Nov. 11, 1924. 1,514,810

W. J. WISCH

PROCESS OF MAKING HOLLOW BALLS

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Fig.1. Fig.2. Fig.3. Fig.4.

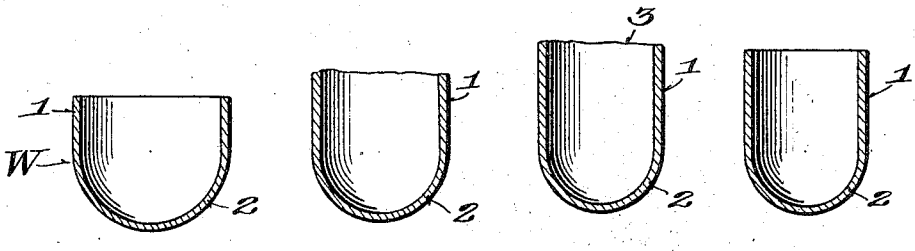


Fig.5. Fig.6. Fig.7.

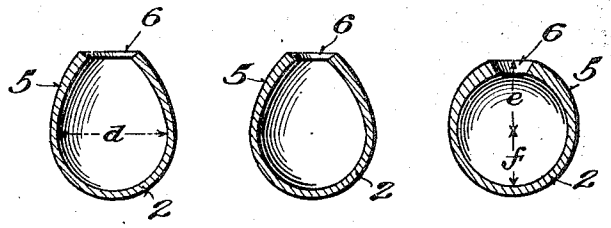
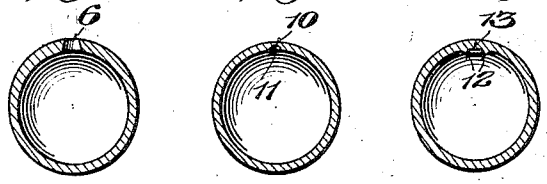


Fig.8. Fig.9. Fig.10.



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Fig. 11.

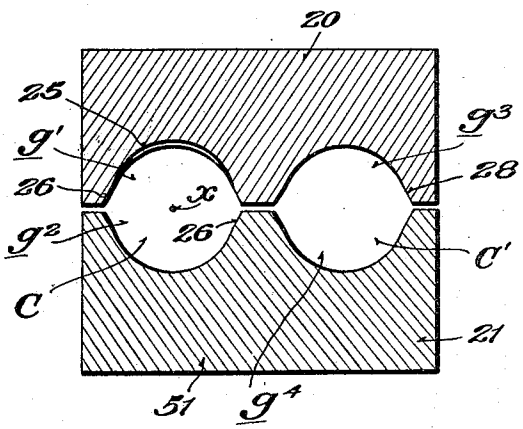


Fig. 12.

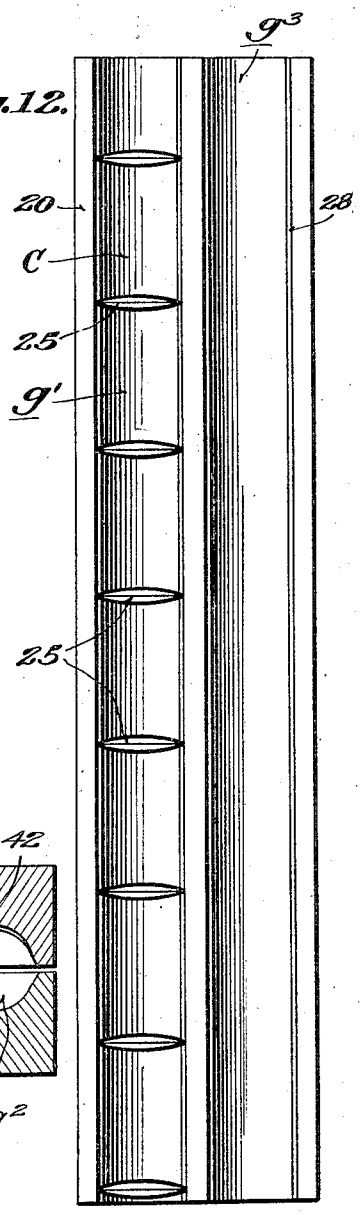
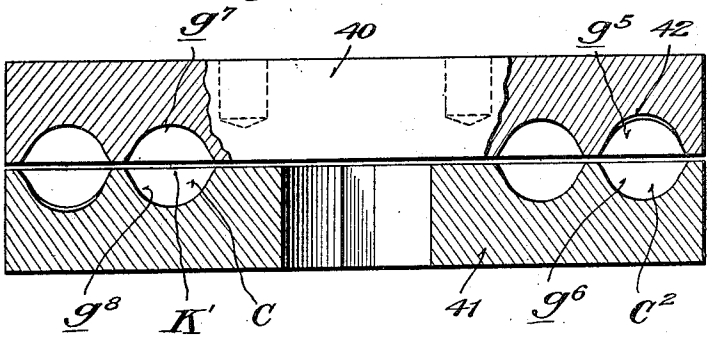


