

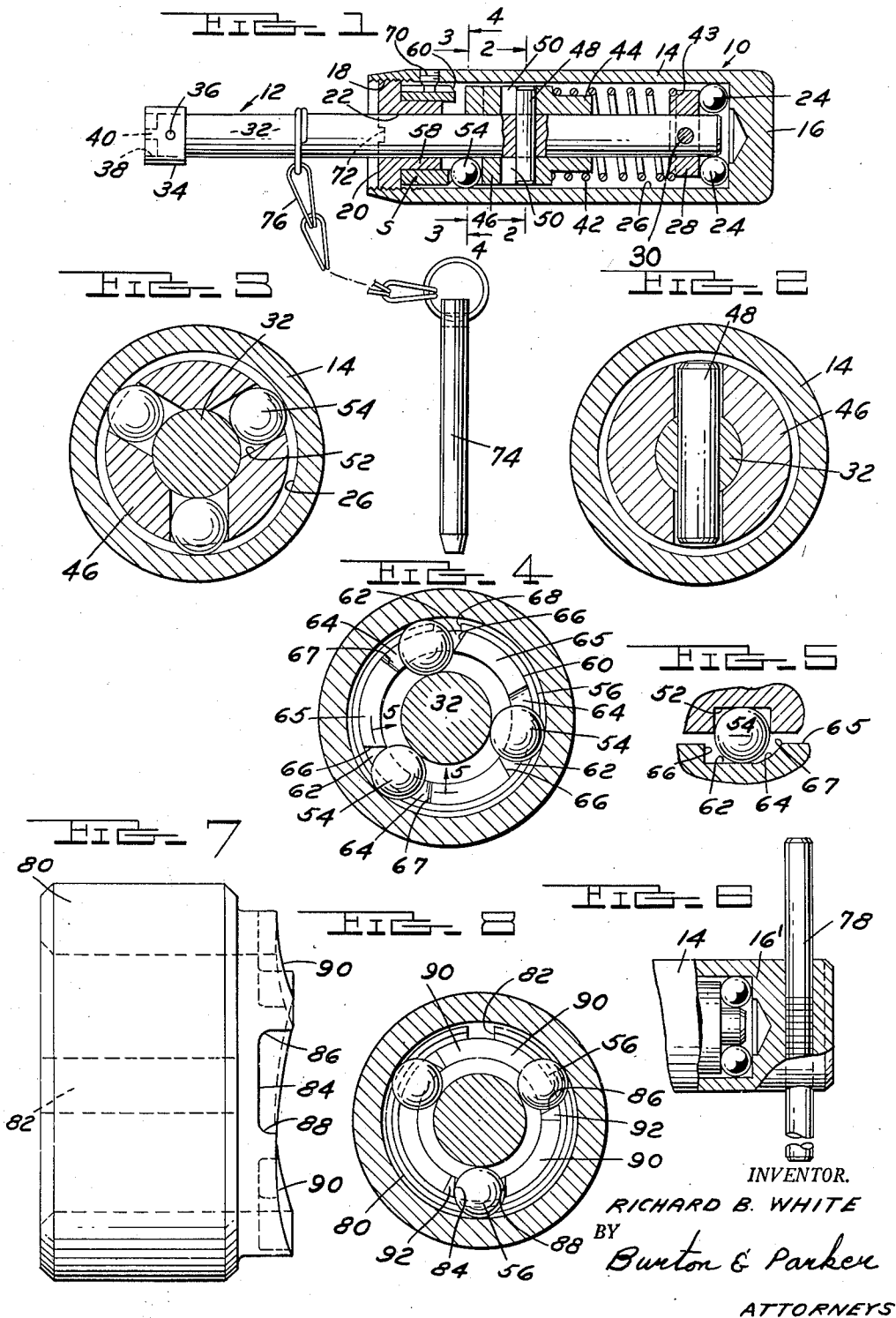
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2,820,381

REVERSIBLE, TORQUE-LIMITING WRENCH

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REVERSIBLE, TORQUE-LIMITING WRENCH

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7 Claims. (Cl. 81—52.4)

This invention relates to a torque wrench and particularly to an over-run or break-away type torque wrench.

