-balls 24 snugly mate with the laterally projecting flange 40 of the ring member 38.

In Figure 8 the resultant assemblage is shown in transverse section and it will be noted that the concentricity of the upper and lower cylindrical flanges 41, 42 insures that the upper and lower shells or half-balls 24 have their axes brought into coincidence. It will also be noted that the flange 40 projects laterally about the equator of the resultant assemblage.

Thereafter I apply a suitable soldering flux in a position to coact with the tin of the assembly ring 38 and the contiguous surfaces of the two shells 24, 24. This I may achieve by causing the assemblage to be rolled, by gravity or otherwise, along tracks or guide rails 44, between and underneath which is a trough or receptacle 45 containing the soldering flux 46, preferably liquid, the parts being so dimensioned and related that, as the ball assemblage moves along the tracks 44, the projecting flange 40 has all its portions progressively brought and dipped into the flux 46. In this manner a quick application and distribution of the soldering flux may be achieved.

Having completed the application of the soldering flux, and bearing in mind that the preferred method of applying the solder comprises, as earlier stated, the application, as by plating, of a coating of tin to the ring 38, I next proceed to cause a flowing of the tin and this I do by appropriate heating of the parts, two illustrative methods and means being indicated in the drawings for this purpose.

Accordingly, referring first to Figure 10, I have there indicated a suitable frame 47 having two pillars or posts 48, 49 provided with suitable bearings for rotatably supporting shafts 50 and 51, respectively. Shaft 50 may be held against axial movement in any suitable manner and is provided with any suitable means such as a belt and pulley, indicated at 52, for effecting a suitable rate, preferably a low rate, of rotation of the shaft 50 and hence of a cup-shaped holder or chuck 53 rigidly mounted upon the inner end of the shaft.

The other shaft 51, coaxial with shaft 50, is also provided with a cup-shaped holder or chuck 54, juxtaposed to the chuck 53, but shaft 51 is slidable in the bearing in the post 49. Moreover, it is provided with a spring 55 interposed between the post 49 and the chuck 54 and acts to yieldingly thrust and hold the shaft 51 and the chuck 54 in a direction toward the left. The outer end of the shaft 51 may be provided with a suitable handle 56 or any other appropriate means for periodically shifting the position of the chuck 54 toward and away from the chuck 53.

The two chucks, at their contiguous faces, are hollowed out or concaved with a radius equal substantially to that of the ball assembly. Upon withdrawing chuck 54 a ball assembly may be positioned between the two chucks, manually or otherwise, with the plane of the ring member 38 extending substantially at right angles to the coincident axes of the two chucks, the ball assembly being gripped between the chucks under the spring action 55 when chuck 54 is released and being rotated due to the drive of the chuck 53.

At one or more points, preferably in the plane of

the ring member 38, is positioned a heater, illustratively taking the form of a gas or Bunsen burner 57, with its frame or point of heat emission positioned in appropriate proximity to the rotating equator portion of the ball assembly. Thereby the equatorial portions of the assemblage are heated to a sufficient degree to cause a flow of the previously applied tin or solder, and as soon as such flow or fusion has taken place, the application of the heat is withdrawn or the ball assemblage removed from the apparatus, whence cooling at any suitable or desired rate may be effected to complete the union of the three parts 24—38—24 (see Figures 7 and 8), the soldering flux previously applied insuring uniform and dependable action of the solder with the adjacent contacting surfaces of the half-balls 24—24.

Or, turning now to Figure 11, I may provide two concaved or cup-shaped electrodes 60 and 61 preferably with their axes coincident and extending vertical and insulatingly mounted in any suitable way (not shown) in any suitable frame (not shown). They may be connected as by conductors 62 and 63 to a suitable source of potential, illustratively indicated in the drawings as a transformer 64.

Any suitable means may be provided for bringing about a manual or periodic separation and approach of the electrodes 60 and 61; for example, the lower electrode 61 may be stationary while the upper electrode 60 may be mounted for movement along its axis, a lever 65 or like mechanism having a suitable connecttion with the shank of the electrode 60 to control up and down movement of the latter. Also, and preferably, movement of the electrode 60 toward the electrode 61, under the control of the lever 65, is brought about through an interposed spring 66.

Accordingly, after the step of applying soldering flux, the electrodes 60, 61 are separated to receive therebetween a ball assembly with the plane of the ring member 38 extending at right angles to the coincident axes of the electrodes, the latter having preferably a concavity of a radius equal to the radius of the half-ball members 24, 24 in order to make a good and large surface contact therebetween.

