Feb. 2, 1960 T. T. BUNCH 2,923,489

LOCKING MECHANISM

Filed March 7, 1956 2 Sheets-Sheet 1

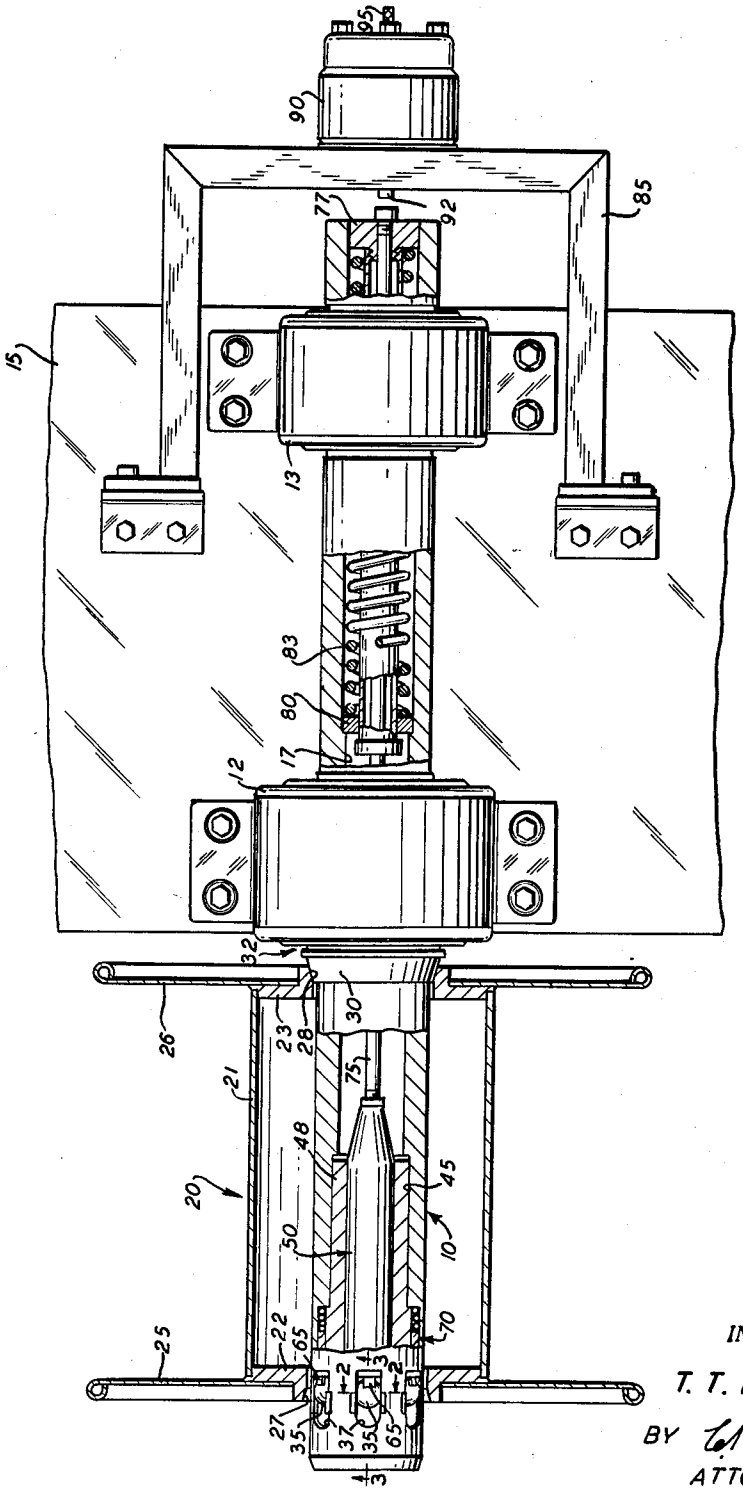


FIG. 1

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2 Sheets-Sheet 2

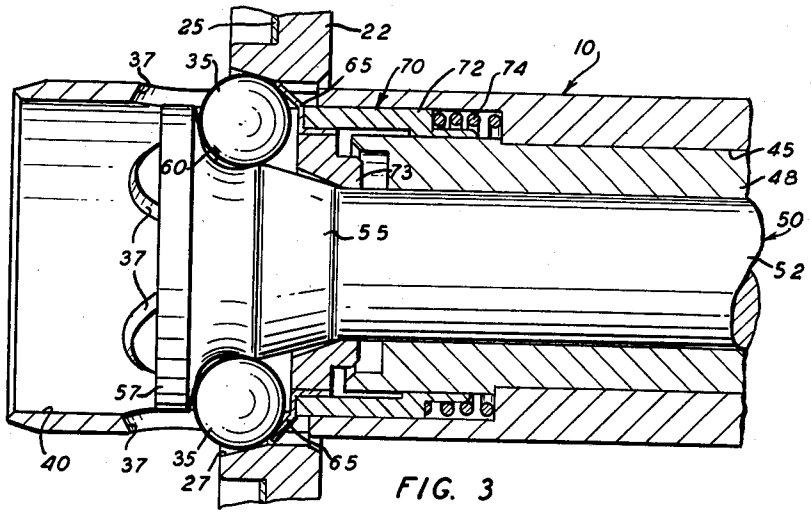


FIG. 3

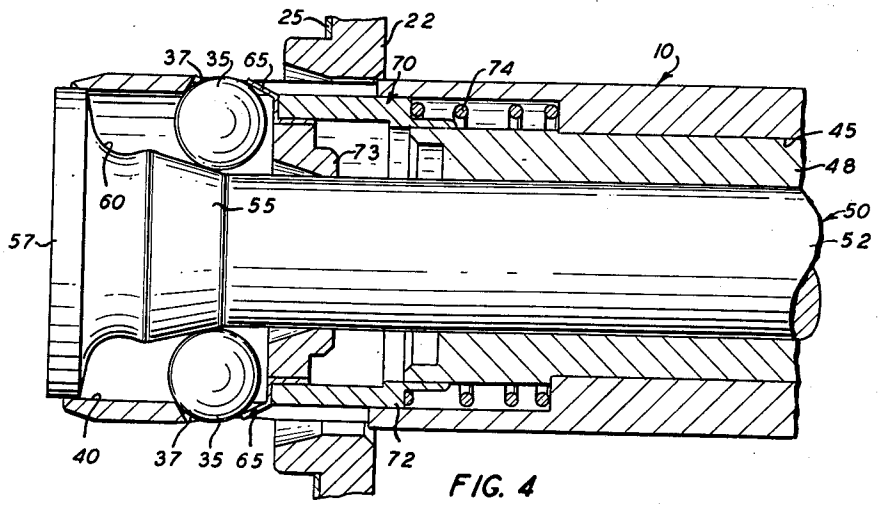


FIG. 4

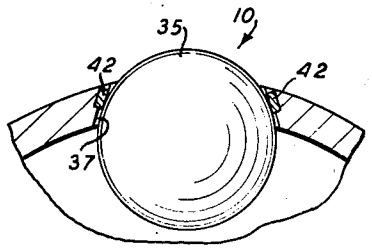


FIG. 2

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Patented Feb. 2, 1960

2,923,489

LOCKING MECHANISM

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Application March 7, 1956, Serial No. 570,051

4 Claims. (Cl. 242—68.3)

This invention relates to locking mechanisms and more particularly to apparatus for supporting an article having an aperture with a shoulder and for positively locking the article upon the supporting apparatus, such as mechanisms for locking a reel on an arbor for rotation therewith.

In strand handling apparatus of the type in which it is necessary to rapidly remove and replace takeup reels on rotatable arbors, it is desirable to provide automatically operable, quick-acting locking mechanisms. Such locking mechanisms should be designed to hold a takeup reel on an arbor for rotation therewith and to release or engage and lift a takeup reel quickly when it is necessary to interchange reels on the arbor. Heretofore, locking mechanisms utilized for this purpose have not been entirely satisfactory, since difficulty is encountered frequently in locking interchangeable takeup reels of slightly different axial or diametrical dimensions upon an arbor.

It is an object of this invention to provide new and improved locking mechanisms.

A further object of the invention is to provide apparatus for supporting an article having an aperture with a shoulder and for positively locking the article upon the supporting apparatus.

It is another object of this invention to provide new and improved mechanisms for locking a reel on an arbor for rotation therewith.

