Nov. 19, 1968 F. A. PACHMAYR ETAL 3,411,406

GUN BARREL BUSHING STRUCTURES

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Fig. 1

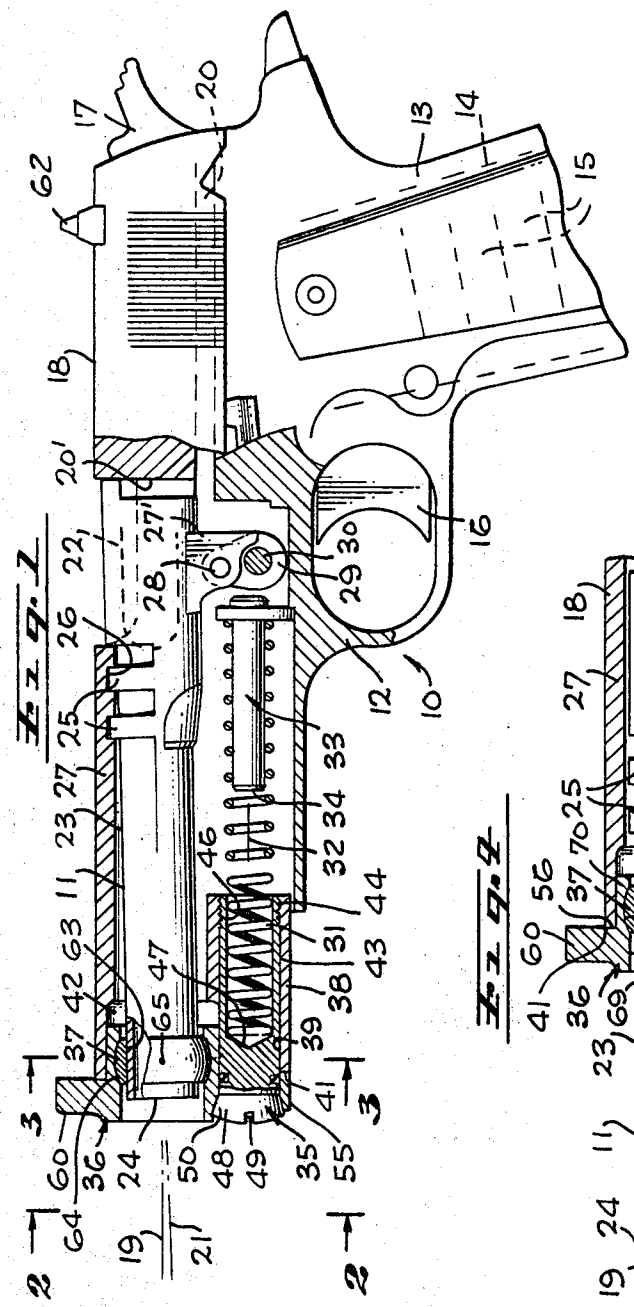


Fig. 2a

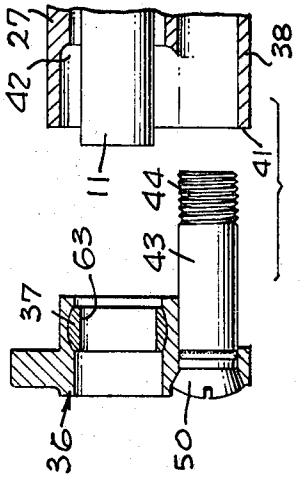
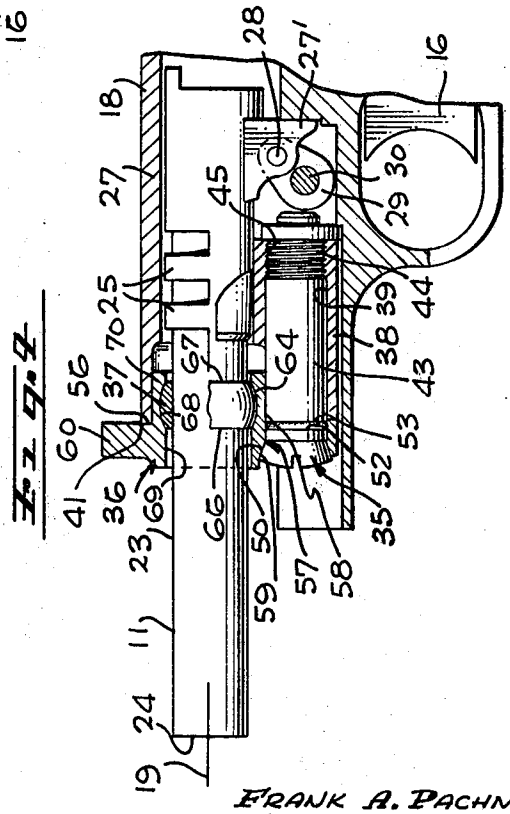


