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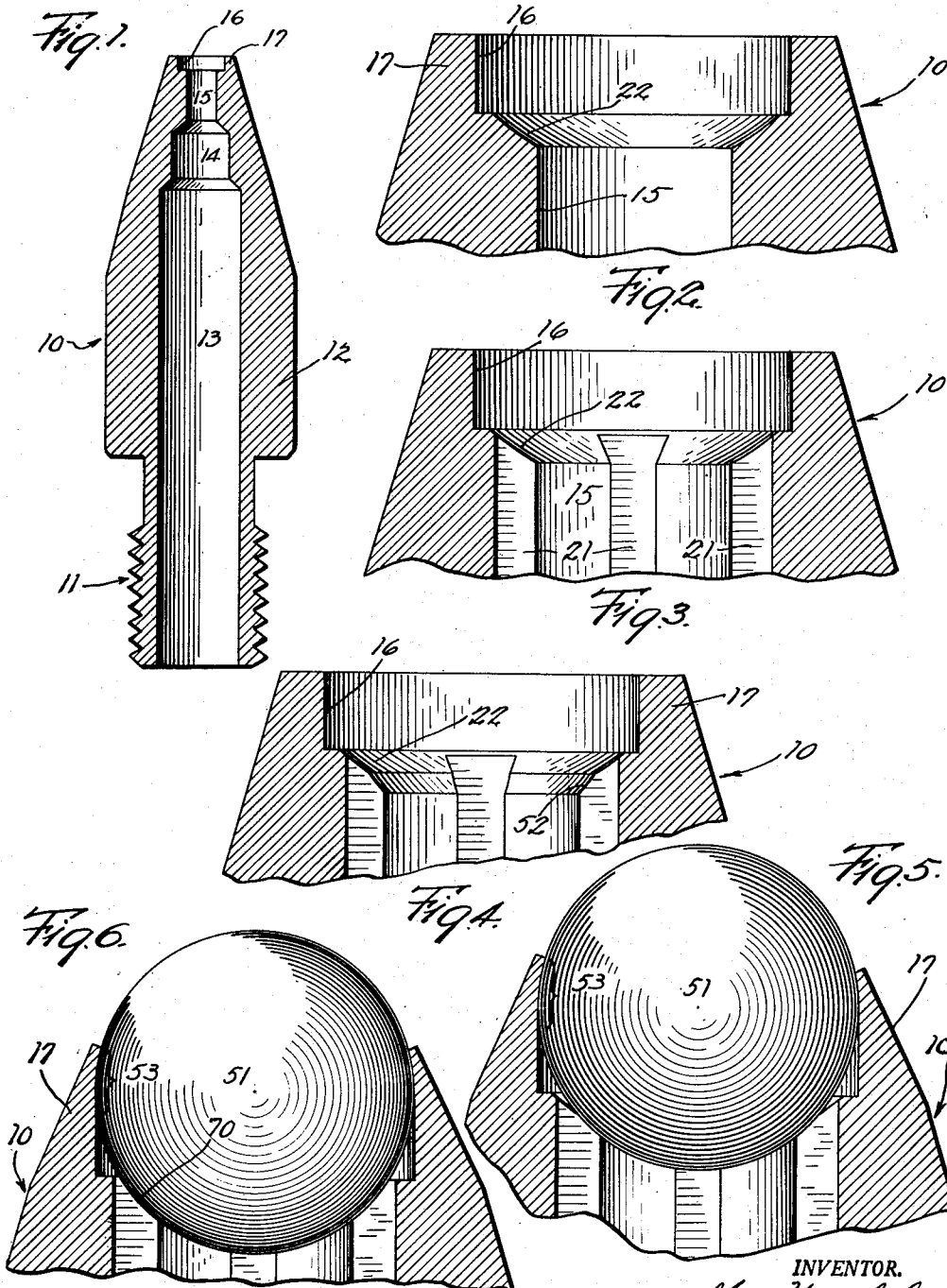
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METHOD OF MAKING BALL-TYPE WRITING TIPS