A locking mechanism illustrating certain features of the invention may include an arbor, a portion of which is hollow and is formed with an elongated longitudinal slot through the periphery thereof. A ball detent is received within the arbor and has a diameter permitting only partial protrusion outward through the slot. The ball detent is initially retracted into the arbor adjacent to a forward end of the slot, in which position of the ball detent an article, having an aperture with a shoulder, and the arbor may be mutually engaged so that the article is positioned loosely about the arbor with the shoulder of the aperture in the article located rearwardly of the ball detent. The apparatus further includes means for extending the ball detent so that a portion thereof protrudes through the slot, means for positively locking the ball detent in the extended position against the action of forces external to the apparatus, and means for moving the extended ball detent longitudinally toward the rearward end of the slot until it engages the shoulder of the aperture in the article to support the article upon said arbor. In addition, means are provided for moving the extended ball detent longitudinally back toward the forward end of the slot, when it is desired to disengage the article and the arbor, and means are employed for retracting the ball detent back into the arbor to permit the article and the arbor to be mutually disengaged.

More specifically, such a locking mechanism may include a tubular cage member having a plurality of longitudinally extending, elongated slots formed through the wall thereof and spaced circumferentially therearound.

An elongated actuator is mounted for longitudinal movement concentrically within the cage member and is provided with a camming surface having a raised annular seat portion at one end thereof and an annular depressed portion at the other end thereof. A plurality of ball detents are positioned between the cage member and the actuator and are retained movably within corresponding slots in the cage member. A plurality of spring-pressed fingers urge the ball detent resiliently against the camming surface and resilient biasing means urge the actuator in a direction such that the ball detents rest on the raised annular seat portion of the camming surface and are supported positively thereby in extended positions wherein a substantial portion of each ball detent protrudes radially outwardly through its respective slot and beyond the periphery of the cage member. Means are provided for moving the actuator longitudinally against the action of the resilient biasing means whereby the ball detents remain supported positively in their extended positions and move longitudinally along the slots with the actuator until they strike simultaneously the end walls of their respective slots. The ball detents are then held stationary while the actuator continues to move and under the urge between the end walls of the slots and the fingers they are retracted radially inwardly into the annular depressed portion of the actuator.

A complete understanding of the invention may be had from the following detailed description of apparatus forming a specific embodiment thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a plan view of a rotatable reel-supporting arbor provided with a locking mechanism forming a specific embodiment of the invention, with parts thereof broken away and a takeup reel mounted on the arbor shown in section;

Fig. 2 is an enlarged, fragmentary, vertical section taken along line 2—2 of Fig. 1;

Fig. 3 is an enlarged, fragmentary, vertical section taken along line 3—3 of Fig. 1 illustrating the locking mechanism in its "detent-lock" position, and

Fig. 4 is an enlarged, fragmentary, vertical section of the locking mechanism as in Fig. 3, but illustrating the locking mechanism in its "detent-release" position.

Referring now to Fig. 1, there is shown an arbor **10** mounted rotatably in pillow block bearings **12** and **13**. The pillow block bearings **12** and **13** are mounted fixedly to a base member **15**. The arbor **10** is designed to be driven rotatably at a relatively high rate of speed by suitable drive means (not shown). An axial, cylindrical bore **17** (Fig. 1) extends longitudinally through the arbor **10** from one end thereof to the other. The free end of the arbor **10**, which is at the left-hand end thereof as viewed in Fig. 1, is cylindrical in shape and is designed to receive and to support a conventional takeup reel, indicated generally by the numeral **20**, for rotation with the arbor.

The takeup reel **20** comprises an elongated, tubular, winding drum **21** secured fixedly at its opposite ends to spaced circular reel hubs **22** and **23**. Attached fixedly to the reel hubs **22** and **23** are annular reel heads **25** and **26**, respectively. The reel hubs **22** and **23** are provided with identical conical sockets **27** and **28**, the walls of which taper inwardly to a minimum diameter sufficiently greater than the outer diameter of the free end of the arbor **10** to provide adequate clearance for ease of inserting the reel **20** on the arbor. The conical sockets **27** and **28** are concentric with respect to the winding drum **21** and the rotational axis of the takeup reel **20**.

When the takeup reel **20** is locked upon the arbor **10** for rotation therewith, as illustrated in Fig. 1, the reel hub **23** is supported upon a conical center **30** forming an integral part of a collar **32** which is secured fixedly

surrounding the arbor 10 concentrically. The conical center 30 is substantially complementary to and is received partly within the conical socket 28 in the reel hub 23. With the conical center 30 wedged within the conical socket 28, a frictional normal force several times greater than the thrust force is developed and the reel hub 23 is gripped tightly for positive rotation of the reel 20 with the arbor 10.