Fig. 2



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Fig. 2

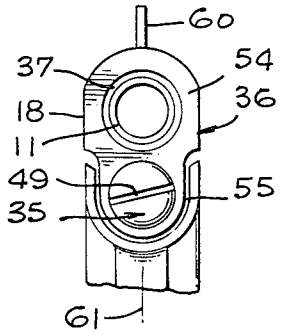


Fig. 3

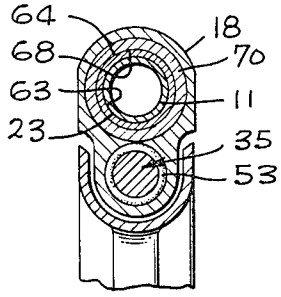


Fig. 5

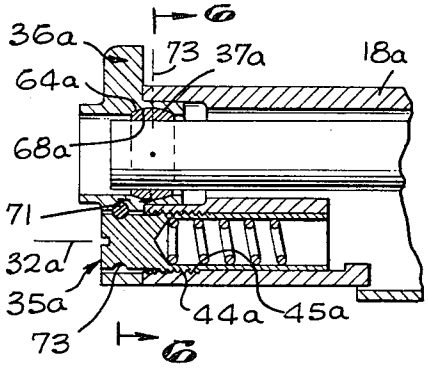


Fig. 6

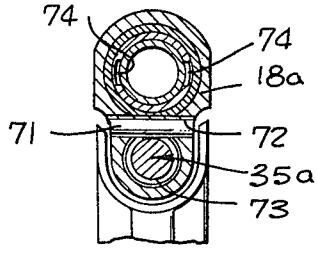
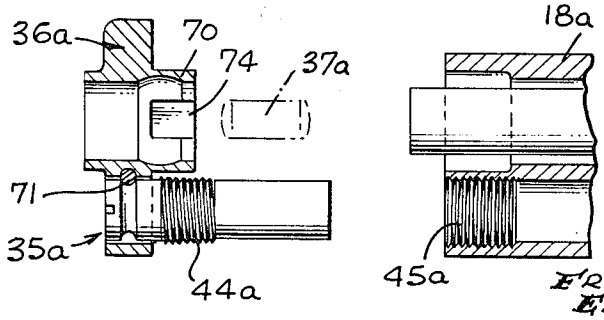


Fig. 7



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GUN BARRELL BUSHING STRUCTURES

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16 Claims. (Cl. 89—196)

ABSTRACT OF THE DISCLOSURE

A gun having a slide mounted for recoiling movement relative to the receiver of the gun, and relative to a barrel whose breech end swings slightly downwardly upon recoil, and including a bushing disposed about and locating the barrel and slidable axially therealong upon recoil, and a bushing retaining structure detachably carried by the slide, with the bushing having a radially outer preferably spherical surface movably contacting and located by a mating essentially internal preferably spherical bearing surface formed in the bushing retaining structure, in a relation guiding the bushing for slight pivotal movement as the breech end of the barrel swings downwardly.

This invention relates to improvements in guns, and particularly to means for accurately locating a gun barrel in a reciprocating slide.

The guns of the present invention are of a general type having a slide which recoils rearwardly relative to the barrel of the gun and against the influence of a recoil spring upon each firing operation, and in which the barrel of the gun has its forward end positioned by the slide, with the breech end of the barrel being mounted for limited rearward and downward swinging movement as the slide recoils. A major object of the invention is to provide improvements in the bushing structure which is provided at the forward end of the gun and barrel for centering the barrel in the slide, while still permitting the desired reciprocal motion of the slide, and also permitting the slight downward swinging movement of the breech end of the barrel. In conventional guns of this type, the bushing locates the barrel only very inaccurately by reason of the necessity for this slight swinging movement of the barrel, so that the barrel is never held tightly and firmly in accurately fixed position by the slide, with resultant inherent inaccuracies and unreliability in the firing characteristics of the gun.