Fig. 13.



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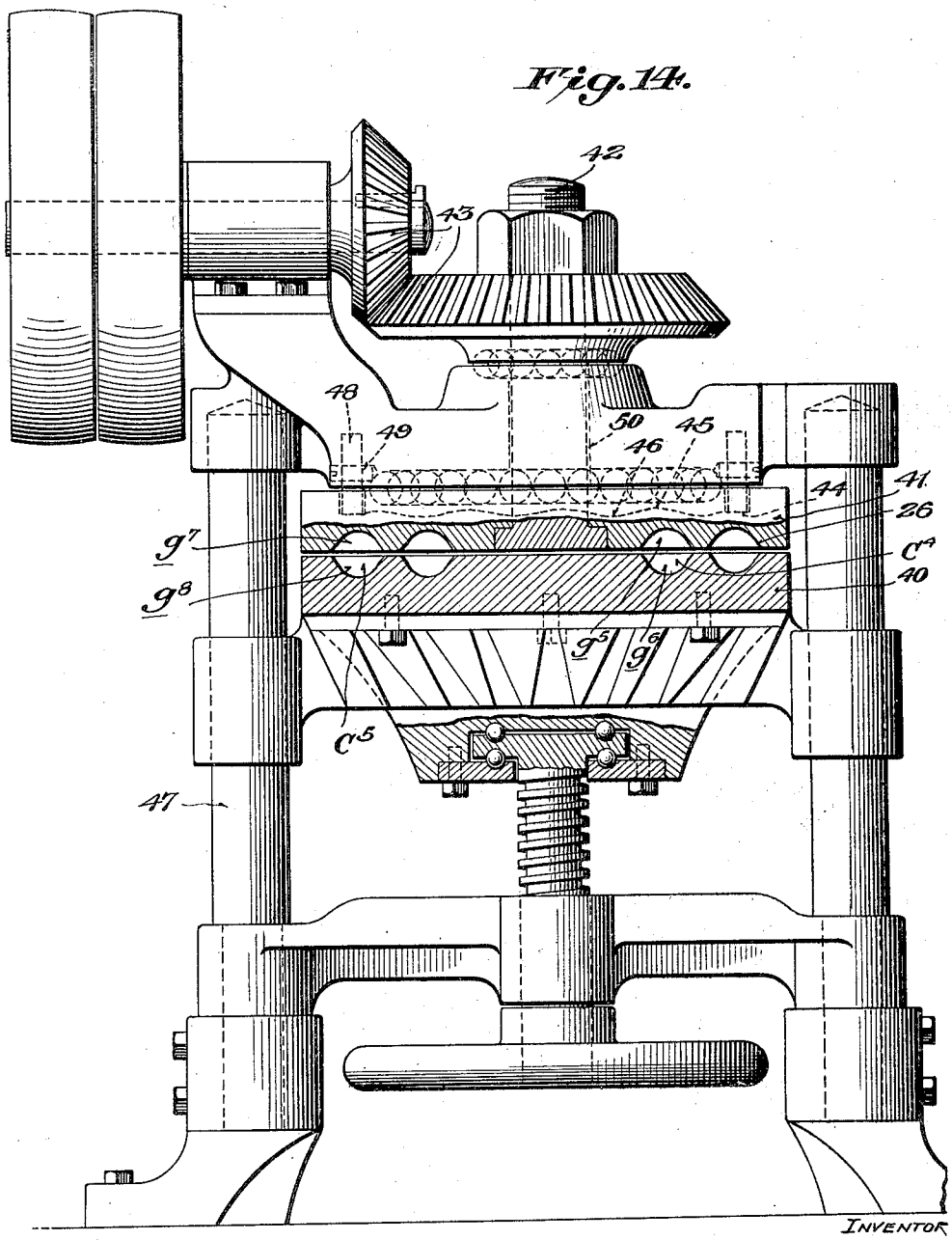
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Fig. 14.