Filed Aug. 13, 1947

2 Sheets-Sheet 1



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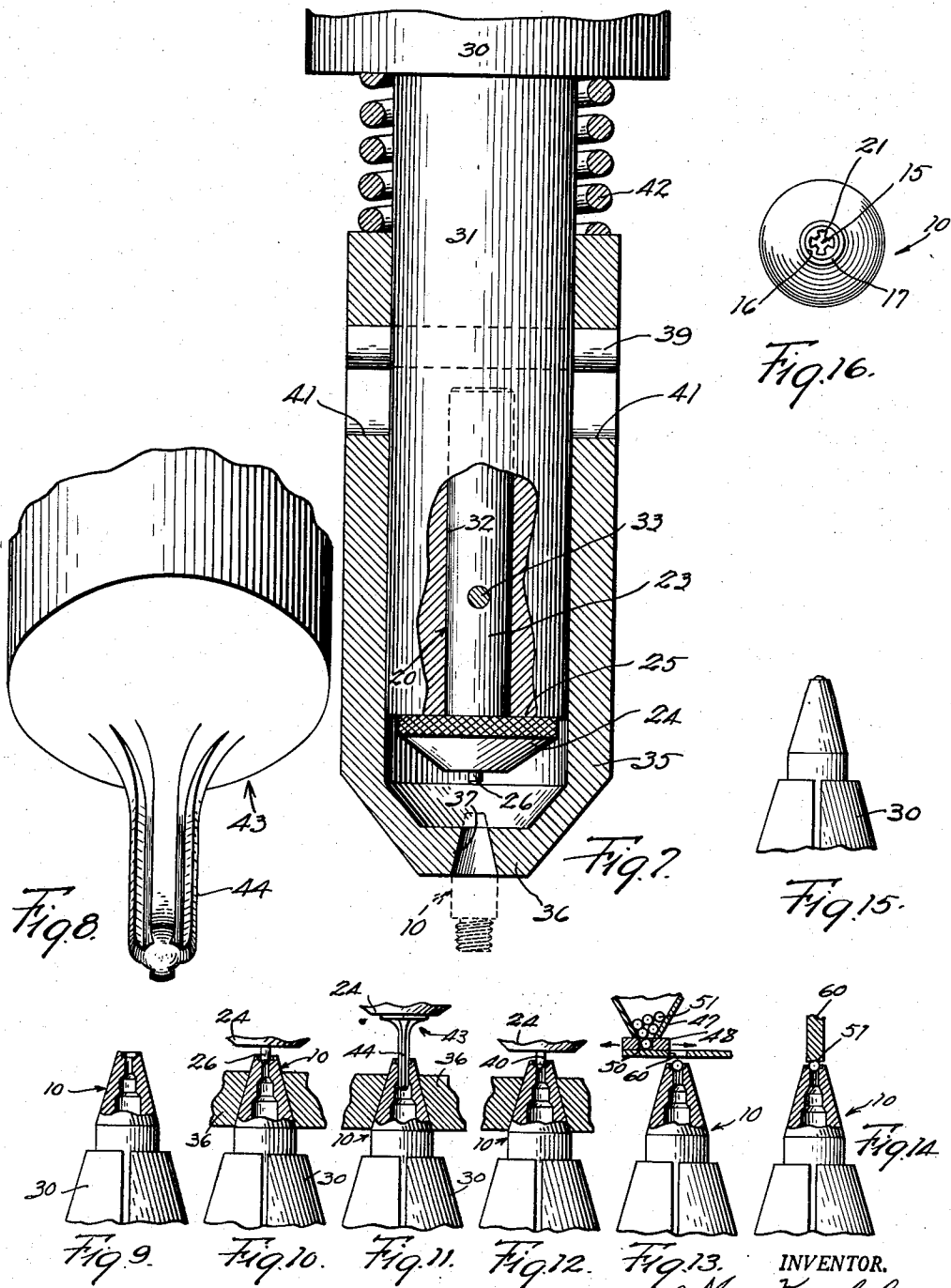
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METHOD OF MAKING BALL-TYPE WRITING TIPS