Another object of the invention is to provide a bushing structure which is more positively and rigidly secured to the slide than has been possible with most prior arrangements.

An assembly embodying the invention desirably includes a bushing element proper which is disposed about the barrel and is slidable along the barrel during recoiling movement of the slide, and which is located relative to the slide by a coacting retaining structure. The bushing has a radially outer surface which movably contacts a surface formed in the retaining structure in a relation guiding the bushing for limited pivotal movement with the contained barrel as the breech end of the barrel swings downwardly upon recoil. These two contacting surfaces are themselves bearing surfaces which accurately locate the bushing and the barrel during the limited pivotal movement, and are preferably spherical surfaces contacting over an extended area.

A unique manner of attachment of the bushing assembly or structure to the slide is attained by employing as a connector element for this purpose a plug which is carried by the slide and against which the recoil spring applies forward recoil resisting force to the slide. This plug may be connected to the slide in an appropriate manner, desirably by a threaded connection, and acts to prevent forward separation of the bushing assembly from the slide. More particularly, the plug may extend through a passage in a lower portion of a retaining part by which the bushing proper is carried, and may have an enlarged head for blocking forward motion of the retaining part. For ease in handling, the plug and bushing structure may be interconnected as a unit prior to their application to the gun, and in a relation enabling rotation of the plug relative to the bushing assembly, but preventing relative axial movement in either direction, to thereby maintain the integrity of the two parts as a unit.

The above and other features and objects of the invention will be better understood from the following detailed description of the typical embodiments illustrated in the accompanying drawings, in which:

FIG. 1 is a side view, partially broken away, of a gun embodying the invention;

FIG. 1*a* shows the bushing assembly of FIG. 1 removed forwardly from the slide;

FIG. 2 is a view taken on line 2—2 of FIG. 1;

FIG. 3 is a vertical section taken on line 3—3 of FIG. 1;

FIG. 4 is a view similar to a portion of FIG. 1, but showing the parts in their recoiled positions;

FIG. 5 is a view similar to the forward portion of FIG. 1, but showing a variational form of the invention;

FIG. 6 is a vertical section taken on line 6—6 of FIG. 5; and

FIG. 7 illustrates the manner of assembly of the FIG. 5 arrangement.

With reference first to FIG. 1, there is shown at **10** an automatic pistol which is of a well known general type, and is completely conventional in all respects except as to the parts shown at the left end of FIG. 1 in the vicinity of the discharge end of gun barrel **11**. The gun includes a receiver **12** having a handle portion **13** within which there is removably received a conventional magazine **14** containing a series of cartridges **15** to be successively fired in the gun. The receiver of course carries the usual trigger **16** by which hammer **17** is actuated to fire a cartridge within the barrel **11**.

To the upper side of receiver **12**, there is movably mounted a slide **18** which is mounted by appropriate guideways extending along opposite sides of the receiver and slide for horizontal reciprocal movement relative to the receiver along the recoil axis **19**, from the battery position of FIG. 1 to the recoiled position of FIG. 4. The guideways may be of conventional construction and are represented at **20** in the figures, and restrain the slide against any motion other than the discussed horizontal sliding movement relative to the receiver.

The forward portion of the slide, forwardly of a vertical forwardly facing shoulder **20'** formed in the slide, is hollow, and contains the previously mentioned barrel **11**. This barrel is tubular and disposed about an axis **21**, which in the battery position of FIG. 1 may be inclined very slightly with respect to recoil axis **19** of the slide. The cartridge to be fired is contained within the breech end of the barrel at the location illustrated at **22** in FIG. 1, and is held in that position by engagement with vertical shoulder surface **20** of the slide. Externally, the barrel may have an outer straight cylindrical surface **23** extending rearwardly from the muzzle end **24** of the barrel to the location of two upwardly projecting semi-circular lugs **25** which in the battery position are received within mating semi-circular grooves **26** formed in the undersurface of the top wall **27** of the slide.

