

[54] **AUTOMATIC FIREARM**
[75] Inventor: **Ernst Hurlemann**, Zurich, Switzerland
[73] Assignee: **Werkzeugmaschinenfabrik Oerlikon-Bührle AG**, Zurich, Switzerland
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[51] Int. Cl.....F41d 5/04
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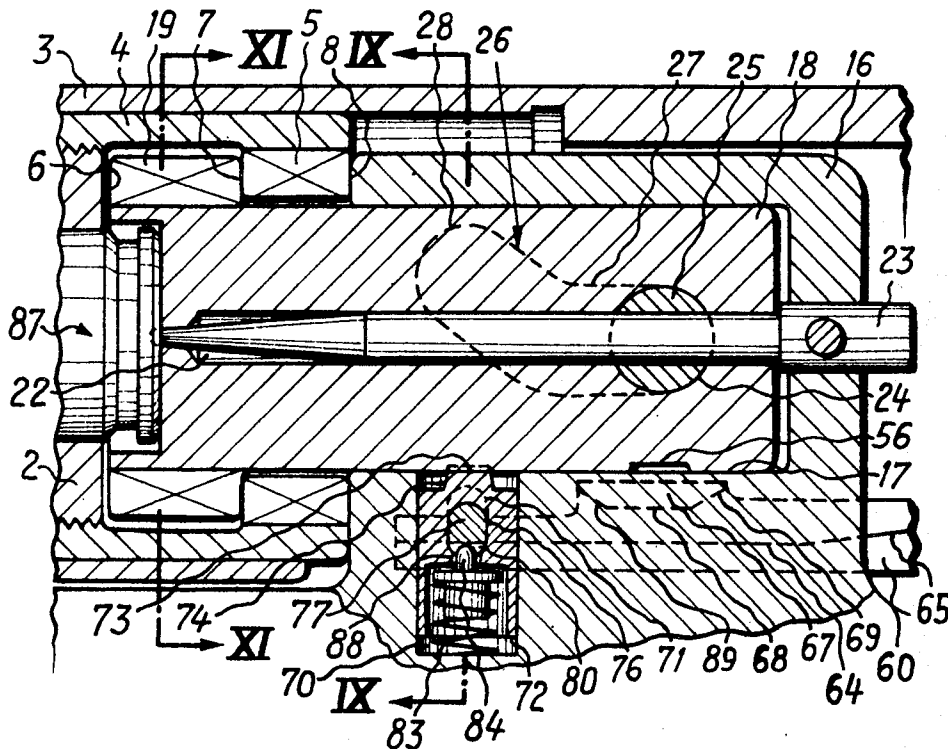
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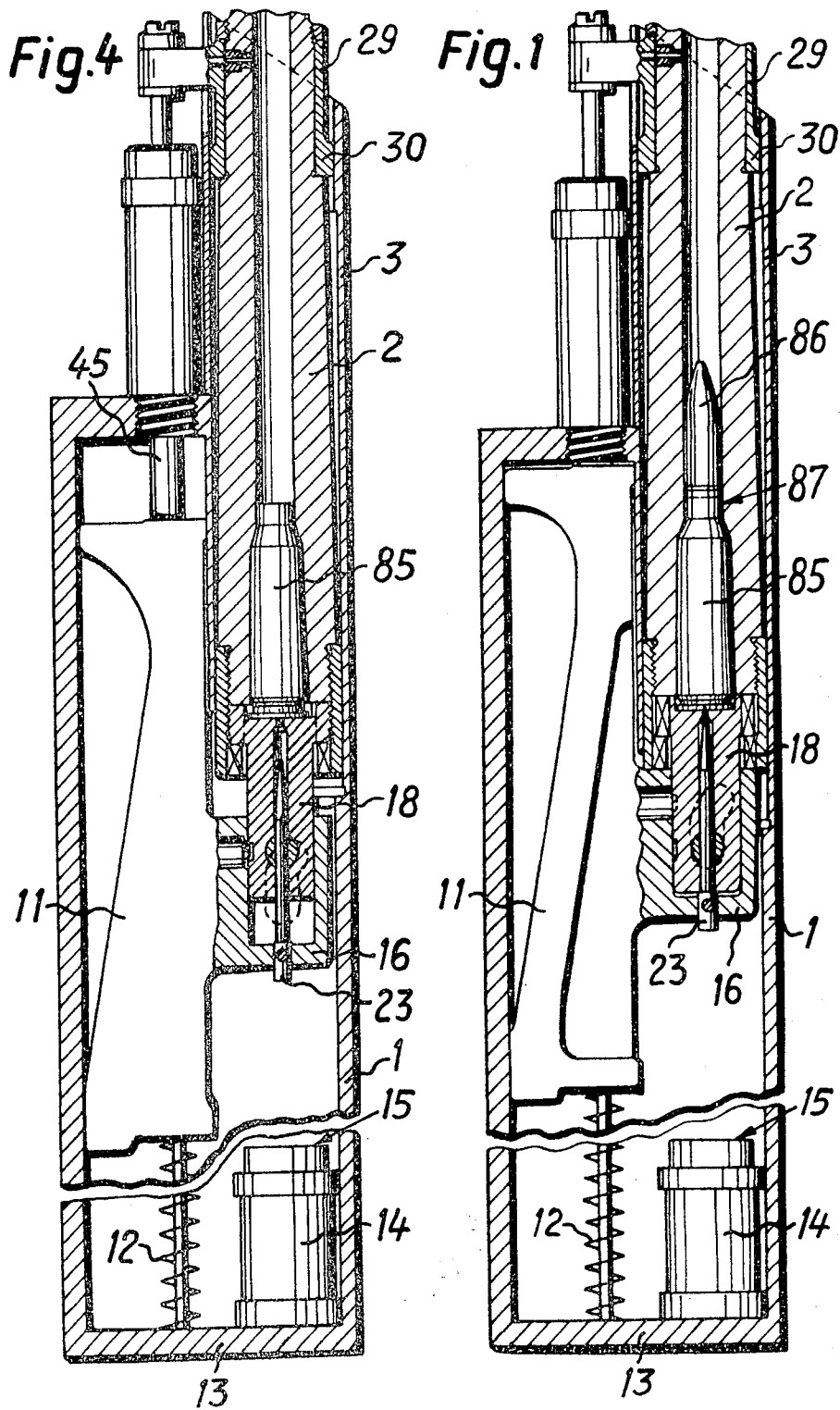
Primary Examiner—Stephen C. Bentley
Attorney—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