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2 Sheets-Sheet 2



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METHOD OF MAKING BALL-TYPE
WRITING TIPS

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This invention relates to the art of manufacturing ball-point writing instruments. In particular it has reference to a method of mounting the writing ball in a socket for retention and universal rotation of the ball therein.

One convenient manner of assembling the writing tip with the barrel, or equivalent part of a ball-point pen, is to provide a separate ball-receiving element herein referred to as a socket, in which the ball is mounted for universal rotation, there being a passage in the socket in communication with the ink reservoir and the rear surface of the ball.

One form of socket found suitable for the purpose comprises a cylindrical member having a frusto-conical forward end and a threaded shank for securement of the socket to the body of the pen. The socket is bored for passage of ink to the ball and the ball is seated and rotatably secured in a recess at the forward end of the socket.

It is highly important to insure that the ball is properly centered in the recess, not only in order that the deforming of the wall of the recess about the ball to secure the ball rotatably therein will result in a predetermined uniform clearance between the socket and the ball, but to allow proper feed of the ink from the passage to and about the rear part of the ball within the socket.

Moreover, it is important that the ball be arranged for rotation on a seat which presents minimum friction to the ball while affording sufficient bearing. By so doing, the ball may rotate freely and thereby apply ink to the writing surface at a rate which avoids skips or faintness in the written line, and the pressure induced in writing is counteracted by a bearing surface not likely to wear prematurely to affect injuriously the working of the pen.

It will be understood by those in this art that the writing ball found preferable for use in an instrument of the type to which the instant application relates is usually one millimeter (0.03937") in diameter and the socket proportionately minute. Accordingly, it will be apparent that the problems of forming the socket and the mounting of the ball therein introduce factors not ordinarily encountered, necessitating special techniques not having parallels in other arts.

In my co-pending United States application Serial No. 723,813, filed January 23, 1947, now abandoned, I have disclosed the general nature of the problem of mounting the writing ball in its socket. Briefly, the step therein disclosed

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contemplates securing the ball rotatably in the socket by deforming the rim or wall of the recess in which the ball is loosely deposited about an equatorial zone of the ball whereby the ball is retained against dislodgment, is freely universally rotatable and proper ink clearance is afforded.

The present application relates to the preparation of the socket in certain respects together with the steps of mounting the ball therein, these various phases being herein described briefly as the saucer-coining operation, the fluting operation, the ball-coining operation and the tip-closing operation.

Accordingly, a principal object of my invention resides in a process for performing certain of the steps incident to the mounting of a writing ball in its socket in a manner which will insure securement of the ball in the socket safely against dislodgment, freely rotatably, and with adequate uniform ink clearance.

Another object is to provide a process step of channeling or fluting the wall of the duct carrying ink to the ball in order that full flow of ink is allowed notwithstanding the presence of the ball at the forward end of the duct.

A further object is to provide a process step of forming a seat for the ball and wherein the ball may rotate while preserving the ball coaxial with that portion of the deformed rim serving to secure the ball in the socket.

Other objects will appear as the description proceeds.

In the drawings:

Fig. 1 is a longitudinal medial cross section of the socket blank prior to the process herein disclosed;

Fig. 2 is a cross-sectional view similar to Fig. 1, but greatly enlarged to illustrate the saucer-coining operation;

Fig. 3 is a view similar to Fig. 2 to illustrate the operation of fluting the ink duct;

Fig. 4 is a view similar to Fig. 2 to illustrate the ball-coining operation;

Fig. 5 is a view showing the ball in position on the ball seat and the tip closed about the ball;

Fig. 6 is a view similar to Fig. 5 showing a seat for the ball but not the separate saucer seat;

Fig. 7 is an elevational view partly in cross section to show a preferred form of saucer-coining tool and combined work and tool holder;

Fig. 8 is a perspective detail of the working end of the fluting tool;

Figs. 9 through 14 show the several steps of the process in sequence;

Fig. 15 is an elevational view of the finally assembled ball and socket; and

Fig. 16 is a plan view of the socket following the fluting operation depicted in Fig. 11.