An object of the invention is the provision of a manually operated torque wrench in which there is gradual build-up of torque between a driven element and a driving element, thereby permitting the operator to sense a solid feel at the break-away point of maximum torque, followed by a positive detenting or ratcheting signaling the completion of the torquing operation.

Another object of the invention is the provision of a torque wrench which will not only permit the torquing of a member to a predetermined torque, and thereafter signal the completion of the torquing operation, but which will also permit the backing up or loosening of an over-torqued member. Heretofore torque wrenches have been adapted to tighten a member to a predetermined torque, but for the most part have not been adapted to reverse the rotation of the member with a torquing limit of substantially greater value. In other words, with many of the prior art torque wrenches the same torque limit was operative during torquing of the member in either direction and therefore to loosen an over-torqued member required another wrench. In the torque wrench herein disclosed backing off of an over-torqued member is accomplished in a unique and simple fashion.

A further object of the invention is the provision of a wrench of small size which will permit wide applications and which has less mass and weight affording a more facile operation. A concomitant object of the invention is the provision of a torque wrench having a one-piece body construction permitting easier assembling of the parts of the wrench and more inexpensive construction.

A still further object of the invention is the provision of a torque wrench wherein the torque limit may be readily preset.

Still another object of the invention is the provision of a torque wrench particularly adapted for use in adjusting the servo bands in automatic type automotive transmissions.

Other objects, advantages, and meritorious features will more fully appear from the following specification, claims, and accompanying drawing, wherein:

Fig. 1 is a longitudinal cross sectional view through a wrench embodying my invention;

Fig. 2 is a cross sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a cross sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a cross sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a cross sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is a modified form of the wrench;

Fig. 7 is a side view of the preferred form of cam; and,

Fig. 8 is a cross sectional view of the preferred form of cam taken along a line similar to 4—4 of Fig. 1.

The general arrangement of an embodiment of my

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invention is shown in Fig. 1 as including a driving handle assembly or driving element generally indicated at 10 with an elongate driven element 12 received therein and provided at the outer end with a head for engaging a device to be torqued. The assembly 10 houses the torque limiting elements of the wrench. The driving handle assembly 10 includes a generally cylindrical handle or body member 14 which may be externally knurled to permit an operator to readily grasp and hold the same. Opposite ends of the cylindrical handle or body member 14 are closed by end wall members. The right hand end of the handle, as viewed in Fig. 1, is closed by an end wall 16 which may be integral with the body as shown. The opposite end of the handle is interiorly threaded as at 18 and the end wall member or plug 20 is threadedly connected to the cylindrical body at such end for adjustable movement axially of the body member.

The end wall member or plug 20, which may also be referred to as a nut, is provided with an axially extending hole 22 through which extends the driven element 12. The opposite end of the driven element 12 is supported within the handle 14 by bearing means which includes anti-friction rollers 24 between which the inner end of the driven element 12 projects. The rollers 24 are seated against the interior peripheral wall 26 of the body 14. A collar 28 is pinned as at 30 to the shaft 32 of the driven element 12 and bears against the anti-friction rollers 24 to rotatably support the end of the shaft 32 against the end wall 16 of the body. The plug or end wall member 20 and anti-friction rollers 24 support the driven element 12 in axial alignment with the body member 14.

Secured to the outer end of shaft 32 of the driven element 12 is a head 34 of any desired type. In the drawings head 34 is shown in the form of a socket member which is pinned to the outer end of shaft 32 as at 36 with the member provided with an inwardly extending socket 38 and a screw driver blade portion 40. Head 34 is particularly adapted to be received in wrenching engagement with servo band adjusting devices of automatic automotive transmissions.