At its underside, the breech end of the barrel has a downwardly projecting lug **27'** which is pivotally connected by a pin **28** to a link **29**, whose lower end is pivot-

ed by a second link 30 to the receiver, to enable the breech end of the barrel to swing rearwardly and downwardly from the FIG. 1 position to the FIG. 4 position upon recoil.

The rearward recoiling motion of slide 18 is resisted by a coil spring 31, which is disposed about a horizontal axis 32 located beneath and parallel to previously mentioned recoil axis 19. The rear end of spring 31 exerts force in a rearward direction against the receiver through a spring guide 33, which may have a forward portion 34 projecting forwardly into the spring. The forward end of coil spring 31 exerts a forward force against slide 18 through a plug 35, which also serves to detachably secure to the slide a bushing retaining or carrying element 36, and a bushing proper 37 disposed about the barrel.

Plug 35 is contained within a downwardly projecting enlargement 38 formed integrally with and carried by slide 18. This enlargement 38 contains a cylindrical passage 39 centered about axis 32 and extending in a front to rear direction generally parallel to the gun barrel. The forward end of the slide, including its enlargement portion 38, may be cut off in a vertical plane, to form a forward vertical surface 41 disposed perpendicular to axes 19 and 32, and extending about both the upper front to rear passage or space 42 within which the barrel is received, and the lower passage 39 within which plug 35 is received.

The plug 35 has an outer cylindrical surface 43 of a diameter corresponding approximately to, and fitting closely within, the wall of passage 39 in the slide. At its rear end, the plug has external threads 44, which are engageable with internal threads 45 formed in the wall of passage 39, to rigidly connect the plug to the slide. Extending into the plug from its rear end, there is formed a passage 46, which may be cylindrical as shown, and which receives the forward end of coil spring 31, with that spring bearing forwardly against a shoulder 47 in the plug to transmit forward force from the spring to the plug. The forward end of the plug may be slightly enlarged to form a circular head 48, typically having a screwdriver slot 49, and presenting a tapering frusto-conical surface 50. Inwardly of head 51 of the plug, there may be provided an annular groove 52 in the side of the plug, containing a friction element 53 typically taking the form of a neoprene O-ring, which projects radially outwardly beyond the cylindrical surface 43 of the plug to engage a mating surface and frictionally retain the plug against unscrewing rotation.

Bushing retaining element 36 extends vertically across the forward side of the slide, and has the outline configuration illustrated in FIG. 2, to provide an enlarged upper portion 54 of a width corresponding to the upper portion of the slide, and a reduced width lower portion 55 of a width corresponding to, and following the contour of, lower downwardly projecting portion 38 of the slide. At its rear side, element 36 has a vertical planar surface 56, which abuts against forward planar surface 41 of the slide. These surfaces 56 and 41 are retained in tight engagement by plug 35, which extends through an opening 57 in the lower portion 55 of element 35. This opening 57 has a cylindrical portion 58 which is aligned with and of a diameter corresponding to, and forms in effect a forward continuation of, passage 39 in the lower portion of the slide. At the forward end of surface 58, opening 57 has an enlarged portion forming a tapering frusto-conical annular surface 59 engaged by surface 50 of the head of plug 35, to thereby transmit rearward force from the plug to element 36. Thus, when the plug is screwed into engagement with threads 45 of the slide, and is tightened, the plug acts to very securely and rigidly hold element 36 in the FIG. 1 position of attachment to the slide.

At its upper side, bushing retaining element 36 has an upwardly projecting portion 60, which forms a forward sight for the gun, lying in the vertical central plane 61 of the barrel, and coacting with the usual rearsight 62 to define the aiming axis of the gun.

Bushing element 37 takes the form of a ring disposed about the cylindrical surface 23 of the barrel, and having an internal cylindrical surface 63 of a diameter corresponding substantially to, and slidably engaging outer surface 23 of the barrel. The fit of these surfaces is sufficiently close to maintain the bushing and barrel always coaxial, while still permitting the desired relative sliding movement of the bushing between the FIG. 1 and FIG. 4 positions. Externally, the bushing has an annular partial spherical surface 64, which is centered about a point 65 on the axis of the barrel, which center point is desirably located midway between the plane of the annular forward end surface 66 of the bushing, and the plane of the annular rear end surface 67 of the bushing. Spherical surface 64 engages a correspondingly spherically curved annular internal surface 68 formed in the wall of a passage 69 extending through the upper portion of element 36. Except at the location of bushing 37, the wall of passage 69 may be of straight cylindrical configuration, and centered about the recoil axis 19 of the slide, and be of a diameter slightly greater than the external diameter of the barrel to enable slight pivotal movement of the barrel relative to element 36. To allow ample room for the reception of bushing 37, element 36 may have a tubular portion 70 projecting rearwardly therefrom and beyond vertical planar surface 56 of element 36, and containing at least a portion of the bushing.