Turning first to Fig. 1, the exemplificative tip or socket 10 there shown is a screw-machine part of brass or other suitable material comprising the following elements: a threaded portion or shank 11 for attachment of the socket to the body of the pen, a body 12 of combined cylindrical and frusto-conical form as shown, cylindrical ink passages 13, 14 and 15 of successively smaller diameters, and a cylindrical square-bottomed recess 16, the latter being at the forward end of the socket 10, and the rim or wall 17 defining the recess. The foregoing details of the socket are not intended to be limitative but are shown only as parts of a typical such member, the only parts pertinent to the instant disclosure being those to which the process may be applicable in accordance with the description to follow.

Recess 16 is preferably machined by using an accurately ground flat-ended drill which assures a floor for the recess which is not only flat but normal to the axis of the socket and thus will not tend to displace the saucer-coining tool from true center. Moreover, the engagement of the ball during the mounting thereof by the wall 17 of the recess tends to maintain the ball centrally of the socket, notwithstanding any inevitable eccentricity of the passage 15 resulting from even most accurately controlled methods of manufacture. For a ball of 0.03937" diameter the passage 15 may have a diameter of 0.024" and the avoidance of whipping or bending of a drill so small is practically impossible.

To receive a ball of the diameter stated, the recess 16 may be 0.0395", representing a radial clearance between the ball and recess of 0.000065" before closing of the rim about the ball. Such minute clearance has been found sufficient to center the ball accurately in the recess for the several operations to be described.

In order that the ink may find access from the duct 15 to the recess 16, the duct, in the preferred form shown, is provided with a plurality of flutes or channels 21 opening at their forward ends into a so-called saucer seat 22 (Figs. 2 and 3) which together with the ball-coined seat or ball seat to be described enables seating of the ball without the likelihood of the latter closing off the forward ends of the channels 21.

The saucer-coining comprises a zone of a spherical surface having a radius, in the example, of 0.026", the center of such sphere being disposed somewhat forwardly of the center of the ball when the latter is in its final or assembled position. For accomplishing the saucer-coining step, I prefer a tool as shown in Fig. 7 comprising a holder 20 including a shank 23 having an enlarged head 24 defining a shoulder 25, and into the lower face of the head is inserted the punch 26. The latter is of any suitably hard material, for example, Carboloy, a commercial form of cemented tungsten carbide, generally cylindrical and with a nose of segmental spherical form of radius 0.026", the cylindrical part having a diameter of 0.0395" to fit within and be guided by the interior wall of the recess 16. Although the means utilized to hold the tool 20 may take any suitable form, I have shown a shank 31 having an aperture 32 to receive the shank 23, a tapered or other pin 33 being driven through the assembly to lock the tool in position with the shoulder

25 abutting the lower end face of the shank 31, whereby the tool is rigidly held and backed up by such abutment.