With a ball assembly thus positioned between the two electrodes and the lever 65 pressed downwardly so that its pressure is exerted through the spring 66, energy from the source of potential 64 begins to flow in the circuit which is closed because of the bridging of the electrodes 60, 61 by the ball assembly. The resultant current flow effects a heating of the ball assembly but, because of the smaller and possibly initially less perfect surface contacts at the ring member 34 and peripheral ends or edges of the half-balls 24, 24, the resultant greater resistance achieves a concentration of the heating effect of the current largely throughout this equatorial region of the assemblage.

A fusion or flow of the tin or solder results accompanied by a uniform flow or distribution of it throughout the adjacent surfaces of the three parts and a good union results. The circuit may be interrupted to bring about a cessation of heat production or the ball assembly may be removed from the circuit or electrodes, to allow cooling and hence "freezing" of the solder to take place.

In either of these methods and apparatuses for effecting the soldering, a dependable and proper union of the previously geometrically and dimensionally accurate parts is achieved, for the flat or plane end edges 31 of the half-balls 24 mate with or rest snugly and flatly against the respective faces of the flange 40 of the ring member 7. This latter action is insured by the pressure with which the parts are pressed toward each other during the soldering action, excess or surplus solder being thus forced out or away from these particular junctions. Thereby, and with appropriate determination of the applied pressure, a minimum layer or thickness of joining solder consistent with appropriate strength and with suitable sealing action is achieved while also a minimum interference with departure from true roundness of the ultimate structure is brought about. In this latter connection it will be recalled that the half-balls 24 are each short of being true hemispheres by substantially half the thickness of the flange 40 of the ring 48, the flange 40 thus forming a band-like portion of the ultimate substantially true sphere; with this interrelation of the parts it is therefore desirable that the layers of solder be not too thick so as not to elongate the hollow ball in the direction of the axis of the ring 38. If desired, compensation for the thicknesses of the layers of solder may be made by correspondingly thinning down somewhat the flange 38.

At the same time the upper and lower flanges 41, 42 (see Figure 7) become united, by the solder, with the inside surfaces, adjacent the equator, of the two half-balls 24, 24, and at this junction or union true coaxial alinement of the two half-balls 24, 24 is achieved and at the same time additional strength given to the joint. Excess solder can accumulate in the circumferential angles or corners, as at 68 in Figure 8, to any desired extent to insure further sealing and joining action.

The resultant ball structure appears as shown in Figure 12, being now a substantially true sphere, hollow and thin-walled and light in weight and having projecting about an equator thereof the flange 40 of the securing and alining ring 38. That flange too is preferably of relatively small thickness and it is now to be removed.

Accordingly, I provide a downwardly movable die member 70 (Figure 12) provided with a recess or seat 71 that is of a radius of curvature equal to that of the outer surface of a half-ball 24 but of a depth less than its radius of curvature. Below the die member 70 is mounted a lower die or shearing member 72. The latter is illustratively in the form of a fixed hollow cylinder or sleeve whose inside cylindrical surface has a diameter or radius of curvature equal to those of the ultimate ball structure, illustratively 0.500 inch. Its upper edge is a cutting edge which is toothed as at 72^a to provide a plurality of individual cutting edges 72^b, 72^b, etc., illustratively four, five or six in number, that are inclined to the horizontal by, for example 45°. With part 70 raised, a ball is now rested on the lower member 72 with the flange 40 resting upon the apices of the plurality of cutting teeth, the lower half of the ball extending into the hole of member 72. Member 70 now moves downwardly, engages the upper half of the ball structure, and forces it downwardly, whereby the flange 40, even though of relatively thin stock, is progressively sheared at four, five or six (as the case may be) different points and, moreover, points uniformly distributed throughout the circle of the flange. Thereby, risk of crushing the upper half-ball member 24 or of distorting it or other parts of the soldered assemblage, is dependably avoided and, furthermore, the risk of disrupting the soldered joints substantially eliminated. The resultant hollow ball is discharged through the lower end of the hole in part 72 and then appears

as shown in Figure 13 from which it will be seen that the external surface of the hollow ball is made up of really three zones of which the middle one is a narrow equatorial zone represented by the outer surface of the sheared thin flange 40.