An automatic firearm having a breechblock and breechblock carrier movable in the breech casing. An element for coupling the breechblock carrier and breechblock is displaceable in the breechblock carrier and engages a groove in the breechblock. A first inclined cam rail supports the coupling element when the breechblock carrier moves to the rear. A second flat cam rail supports the coupling element in a coupling position during forward motion of the breechblock carrier. Deflecting faces are provided for transferring the coupling element to and from the two surfaces. This arrangement decreases the forces applied to the cam rails thus decreasing the likelihood of distortion.

5 Claims, 13 Drawing Figures

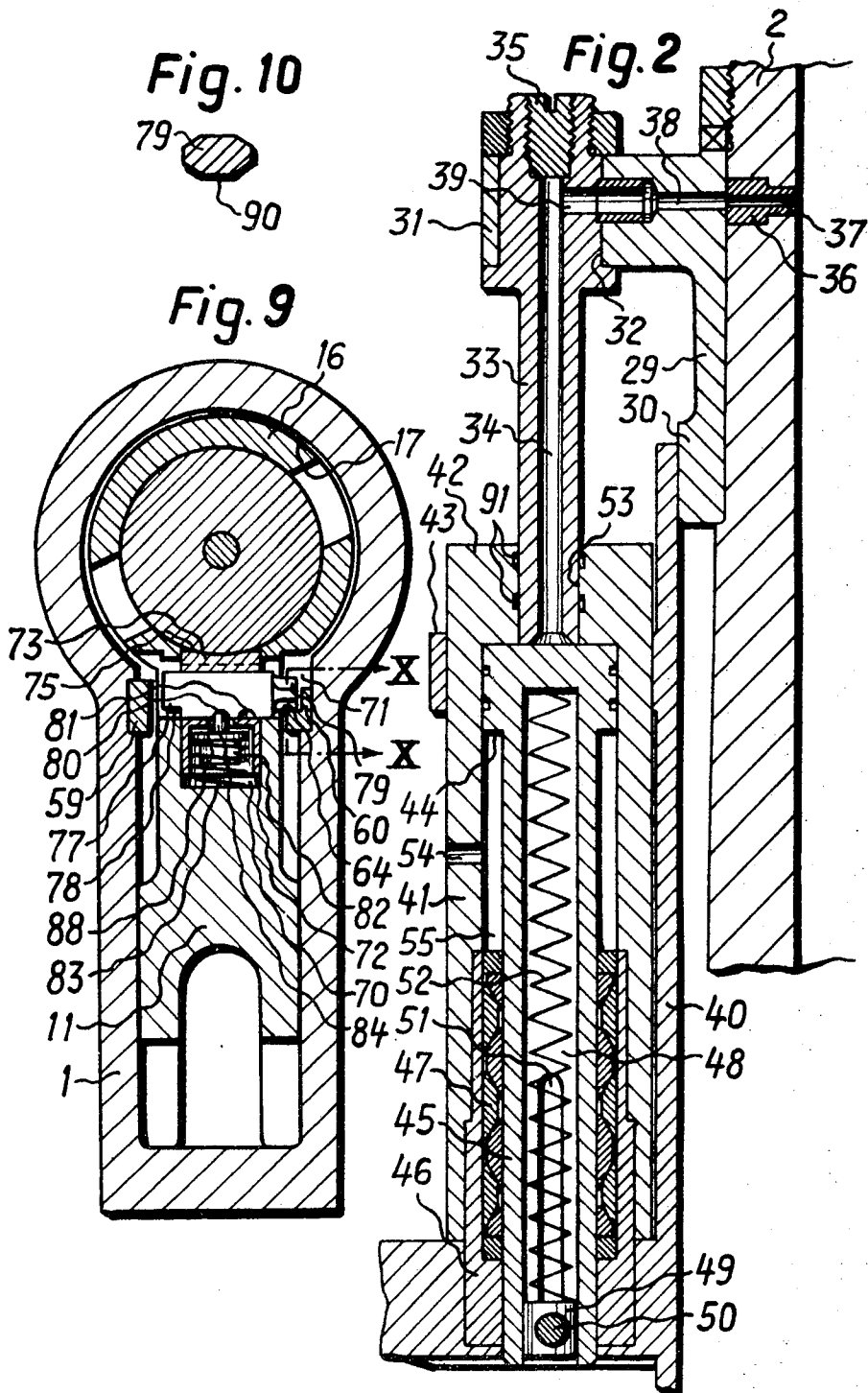




ERNST HURLEMANN, Inventor

BY, *Wendroth Lind & Ponack*

Attorneys



ERNST HURLEMANN, Inventor

By *Wendroth Lind & Porack*

Attorneys

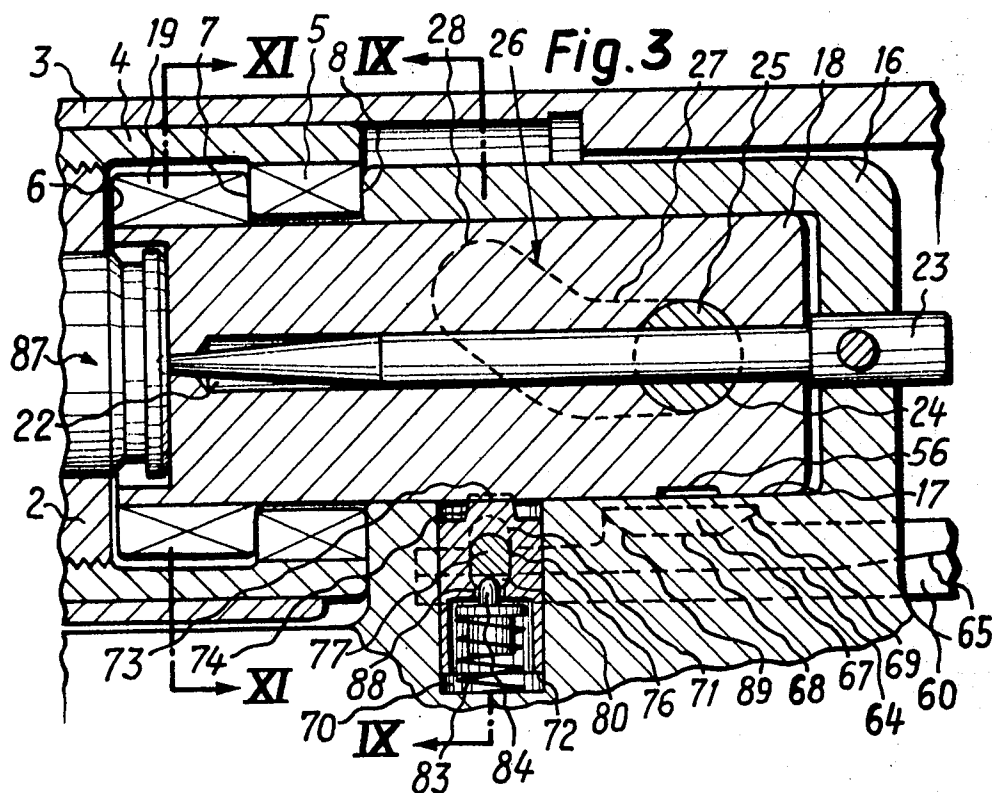
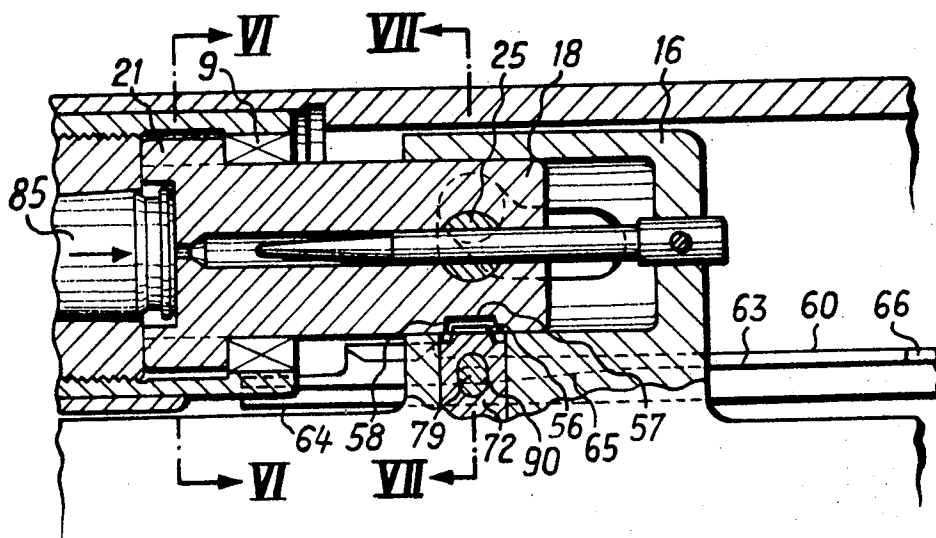