During the saucer-coining and succeeding steps, the socket must be held firmly with respect to the tools utilized to operate thereon. Since the cylindrical surface of body 12 is machined in the same setting as the recess 16 these two portions are co-axial, and in order to attain corresponding coaxial alignment of the recess 16 with the tools subsequently employed in the ball-mounting operation, the socket is preferably supported by the cylindrical portion of the body 12 in a collet or other suitable chucking means 30 (Fig. 9). A suitable clearance is provided below the gripping part of the jaws of the collet to accommodate threaded portion 11, this part not being gripped in any way. The chuck, carried on any suitable table may be brought into coaxial alignment with the tools, or the chuck may be held in a fixed position and the tools indexed into relation therewith. In either event, during certain of the operations, the forward conical end of the socket is preferably maintained in alignment with the tool by a portion of the tool. Thus, referring again to Fig. 7, the shank 31 is encompassed by a sleeve 35 having a lower end or cup portion 36 provided with a frusto-conical aperture 37 adapted to engage snugly over the corresponding portion of the socket 10. To avoid binding between the tool and the socket, it is desirable to allow a minute clearance between the shank 31 and the mounting 29 therefor, and thereby permit the tool to center or accommodate itself with respect to the socket in order to grip the same without disturbing the predetermined position thereof as fixed by the chuck in which the socket is held. It will be understood that the jig or machine of which the chuck and the tool are components is so constructed that the punch 26 lies in axial alignment with the recess 16. Obviously, any misalignment will cause the punch 26 to deform the wall 17 of the recess and therewith produce an eccentrically coined saucer seat.

Sleeve 35 is retained in an angular sense by a pin 39 carried in the shank 31 and engaging a pair of slots 41-41 in the sleeve 35. A compression spring 42 intermediate the sleeve 35 and mounting 29 urges the sleeve constantly in a downward sense, so that after the tool as an entirety is thrust downwardly to cause aperture 37 to engage the socket, the spring 42 will be compressed to maintain such engagement while the punch 26 and the tools to be subsequently described each perform their intended function.

Accordingly, the socket being in proper relation with the tool of Fig. 7, continued downward movement of the shank 31 carries the punch 26 into the recess 16 and against the floor thereof to deform part of such floor and part of the wall of the duct 15 into the saucer-like zone 22 (Figs. 2 and 10), the dimension from the upper edge of the rim 17 to the lowermost point of the punch 26 being, in the example, 0.0165". By suitable regulated pressure and time the axial movement of the punch is controlled to provide a spherical impression in accordance with the dimension just noted.

As previously pointed out, flutes 21 (Figs. 3 and 16) are provided to allow the ink to flow from the duct 15 to that space bounded between the recess 16 and the mounted ball. To this end, I provide a piercing or fluting tool 43 (Fig. 8) having a transverse cross section which may be

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termed "sprocket-shaped," there being in this instance four outstanding ribs or piercing elements 44, each of which is effective to form a channel 21 (Figs. 3 and 16). Elements 44 are narrower at their inner periphery than at their outer periphery to produce channels having acutely angled inner corners (Fig. 3). By so shaping the cross-sectional configuration of the channels sufficient space is afforded for exit of ink therefrom to the space intermediate the ball and recess 16, while allowing sufficient metal to remain intermediate the channels to provide an adequate seat for the ball. At its lower end the tool 43 is substantially hemispherical in order that the same may, at the beginning of the piercing operation, center itself with respect to the saucer seat 22. When the minute size of the tool 43 is considered, namely a maximum transverse dimension of 0.035" at the working portion thereof, it will be apparent that deformation of the relatively softer wall of the duct 15 can be successfully accomplished by simple displacement of the metal thereof.

Tool 43 is interchangeable with the saucer-coining punch 26 of Fig. 7 and is so mounted, but from a manufacturing standpoint, complete tools would be made up separately. In either event during saucer-coining the socket is held in an aperture 37 in the same manner as explained in connection with Fig. 10. Upon location of the socket in operative relation with the tool 43, downward movement imparted thereto (Fig. 11) thrusts the piercing portion through the duct 15, the rounded nose thereof cooperating with the seat 22 in initially centering the tool. Channels 21 are thus formed, the relative proportions thereof with respect to the seat being as shown in Fig. 3, from which it will be noted moreover that the outer wall of each channel lies almost coincident with the outer periphery of the seat 22.