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UNITED STATES PATENT OFFICE.

WALTER J. WISCH, OF BALTIMORE, MARYLAND.

PROCESS OF MAKING HOLLOW BALLS.

Application filed December 22, 1920. Serial No. 432,466.

To all whom it may concern:

Be it known that WALTER J. WISCH, a citizen of the United States, residing at Baltimore city, State of Maryland, has invented certain new and useful Improvements in Processes of Making Hollow Balls, of which the following is a specification.

My invention relates to a method of making balls, and especially to an improved method of economically producing hollow balls of exceptionally desirable characteristics.

A leading characteristic of my improved method consists in simultaneously hammering or pounding, and rolling, the partly formed balls to bring them to the desired final form. The causes the metal of the ball to flow so that the opening is closed, in an improved manner, and the wall is brought to a remarkably uniform thickness throughout. The closure of the opening is very complete and homogenous, so that the substance of the hollow ball is continuous and of substantially uniform strength throughout. The complete balls are furthermore characterized by absence of any definite or considerable inner peak or projection of metal at the place previously occupied by the opening in the partly finished ball. In some cases, if the combined rolling and hammering operation is continued to a sufficient extent, a minute annular ridge is formed on the inner surface of the ball at a point surrounding the previous location of the opening. If the finishing process is discontinued shortly before the point just described, this small annular ridge is absent, and instead there is a slight depression in the inner surface of the wall at a point corresponding with the previous location of the opening.

Another characteristic of the process consists, in some cases, in making the hollow blank in a slightly elongated or ovoid form, and utilizing this ovoid form of the blank in effecting the combined rolling and hammering action.

Another characteristic of the process consists in forming the hollow blank in certain of its stages with its wall substantially thicker, adjacent to the opening, than other parts of the wall.

Other characteristics of the process will be sufficiently explained in connection with a detailed description of one complete performance of the process as carried out by representative apparatus, sufficient parts of which are shown in a diagrammatic way in the accompanying drawing.

Figures 1 to 10 inclusive are transverse sections through the ball blank and ball, in different stages of its progress from the first formation of the blank to completion of the ball. The different steps are explained hereafter.

Fig. 11 is a transverse section of one representative forming device used in the combined rolling and hammering of the blank to close the opening and otherwise shape the ball.

Fig. 12 is a plan view of one of the members of Fig. 11. In these two figures, the rolling members are straight bars or plates provided with straight grooves.

Fig. 13 is a diagrammatic view of rotary rolling members, in which the rolling plates are circular and the grooves are of annular form.

Fig. 14 is an elevation, with some parts in section, of a rolling and hammering machine arranged for rotary movement of the plates.

Fig. 1 shows the first step in the formation of the blank, consisting in punching or pressing a piece of sheet metal in suitable dies into cup form, the dies being usually arranged so that the upper, cylindrical part 1 of the wall W is made slightly thicker than the lower, hemispherical part 2.

