AMENDED SPECIFICATION

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PATENT SPECIFICATION

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735,703

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COMPLETE SPECIFICATION

Improvements in or relating to Collets and Collet Chucks

We, NATIONAL RESEARCH DEVELOPMENT CORPORATION, a British Corporation established by statute, of 1, Tilney Street, London, W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to collets and collet chucks and particularly to improved constructions of collets for such chucks and methods of making them. By the term collet is meant one of a series of sleeve-like components, each of which is designed to accommodate a different range of work size and is adapted for use with a collet chuck for the purpose of allowing work of the appropriate size to be passed through and accommodated in the chuck, and each component incorporates gripping members adapted to be actuated by means associated with the chuck so as to be brought into gripping engagement with the work.

It is an object of this invention to provide a collet component for use in a collet chuck, the component including movable work engaging members which when moved radially into gripping engagement with a workpiece will effectively grip the workpiece and exert a substantially parallel and evenly distributed concentric gripping pressure over the whole of that part of the length of the workpiece which they engage.

To this end, according to the invention, a collet adapted for use with a collet chuck comprises an annularly shaped cage-like body formed by a plurality of interdependent rigid segmental members disposed relatively to one another so as to provide therebetween a number of spaced guideways disposed circumferentially around a central work receiving space extending longitudinally of the cage, and a plurality of separate movable gripping members located in said guideways so as to be slidable radially therein with respect to the cage-like body, the gripping members being retained in their guideways so as to form therewith a unitary collet assembly the cage-like body having a conically shaped peripheral portion which is adapted to fit within a complementarily coned body, associated with the chuck, which coned body is caused to act upon the gripping members as relative sliding movement occurs between them and the coned body to cause said gripping members to move radially and in unison into gripping relation with the work. Any suitable means may be provided for urging the gripping members in unison so as to cause them simultaneously to move radially with respect to the fixed cage and chuck body.

The gripping members may be arranged so that under the action of said complementarily coned body they slide in unison longitudinally within said guideways whilst at the same time executing the radial movement. At all positions over the full range of movement of the gripping members, the work engaging portions formed thereon are maintained parallel to one another and therefore one collet may be employed to grip work of varying diameters within limits, e.g. throughout a range of $\frac{1}{8}$ inch.

The collet preferably comprises a fixed cage formed of a plurality of spaced segments interdependent on one another to define clear spaces therebetween, the segments being held fast in position by means of retainer rings.

In order that the invention may be more clearly understood several embodiments will now be described by way of example together with divers ways of bringing the gripping members of the collets into engagement with the workpiece. In the following description re-

[*Price 3s. 6d.*]

ference will be made to the accompanying drawings in which Fig. 1 is a sectional perspective of one form of a collet embodying the invention together with its associated operating mechanism; Fig. 1*a* is a part sectional elevation of the collet shown in Fig. 1 but having a modified operating mechanism; Figs. 2 and 3 are side and end elevations of a toggle operated collet chuck and a modified form of collet mounted therein for operation; Fig. 4 is a view of a swarf ring for the collet.

Referring firstly to Fig. 1 of the accompanying drawings, the cage 1 is formed by a plurality of members or so-called segments 1*a*, e.g. of steel, which are approximately sector shaped in cross-section and taper along their length. These are formed from a short frustoconical body having a central bore therethrough as by being drilled axially. An annular recess 2 having a short tapered portion as shown at 2*a* is formed in the large, or front, end of the body and an annular recess 3 at the small, or back, end of the body. The body is then longitudinally slot milled through radially at equidistantly spaced positions circumferentially thus dividing the body into twelve equally spaced apart segments 1*a*. The segments 1*a* are held in spaced relationship with one another around a central work-receiving space by so called retainer rings, viz. ring 4 fitting into the back annular recess 3 and a two-piece diametrically split ring 5 having a tapered portion on its outer periphery fitting into the tapered portion 2*a* of the front annular recess 2. The two rings 4 and 5 also link the segments 1*a* to form the cage-like body.