The operation heretofore referred to as "ball-coining" or ball seating may be accomplished either with a separate tool, or through the medium of the ball itself. In the former instance a punch 40 (Fig. 12) similar to punch 26 may be employed, the same having a spherically segmental nose of diameter 0.03937". Impression of the punch 40 upon the saucer seat 22 will result in a zone 52 (Fig. 4) of the same diameter as the writing ball, and hence a seat therefor.

Following the steps just described a ball 51 (Fig. 5) is deposited loosely in the recess 16 (Fig. 13) and is centered primarily by the seat 52 just described and secondarily by the close fit between the ball and the inner wall of the recess 16. Any convenient means for dispensing the balls 51 may be employed, for example, a hopper 47 and sliding gate 48, the latter having an aperture 50 arranged so as to dispense one ball through aperture 60 upon each sliding operation of the gate.

Closure of the rim 17 about the ball may be accomplished in any preferred manner as by swaging, by direct pressure not comprising blows, or by spinning, the last named being disclosed in my co-pending application hereinbefore referred to. In any case, the problem is one of deforming the rim 17 about the ball to secure the same rotatably in the socket, while preserving a predetermined clearance therebetween whereby the ball may carry the tacky ink from the recess to the exterior of the pen for application to the writing surface.

In large scale manufacture, it is practically impossible to produce balls all having a precisely uniform diameter corresponding to that of the

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punch 40. In that event, I may, as an alternative mode of procedure provide that each individual ball be provided with its own seat 70 (Fig. 5).

To attain this last noted alternative, the ball is made to serve as a punch in forming its own seat. I accomplish the foregoing step by applying pressure to the ball prior to or during the rim closing operation. Such pressure may be applied by forcing a concavely-nosed pin 60 (Fig. 14) against the ball to deform a part of the saucer-seat to conform with the surface of the ball (Figs. 4 and 14). Simultaneously therewith, or subsequently thereto, the rim 17 is deformed about an equatorial zone 53 of the ball by any of the methods heretofore noted, for example, by spinning. The completely assembled socket and ball will then appear as shown in Fig. 5 or 15.

The saucer-coining, ball-coining and rim-closing operations depend both on the pressure applied to the tool or ball, as the case may be, and the duration of such application. This necessary combination of pressure and time will be appreciated when the coining operations are viewed as a forcible deformation or flowing of the metal. Thus the inherent capacity of the deformed metal to return to its former state is better neutralized as the length of time and pressure is applied is increased. However exigencies of production place a practical limit on the time during which the pressure may be maintained. Accordingly the coining operations require an appropriate selection, not only of pressure, but of the time such pressure must be applied.

Alternatively the saucer seat 22 may be dispensed with and yield the result shown in Fig. 6. In this case, it will be noted that when forming a ball-seat and a saucer-seat or merely the ball-seat due care must be exercised to avoid too extreme an application of pressure. Should that occur the exit ends of the channels 21 might conceivably be blocked off entirely.

By providing a seat 52 for the ball 51 independently of the saucer-seat 22, the forward ends of the channels 21 are substantially exposed in the plane of the seat 22 in order that the ink may readily exit therefrom and into the space rearwardly of the ball. Otherwise stated, the trapezoidal cross-sectional areal extent of the channel ends is such as to present a fraction thereof substantially in excess of one half in the plane of the seat 22 (Fig. 4).

Although Figs. 5 or 6 might indicate that the closure of the rim 17 about the ball 51 is absolute, it will be understood that an annular space having a width on the order of a few millionths of an inch remains between the ball and rim, the scale of the drawing preventing any reasonable showing thereof.

From the foregoing, it will be comprehended that my process affords an efficient and simple series of steps for mounting a writing ball in its socket for relatively free, universal rotation therein, while providing the requisite passages therewith whereby ink may be fed at a constant rate to the space rearwardly of the ball. It is to be particularly noted that the ball is retained and supported at a plurality of spaced apart points so distributed as to assure freedom from binding as the ball rotates.