Fig. 2 shows the blank pressed deeper. The thickness of both parts 1 and 2 of the shell has been somewhat decreased, and the difference in thickness between the two parts has been somewhat increased. Fig. 3 shows a continuation of the pressing in which the cylindrical part 1 is elongated still more, and slightly reduced in thickness, and the thickness of the hemispherical part 2 is further reduced, and the difference between the thickness of the two parts is still farther increased. Fig. 4 shows the blank in the same condition except that the ragged upper edge 3 of Fig. 3 has been trimmed off smooth, the height of the trim being calculated with reference to the size of the opening which it is desired to preserve in the blank up to the point of rolling or hammer-

ing. Fig. 5 shows the blank after being treated in suitable forming dies, so that it assumes a general "egg" shape, the upper portion 5 now being curved inwardly toward the opening 6. In this operation, the thickness of the wall of ovoid part 5 increases gradually from the diameter d to the edge of the opening 6, and the average thickness of this part of the blank is decidedly greater than that of the hemispherical portion 2. Due to the compression of the metal in the direction of the vertical dimension of the blank in this forming operation, the thickness of the hemispherical portion has been increased somewhat, and the average thickness of part 5 has been increased still more markedly in comparison with the thickness of part 1. As clearly shown, the thickness of part 5 increases gradually and rather uniformly from the diameter d to the limits of opening 6. Fig. 6 shows a further forming operation in which the thickness of both parts of the blank has been increased, but the thickness of the ovoid portion adjacent to the opening has been increased in an ascending ratio so that the difference in thickness between the metal adjacent to the opening, and the thickness of portion 2 is markedly increased. Fig. 7 shows the blank after treatment in another suitable forming die in which the entire blank is still further compressed lengthwise, so that part 5 is now approximately spherical, although slightly elongated, the dimension e being slightly greater than the dimension f, which is a radius of the hemispherical part 2. The thickness of the wall of the blank has also been increased throughout, and the thickness of the part adjacent to the opening 6 has been increased still more in relation to the thickness of the hemispherical portion. The rate of increase of the thickness of part 5 of the shell is graphically shown in Figures 5, 6 and 7, with some exaggeration, since it is impossible in views of reasonable size to show relative dimensions accurately.

The previously described steps may be regarded as preliminary steps, and are analogous to known methods of producing blanks for final rolling, except with regard to the particular dimensioning of the shell described to adapt it especially to the final rolling and hammering process, and particularly with regard to the final formation of the blank as shown in Fig. 7 with substantially one-half of slightly increased radial depth than that of the other, which is a hemisphere, the radial depth of the elongated portion being measured at the center of the opening.

While the blank as preliminarily formed in Fig. 7 is preferred for the final process described just hereafter, I do not limit myself to the preliminary formation of blanks in the precise form shown. Any other suitable blank of approximate spherical form and substantial wall thickness, and having an opening of suitable size, may in some cases be treated by the final rolling and hammering process to close the opening, and render the thickness of the wall sufficiently uniform throughout.

Considering the blank in a preferred final preliminary form as shown and described in connection with Fig. 7, a suitable number of such blanks are placed in a rolling channel C, Fig. 11, which consists of two grooves, g^1 and g^2, formed in bars or plates 20, 21 respectively. These plates may be straight, as shown, in a representative form of apparatus for carrying out the process, and the grooves may be straight, and the rolling movement of the two plates and their respective grooves may be a relative linear reciprocatory movement produced by any suitable mechanism. As the grooves reciprocate carrying the balls back and forth between them under suitable pressure exerted through the plates by any suitable means, the balls in addition to this rolling treatment are subjected to a simultaneous pounding or hammering, which may be effected in various ways. Where the blanks are of elongated or ovoid form as above described, the hammering effect may be obtained to a sufficient degree by rolling the balls in smooth grooves. The blanks are continually presented to the grooves in different positions, and due to their unequal dimensions are bumped or hammered in the grooves until they are reduced to true finished form. In cases where the elongation of the blanks is insufficient to produce this result, or where spherical blanks are used, one representative way of pounding the balls consists in providing either or both of the grooves, in this particular example the groove g^1, with irregularities 25. These humps or irregularities are provided more specifically in the present instance by cutting in the surface of groove g, which is substantially a semi-circle in transverse section, at suitable intervals, depressions 25, which may have the form of spherical segments, equivalent to the form of depressions which would be produced by depressing into the groove, to a slight extent, a sphere of somewhat greater diameter than that of the groove. The depressions so produced, by whatever means, are substantially oval lateral depressions in the main groove surface. The blanks therefore, as they are alternately rolled back and forth between the plates in the channel C are subjected to the rolling and compressing action of both of the grooves, and simultaneously, to bumping or hammering as the balls encounter the edges of depressions 25.