To now describe a cycle of use of the gun, assume that the gun is initially in the condition of FIG. 1, with a cartridge contained in the breech end of barrel 11. In this condition, when trigger 16 is pulled, it actuates hammer 17 to fire the cartridge, and produce gases within the barrel acting to force the bullet forwardly therefrom. The reaction produced by these gases exerts a rearward force through the cartridge case against vertical shoulder surface 20 of the slide, to cause rearward recoiling motion of the slide from the FIG. 1 position to the FIG. 4 position, in which the spent cartridge case is ejected automatically, and a next successive cartridge is fed upwardly from magazine 14 into the space in front of shoulder surface 20, to be forced forwardly into the breech end of the barrel by the forward returning movement of the slide under the influence of recoil spring 31.

As the slide 18 moves rearwardly during a recoiling motion, the breech end of the barrel 11 moves slightly rearwardly and downwardly as permitted by swinging movement of link 29 between its FIG. 1 and FIG. 4 positions, so that the connection provided between the barrel and slide by lugs 25 and notches 26 is temporarily broken. On the forward returning movement of the slide, shoulder surface 20 of the slide engages the breech end of the barrel to return it forwardly and upwardly to the FIG. 1 battery position.

When the slide recoils, it carries with it bushing 37, which slides rearwardly along the outer surface of the barrel to the FIG. 4 position. As the breech end of the barrel swings downwardly, bushing 37 pivots slightly within the bushing retaining element 36, as permitted by the bearing engagement of spherical surfaces 64 and 68, so that the barrel is free for the desired limited motion, and yet is very effectively guided and restrained and accurately positioned by bushing 37 and element 36. Thus, in the battery position of FIG. 1, the forward end of the barrel is located very precisely relative to the slide and relative to the forward sight 60 of the gun, to avoid the inaccuracies in aiming which occur in conventional guns as a result of the imprecision with which the forward end of the barrel is held and located.

When it is desired to disassemble the gun for cleaning or other purposes, plug 35 may be unscrewed by a screwdriver or other tool engaging groove 49, to break the threaded connection at 44–45, so that the plug may be pulled out of its passage 39 in the slide. This frees element 36 for removal from the slide and barrel. The parts may be reassembled by merely positioning element 36

properly in the slide and about the barrel, and then screwing plug **35** into its FIG. 1 position, with the friction element **53** engaging cylindrical surface **57** of element **36**, or cylindrical surface **39** of the slide, to retain the plug against unscrewing rotation from its assembled position.

FIGS. 5 to 7 show a variational form of the invention in which plug **35***a* is connected to bushing or retaining element **36***a* by means of a pin **71** received within a horizotal passage **72** in the lower portion of slide **18***a*, at a location to be received within an annular groove **73** formed in the outer surface of the plug. This pin retains the plug permanently in assembled relation with respect to element **36***a*, so that these two parts may be handled as a unit when detached from the rest of the gun, and yet pin **71** enables rotary motion of plug **35***a* about its axis **32***a* for screwing threads **44***a* of the plug into threads **45***a* of the slide. In FIGS. 5 and 6, these threads are illustrated as located near the forward end of the plug, rather than at its rear end as in the first form of the invention.

Bushing **37***a* may be the same in FIGS. 5 and 6 as in the first form of the invention, and has an outer spherical surface **64***a* engaging an internal spherical surface **68***a* in pivotal relation. Rearwardly of the transverse vertical central plane **73** of the annular spherical groove defined by surface **68***a*, the element **36***a* may have two diametrically opposite internal axially extending notches **74** of a size enabling initial insertion of ring **37***a* into the groove in element **36***a* through these notches. This manner of insertion is illustrated in FIG. 7, in which the bushing **37***a* is shown in a horizontally extending position, to be inserted forwardly through notches **74** and then turned about its axis to the FIG. 5 vertically extending position.