A compression coil spring 42 is received over shaft 32 within body 14. The spring encircles a locating shoulder 43 on the collar 28 and bears against the collar and at its opposite end encircles a locating shoulder 44 and bears against a carriage member 46. The carriage member encircles shaft 32 and is connected thereto by pin 48 for non-rotatable movement with respect to shaft 32. Carriage 46 is provided with radially and axially extending slots 50 on opposite sides of shaft 32, and pin 48 is received within such slots. With the provision of slots 50 the carriage 46 may shift axially along shaft 32 but is restrained against relative rotation with respect to shaft 32. The interfitting relation between pin 48 and slots 50 is more particularly shown in Fig. 2.

The outer end face of carriage member 46 is opposed to the end wall member or plug 20, and such face of the carriage member defines a plurality of annularly arranged radially extending equidistantly spaced apart ball or roller receiving seats 52. While three such seats are shown, more or less may be feasible if desired. A ball bearing or roller 54 is rotatably received within each of the seats 52 as shown in Figs. 1, 3, and 5. The balls 54 bear against the side walls of the slots 52 and against the inner peripheral wall 26 of body 14 and against the shaft 32 of the driven element 12, all as shown in Fig. 3.

The end wall member or plug 20 defines in that face opposed to the balls 54 a plurality of annularly arranged camming surfaces, one for each ball. For this purpose the end wall member includes a camming sleeve S which is received over an annular boss 58 formed on the inner

end of the plug. Two different sleeves are shown in the drawings, one being indicated at 56 and shown in Fig. 4, while the other is indicated at 80 and shown particularly in Figs. 7 and 8. Each sleeve is rotatable relative to the boss. The inner end of each sleeve projects inwardly beyond the boss and is provided with three ball receiving recesses.

Considering in detail first camming sleeve 56, the end of the sleeve is chamfered as at 60 and is also cut away at three equidistantly spaced apart points to define ball receiving camming recesses 62, each having a camming surface 64 as shown in Figs. 4 and 5. Each camming surface 64 terminates in a flat portion 65 extending between adjacent camming recesses at a line of intersection 67, which, as shown in Fig. 4, extends along a chord displaced laterally from a diameter of the sleeve 56. In addition to the camming surface, and at the opposite side of the recess from the camming surface, there is a wall 66 which extends normal to the plane of the bottom wall of the recess, as shown in Fig. 5, and along a chord of the annular sleeve as shown in Fig. 4.

In order to prevent relative rotation between the camming sleeve 56 and driving element 14, an axially extending slot 68 is formed in the periphery of the sleeve, and a set screw 70 is threaded through the wall of the body 14 and cooperates with the slot as shown in Figs. 1 and 4. Spanner wrench engaging notches 72 may be provided in the outer face of end wall member or plug 20 to facilitate turning thereof. Upon loosening set screw 70, inward or outward threading of the plug will effect an increase or decrease in the spring tension of the compression coil spring 42 and thereby determine the force tending to keep the balls or rollers 54 within the camming recesses 62.

Considering together Figs. 1 and 4, and assuming that the shaft 32 of the driven element is held stationary, upon clockwise rotation of the driving element, camming surfaces 64 of the camming recesses will be moved against the balls 54. As the turning moment or torque increases, the balls will tend to ride up the camming surfaces and out of the recesses 62 urging the carriage axially along the shaft 32 in a direction further separating the carriage from the end wall member 20. As the balls ride up the camming surfaces 64, the force resisting movement of the balls up the camming surfaces gradually increases, and this is reflected as a torque resisting rotation of the driving element, and such torque resisting rotation of the driving element has a positive feel which the operator of the wrench can readily sense. The balls continue to ride up the camming surfaces until reaching the lines 67 of intersection of the camming surfaces and the flats 65, whereupon the balls ride across the flats 65 and drop into the adjacent camming recesses. When the balls ride across the flats 65 the force resisting rotation of the driving element is comparatively small in relation to that force required to move the balls up the camming surfaces, and the operator senses immediately a difference in the amount of force required to rotate the driving element. As the balls snap down into the adjacent camming recesses under the force of spring 42, there is a positive detenting action which the operator readily senses. If continued rotation of the driving element is effected, the operator senses a continuous ratcheting or snapping action with the wrench, signaling the completion of the torquing operation and indicating that the device engaged by the driven element to be torqued has been tightened to the torque limit of the wrench.