Griping members 6 are accommodated in the intermediate spaces between the segments 1*a* of the cage 1 so that they can slide relatively between the segments 1*a* in both a radial and a longitudinal direction with respect to the cage 1. Each gripping member 6 is wedge-shaped as shown and has one outer tapering edge 6*a* which conforms substantially to the taper of the cage 1 formed by the segments 1*a*; the flanks 6*b* of each gripping member when in position lie adjacent to the flanks of the segements 1*a* and the larger end face of the wedge lies approximately adjacent the front edge 1*b* of the segment assembly or cage 1. The face 6*c* of each wedge-shpaed gripping member 6 opposite the tapered face 6*a* thereof constitutes a work engaging jaw portion and takes up a position slightly projecting into the bore of the segment assembly 1 when the jaws are at their position of maximum opening at which position they are shown in Fig. 1. In order that the gripping members 6 may be retained in their position between the segements 1, each is provided with an aperture as at 7 through which the two halves of the diametrically split retainer ring 5 can be threaded. Each aperture 7 is wedge-shaped and is a little larger than the section of the split retainer ring 5 so that the desired relative sliding movement can take place between gripping members 6 and the split retainer ring 5. Thus, in the assembly of the collet, the members 6 may be withdrawn from an initial location within the assembly of segments 1*a* sufficient to thread the two halves of the split ring 5 through the apertures 7 and the split ring 5 with gripping members 6 linked thereby is then pressed home in the annular recess 2 in the larger end of the segment assembly. The split retainer ring 5 then anchors the individual segments 1*a*, retaining them together in firm formation as a cage.

Screws or, if desired, induction welds may be used to secure the split ring 5 and also the back ring 4 to each of the segments 1*a* where the surfaces of these members abut against one another. The rear ends of the gripping members 6 are each provided with a hole 10 for housing means associated with the cage-like body including a return spring 11 which acts against the back ring 4 and tends to keep each of the gripping members 6 in the open or expanded position by urging them radially outwards, as shown, with the small end of the tapered aperture 7 in each of the gripping members 6 seating against the tapered split ring 5. Hence endwise pressure on the front ends of the gripping members 6 will tend to push them longitudinally of the axis of the collet against the action of the return springs 11, and each gripping member 6 in its longitudinal movement will be guided to move radially inwards between two adjacent segments by the relative sliding between the aperture 7 in each gripping member 6 and the tapered split ring 5 fixedly secured to the segments. On release of such endwise pressure the return springs 11 serve to return the gripping members 6 to their original position, the gripping members 6 thus moving radially outwards whilst making their short return longitudinal movement.

In order to provide means of applying endwise pressure on to the individual front end faces of the gripping members 6, a pressure plate 12 being a part of the collet chuck is applied to the front end of the collet. This plate is in the form of a ring which has one face exhibiting projections 13 and its opposite face 14 provided with an outwardly coned surface. Extending from the plate 12 at positions intermediate the projections 13 are a number of dowels 15 which enter an equivalent number of holes 16 drilled in front faces of certain of the segments 1*a*, the dowels 15 being slidable within the holes 16 and thus locating the projections 13 relatively to the front ends of the gripping members 6 so that they may be brought to abut against the gripping members 6 to urge the latter uniformly against the return springs 11.

In operation, the improved collet, i.e. the cage comprising the assembly of segments 1*a*,

gripping members 6 and pressure plate 14 is applied into the hardened and ground cone of the chuck body 17. The gripping members 6 are operated towards the rear or small end of the body by rotation of a cap nut 18 screwed on to an outer portion of the chuck body 17 and having a projecting flange 19, an internally tapered portion 19*a* of which engages over the coned face of the pressure plate 14. Rearward movement of the gripping members 6, which may be ground to a small radius on both the outside and inside contacting edges, viz. at 6*a* and 6*c* where these engage respectively the chuck body cone 17 and the workpiece (not shown) permits the members 6 to close concentrically inwards radially, the members 6 sliding in the guideways defined by the interleaving segments 1*a*. The pressure of gripping on to a workpiece, e.g. a round bar (not shown), will be automatically ensured through the contact which the outer edges 6*a* of the gripping members 6 make along the inner tapered wall of the coned chuck body 17. The work engaging portions 6*c*, of the gripping members 6 will give parallel closing throughout the whole range of each collet. On release of the endwise pressure exerted by the cap nut 19, the return springs 11 will operate the gripping members 6 towards the front, or large diameter end of the body 17 and thus open the collet.

An alternative means of imparting endwise or longitudinal movement to the gripping members 6 which may be employed is shown in Fig. 1*a* and in this Fig. the segments forming the cage of the collet are omitted for the sake of clarity. In this construction the pressure plate of the chuck is dispensed with and each gripping member of the collet as at 6^1 is extended forwards from the front face of the collet so that when positioned in a chuck body 17^1 a projecting portion of each gripping member 6^1; shaped as shown at 6*e* is capable of co-operating directly with a tapered portion $19a^1$ of a flange 19^1, of a sleeve 20. The sleeve 20 is a sliding fit on an outer cylindrical portion of the chuck body 17^1, with a keyway 21 engaged by a key 22 formed on the sleeve 20 so as to stop the latter from rotating. In this construction a thread 23 is formed on the outside diameter of the sleeve 20 and a closing nut 24 thread will engage it, the nut 24 itself being restrained from longitudinal movement; thus the sleeve 20 will not rotate when the nut 24 is turned, but will slide inwards and move the gripping members 6^1 down the tapered wall of the chuck body 17^1.