Instead of providing the installation grooves **74** of FIGS. 5 to 7, the bushing **37** of FIGS. 1 to 4 or the bushing **37***a* of FIGS. 5 to 7 may be installed by first forming the rear end of tubular portion **70** of element **36***a* to a rearwardly flaring condition, in which bushing **37** may be easily inserted forwardly, and then spinning tubular portion **70** radially inwardly about the bushing and into conformity therewith. Conversely, instead of initially forming element **36** of a flaring condition, it may be formed originally to its illustrated final condition, and bushing **37** may be formed undersize and then expanded outwardly against the wall of the spherically shaped groove, and into conformity therewith. In either event, the part which is either spun inwardly or expanded outwardly would normally be of a softer material than the other part, and for example might be formed of a brass or other non-ferrous bearing material, while the other element **36** or **37** could be formed of hardened steel.

We claim:

1. A gun including a receiver, a slide mounted for recoiling movement relative to said receiver, a barrel mounted for slight upward and downward swinging movement of the breech end of the barrel relative to said receiver during said recoiling movement of the slide, a bushing disposed about and locating said barrel and slidable therealong axially of the barrel upon said recoiling movement of the slide, and a bushing retaining structure detachably carried by the slide, said bushing having a radially outer surface movably contacting and located by a mating essentially internal bearing surface formed in said retaining structure in a relation guiding the bushing for slight pivotal movement relative to said retaining structure and said slide about an axis disposed essentially transversely of the barrel upon said slight swinging movement of the breech end of the barrel.

2. A gun as recited in claim **1**, including a connection for detachably securing said retaining structure to the forward end of said slide.

3. A gun as recited in claim **1**, including a recoil spring, a plug for retaining said spring, and means for detachably connecting said plug to the slide, said plug being constructed to hold said retaining structure against detachment from the slide.

4. A gun including a receiver, a slide mounted for recoiling movement relative to said receiver, a barrel mounted for slight upward and downward swinging movement of the breech end of the barrel relative to said receiver during said recoiling movement of the slide, a bushing disposed about and locating said barrel and slidable therealong axially of the barrel upon said recoiling movement of the slide, a recoil spring, a plug against which said spring exerts force in a forward direction, means for detachably securing said plug to said slide, and means for transmitting force in a forward direction from said bushing to said plug so that the plug retains the bushing against forward removal from the slide.

5. A gun as recited in claim **4**, in which said last mentioned means include a structure for retaining said bushing and containing a passage through which said plug extends, said plug having a shoulder bearing rearwardly against said structure.

6. A gun including a receiver, a slide mounted for recoiling movement relative to said receiver, a barrel mounted for slight upward and downward swinging movement of the breech end of the barrel relative to said receiver during said recoiling movement of the slide, a bushing disposed about and locating said barrel and slidable therealong axially of the barrel upon said recoiling movement of the slide, a recoil spring for resisting rearward movement of the slide, a plug against which said spring exerts force forwardly, and interengaging threads on said plug and said slide for transmitting said forward force of the spring to said slide.

7. An assembly to be applied to a gun having a barrel, a recoiling slide, and a recoil spring; said assembly including a structure to be received about said barrel and be carried by the slide for recoiling movement therewith, a plug to receive the forward force of said spring, and a connection between said plug and said structure connecting the plug to said structure prior to their attachment to the gun and mounting the plug for rotation relative to said structure but retaining the plug against relative axial movement in a forward direction and also against relative axial movement in a rearward direction.

8. A gun including a receiver, a slide mounted for recoiling movement relative to said receiver, a barrel mounted for slight upward and downward swinging movement of the breech end of the barrel relative to said receiver during said recoiling movement of the slide, a bushing disposed about and locating said barrel and slidable therealong axially of the barrel upon said recoiling movement of the slide, and a bushing retaining structure detachably carried by the slide, said bushing having a radially outer surface movably contacting and located by a mating bearing surface formed in said retaining structure in a relation guiding the bushing for slight pivotal movement relative to said retaining structure and said slide about an axis disposed essentially transversely of the barrel upon said slight swinging movement of the breech end of the barrel, said engaging surfaces of the bushing and retaining structure being curved substantially spherically about a center located substantially on the axis of said barrel.