In the event that the device to be torqued by the wrench has heretofore been over-torqued, the operator may back the device off to relieve the torque thereupon, by use of the wrench hereinabove described, and thereafter adjust the torque setting of the device. The torque limit of the wrench when the driving element is turned in a counter-clockwise direction as viewed in Fig. 4 is

substantially twice that when turned clockwise. When the driving element 14 is turned in a counter-clockwise direction the balls 54 about the surfaces 66 of the camming recesses, and such surfaces tend to urge the balls radially outwardly against the peripheral wall 26 of body 14, and, while tending to lift the balls out of the recesses, do not do so until substantially twice the torque is applied as compared with that necessary to carry the balls up the camming surfaces 64. Because the balls are not lifted out of the recesses except with a substantial torque they maintain an interlock between the driving and driven elements such that the driven element may be turned counter-clockwise as though it were integral with the driving element.

A wrench, gauge block, or any other element such as 74 that may be useful at the time of the torquing operation, may be loosely connected to the shaft 32 of the torque wrench by means of a chain or the like 76. The chain 76 prevents loss of the element 74 and ensures that it and the torque wrench are always present at the same time at the device to be torqued.

Shown in Fig. 6 is a modification of the torque wrench hereinabove described, wherein a rod 78 or the like extends perpendicularly to the body 14 of the wrench through the end wall member 16¹ which may be of greater thickness than the end wall member of the wrench shown in Fig. 1. The rod 78 will facilitate turning of the body member 14 when the torque limit of the wrench is such that it is difficult to hold onto the body 14 simply by grasping the same in the usual manner.

The camming sleeve 80 is shown in detail in Figs. 7 and 8. It is similar to sleeve 56 in that it is provided with an axially extending groove in its periphery into which set screw 70 is received. Such groove is indicated at 82. The groove and set screw prevent the cam sleeve from rotating relative to the driving handle element 14. Sleeve 80 is received in rotatable engagement over boss 58 on the closure member or plug 20.

That end of sleeve 80 which is opposed to the carriage 46 is shaped to define a plurality of ball receiving camming recesses 84. Three such recesses are shown and are peripherally spaced apart in relation corresponding to the spacing of the seats 52 in the carriage. Each recess is provided with a side wall 86 which extends axially upwardly from the bottom of the recess. Another side wall 88 of each recess extends upwardly from the bottom wall of the recess parallel to wall 86, but the height of side wall 88 is substantially half that of wall 86. Between the upper edges of side wall 88 of one camming recess and the side wall 86 of an adjacent camming recess extends an inclined camming surface 90 over which the balls 54 ride in passing from one recess to the next recess.

Assuming that the driving handle element is turned in a clockwise direction as viewed in Fig. 8, the camming sleeve will similarly be turned by the interengagement of the set screw 70 with the notch 82. The side walls 88 of the camming recesses will be forced into engagement with the balls 54 and when the torquing forces between the carriage 46 and the camming sleeve 80 have reached sufficient proportions, the balls 54 will ride up over side walls 88 and onto camming surfaces 90 to the upper end of wall 86 of the next adjacent recess and will thereafter drop down into such recess. Camming surfaces 90 serve to raise the balls the distance necessary to permit the same to drop into the next adjacent recesses. The torque limiting function is accomplished by the height of side wall 88. The height of side wall 88 may be accurately controlled during production of the camming sleeves 80 more accurately than can the camming surfaces 64 in the embodiment shown in Figs. 4 and 5. The camming sleeve 80 causes a definite detenting action which is sensed by the operator and which signals completion of the torquing operation.