The reel hub 22 is supported by six, equally spaced, ball detents 35—35, preferably made of hardened steel. The ball detents 35—35 normally protrude from six, corresponding, elongated slots 37—37 formed in and spaced circumferentially around the periphery of the arbor 10. A substantial predetermined and exact portion of each of the ball detents 35—35 extends beyond the periphery of the arbor 10 and is received within the socket 27 formed in the reel hub 22, as shown in Fig. 3. The protruding portions of the ball detents 35—35 are thrust axially against the walls of the socket 27 and the resulting wedging action causes the reel hub 22 to be gripped tightly for positive rotation with the arbor 10. With the reel hubs 22 and 23 thus gripped, the tubular winding drum 21 of the takeup reel 20 is substantially concentric to the rotational axis of arbor 10.

As shown in Fig. 3, the slots 37—37 communicate with a relatively short, cylindrical, counterbore 40 formed in the left-hand extremity of the arbor 10 in concentric alignment with the bore 17. The longitudinal side walls of each of the slots 37—37, as shown in detail in Fig. 2, are constricted so that the inner opening thereof provides sufficient operating clearance for its associated ball detent 35, whereas the outer opening thereof is smaller than the diameter of the ball detent so that the latter is prevented from falling completely outwardly through the slot. To reduce the wearing away of the longitudinal side walls of the slots 37—37, the walls are provided with hard, sintered, metallic carbide inserts 42—42. The left-hand end of each of the slots 37—37 is semicircular in configuration, as shown in Fig. 1. The semicircular end thus formed is constricted, as shown in Fig. 3, in a manner similar to the manner of the longitudinal side walls of each of the slots 37—37.

The arbor 10 is provided with another relatively short, concentric counterbore 45 which extends a short distance to the right from the larger counterbore 40. A hardened sleeve bushing 48 is positioned within the counterbore 45 and held fixedly in place by means of a force fit and the left-hand end of the sleeve bushing extends partly into the counterbore 40. The sleeve bushing 48 serves primarily as a bearing and guide for an axially movable detent actuator, indicated generally by the numeral 50.

The detent actuator 50, which is shown in Fig. 3 in its "detent-lock" position, has a generally cylindrical shank 52 at the right-hand end thereof. The shank 52 is slidably received within the sleeve bushing 48. Adjoining the left-hand end of the cylindrical shank 52 and formed integrally therewith is a frustoconical neck 55 (Figs. 3 and 4) having a uniform taper. Adjoining the left-hand end of the frustoconical neck 55 at its maximum diameter and formed integrally therewith is a head 57 which flares outwardly to a maximum diameter slightly less than the internal diameter of the axial counterbore 40. Formed in the periphery of the head 57, immediately adjacent to the frustoconical neck 55, is an annular seat 60 having minimum diameter somewhat less than the diameter at the point at which the head 57 joins the neck 55.

Normally the ball detents 35—35 are resting in and against the annular seat 60 formed in the detent actuator 50, as illustrated in Fig. 3, and are held in this position by six, angularly projecting retainer clips or spring-pressed fingers 65—65 preferably formed from spring steel. The retainer clips 65—65 are mounted fixedly to a slidable, spring-biased, retainer clip assembly 70 which comprises a sleeve 72 and an annular collar insert 73 fitted within the left-hand end of the sleeve. The sleeve 72 is slidably

mounted in the counter bore 40 surrounding one end of the sleeve bushing 48 and the annular collar insert 73 is positioned loosely around the shank 52 of the detent actuator 50. The retainer clip assembly 70 is urged resiliently leftwardly by a helically coiled compression spring 74 which is mounted in the counterbore 40 surrounding the sleeve bushing 48.