Various refinements may desirably be made

in the form of the grooves. The main portion of the smooth groove g^2 is preferably formed on a circular radius from the center x.

Preferably each of the grooves is formed with a lateral "relief" near the sides of the grooves. This may be provided by making in the side wall of each groove a bevel 26, which may be cut at an angle of 30 degrees, more or less, in relation to a vertical dimension, intersecting the groove proper at a point a suitable distance inward from the main plate surface.

By the treatment in the rolling and hammering grooves, the ovoid blank goes through the changes indicated in Figures 8 and 9. Groove g^2 of true semi-circular section controls the spherical shaping of the entire ball. The irregular groove g^1, by its combined rolling and hammering action swages or flows down the metal of the ball shell from the form shown in Fig. 7 to the form shown in Fig. 8 and then in Fig. 9; i. e., the metal of the wall is formed or caused to flow until it assumes uniform thickness, and simultaneously the metal surrounding the opening 6 is swaged and flowed inwardly until the surface metal joins at 10, Fig. 9, leaving a shallow inner depression 11. The ball is then complete, of true spherical form and with uniform wall thickness, and with an unbroken homogeneous surface, but slightly larger than the preferred final diameter, and with the opening truly closed, but not in the usually preferred final form. While the balls may be used in the condition shown in Fig. 9, it is generally preferred to give them a final treatment in smooth finishing grooves, such as the grooves g^3, g^4, formed respectively in roll plates 20 and 21, constituting a channel C^1 of true circular cross section except for lateral relief cuts 28 provided on the edges of the grooves, the same as in the case of g^1, g^2. By reciprocation of the plates, the balls are rolled down in these grooves to the form shown in Fig. 10. The diameter of the balls is slightly reduced, the wall thickness slightly increased and left uniform, and the opening is completely closed, leaving the inner surface of the ball almost flush at the point where the opening was formerly, or else leaving a very slight annular ridge 12 surrounding an area 13, which has a radial thickness substantially the same as other parts of the wall.

Instead of straight rolling plates, the plates may be made circular, with annular grooves as shown in Fig. 13. The grooves constituting the two channels C and C^1 have all the characteristics described in connection with Figures 11 and 12, and are substantially the equivalents of those grooves, arranged in circular form for continuous circular rolling, in which the two plates may be revolved in opposite directions, or either one may be held stationary and the other rotated continuously in either direction or oscillated in alternately opposite directions.

Fig. 14 shows in sufficient detail one complete machine for carrying out the final steps of the process, and also shows a modification of the combined rolling and hammering operation. For this purpose one of the plates, for instance plate 40, is held stationary, and the other plate 41 is revolved by means of a shaft 42, and gears 43. The plate 41 is also free to move vertically in relation to plate 40, and suitable vertical movement or reciprocation is imparted to plate 41 by an annular cam surface 44 on the plate, this surface being in wave formation with alternate humps 45, and hollows 46, shown in exaggerated form in the figure. The frame 47 carries one or more, usually a plurality of cam rolls 48, mounted on pins 49 in the frame, and these rolls are spaced uniformly about the rotative center. All of the grooves in this instance are made smooth, and of substantially semi-circular cross section except for the relief cuts 26 provided as previously described. The grooves g^5, g^6, constituting channel C^4 for the first rolling and hammering operation are formed at a slightly larger radius than grooves g^7, g^8, which constitute channel C^5 for the final operation. The rolling of the balls in channel C^4 is conducted in an obvious way, and they are simultaneously pounded or hammered by the action of cam rolls 48 on the cam surface 44, giving an effect substantially like that of the irregular groove g^1 of Figures 11 and 12. The finishing rolling in channel C^5 may be a simple rolling operation as described in connection with Figures 11 and 12, or it may be a combined rolling-and-hammering operation. Evidently, the different rolling operations may be carried out in different machines, so that if desired, one machine may be arranged for the combined rolling and hammering operation, and another machine may be arranged for a final smooth-rolling operation.