In a further modified form of operating a collet according to the invention, the gripping members of the collet are adapted to be moved in their guide ways by means of a lever operated toggle mechanism. A suitable form of such mechanism is shown in sectional elevation and cross-section in Figs. 2 and 3 respectively, Fig. 3 being shown in section along a line III—III in Fig. 2.

The selection of toggle mechanism as a means of operating the collet involves a modified form of body cone 17^{11} having longitudinally extending splines 80, of short length as shown in dotted outline in Fig. 2 and situated at 120° around its outer diameter as indicated in Fig. 3. Within the clearances, or splineways, between the splines 80 is slidably mounted a complementary splined sleeve 81 which has a tubular portion 82 and a splined, or tongued, portion 83 extending rearwardly. The rearward extremities of the tongued portion are joined by a screwed ring 84 which engages an external screw thread 85 formed on the ends of the tongues. The outer diameter of the splined sleeve 81 is such that when it is mounted on the body cone 17^{11}, there is a small clearance 86 between it and an outer sleeve 87. The sleeve 87 is a fixed member, a portion of which encloses the open sides of the splineways defined between the splines of the portion 83 and which bears upon the outside diameter of the splines as shown. Countersunk screws 87*a* are employed to secure the fixed sleeve member 87 to the splines 80 of the body cone 17^{11}. The sleeve member 87 has three recesses as at 88, each accommodating one of a group of toggle mechanisms disposed at equal spacings around the sleeve member and, adjacent each of such recesses, the member 87 is slotted through as at 89 so that pins 90 fixed in the tongues 83 of the slidable member 81 may project through into the recesses and so to co-operate with the links 91*a*, 91*b* of the toggle mechanisms the pivots of which are as at 91*c*. The link 91*b* of each toggle device or mechanism abuts against one end of an adjustable pin 92 housed in a hole formed through part of the sleeve 87. A forward extension of the fixed sleeve 87 is screw threaded at 87*b* and carries a split locking adjusting nut 93 against which the other ends of the pins 92 abut.

The locking adjusting nut 93 is of a known type and comprises a nut split through at one portion of its periphery and partially split as at 93*a* at one or more further portions of its periphery. On either side of and adjacent to the split throught portion, a boss is formed. Each boss (not shown) is drilled and tapped to take a bolt and nut fastening means, capable of closing the split in the nut and thus contracting the nut 93 into firm engagement with the threaded portion 87*b*. When the fastening means is slack and the nut 93 consequently loose upon the threaded portion 87*b*, the nut 93 can be rotated and hence moved longitudinally with respect to the sleeve 87. This longitudinal movement serves as an adjustment for the effective range of movement of the toggle by causing simultaneous adjustment of the relative positions of the pins 92 in their holes which positions in turn determine the positions of the abutments for the

levers 91*b* of the toggle mechanisms. The positions of the abutments for the levers 91*b* determine the distance of travel of the end of the other toggle lever 91*a* when the toggle mechanism is operated and hence the extent of movement imparted to the sliding member 81.

The toggle members 91*a*, 91*b* co-operating with the projections 90 of the sleeve 82 work against abutments afforded by pins 94, urged thereagainst by springs 95 located in bores in the rear end of the fixed sleeve 87. An upper rear portion of the sleeve 87 is feather-keyed at 96 to a cam ring 97. The cam ring 97 has an inclined annular cam surface 98 which co-operates with a roller 99 mounted at the pivot 91*c* of the toggle links 91*a*, 91*b* of each toggle mechanism so that axial movement of the cam ring 97 causes relative movement between the roller 99 and the cam which is effective to press the toggle pivot inwards radially into its recess 88 tending to bring the toggle links 91*a* and 91*b* into alignment with one another. The pins 90 are thereby moved axially carrying with them sliding member 81 through a thrust closing ring 100, movement is imparted to the gripping members or jaws 106 of the collet. The latter, being of a construction generally as shown in Fig. 1, provides a cage-like body with a plurality of guideways, defined by circumferentially spaced segments 106*a*, for gripping members 106. The cam ring 97 is operated by means of a lever 101 provided on a yoke member 102 which is pivoted at 103 on a suitable part of the lathe or the like and having shoes to engage a groove 104 in the outer periphery of the cam ring 97. By this means the gripping members 106 are simultaneously moved towards the rear of the chuck and as they move longitudinally in their guideways they are guided so as to move radially inwards by virtue of contact of their outer faces with the inner coned surface of the body cone 17^{11}. In order to provide for effective release of the gripping members 106 each of these members is provided with a small extension 107 extending laterally and engaging in a recess, with a small degree of clearance, formed between the rear face of the thrust closing ring 100 and the forward face of a withdrawing washer 108 held in position by the thrust closing ring against a shoulder on the sleeve member 81. Thus when the toggle links 91*a*, 91*b* are released initially from their aligned position under the action of a leaf spring 91*d*, the sliding member 81 is urged to the right by means of the abutment and spring means 94, 95. The sliding member 81 engages, through the withdrawing washer 108, the gripping member projections 107 and as the gripping members slide forward longitudinally over the cone surface of the body cone 17^{11}, the projections 107 extend further and further into the recess.