The detent actuator 50 is attached fixedly at its right-hand end to an elongated actuator rod 75 (Fig. 1) which extends longitudinally through the bore 17 to the right-hand end of the arbor 10 where it is connected operatively to a cylindrical plunger 77. The plunger 77 is provided with an annular shoulder which fits closely and slidably within the bore 17. Fixedly mounted within the bore 17 of the arbor 10 at an intermediate point therealong is an annular collar 80 (Fig. 1) which serves as a stop for a relatively strong, helically-coiled compression spring 83 positioned between the collar 80 and the annular shoulder on the plunger 77. The compression spring 83 surrounds the actuator rod 75 concentrically and urges the plunger 77 and its operatively connected actuator rod 75 rightwardly, as viewed in Fig. 1. Normally, the resilient force of the compression spring 83 holds the detent actuator 50 in its "detent-lock" position, in which it is shown in Figs. 1 and 3 with the portions of the ball detents 35—35 extending through the slots 37—37 wedging tightly into the conical socket 27 of the reel hub 22 to force the conical center 30 (Fig. 1) on the collar 32 into a wedging fit within the conical socket 28 of the reel hub 23.

Mounted fixedly to the base member 15 is a generally U-shaped bracket 85 (Fig. 1) designed to support a pneumatic cylinder 90 having a longitudinally extending, movable piston rod 92. An air hose 95 connects the pneumatic cylinder 90 to a supply of compressed air (not shown) suitably controlled by valve means (not shown). When air under pressure is admitted to the pneumatic cylinder 90, the piston rod 92 is moved leftwardly, as viewed in Fig. 1, to an extended position. In its extended position, the piston rod 92 engages the right-hand end of the actuator rod 75 and forces it to the left against the action of the compression spring 93 and thereby moving the detent actuator 50 slidably to the left into detent-release" position, as shown in Fig. 4. When in its "detent-release" position, the detent actuator 50 is positioned with the annular seat 60 located to the left of the forward end wall of the slots 37—37.

Operation

For the purpose of this description, it will be assumed that a takeup reel 20 is positioned on the arbor 10 and that the detent actuator 50 is in its "detent-lock" position, as shown in Figs. 1 and 3. With the detent actuator 50 in its "detent-lock" position, the ball detents 35—35 are retained in the annular seat 60 (Fig. 3) with substantial portions thereof extending through the slots 37—37 in the arbor 10 and are urged axially into wedging engagement with the walls of the conical socket 27 of the reel hub 22. The relatively strong compression spring 83 wedges the ball detents 35—35 tightly against the walls of the conical socket 27 with sufficient force to urge the conical center 30 of the collar 32 likewise into tight wedging engagement with the complementary conical socket 28 of the reel hub 23. In this manner the reel hubs 22 and 23 are forced to assume a position concentric to the arbor axis and are locked positively upon the arbor 10 for rotation therewith.

When it is desired to remove the takeup reel 20 from the arbor 10, valve means (not shown) are operated to admit air under pressure to the pneumatic cylinder 90, thereby actuating the piston rod 92 to its extended position. In moving to its extended position the piston rod 92 moves the detent actuator 50 leftwardly against the action of the compression spring 83 to its "detent-release" position, as shown in Fig. 4. Initially, as the detent actuator 50 moves to the left to its "detent-release"

position, the ball detents 35—35 are retained within the annular seat 60 and move leftwardly with the detent actuator. However, when the detent actuator nears it "detent-release" position the ball detents 35—35 simultaneously strike the forward inwardly sloping walls of the slots 37—37.

At this point, the axial travel of the ball detents 35—35 is stopped by the forward end walls of the slots 37—37 while the detent actuator continues moving leftwardly toward its "detent-release" position. The ball detents 35—35 which now bear against the inward sloping forward end walls of the slots 37—37 unseat from the annular seat 60 and retract as the inclined surface of the frustoconical neck 55 of the detent actuator 50 recedes. Under the urge between the cooperating inward slopes of the end walls of slots 37—37 and the spring actuated retainer clips 65—65, the ball detents 35—35 continue to move radially inwardly until no portions thereof protrude outside the periphery of the arbor 10. Thus, with the detent actuator 50 held in its "detent-release" position, as shown in Fig. 4, the ball detents 35—35 are retracted fully and the takeup reel 20 may be removed readily from the arbor 10.

Another takeup reel 20 may then be positioned around the arbor 10 supported by an external supporting means (not shown) with the conical socket 23 in the reel hub 28 near the conical center 30. To lock the new takeup reel 20 in place, the pneumatic cylinder 90 is disconnected from the compressed air supply, whereupon the piston rod 92 is retracted. As the piston rod 92 is retracted, the compression spring 83 forces the detent actuator 50 to the right into its "detent-lock" position, as shown in Fig. 3.