Because the side wall 86 of each camming recess is substantially twice the height of side wall 88, substantially

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twice the torque is required when the driving handle element is turned in a counterclockwise direction to effect disengagement between the driving and driven elements so that relative rotation therebetween may occur. As a result, the camming sleeve 80 will function to permit the torque wrench to be used in backing off or loosening a member which has been overtorqued theretofore. It will be noted that side walls 86 and 88 as viewed in Fig. 8 are cut along planes lying substantially on chords paralleling a radius of the sleeve 80, and that at the top of the rise of camming surfaces 90 there is a flat portion 92 just before the side walls 86 of the adjacent recesses 84. The balls ride over these flats just before dropping into the recesses.

What I claim is:

1. A torque wrench comprising: a hollow cylindrical driving element having opposed end wall members; an elongate driven element having an inner end received through one of said end wall members and having an outer end adapted to engage a device to be torqued; bearing means supporting the inner end of the driven element in coaxial alignment with the driving element and in rotatable engagement with that end wall member opposite the end wall member through which the driven element extends; a carriage member mounted on the driven element adjacent that end wall member through which the driven element extends with one end face of the carriage member and the inner face of the adjacent end wall member opposed to each other; the opposed face of one of the members defining a plurality of annularly arranged roller-receiving seats and the opposed face of the other member defining an equal number of complementally arranged camming surfaces; a roller received in each seat and adapted to bear against a complementary camming surface; means coupling the driven element to the carriage for rotation therewith and for freely shiftable movement of the carriage axially of the driven element; a compression spring disposed between said bearing means and carriage member and tensioning the carriage against the rollers to yieldingly hold the rollers against the camming surfaces in opposition to opposed torquing faces between the driving element and carriage member; whereby upon the opposed torquing forces between the driven element and driving assembly exceeding the spring tensioning of the rollers against the camming surfaces, the rollers will ride up the camming surfaces shifting the carriage axially on the driven element in a direction separating said opposed faces thereby permitting the rollers to pass annularly from one camming surface to the next camming surface with an accompanying relative rotation between the driving and driven elements.

2. A torque wrench comprising: a hollow cylindrical driving handle assembly having opposed end wall members, means coupling one of said end wall members to the driving handle assembly for adjustable shiftable movement axially of the assembly, an elongate driven element having an inner end received through one of said end wall members and having an outer end adapted to engage a device to be torqued, bearing means supporting the inner end of the driven element in coaxial alignment with the driving handle assembly and in rotatable engagement with that end wall member opposite the end wall member through which the driven element extends, a carriage member mounted on the driven element adjacent that end wall member through which the driven element extends with one end face of the carriage member and the inner face of the adjacent end wall member opposed to each other, the opposed face of one of the members defining a plurality of roller-receiving seats and the opposed face of the other member defining an equal number of complementally arranged camming surfaces, a roller received in each seat and adapted to bear against a complementary camming surface, means coupling the driven element to

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the carriage for rotation therewith and for freely shiftable movement of the carriage axially of the driven element, compression spring means disposed between said bearing means and carriage member and tensioning the carriage against the rollers to yieldingly hold the rollers against the camming surfaces in opposition to opposed torquing forces between the driving handle assembly and carriage member, and said adjustable end wall member being axially shiftable to preset the tensioning of the rollers against the camming surfaces.