In order to prevent the entry of the swarf into movable parts of the collet a swarf ring may be fitted between the front of the collet and the thrust ring 100. To enable a swarf sealing ring to be fitted the front of each blade 106 is chamfered peripherally and a similar chamfer is formed on the ring 100 of the chuck. The swarf ring itself may consist of a ring of rubber or other suitable material as shown at 109 inserted into the space formed by the chamfered portions of the collet. Alternatively, the front ring 100 may be recessed at the side nearest the gripping members to take a segmental ring 110 (Fig. 4) being a ring formed by a number of segments of rigid material, held together at its inner diameter a rubber ring 109*a* fitting, in dovetail fashion the inner periphery of the ring. The segments of the ring 110 are put into slight initial compression by means of a surrounding wavy circlet spring 111 which provides a yielding pressure on the segments, so holding the rubber ring 109*a* in a swarf excluding position. The segments and also the inner rubber ring 109*a* may be rubber bonded together, the bonding being between the adjacent faces of the segments and the rubber ring.

Instead of forming the collet segments (as for example the segments 1*a* of Fig. 1) in the manner described above, they may be moulded from a synthetic plastic material, a similar form of cage-like body being built up from such segments of synthetic plastic material.

Also, the gripping members of the collet may have their work-engaging surfaces either plain or thread-like according to whether the work piece which they are to hold is or is not threaded on its surface.

WHAT WE CLAIM IS:—

1. A collet adapted for use with a collet chuck and comprising an annularly shaped cage-like body formed by a plurality of interdependent rigid segmental members disposed relatively to one another so as to provide therebetween a number of spaced guideways disposed circumferentially around a central work receiving space extending longitudinally of the cage, and a plurality of separate movable gripping members located in said guideways so as to be slidable radially therein with respect to the cage-like body, the gripping members being retained in their guideways so as to form therewith a unitary collet assembly, the cage-like body having a conically shaped peripheral portion which is adapted to fit within a complementarily coned body associated with the chuck, which coned body is caused to act upon the gripping members as relative sliding movement occurs between them and the coned body to cause said gripping members to move radially and in unison into gripping relation with the work.

2. A collet adapted for use with a collet chuck and comprising an annularly shaped cage-like body formed by a plurality of interdependent rigid segmental members disposed relatively to one another so as to provide there-

between a number of circumferentially spaced guideways extending longitudinally of the cage, and a plurality of separate movable gripping members located within said guideways so as to be slidable radially therein with respect to the cage-like body, the gripping members being arranged under the control of means associated with the cage-like body tending to urge the gripping members radially away from gripping position, the gripping members being retained within the guideways so as to form therewith a unitary collet assembly such that with the cage-like body having a conically shaped periphery portion with which a complementarily coned body, associated with the chuck, is adapted to co-operate, said coned body acts upon said gripping members as relative sliding occurs between the coned surfaces thereof and the coned body to cause said gripping members to move radially and in unison into gripping relation with the work.

3. A collet as claimed in Claim 1 or Claim 2, wherein the gripping members are arranged so that they slide in unison longitudinally within said guideways whilst at the same time executing the radial movement.

4. A collet as claimed in Claim 1, 2 or 3 in which the segmental members are held fast in position by means of retainer rings disposed at opposite end regions of the cage.

5. A collet as claimed in Claim 1 or Claim 2 wherein the gripping members are each apertured and provided with a retainer ring threaded through the apertures so as to link the group of gripping members within their guideways, the aperture in each gripping member being shaped and dimensioned to permit of the movement in unison of the griping members into and out of workpiece-gripping position.

6. A collet as claimed in any one of Claims 1 to 5, wherein the gripping members are each formed with tapered edges conforming to the conicity of the complementarily coned body.

7. A collet as claimed in Claim 3, in which the gripping members are arranged to be moved longitudinally in unison and to assume the gripping position by means acting at one end of said members against spring bias tending to return said members from the gripping position.

8. A collet as claimed in Claim 1, 2 or 3, mounted so that the complementarily coned body can co-operate therewith and the assembly of said collet and said body having means for preventing entry of swarf into movable parts of the collet including a ring consisting of rubber or the like located at the frontal region of the collet.

9. A collet as claimed in Claim 1 or 2, wherein the ring of rubber or the like is held in position by means of a segmental ring, the segments of which are compressed initially by means of a surrounding circlet spring member which provides a yielding pressure on the segments.