As the detent actuator 50 begins to move to the right toward its "detent-lock" position, the ball detents 35—35, which are restrained initially against axial movement by the forward end walls of the slots 37—37 and the retainer clips or spring-pressed fingers 65—65, ride up the inclined surface of the frustoconical neck 55. The ball detents 35—35 become seated again in the annular seat 60 and are held positively in their extended positions in which predetermined portions thereof project radially outwardly beyond the periphery of the arbor. Thereafter the ball detents 35—35 are moved longitudinally within the slots 37—37 toward the conical center 30. Under the action of the compression spring 83, the ball detents 35—35 are forced into wedging engagement with the walls of the conical socket 27 in the reel hub 22 and, in turn, thrust the takeup reel 20 axially to the right until the conical center 30 is wedged tightly into positive gripping engagement with the walls of the conical socket 28 of the reel hub 23. The takeup reel 20 is now engaged positively with the arbor 10 and will rotate therewith.

It may be seen that the above-described locking mechanism will function equally well notwithstanding the fact that the axial length, the socket diameters or the initial loading position of one takeup reel may differ somewhat from those of another takeup reel by which the former is replaced. As described hereinabove, the ball detents 35—35 move to their fully extended positions immediately atfer the detent actuator 50 begins its rightward travel to its "detent-lock" position. Thus, the ball detents move longitudinally to the right along the slots 37—37 in their fully extended positions until they are wedged tightly into the conical socket 22 in the reel hub 27 and force the conical center 30 tightly into the other conical socket 23 in the reel hub 28. In this manner, the locking operation ball detents 35—35 are not affected by substantial differences, within design limits, in the axial lengths of different takeup reels employed. Similarly, allowable differences in the diametrical dimensions of the conical sockets in the reel heads do not affect the locking operation.

It will be understood that the present invention is not limited to the specific embodiment thereof herein-

above described, but may be readily modified and incorporated in various types of apparatus without departing from the spirit and scope of the invention. While the above-described apparatus is particularly suitable for use in locking takeup reels or the like on rotating arbors, it is manifest that the principles of the invention may be embodied in various types of apparatus.

What is claimed is:

1. Apparatus for supporting an article having an aperture with a shoulder and for positively locking the article upon the supporting apparatus, which comprises an arbor, a portion of the arbor being hollow and formed with an elongated longitudinal slot through the periphery thereof, a ball detent received within said arbor and having a diameter permitting only partial protrusion outward through the slot, said ball detent being initially retracted into said arbor adjacent to a forward end of the slot, in which position of said ball detent the article and said arbor may be mutually engaged so that the article is positioned loosely about said arbor with the shoulder of the aperture in the article located rearwardly of said ball detent, means for extending said ball detent so that a portion thereof protrudes through the slot, means for positively locking said ball detent in the extended position against the action of forces external to the apparatus, means for moving the extended ball detent longitudinally toward the rearward end of the slot until it engages the shoulder of the aperture in the article to support the article upon said arbor, means for moving the extended ball detent longitudinally back toward the forward end of the slot when it is desired to disengage the article and said arbor, and means for retracting said ball detent back into said arbor to permit the article and said arbor to be mutually disengaged.

2. Apparatus for supporting an article having an aperture with a shoulder and for positively locking the article upon the supporting apparatus, which comprises an arbor, a portion of the arbor being hollow and formed with an elongated longitudinal slot through the periphery thereof, a ball detent received within said arbor and having a diameter permitting only partial protrusion outward through the slot, a movable actuator mounted within said arbor and having its surface engaging said ball detent, the surface of said actuator being so constructed and arranged that at an initial position of said actuator said ball detent is retracted into said arbor adjacent to a forward end of the slot, in which position of said ball detent the article and said arbor may be mutually engaged so that the article is positioned loosely about said arbor with the shoulder of the aperture in the article located rearwardly of said ball detent, means for moving said actuator in a first direction, the surface of said actuator being further constructed and arranged so that upon this movement said ball detent is first extended so that a portion thereof protrudes through the slot and is supported in extended position by a portion of the surface of said actuator and is then moved longitudinally along the slot until it engages the shoulder of the aperture in the article to support the article upon said arbor, the portion of the surface of said actuator which supports said ball detent interacting with the forward end of the slot for positively locking said ball detent in its extended position against the action of forces external to the apparatus, and means for moving said actuator in a second direction when it is desired to disengage the article and said arbor, the surface of said actuator being further constructed and arranged so that upon movement of said actuator in the second direction said ball detent remains supported in its extended position and moves back toward the forward end of the slot until said ball detent strikes the forward end of the slot, whereupon the forward end of the slot operates in conjunction with further movement of said actuator in the second direction to retract said ball detent back into said arbor to permit the article and said arbor to be mutually disengaged.

3. Apparatus for supporting an article having an aperture with a shoulder and for positively locking the article upon the supporting apparatus, which comprises an arbor, a portion of said arbor being hollow and formed with an elongated longitudinal slot through the periphery thereof, a ball detent received within said arbor and having a diameter permitting only partial protrusion outward through the slot, an actuator mounted within said arbor for longitudinal movement with respect thereto, resilient means for urging said ball detent into contact with said actuator, said actuator having a seat for said ball detent and a camming surface adjacent to the seat, said actuator being so shaped that at an initial longitudinal position thereof said ball detent is retracted into said arbor adjacent to a forward end of the slot, in which position of said ball detent the article and said arbor may be mutually engaged so that the article is positioned loosely about said arbor with the shoulder of the aperture in the article located rearwardly of said ball detent, means for moving said actuator longitudinally in a first direction so that the camming surface thereof extends said ball detent against the action of said urging means until said ball detent is forced into the seat of said actuator with a portion of said ball detent protruding through the slot, said ball detent being positively locked in the extended position against the action of forces external to the apparatus by the interaction between the seat and the forward end of the slot, further longitudinal movement of said actuator in the first direction operating to move the extended ball detent longitudinally toward the rearward end of the slot until it engages the shoulder of the aperture in the article to support the article upon said arbor, and means for moving said actuator in the reverse longitudinal direction when it is desired to disengage the article and said arbor, said ball detent remaining supported in its extended position by the seat and moving longitudinally along the slot with said actuator until said ball detent strikes the forward end of the slot, whereupon said ball detent is held stationary with respect to further longitudinal movement of said actuator, and upon further longitudinal movement of said actuator in the reverse direction, said ball detent is forced out of the seat by the forward end of the slot, said ball detent being retracted along the camming surface back into said arbor by the resilient means to permit the article and said arbor to be mutually disengaged.

4. Apparatus for supporting an article having an aperture with a shoulder and for positively locking the article upon the supporting apparatus, which comprises an arbor, a portion of said arbor being hollow and formed with a plurality of elongated longitudinal slots through the periphery thereof and spaced therearound, a plurality of ball detents received within said arbor, one associated with each slot and having a diameter permitting only partial protrusion outward through its associated slot, an actuator mounted centrally within said arbor for longitudinal movement with respect thereto, a plurality of spring-pressed fingers mounted within said arbor and designed for urging said ball detents into contact with said actuator, said actuator having a raised annular seat at a forward end thereof for receiving said ball detents and an inwardly-tapering camming surface rearwardly of the seat, said actuator being initially positioned so that said ball detents are retracted into said arbor adjacent to a forward end of the slot in contact with the camming surface, in which position of said ball detents the article and said arbor may be mutually engaged so that the article is positioned loosely about said arbor with the shoulder of the aperture in the article located rearwardly of said ball detents, resilient means for moving said actuator rearward so that the camming surface thereof extends said ball detents against the action of said spring-pressed fingers until said ball detents are forced into the seat of said actuator with portions of said ball detents protruding through the slots, said ball detents being positively locked in the extended position against the action of forces external to the apparatus by the interaction between the seat and the forward ends of the slots, further rearward movement of said actuator by said resilient means operating to move the extended ball detents longitudinally toward the rearward ends of the slots until they engage the shoulder of the aperture in the article to support the article upon said arbor, and means for moving said actuator forward against the action of said resilient means when it is desired to disengage the article and said arbor, said ball detents remaining supported in their extended positions by the seat and moving longitudinally along the slots with said actuator until said ball detents strike the forward ends of the slots, whereupon said ball detents are held stationary with respect to further longitudinal movement of said actuator and, upon further longitudinal movement of said actuator in the forward direction, said ball detents are forced out of the seat by the forward ends of the slots, said ball detents being retracted along the camming surface back into said arbor by said spring-pressed fingers to permit the article and said arbor to be mutually disengaged.

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