While I have shown and described particular ways in which invention may be practiced, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the ap-

pended claims to cover any such modifications as fall within the true spirit and scope of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In the art of manufacturing ball point writing instruments, providing a one-piece tip member having a forwardly positioned ball-receiving socket including a forwardly positioned deformable annular ball-retaining rim and a coaxial ink feeding passageway, said passageway having a lesser diameter than said socket and a ball to be received therein and said passageway extending rearwardly through said tip from said socket, the side walls of said socket and said feeding passageway defining an annular base portion for said socket, thrusting a fluting tool in a rearward direction through said feeding passageway, said fluting tool having a maximum diameter less than the diameter of said socket but greater than the diameter of said passageway whereby to form a plurality of circumferentially spaced and longitudinally extending parallel channels opening into said socket through said annular base portion and defining ball seating segments in said annular base portion between each channel and whereby the material of the tip member dislodged by said fluting tool is displaced toward the rearward portion of said tip member remote from said socket, thereafter spherically swaging the annular base portion of said socket only between the forward ends of said channels to form a plurality of separate spherical surfaces on said ball-seating segments, said surfaces having a common center lying on the longitudinal axis of said feeding passageway and each spherical surface having the same radius as a ball to be mounted in said socket, each of said spherical surfaces also being located on each of said segments wholly between the defining channels and each of said channels opening into said socket in areas spaced radially outwardly from the outer edges of said spherical surfaces whereby said channels open into an annular cavity defined by said ball, said annular base portion and said side wall when said wall is supported in said socket on said surfaces, and thereafter securing a writing ball having said radius within said socket by deforming said annular rim around the equatorial zone of said ball while urging said ball into seating engagement with said surfaces.

2. In the art of manufacturing ball point writing instruments, providing a one-piece tip member having a forwardly positioned ball-receiving socket including a forwardly positioned deformable annular ball-retaining rim and a coaxial ink feeding passageway, said passageway having a lesser diameter than said socket and a ball to be received therein and said passageway extending rearwardly through said tip from said socket, the side walls of said socket and said feeding passageway defining an annular base portion for said socket lying in a plane perpendicular to said side walls and the axis of said socket and said passageway, swaging the base portion of said socket to provide a saucer-like depression in the form of a substantially spherical segment having a center lying on said axis and having a radius greater than the radius of a ball to be mounted in said socket, thereafter

thrusting a fluting tool in a rearward direction through said feeding passageway, said fluting tool having a maximum diameter less than the diameter of said socket but greater than the diameter of said passageway whereby to form a plurality of circumferentially spaced and longitudinally extending parallel channels opening into said socket through said annular base portion and defining ball-seating segments in said annular base portion between each channel and whereby the material of the tip member dislodged by said fluting tool is displaced toward the rearward portion of said tip member remote from said socket, thereafter spherically swaging said saucer-like depression only between the forward ends of said channels to form a plurality of separate spherical surfaces on said ball-seating segments spaced radially inwardly from the outer periphery of said saucer-like depression, said surfaces having a common center lying on said axis and each spherical surface having the same radius as a ball to be mounted in said socket, each of said spherical surfaces also being located on each of said segments wholly between the defining channels and each of said channels opening into said socket in areas spaced radially outwardly from the outer edges of said spherical surfaces whereby said channels open into an annular cavity defined by said ball, said annular base portion, said saucer-like depression and said side wall when said ball is supported in said socket on said surfaces, and thereafter securing a writing ball having said radius within said socket by deforming said annular rim around the equatorial zone of said ball while urging said ball into seating engagement with said surfaces.

3. The process recited in claim 1 wherein said swaging step is effected with a tool having a spherical segment and wherein said ball is thereafter inserted into said socket before the securing step.

4. The process recited in claim 1 wherein said swaging step is effected by inserting said ball in said socket and applying pressure thereon in the direction of said longitudinal axis while the center of the ball is coincident with said axis.

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