3. A torque wrench comprising: a hollow cylindrical driving handle assembly having opposed end walls, means coupling one of said end walls to the assembly for adjustable shiftable movement axially of the assembly, an elongate driven element having an inner end received through one of the end walls of the driving handle assembly and having an outer end adapted to engage a device to be torqued, bearing means supporting the inner end of the driven element in coaxial alignment with the driving handle assembly and in rotatable engagement with that end wall of the assembly opposite that end wall through which the driven element extends, that end wall through which the driven element extends provided with a plurality of annularly arranged camming surfaces, a carriage mounted on the driven element interiorly of the driving handle assembly and provided in that face opposed to the camming surfaces of said one end wall with a plurality of roller-receiving seats, means coupling the driven element to the carriage for rotation therewith and for freely shiftable movement of the carriage axially on the driven element, a roller disposed in each seat and adapted to bear against the camming surfaces and cooperable therewith to effect rotation of the carriage upon rotation of the driving handle assembly, compression spring means disposed between said bearing means and carriage tensioning the carriage against the rollers to yieldingly hold the rollers against the camming surfaces, and said adjustable end wall being axially shiftable to preset the spring tension of the spring means and determine the force yieldingly holding the rollers against the camming surfaces.

4. In a torque wrench: a hollow cylindrical driving handle element closed at one end by an integral end wall, a nut threadedly connected to the opposite end of the handle element, a driven element received coaxially through the nut with an outer end having a part engageable with a device to be torqued, means supporting the inner end of the driven element in rotatable engagement with the integral end wall of the driving element, a camming sleeve connected to said nut and exhibiting a plurality of annularly arranged camming recesses with one side of each recess defining a concave camming surface and the opposite side defining a straight edge rising sharply from the floor of the recess, a carriage mounted on the driven element with an end face opposed to said camming recesses and defining a plurality of roller-receiving seats disposed opposite each camming recess, means coupling the carriage to the driven element for rotatable movement therewith and for axially shiftable movement therealong toward and away from said recesses, a roller disposed in each seat and received in each recess, spring means bearing against said bearing means at one end and the carriage at the opposite end and yieldingly tensioning the carriage toward said nut to grip the rollers between the nut and carriage and urge the rollers into the recesses, and said camming surfaces operable to shift the rollers axially out of the recesses against the spring tension upon torquing of the driving member in one direction and said straight edges of the recesses acting to retain the rollers in the recesses to interlock the driving and driven elements when the driving element is torqued in the opposite direction.

5. The invention as defined in claim numbered 4 characterized in that said straight edges of the camming recesses lie on chords of the sleeve and serve to urge the rollers radially outwardly and against the inner wall of

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the driving element to retain the rollers in the recesses when the driving element is torqued in a direction opposite that tending to urge the camming surface against the rollers.

6. The invention as defined in claim numbered 4 characterized in that the said nut is provided with an annular boss extending inwardly of the driving element and the camming sleeve is rotatably received over said boss, and means are provided engaging the driving element and the sleeve and operable to permit axial shifting of the sleeve upon threading of the nut relative to the driving element but operable to prevent rotatable movement of the sleeve relative to the driving element.

7. A torque wrench comprising: a hollow cylindrical driving handle element open at one end and closed at the opposite end, a driven element coaxially received at one end within the driving element, bearing means supporting the inner end of the driven element at the closed end of the driving element, closure means encircling the driven element and removably closing the open end of the driving element, a carriage mounted on the driven element interiorly of the driving element for rotation with the driven element and axially shiftable therealong, spring means biasing the carriage toward the closure means, said

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carriage provided in that end opposed to the closure means with a plurality of body receiving seats, said closure means provided with ball receiving cam recesses, each recess having a side wall extending axially of the closure means and another side wall paralleling the first but of a lesser height from the bottom of the recess, and an inclined camming surface extending from the top of the second mentioned side wall of each recess toward the first mentioned side wall of the next adjacent recess, and a ball member received in each seat and shiftable upon relative rotation between said elements from one camming recess to the next.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,820,381

January 21, 1958

Richard B. White

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the drawings, the letter "S" appearing in Fig. 1 should read -- 56 --; in the printed specification, column 2, line 71, for "sleeve S" read -- sleeve 56 --; column 8, line 2, for "body" read -- ball --.

Signed and sealed this 1st day of April 1958.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents