Aug. 11, 1959 H. BRONSTEIN 2,898,797

CAM OPERATED BALL DETENT COUPLING PIN

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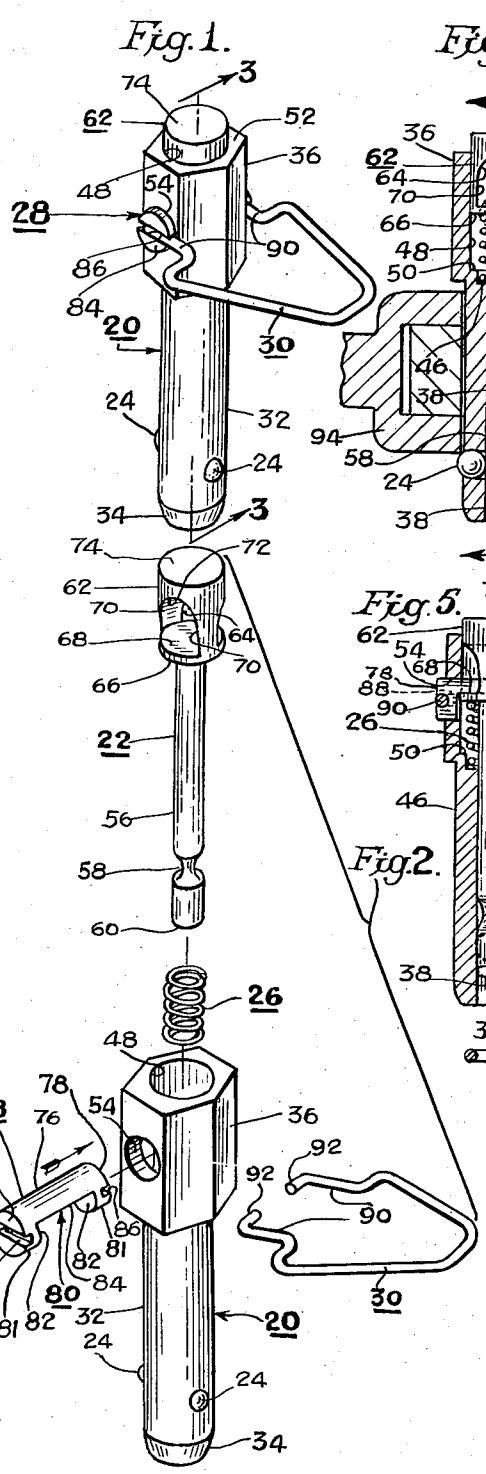

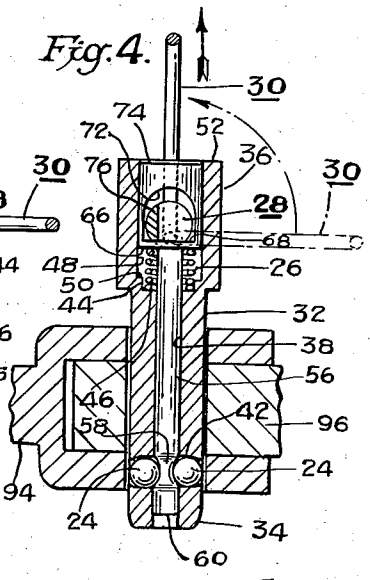

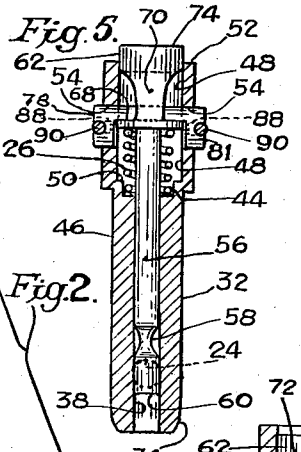

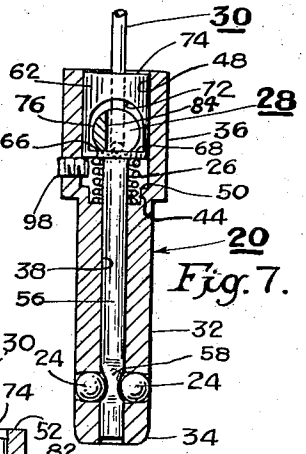

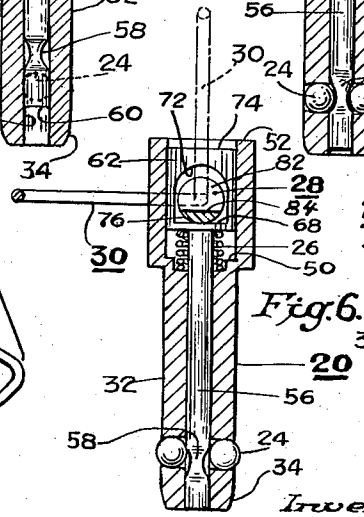

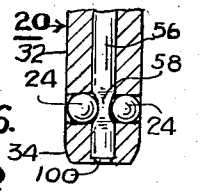

Fig. 2.

Fig. 7.

Fig. 8.

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CAM OPERATED BALL DETENT COUPLING PIN

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3 Claims. (Cl. 85—5)

The present invention relates to a device for connecting articles having openings which can be brought into registration and it relates more particularly to an automatically-locking quick-release device of this general character.

It has heretofore been suggested to provide locking pins intended to be inserted into aligned openings in a plurality of objects; the pins having means for automatically locking them in connecting position and also being provided with fast acting release mechanism enabling them to be withdrawn quickly and easily so as to free the attached articles.

However, the prior-art structures heretofore employed have not proven entirely satisfactory in that they are relatively difficult to operate, sometimes fail to release properly, are susceptible to accidental release, and occasionally jam due to adverse action of moisture and/or foreign material on its working parts.

Accordingly, the present invention contemplates a new and improved self-locking quick-release coupling pin of the character described wherein the shortcomings of the prior-art are eliminated or minimized.

Generally speaking, the novel self-locking quick-release coupling pin of the present invention provides a new and improved construction which is firmly and securely locked against accidental release, in which the operating handle is held in readily accessible and convenient position for maximum speed of release; wherein ease of release is ensured by novel cam mechanism which is fully enclosed to protect it against moisture and foreign material; which provides positive locking and unlocking action; which can be mallet driven into bind fits without damage to its operating parts, which is provided with a polygonal head permitting use of a wrench to facilitate removal from bind fits; and which can be easily and inexpensively manufactured and is durable and dependable in operation.

Other objects and advantages of the present invention are apparent in the following detailed description, appended claims and accompanying drawings.

For the purpose of illustrating this invention certain forms thereof, which are presently preferred, are illustrated in the accompanying drawings. It is to be understood, however, that the present invention is not limited to the precise embodiments disclosed and that the various parts and elements can be differently arranged and organized without departing from the spirit of this invention.

Referring to the accompanying drawings in which like reference characters indicate like parts throughout:

Figure 1 is a perspective view of a locking quick-release coupling pin forming one embodiment of the present invention; the coupling pin being shown in locking position.

Figure 2 is an exploded perspective view of the embodiment of Fig. 1.

Figure 3 is a vertical cross-sectional view taken along the line 3—3 of Fig. 1 and showing the pin in coupling position connecting two apertured members.

Figure 4 is a cross-sectional view like that of Fig. 3, but showing the position of the parts when the coupling pin is in releasing position.

Figure 5 is a vertical cross-sectional view of the coupling pin of Fig. 1 but taken in a plane generally at right angles to that of Fig. 3.

Figure 6 is a vertical cross-sectional view generally like those of Figs. 3 and 4 but showing the cam member and the pull handle rotated 180° from the position of Fig. 3.

Figure 7 is a cross-sectional view generally like that of Fig. 4, but showing another embodiment of the present invention, employing a stop for the operating member.

Figure 8 is a fragmentary cross-sectional view showing still another embodiment of the invention utilizing an alternative form of stop.

According to the embodiment of Figs. 1–5, the novel coupling pin of the present invention comprises a body or housing 20, an operating member or plunger 22, a pair of locking balls 24, a helical spring 26, a cam member 28, and a wire pull handle 30; the individual parts being best shown in the exploded view of Fig. 2.

The body or housing 20 has an elongated cylindrical main portion 32 which is provided with a taper or bevel 34 at its forward end for ease of insertion into a bind fit.

The body or housing 20 is also provided with an enlarged rear portion 36 which has a hexagonal (or other polygonal) configuration so that it can be gripped by a wrench or other tool to facilitate removal from a bind fit; the twisting motion imparted by the wrench tending to ease the cylindrical portion 32 out of the bind fit in a manner which is obvious to those skilled in the art.

The main cylindrical portion 32 of the body 20 is provided with an axially-extending cylindrical opening or bore 38.

A pair of diametrically opposed radial openings or bores 42 are formed in the cylindrical portion 32 slightly inwardly of the tapered front end 34. The openings 42 communicate with the bore 38 and are so dimensioned relative to the balls 24 that, when the balls are positioned within the openings 42 and radial outward pressure is applied to them, they can move only into the partially protruding position shown in Figs. 1 and 3.

The bore 38 communicates at its rear end with a larger-diameter relatively short counterbore 44 which begins generally at the front of the enlarged hexagonal portion 36. An inwardly directed annular shoulder 46 is provided at the front end of the counterbore 44.

A still larger diameter counterbore 48 communicates with the rear end of the counterbore 44 and extends rearwardly therefrom to the end of the body 20. An inwardly directed annular shoulder 50 is formed at the front end of the counterbore 48 and an annular shoulder 52 is provided at the end of the body 20 surrounding the counterbore 48 and forming a surface which can be hammered by a mallet or the like to drive the coupling pin into a bind fit as will be more fully described hereinbelow.

A pair of diametrically opposed cylindrical openings 54 extend radially through the enlarged rear portion 36 of the body 20 and communicate with the rearmost and largest counterbore 48 as indicated in Figs. 2 and 5.

Coming now to the operating member or plunger 22, this element comprises an elongated generally cylindrical stem or spindle 56 having an annular groove 58 formed therein slightly inward of its forward free end 60.

At the rear end of the stem 56 there is formed an enlarged generally cylindrical portion 62. The cylindrical

portion 62 has an opening 64 of novel configuration, extending diametrically therethrough, as best shown in Figs. 1, 3 and 5. The opening 64 is spaced slightly to the rear of the front end of the portion 62 which has a forwardly directed annular shoulder 66.

Thus, the opening 64 is defined by a flat circular cam-follower wall 68, best shown in Fig. 2, from which a pair of diametrically opposed walls 70 extend generally axially and rearwardly (vertically in Figs. 1 and 3); the walls 70 merging into a generally arcuate wall 72, as indicated in Figs. 2 and 3. As shown in Fig. 5, the wall 72 also flares outwardly from the relatively narrow walls 70.

As best shown in Fig. 3, the opening 64, in cross-section, generally resembles a somewhat flattened ellipse in which one end has been cut off by a straight line extending through the corresponding focus perpendicular to the transverse axis.

The diameter of the stem 56 is such that it fits slidably within the bore 38 of the body 20 while the diameter of the enlarged portion 62 is such that it fits slidably within the counterbore 48 of said body 20. The overall length of the operating member 22 is preferably slightly less than that of the body 20 so that, when the operating member is in its forwardmost advanced position (in which its front end 60 contacts the stop shoulder 40), the flat circular end wall 74 of the portion 62 is recessed slightly within the annular shoulder 52, as best shown in Fig. 4.

The cam member 28 is also of novel construction and has a generally cylindrical convex surface 76 and flat circular end walls 78. A notch 80 is formed in the cylindrical portion of the cam member 28; the notch being defined by a pair of parallel plane surfaces 82 which extend transversely inwardly for somewhat more than half the diameter of the member 28 and by a plane surface 84 which extends longitudinally intermediate the inner edges of the surfaces 82.

Each of the flat end walls 78 is provided with a generally diametrically extending groove 86. A small hole 88 extends generally axially inward a short distance from each groove 86, at a point which is spaced from the axis of the cam member 28.

The pull handle 30 is formed from a length of somewhat resilient, but form-retaining wire or the like, bent into a general keystone or other suitable shape with a pair of opposed arm portions 90 provided with inwardly directed free ends 92. The pull handle 30 can be connected to the end wall 78 of the cam member 28 by manually spreading apart the opposed arm portions 92 and then permitting the ends 92 to snap into place within the holes 88; the resilience of the wire pull handle maintaining the opposed arm portions 90 snugly in position within the grooves 86, as best indicated in Figs. 1 and 5.

The novel coupling pin of the present invention is assembled in the following manner.

The balls 24 are dropped into the bore 38 (from the counterbore 48) and are positioned within the ball openings 42. The helical spring 26 is then placed about the stem 56 of the operating member 22 and the latter inserted into the body from the rear end thereof. In the position shown in Fig. 3, the balls 24 are maintained in protruding position within the openings 42 by the forwardmost (lowermost in Fig. 3) end of the cylindrical portion 32 of the operating member 22. It can be seen that, in this position, the spring 26, which encircles the rearmost (uppermost in Fig. 3) end of the cylindrical portion 32 is disposed partly within the intermediate counterbore 44 and partly within the largest rearmost counterbore 48. One end of the spring 26 is seated against the annular shoulder 46 while the other end bears against the annular shoulder 66 of the rear portion 62 of the operating member 22.

It is apparent that the spring 26 acts, in compression, to resist forward (downward in Fig. 3) movement of the operating member relative to the body.

After the operating member has thus been inserted into the body or housing, it is forced downward against the spring (by pressure applied manually to the wall 74) until the opening 64 and the diametric openings 54 are in alignment. The cam member 28 can then be inserted in the position shown in Fig. 6 (i.e. with its notch 80 facing rearwardly or upwardly) so as to extend through the aligned openings 64 and 54. As is evident from Fig. 6, the axial dimension of the opening 64 is somewhat greater than the diameter of the openings 54 and the cam member 28, so that the un-notched end portions 81 of the cam member can pass through all of the aligned openings.

The axial dimension of the cam member 28 is such that it protrudes slightly at both sides of the portion 36 as indicated in Fig. 5.

After the cam member has thus been inserted, it is rotated 180° clockwise to the position of Figs. 3 and 5 and the manual pressure on the end wall 74 is removed whereupon the spring 26 moves the operating member from the position of Fig. 6 to the position of Figs. 3 and 5 wherein the shoulder 66 fits within the notch 80 and the flat cam-follower wall 68 bears against the longitudinal notch wall 84.

It is apparent that the pressure of the spring 26 not only urges the operating member 22 to the rearmost (uppermost) position shown in Fig. 3 as well as in Fig. 1 and in Fig. 5 but also prevents the cam member 28 from being displaced from its assembled positions. Additional protection against displacement is afforded by the pull handle 30 which is connected to the end wall 78 after the cam member is installed as described above.

It is apparent that the pressure of the spring 26 normally maintains the operating member 22 in the rearmost (uppermost) position shown in Fig. 3, wherein the balls 24 are held in protruding locking position, with the pull handle 30 disposed generally horizontally.

When the pull handle 30 is grasped and swung upwardly from the position of Fig. 3 to the vertical position of Fig. 4, the cam member 28 is rotated (counterclockwise in Fig. 4) so that the longitudinal notched surface 84, instead of being horizontal, is moved to vertical position and, during this rotation, one of the longitudinal edges of the surface 82 is displaced downwardly, in a camming action against the wall 68, so as to shift the operating member 22 forwardly (downwardly) against the pressure of the spring 26, to the position shown in Fig. 4. In the latter position, the annular groove 58 in the stem 56 is brought into alignment with the balls 24 so that the balls are free to retract within the openings or bores 42. Thereafter a further pull upon the handle 30 (in the upward direction indicated by the arrow in Fig. 4) releases the coupling pin from the elements connected thereby which, in Fig. 3, are indicated, for purposes of illustration, as comprising apertured clevis and tongue members 94 and 96 respectively, such as can be used for connecting a trailer.

In order to re-connect the members 94 and 96, they are first brought into alignment, after which the handle 30 is raised to vertical unlocking position, the cylindrical portion 32 re-inserted into the aligned openings and the handle released whereupon it snaps back to horizontal locking position, forcing the balls 24 into protruding relationship underlying the connected members.

The axial dimension of the cylindrical portion 32 from the forward end of the hexagonal portion 36 to the balls 24 should, of course, be somewhat greater than the combined thickness of the members 94 and 96 in order to permit the members to be interconnected.

In the case of a bind fit, where manual pressure is incapable of forcing the coupling into place, it is a simple matter to drive it home by hitting the rear end with a mallet or the like. This does not injure the operating mechanism because, upon initial contact of the mallet, the wall 74 of the operating member is simply forced to

recessed position, after which the force of the blow is taken by the annular shoulder **52** of the body **20**. This preliminary downward movement of the operating member **22** retracts the balls **24** in a manner described above so that the balls and the cylindrical portion **32** can be driven into the bind fit by the main force of the blow.

As mentioned above, where the bind fit is sufficiently tight to prevent withdrawal of the coupling pin by direct manual pull (in the direction of the arrow in Fig. 4) additional releasing stress can be exerted by applying a wrench to the hexagonal portion **36** to give a twisting as well as a pulling action.

It is obvious that, with the pull handle maintained in generally right angular position relative to the body **20** of the coupling pin, it is much more accessible and can be much more readily and conveniently grasped and pulled thereby providing a greater margin of speed and safety in cases of emergency.

In the event that the pull handle is accidentally broken during use, it is still possible to shift the coupling pin to unlocking position (either by applying manual pressure to the wall **74** or by inserting a screwdriver into one of the grooves **86** so as to rotate the cam member **28**) after which the coupling pin can be grasped, either manually or by any suitable gripping tool, and pulled free. The pressure of the spring **26** forcing the wall **68** against the notched surface **84** provides a positive lock and ensures against accidental disengagement.

The 180° rotated position of the cam member **28** shown in Fig. 6 provides an alternative locking or coupling position in which the balls are maintained in protruding position by that portion of the stem **56** which is inward of (above) the groove **58**. While there is no positive locking of the operating member in this last-mentioned coupling position, it is sometimes desirable to have two alternative locking positions in which the pull handle is disposed on opposite sides of the body **20**.

The novel locking quick-release coupling pin construction of the present invention has a wide variety of uses. Thus, in addition to its use in trailer couplings or towbars, as mentioned hereinabove, the coupling pin can be used in many different ways, as for example aircraft cockpit ejection mountings, removable seat fastenings, landing gear down-locks, temporary assemblies and mountings for use in cargo handling and machinery shipping, assembly of temporary structures, etc. It is apparent that the cam mechanism is fully enclosed and protected from water and dirt so as to minimize the possibility of rusting or jamming. Thus, dependable and long-lasting operation of the coupling pin is assured.

In Fig. 7 there is shown another embodiment of the present invention in which a stop pin **98** is screwthreadedly or otherwise suitably mounted within the hexagonal portion **36** so as to project inwardly into the counterbore **48** and to halt forward (downward) movement of the shoulder **62** of the operating member **22** at the releasing or uncoupling position.

The cam member **28** is first installed in the manner described above and rotated clockwise to the coupling or locking position corresponding to that shown in Figs. 3 and 5. The stop pin **98** is subsequently inserted so as to limit the return (counterclockwise) rotation of the cam member and the pull handle **30** to the 90° rotated vertical releasing or uncoupling position of Fig. 7.

It is apparent that, if desired, the stop pin **98** can be removed (or, instead, can be replaced by a shorter pin which will not project into the counterbore **48**) in which case there is no longer any positive stop for the operating member in unlocking position. In such case, the pull handle **30** can be swung counterclockwise beyond the vertical position of Fig. 7, as described above in connection with the embodiment of Figs. 1–6.

In Fig. 8, there is shown another embodiment which generally resembles that of Figs. 1–6, but incorporates a stop which can be used in place of the pin **98** of Fig. 7. This alternative stop comprises an inwardly directed annular stop shoulder **100** formed at the front end of the main bore **38** against which the forward free end **60** of the operating member stem **56** abuts when the handle and the cam member are rotated 90 degrees from the locking position (corresponding to that of Figs. 3 and 5) to the uncoupling or releasing position (corresponding to that of Fig. 4).

As in the embodiment of Fig. 7, the cam member is installed before the stop shoulder **100** is formed since once the shoulder **100** is formed the operating member and the cam member can no longer be placed into their installing positions corresponding to those shown in Fig. 6.

In other words, the operating member and the cam member are first positioned as in Fig. 6 for installation, after which the cam member is swung back 180 degrees clockwise to the position corresponding to Fig. 3, in which the stem end **60** is retracted within the bore **38**, whereupon the shoulder **100** is formed by striking the front end of the bore **38** within appropriate conventional punch or die (not shown) which forms the annular shoulder **100** at a point which will stop the stem end **60** in the uncoupling or releasing position of the operating member and cam member.

In all embodiments of the present invention, the annular groove **58** is preferably made slightly oversize relative to the balls **24** to provide a little leeway as to the uncoupling or releasing position of the operating member and the cam member.

It is apparent that, instead of employing two diametrically opposed ball openings **42** and a corresponding number of balls **24**, it is possible to employ only a single opening and ball. Likewise, three or four or any other number of circumferentially distributed ball openings and balls can be used, if desired; all of the balls retracting into the annular groove of the operating member stem in the same manner as described hereinabove.

One great advantage of the present construction is that a single motion of the hand is all that is required to flip the operating member to unlocking position and thereafter to pull the locking pin free. In prior-art constructions, the pull handle is loose so that it is frequently difficult to find and grasp. Furthermore, in many prior-art constructions, a mere pull on the handle does not free the locking pin and, instead, manual forward pressure of a thumb on the protruding end of the operating member is also necessary. This is extremely inconvenient and frequently causes blisters and cuts on the hand of the workman.

Moreover, the additional time required to operate the conventional constructions of the prior-art represents a marked disadvantage, especially in aircraft cockpit ejection systems, wherein a split second delay can often mean the difference between life and death.

The present invention can be embodied in other specific forms and, therefore, the foregoing embodiments are to be considered in all respects merely as illustrative and not restrictive, reference being made to the appended claims as indicating the scope of this invention.

Having thus described my invention, I claim as new and desire to protect by Letters Patent the following:

1. In a quick-release coupling pin, an elongated body having an axial aperture formed therein and having at least one radial opening adjacent its forward end and communicating with the axial aperture and having an opening extending transversely therethrough adjacent its rear end and intersecting the axial aperture, an elongated operating member axially movable within the aperture of the body, said member having a recess formed therein somewhat rearward of its forward end, a locking ball or the like contained within the radial opening of the body, said ball being free to retract fully within the body when the recess of the operating member is brought into alignment therewith, axial movement of the operating member from the last-mentioned position causing it

to force the ball radially outwardly to locking position wherein it protrudes partially from the body, a spring disposed within the body and urging the operating member rearwardly relative to the body, said operating member having a transverse opening formed therein adjacent its rear end, said transverse opening being defined in part by a generally transversely disposed cam-follower surface, a cam member extending transversely through the intersecting axial aperture of the body and the transverse opening of the operating member, said cam member being rotatably mounted relative to the body and being substantially enclosed therewithin with only its ends exposed relative thereto, said cam member being generally cylindrical with flat circular end walls and with a notch formed by two spaced parallel plane walls extending radially inward a distance greater than the radius and less than the diameter of said cam member and by a plane wall extending longitudinally intermediate the inner edges of the radial walls, the cam-follower surface of the operating member being disposed within the notch and being normally held by the spring in abutting relationship to the longitudinal plane wall of the notch, and a pull handle rigidly connected to the exposed ends of the cam member, said pull handle being movable between a position generally perpendicular to the body and a position generally coplanar to the body to rotate said cam member between a locking position and an unlocking position, initial rotation of the cam member from the locking position causing one longitudinal edge of the longitudinal notch wall to wipe across and displace the cam-follower surface against spring pressure, subsequent rotation of the cam member causing the convex outer cylindrical surface of the cam member to wipe across and further displace the cam-follower surface, opposite rotation of the cam member automatically permitting spring-actuated return movement of the operating member to locking position.

2. A quick-release coupling pin in accordance with claim 1 in which each of the end walls of the cam member is diametrically grooved, and the pull handle is formed of somewhat resilient but form-retaining wire which is bent to provide opposed arm portions, said arm portions being secured within the grooves in the end walls of the cam member.

3. A quick-release coupling pin in accordance with claim 1 in which each of the end walls of the cam member has a recess formed within its diametrical groove, and the free ends of the arms of the pull handle are provided with inwardly directed fingers which extend into said recesses.

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