10. Collets as claimed in Claim 1, substantially as herein described with reference to the accompanying drawings.

11. A collet constituted as claimed in Claim 1 and having operating mechanism therefor substantially as herein described with reference to the accompanying drawings.

A. F. BURGESS,
Chartered Patent Agent,
Agent for the Applicants.

PROVISIONAL SPECIFICATION

Improvements in or relating to Collets and Collet Chucks

We, NATIONAL RESEARCH DEVELOPMENT CORPORATION, a British Corporation established by Statute, of 1 Tilney Street, London, W.1, do hereby declare this invention to be described in the followling statement:—

This invention relates to collet chucks and particularly to improved constructions of collets for such chucks and methods of making them.

It is an object of this invention to provide a collet component for a collet chuck, the component including movable work-engaging members which, when contracted into gripping engagement with a workpiece, will effectively grip the workpiece and exert a substantially parallel end evenly distributed concentric gripping pressure over the whole of that part of the length of the workpiece which they engage.

To this end, according to the invention, a collet, adapted for use within an internally coned body as, for example that of a collet chuck, comprises a similarly externally coned cage-like body formed by a plurality of interdependent segmental members disposed relatively to one another so as to provide therebetween a number of guideways extending longitudinally of the cage and a plurality of independent movable gripping members adapted to slide in unison longitudinally within the said guideways. The gripping members are adapted, during operation into gripping relation with the work, each to co-operate with the said internally coned body so that simultaneously with their longitudinal movement in the guideways, they are constrained to move radially and in unison by reason of their engagement with the coned body. At all positions over the full range of movement of the gripping members, the jaws formed thereon are maintained parallel to one another and therefore one collet may be employed to grip work of varying diameters within limits e.g. throughout a range of $\frac{1}{8}$ inch.

The collet preferably comprises a fixed cage formed of a plurality of spaced segments independent one of another and defining clear spaces therebetween, the segments being held fast in position by means of retainer rings. Any suitable means may be provided for urging the gripping members longitudinally and in unison so as to cause them simultaneously to move radially with respect to the fixed cage and chuck body.

In one embodiment of the invention by way of example the cage is formed by a plurality of members or so-called segments, e.g. of steel, which are approximately sector shaped in cross section and taper along their length. These are formed from a short frusto-conical body having a central bore therethrough as by being drilled axially. An annular recess having a short tapered outer diameter at the bottom is formed in the large, or front end, and an annular recess at the small, or back, end of the body. The body is then longitudinally slot milled through radially at equidistantly spaced positions circumferentially thus dividing the body into a number, (three, four or more) of equal spaced apart segments. These segments are held in spaced relationship with one another by a ring fitting ino the back annular recess and a two-piece split ring of tapered outside diameter section fitting into the tapered portion of the front annular recess.

The gripping members are accommodated in the intermediate spaces between the segments of the cage and are shaped as jaw blades so that they can slide relatively between the segments in both a radial and a longitudinal direction with respect to the cage. Each gripping member is wedge-shaped and has one outer tapering edge which conforms substantially to the taper of the cage formed by the segments; the flanks of each wedge member when it is in position, lie adjacent the flanks of the segments and the larger end face of the wedge lies approximately adjacent the front edge of the segment assembly. The face of each wedge-shaped gripping member opposite to the tapered face thereof constitutes a work engaging jaw portion and takes up a position slightly projecting into the bone of the segment assembly when the jaws are at their position of maximum opening. In order that the gripping members may be retained in their position between the segments, each is provided with an aperture through which the two halves of the tapered split ring mentioned above can be threaded. The aperture is wedge shaped and its contour is a little larger than the contour of the section of the split ring so that the desired relative sliding movement can take place between the blade aperture and the section of the split ring. Thus in the assembly of the device, the members may be withdrawn from an initial location within the assembly of segments sufficient to thread the two halves of the split ring through the apertures and the split ring with jaws linked thereby is then pressed home in the annular recess in the larger end of the segment assembly. The split ring then anchors the individual segments, holding them together in firm formation as a cage.

Screws, or if desired, induction welds, may be used to secure the split ring and also the back ring to each of the segments where the surfaces of these members abut against one another. The rear ends of the gripping members are each provided with a hole for housing a return spring which acts against the back ring and tends to keep each of the gripping members in an expanded position with the small end of the tapered aperture in the gripping members seating against the tapered split ring. Hence endwise pressure on the front ends of the gripping members will tend to push them longitudinally of the axis of the collet against the action of the return springs, and each gripping member in its longitudinal movement will be guided to move radially inwards between two adjacent segments by the relative sliding between the aperture in each gripping member and the tapered split ring fixedly secured to the segments. On release of such endwise pressure the return springs serve to return the gripping members to their original position, the gripping members thus expanding radially whilst making their short return longitudinal movement.