Fig. 5



ERNST HURLEMANN, Inventor

By *Wendroth & P. Mack*
Attorneys

Fig. 11

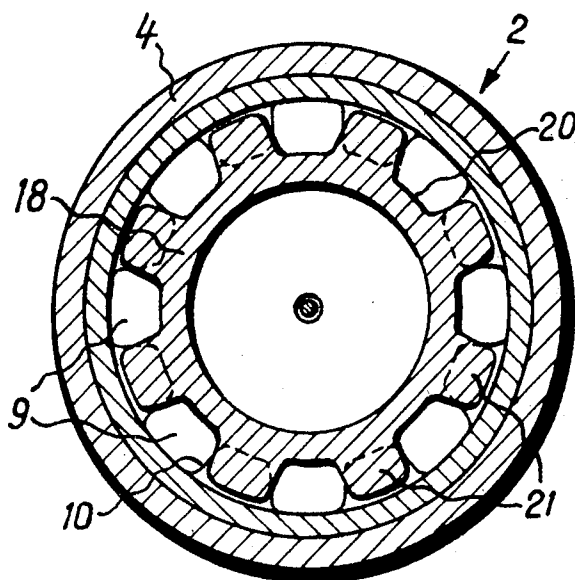
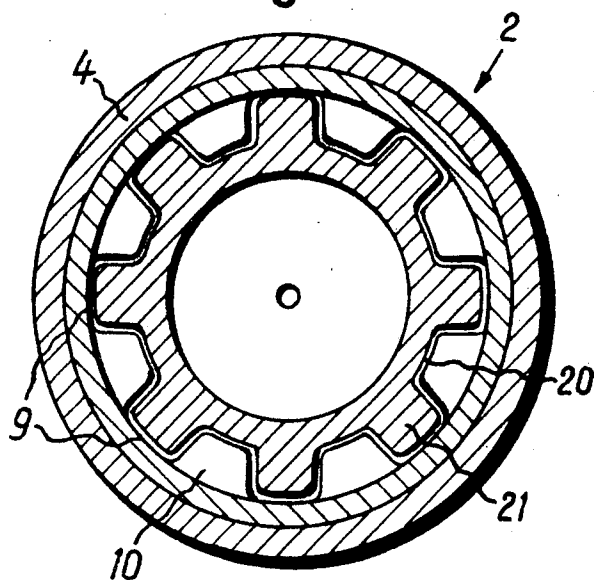
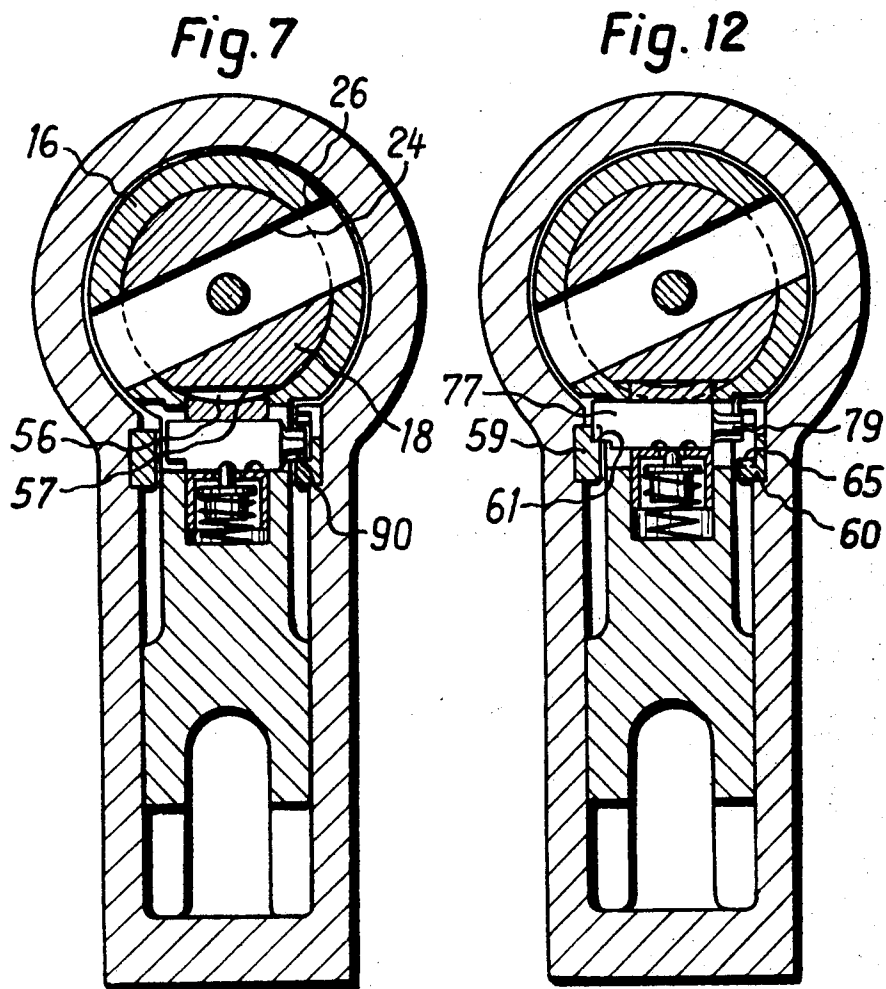