The resultant hollow ball structure may now be "finished" in any suitable manner, that is, as to its surfacing. For example, it may now be "tumbled" with a suitable tumbling or abrasive compound, after which it may even be ground in a grinding machine or other suitable grinding apparatus, it being noted that, though hollow and light in weight, it has sufficient strength and rigidity to withstand the removal of some metal by grinding where, as may be desired under certain circumstances, greater precision may be desired. After tumbling and/or grinding, it may be burnished and then, preferably, it is electroplated with a suitable metal, illustratively tin, for reasons earlier above pointed out. In Figure 14 the ball is shown after the completion of the tinplating and at 75 is indicated, somewhat exaggerated, the outer coating of tin. The latter may be of a thickness appropriate to the particular use to which the ball is put and for usual types of whiskeys and gins, a tinplating of slightly under 0.001 inch in thickness will suffice.

The shearing step indicated in Figure 12 and above described not only shears off the surface or projecting portions of the flange 40 but also cleans off surplus solder that might be accumulated during the soldering operation and also smooths off and virtually merges together the external surfaces of the three parts that make up the ball. This and subsequent steps, where the latter are employed, insures the provision of a smooth, clean, substantially spherical surface, free from protrusions or projections, onto which the plated coating 75 of Figure 14 is laid down. The latter, moreover, also forms a continuous and non-porous envelope for encasing the ball, gives double security against leakage of liquid into the ball, and also gives the ball a neat, clean, and smooth external surface.

The weight of the ball, utilizing the illustrative dimensions above given, will be found to be between 13.5 and 15 grains, thus meeting the ratio above outlined and in general meeting all of the requirements and characteristics above set forth in detail. It may be noted that, in a given run of production, I prefer to use the step of grinding, described above, or other means of abrading, of the ball construction prior to plating to bring about, where necessary, a sufficient reduction in weight to give the ultimate construction, that is, after plating, the desired factor of weight.

It will thus be seen that there has been provided in this invention a ball construction and method and apparatus for making it in which the various objects hereinbefore noted, together with many thoroughly practical advantages are successfully achieved.

As many possible embodiments may be made of the mechanical features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth, or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a method of hollow metal ball construction, the steps which comprise forming out of sheet metal two shells each slightly less than a true hemisphere, forming a cylindrical band of an outside diameter such that its ends are receivable into the open ends of said shells and with an outwardly projecting centrally positioned flange of a thickness substantially equal to that by which said two shells lack being a true sphere, applying solder to said band member, assembling the latter to said two shells with the end edges of the latter contacting said flange and with said cylindrical band portion alining said two shells coaxially, and heating the resultant assemblage to cause flow of the solder and union thereby of the two parts.

2. In a method of hollow metal ball construction, the steps which comprise forming out of sheet metal two shells each slightly less than a true hemisphere, forming a cylindrical band of an outside diameter such that its ends are receivable into the open ends of said shells and with an outwardly projecting centrally positioned flange of a thickness substantially equal to that by which said two shells lack being a true sphere, applying solder to said band member, assembling the latter to said two shells with the end edges of the latter contacting said flange and the said cylindrical band portion alining said two shells coaxially, heating the assembled parts to cause flow of the solder while pressing the two shells toward each other and hence against said flange, and then cooling the assemblage to freeze the solder.

3. In a method of hollow metal ball construction, the steps which comprise forming out of sheet metal two shells each slightly less than a true hemisphere, forming a cylindrical band of an outside diameter such that its ends are receivable into the open ends of said shells and with an outwardly projecting centrally positioned flange of a thickness substantially equal to that by which said two shells lack being a true sphere, assembling said two shells and said band with the ends of the latter received respectively into the open ends of said shells and with the edges of the latter abutting said flange, and sealing the junctions therebetween.

4. In a method of hollow metal ball construction, the steps which comprise forming out of sheet metal two shells each slightly less than a true hemisphere, forming a cylindrical band of an outside diameter such that its ends are receivable into the open ends of said shells and with an outwardly projecting centrally positioned flange of a thickness substantially equal to that by which said two shells lack being a true sphere, and soldering said two shells and band together with the ends of the latter received respectively into the ends of said shells.

5. In a method of hollow metal ball construction, the steps which comprise pressing together two sheet metal substantially hemispherical shells with a cylindrical band having its ends received into the otherwise open ends of said shells and having laterally projecting means for engagement with the peripheral edge of at least one of said shells whereby the aforesaid pressing together of the parts is prevented from tilting the band and the ends of the latter are maintained in alinement respectively with the otherwise open ends of said shells, adjacent contacting surfaces having solder applied thereto, and heating the parts while being pressed together to cause flow of the solder, and then cooling the parts.