In order to provide means for applying endwise pressure on to the individual front end faces of the gripping members, a pressure plate is applied to the front end of the collet. This plate is in the form of a ring which has one face containing stub spline projections and its opposite face provided with an outwardly coned surface. Extending from its splined face are a number of dowels which enter an equivalent number of holes drilled in the front faces of certain of the segments, the dowels being slidable within the holes and thus locate the splines relatively to the front end of the gripping members so that they may be brought to abut against the gripping members to urge the latter uniformly against the return springs.

In operation, the improved collet i.e. the cage comprising the assembly of segments, gripping members and pressure plate is applied into the hardened and ground cone of the chuck body. The gripping members are operated towards the rear or small end of the body by the rotation of a cap nut screwed on to the outer chuck body and having an internally projecting flange, a tapered portion of which engages over the coned face of the pressure plate. Rearward movement of the gripping members, which may be ground to a small radius on both the outside and inside contacting edges, viz. where these engage respectively the chuck body cone and the workpiece, permits these members to close concentrically inwards radially, the members sliding in the guideways defined by the interleaving seg-

ments. The pressure of gripping on to a workpiece, e.g. a round bar, will be automatically ensured through the contact which the outer edges of the gripping members make along the inner tapered wall of the coned chuck body. The work engaging portions, or jaws, of the gripping members will give parallel closing throughout the whole range of each collet. On release of the endwise pressure exerted by the cap nut, the return springs will operate the gripping members towards the front, or large diameter, of the body and thus open the collet.

Any other suitable means of imparting endwise or longitudinal movement to the gripping members may be employed. For example the pressure plate may be dispensed with and each gripping member may be extended proud of the chuck body and shaped so as to co-operate directly with the flange of the cap nut. Also, instead of the cap nut being screwed directly on to the chuck body the nut may be replaced by a sleeve which is provided with a cap or flange similar to the cap nut and which is a sliding fit on the plane portion of the chuck body, with key or pin and slot means for stopping it from rotating. In this construction a thread will be formed on the outside diameter of this sleeve and the closing nut thread will engage it, the nut itself being restrained from longitudinal movement, thus the cap or nose will not rotate when the nut is turned, but will slide inwards and operate the gripping members down the tapered wall of the chuck body. Alternatively a suitable toggle lever device or a fluid operated mechanism for opening and closing the collets may be incorporated with the chuck so that these operations may be performed without stopping the machine in which the chuck is being used.

Instead of forming the segments in the manner described above, they may be moulded from a plastic material and a similar cage built up from the plastic segments.

Also the return springs may be mounted in housings which are parallel to the axis of the chuck or set at an angle thereto so that they may, in the latter case, exert a more direct thrust on the gripping members to more readily force them up and in contact with the inclined body cone of the chuck and thus open the collet.

A number of such parallel closing collets is contemplated covering a desired range of sizes from, say, 1/32 inch to $1\frac{1}{4}$ inches or larger diameter, thus obviating a very large number of normal steel spring collets.

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Chartered Patent Agent,
Agent for Applicants.

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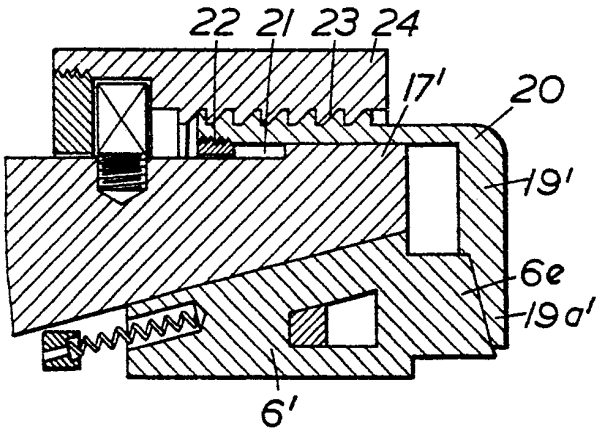
Fig. 1a