9. A gun as recited in claim **8**, in which said bushing is a ring having a cylindrical inner surface slidably contacting the barrel, said retaining structure being disposed about said bushing, said spherical surface of the retaining structure being engageable in opposite axial directions against the outer bushing surface in a relation positively locating the bushing axially.

10. A gun including a receiver, a slide mounted for recoiling movement relative to said receiver, a barrel mounted for slight upward and downward swinging movement of the breech end of the barrel relative to said receiver during said recoiling movement of the slide, a bushing disposed about and locating said barrel and slid-

able therealong axially of the barrel upon said recoiling movement of the slide, a bushing retaining structure detachably carried by the slide, said bushing having a radially outer surface movably contacting and located by a mating bearing surface formed in said retaining structure in a relation guiding the bushing for slight pivotal movement relative to said retaining structure and said slide about an axis disposed essentially transversely of the barrel upon said slight swinging movement of the breech end of the barrel, a recoil spring, a plug for retaining said spring, and interengaging threads on the plug and slide for detachably connecting said plug to the slide, said plug being constructed to hold said retaining structure against detachment from the slide.

11. A gun including a receiver, a slide mounted for recoiling movement relative to said receiver, a barrel mounted for slight upward and downward swinging movement of the breech end of the barrel relative to said receiver during said recoiling movement of the slide, a bushing disposed about and locating said barrel and slidable therealong axially of the barrel upon said recoiling movement of the slide, a bushing retaining structure detachably carried by the slide, said bushing having a radially outer surface movably contacting and located by a mating essentially internal bearing surface formed in said retaining structure in a relation guiding the bushing for slight pivotal movement relative to said retaining structure and said slide about an axis disposed essentially transversely of the barrel upon said slight swinging movement of the breech end of the barrel, said retaining structure containing a first passage extending in a front to rear direction for receiving said bushing and barrel, and containing a second front to rear passage therebeneath, there being a recoil spring, and a plug for retaining said spring and extending through said second passage and acting rearwardly against the retaining structure in a relation holding the latter against removal from the slide.

12. A gun as recited in claim **11**, including interengaging threads on said plug and slide for securing the plug to the slide.

13. A gun as recited in claim **11**, including means forming a rotary connection between the plug and retaining structure before their connection to the slide and securing them against axial separation in either direction but permitting rotation of the plug relative to the slide.

14. A gun as recited in claim **8**, in which said bushing is a ring having a cylindrical inner surface slidably contacting the barrel, said retaining structure having a first portion located forwardly of said slide and having an essentially tubular portion projecting rearwardly into the slide and disposed about said bushing, said mating spherical surface of the retaining structure being contained within and formed by said essentially tubular portion of the retaining structure and being engageable in opposite axial directions against the outer bushing surface in a relation positively locating the bushing axially, said first portion of the retaining structure containing a passage extending therethrough generally parallel to said barrel at a location beneath the barrel, a recoil spring for resisting recoiling movement of the slide relative to the receiver, a plug against which said spring exerts force in a forward direction and extending through said passage in the retaining structure, and threads on said plug and slide engageable to connect the plug to the slide, said plug having a head for exerting rearward force against said retaining structure to retain the latter against separation from the slide.

15. An assembly to be applied to a gun having a barrel, a recoiling slide, and a recoil spring; said assembly including a structure to be received about said barrel and be carried by the slide for recoiling movement therewith, a plug to receive the forward force of said spring, and a connection between said plug and said structure connecting the plug to said structure prior to their attachment to the gun and mounting the plug for rotation relative to said structure but retaining the plug against relative axial movement in either direction, said connection including a pin carried by said structure and received within a groove in said plug.

16. A gun including a receiver, a slide mounted for recoiling movement relative to said receiver, a barrel mounted for slight upward and downward swinging movement of the breech end of the barrel relative to said receiver during said recoiling movement of the slide, a bushing disposed about and locating said barrel and slidable therealong axially of the barrel upon said recoiling movement of the slide, a bushing retaining structure detachably carried by the slide and relative to which said bushing is free for slight pivotal movement with the barrel, and a forward sight for the gun carried by said retaining structure.

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