6. In a method of hollow metal ball construction, the steps which comprise pressing together two sheet metal substantially hemispherical shells

with a cylindrical band having its ends received into the otherwise open ends of said shells, and applying a pressure sufficient to cause the end edges of said shells to abut against an outwardly projecting flange on said band, and heating the resultant assemblage while still pressed together to cause flow of solder to take place at adjacent contacting surfaces of the parts, and then cooling the assemblage.

7. The steps as claimed in claim 6 to which is added the step of trimming off the outwardly projecting flange to an outside diameter substantially equal to that of said hemispherical shells.

8. The steps as claimed in claim 6 to which are added the steps of severing those portions of said outwardly projecting flange that extend beyond the outside radius of said shells, and plating a metal coating on the exterior surface of the resultant hollow ball.

9. In a method of hollow metal ball construction, the steps which comprise pressing together two sheet metal substantially hemispherical shells with a cylindrical band having its ends received into the otherwise open ends of said shells, adjacent contacting surfaces having solder applied thereto, heating the parts while being pressed together to cause flow of the solder, and then cooling the parts, abrading the external surface of the resultant hollow ball, and depositing a metal coating over the external surface thereof.

10. In a method of metal hollow ball construction, the steps which comprise securing together two substantially hemispherical sheet metal shells and an intermediate alining member in the form of a cylindrical band having its ends respectively received within the ends of said shells and having an outwardly projecting flange, resting the resultant assemblage in a die seat of less than hemispherical extent and receiving therein the major portion of one of said shell parts, thereby to sustain the sheet metal of the latter against deformation, and shearing off the laterally projecting portions of said projecting flange.

11. In a method of metal hollow ball construction, the steps which comprise securing together two substantially hemispherical sheet metal shells and an intermediate alining member in the form of a cylindrical band having its ends respectively received within the ends of said shells and having an outwardly projecting flange, resting the resultant assemblage in a die seat of less than hemispherical extent and receiving therein the major portion of one of said shell parts, thereby to sustain the sheet metal of the latter against deformation, and progressively shearing off, in a plurality of increments distributed about the periphery of the flange, the portion of the latter projecting beyond the radius of said shell parts.

12. In a method of metal hollow ball construction, the steps which comprise securing together two substantially hemispherical sheet metal shells and an intermediate alining member in the form of a cylindrical band having its ends respectively received within the ends of said shells and having an outwardly projecting flange, and removing those portions of said flange that extend beyond a sphere whose radius is the same as that of said hemispherical shells.

13. A hollow metal ball comprising, in combination, two sheet metal shells each slightly less than a true hemisphere and an alining and connecting member therefor, said member comprising a cylindrical band of an outside diameter such that its ends are receivable into the open ends of said shells for thereby alining the latter and bringing their axes into coincidence, said band having an outwardly projecting substantially centrally positioned flange of a thickness substantially equal to that by which said two shells lack being a true sphere, said flange being positioned between the end edges of said shells and having an outside radius equal to the radius of said hemispherical shells.

14. A hollow metal ball comprising two substantially hemispherical shells with means alining them coaxially and securing them together and sealing the junction therebetween, said means comprising a band-like member having portions projecting respectively into said two shells and in engagement with interior surfaces of the latter, said member having outwardly projecting means for engagement with edge portions of at least one of said shells to prevent tilting of said band-like member and said one shell out of coaxial relationship.

15. A sub-assembly hollow ball construction comprising two substantially hemispherical shells respectively received over the ends of a securing and alining member, the latter having outwardly projecting means interengaging with edge portions of at least one of said shells for preventing tilting of said member.

16. A sub-assembly hollow ball construction comprising two substantially hemispherical shells respectively interfitted with the ends of a cylindrical band-like member that has an outwardly projecting flange that is interposed between the end edges of said two shells, said flange being of a radius greater than the radius of said shells.

17. A hollow metal ball construction comprising, in combination, two sheet metal substantially hemispherical shells of small thickness having received within their ends and being thereby alined a band-like member whose outside radius is substantially equal to the inside radius of said shells, said shells and said band member being soldered together, and an electro-deposited metal coating over the external surface of the resultant hollow ball for insuring the sealing of the soldered joints between said shells and band member.

18. A hollow metal ball comprising three sheet metal parts whose external surfaces are respective segments of a spherical surface of the same radius, two of which parts are cap-like members and the third being an intermediate band-like spherical sectional member, said members having means whereby they are interfitted and when interfitted make up a substantially true hollow sheet metal sphere.

KNUD KNUDSEN.