735,703 AMENDED SPECIFICATION

2 SHEETS

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SHEET 1

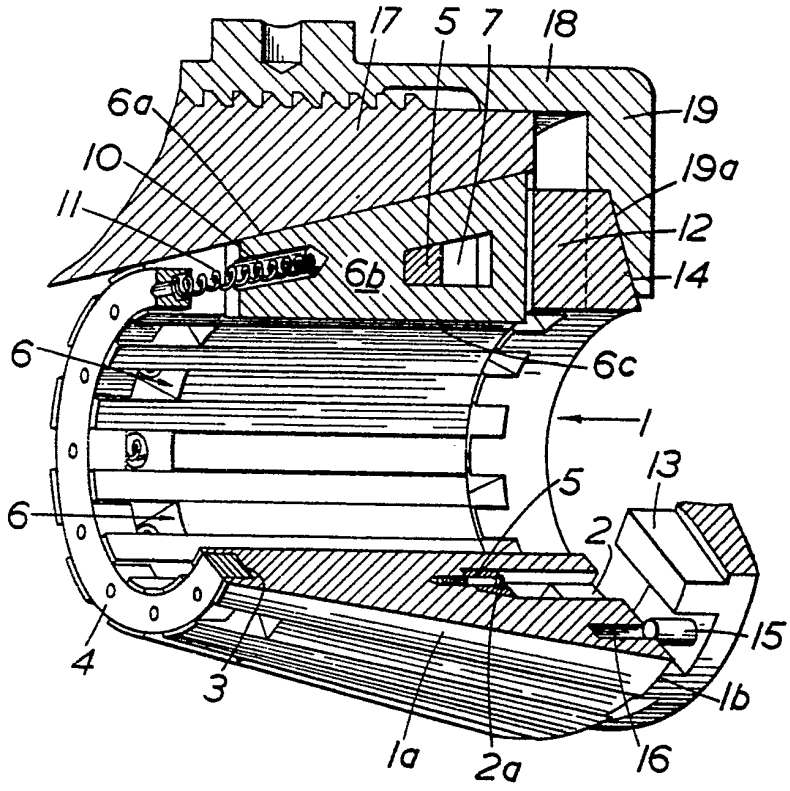


Fig. 1

1'

735,703 AMENDED SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

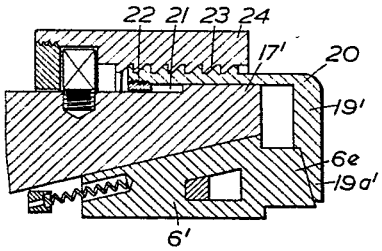


Fig. 1a

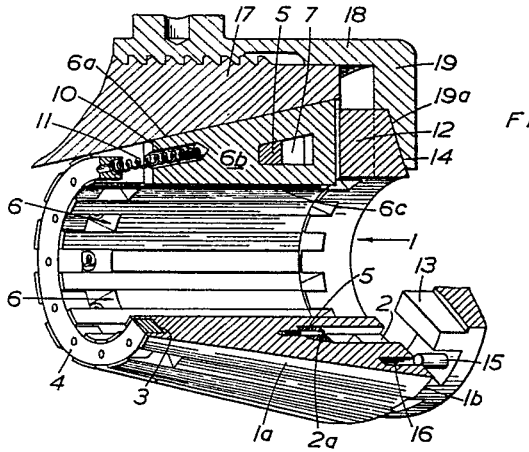
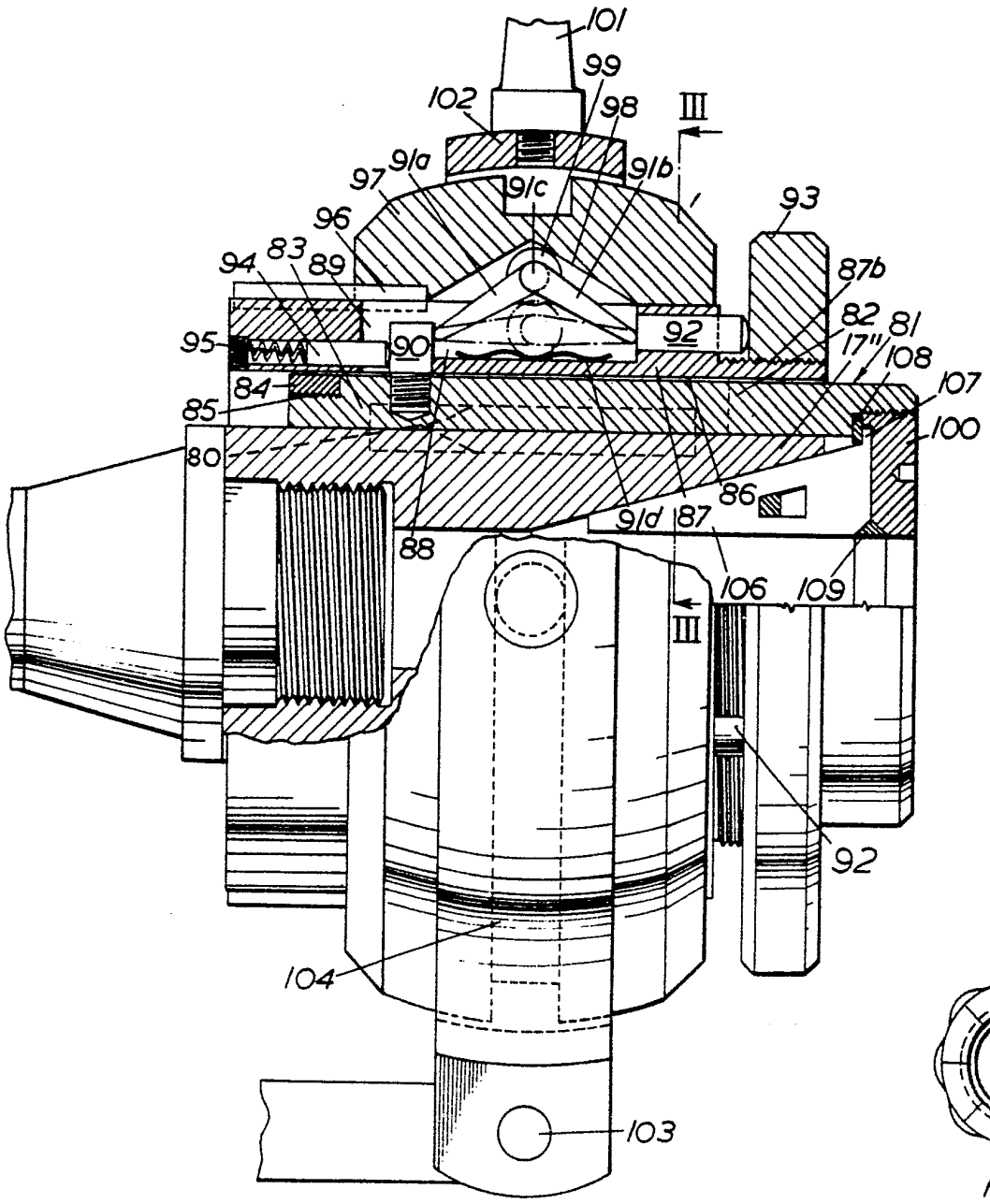