The process as above described in connection with the machine of Figure 14 is adapted for rolling spherical blanks, or other blanks where the non-spherical form of the blanks themselves is not considered sufficient to provide the necessary hammering action. Where ovoid blanks, as described above, are used, sufficient hammering effect may be obtained in most cases, as previously suggested, by rolling the ovoid blanks in smooth grooves, without the cam surface 44 and cam rolls 33; and the machine of Figure 14 may be adapted for this method of rolling by removing the cam rolls 48. Preferably also the bearing 50 which accommodates shaft 42 is made, as shown, with considerable clearance, from the shaft. This per-

mits the movable rolling plate to have a certain amount of lateral freedom, and to position the grooves to the best advantage with regard to the momentary position of the blanks.

I claim:

1. The process of rolling hollow balls, comprising simultaneously rolling and hammering at right angles to the path of the rolling movement, a hollow globular blank, the hammering being continuous and substantially uniform during the entire operation.

2. The process of rolling hollow balls, comprising forming by successive preliminary operations a hollow metal shell, approximately spherical, with an opening at one point, and then simultaneously rolling and hammering the blank at right angles to the path of the rolling movement to close the opening, and complete the shaping of the ball, the hammering being continuous and substantially uniform during the entire operation.

3. The process of making hollow balls, comprising forming sheet metal into approximately spherical form with an opening at one point, the wall of the blank adjacent to the opening being somewhat thicker than other parts of the wall, and then simultaneously rolling and hammering the blank until the opening is closed and the thickness of the wall is rendered substantially uniform throughout.

4. The process of making hollow balls, comprising forming sheet metal into approximately spherical form with an opening at one point, the part of the blank containing the opening being slightly elongated or ovoid, and the other part being more nearly truly hemispherical, and then rolling the blank and simultaneously hammering it to close the opening by knitting the metal homogeneously together, and reduce the ovoid portion to approximately true hemispherical form.

5. The process of making hollow balls, comprising forming sheet metal into approximately spherical form with an opening at one point, the part of the blank containing the opening being slightly elongated or ovoid, and the other part being more nearly truly hemispherical, the wall adjacent to the opening being substantially thicker than portions of the wall more remote from the opening, and then rolling the blank and simultaneously hammering it to close the opening by knitting the metal homogeneously together, and reduce the ovoid portion to approximately true hemispherical form, and to flow the metal of the wall away from the thicker portion, so that the wall is reduced to substantially uniform thickness throughout.

6. The process of making hollow balls, comprising forming a sheet metal blank with an opening at one place, simultaneously rolling and hammering the blank to flow the metal and partially close the opening and to reduce the blank to nearly its final diameter with the wall of nearly uniform thickness throughout, and then rolling the blank to reduce it to final diameter and thickness and to complete the closing of the metal at the former location of the opening.

7. The process of making hollow balls comprising forming a substantially cup-shaped blank, maintaining the closed part of the blank in substantially hemispherical form, and compressing the other part of the blank into substantially ovoid form and simultaneously increasing the thickness of the wall as it approaches the opening, and finally compressing the blank until the ovoid portion in its longitudinal axis is only slightly longer than the radius of the hemispherical portion, retaining the opening in the ovoid part of the blank in line with the longest axis of the blank, the wall of the blank adjacent to the opening being substantially thicker than other parts of the wall, the blank thus formed being adapted for final treatment by combined hammering and rolling.

In testimony whereof I affix my signature.

WALTER J. WISCH.