Fig. 1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102
98
III
91a
91b
97
91c
93
96
94
83
89
87b
82
81
95
90
92
17"
108
84
107
85
100
80
86
91d
87
88
106
109
III
92
104
103

Fig. 2

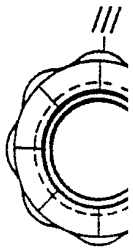
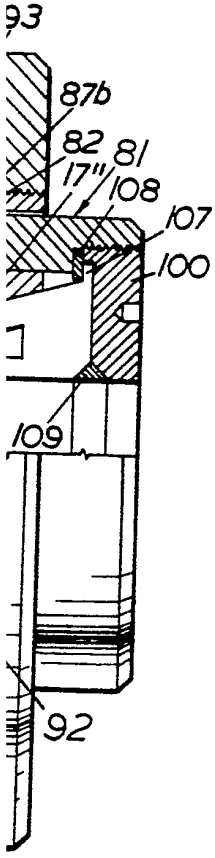

III

Fig.

735,703 AMENDED SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.



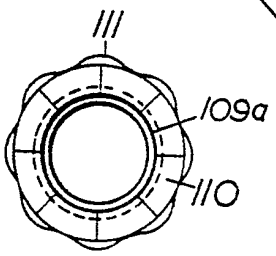


Fig. 4

Fig. 3

735,703 AMENDED SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

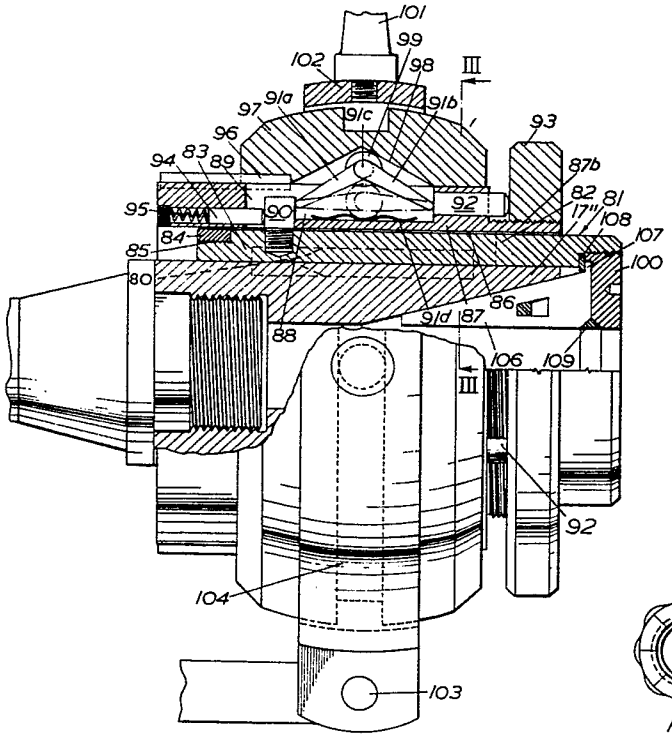


Fig. 2

Fig. 4

Fig. 3