Fig. 6



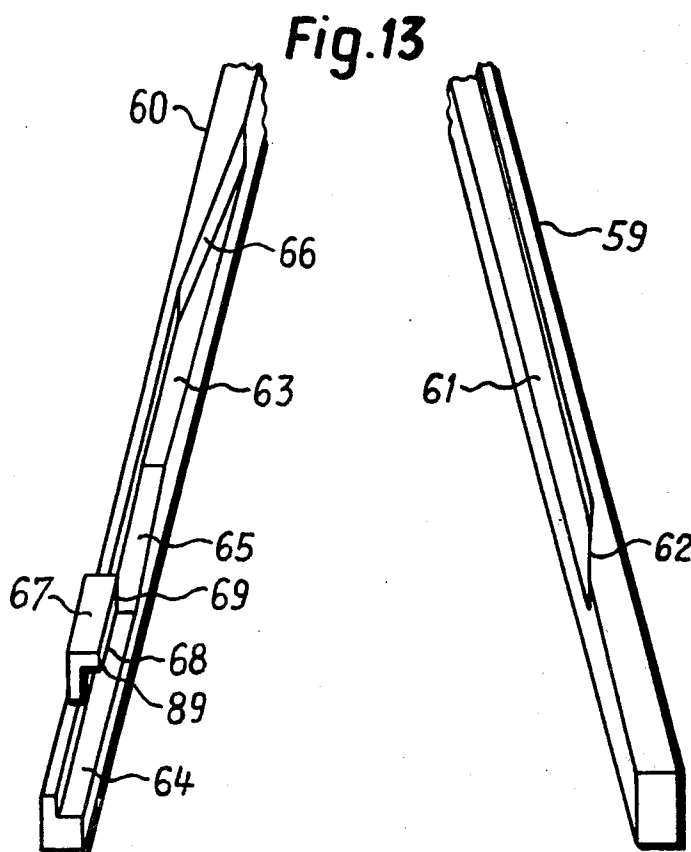
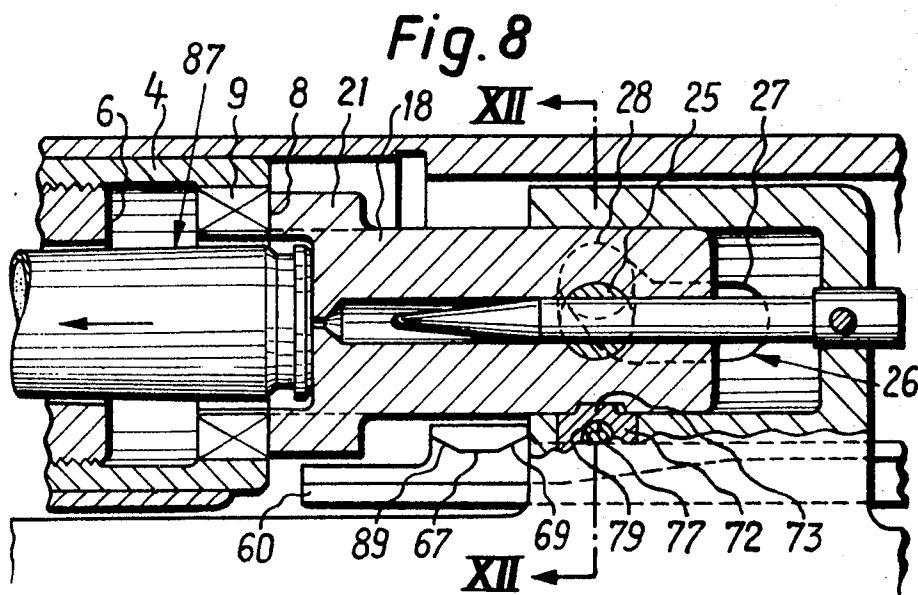
ERNST HURLEMANN, Inventor

By *Wendroth, Lind & Ponack*
Attorneys



ERNST HURLEMANN, Inventor

By *Wendroth Lindorack*
Attorneys



ERNST HURLEMANN, Inventor

By *Wendroth Lind & Ponack*

Attorneys

AUTOMATIC FIREARM

The invention relates to an automatic firearm of the type including a mechanism for coupling a breechblock carrier to a breechblock, the breechblock carrier and breechblock both being axially movable in a breech casing, said mechanism including a coupling element displaceable in the breechblock carrier and adapted to engage a groove in the breechblock, a cam face inclined in relation to the direction of displacement inside the breech casing and adapted to support the coupling element which engages the groove in the breechblock and remains in engaging position when the breechblock carrier moves to the rear.

A known firearm of this type contains a rotary locking mechanism. Locking and unlocking is achieved by rotating the breechblock in its forward position into and out of an angular position in which it is supported by a part affixed to the barrel. Rotation of the breechblock is effected by relative motion between the breechblock and the breechblock carrier, a pin in the breechblock riding in cam slots in the breechblock carrier. After each round has been fired relative motion between breechblock and breechblock carrier must not take place between the instant the breechblock is unlocked to the instant it is relocked for firing the next round since otherwise the breechblock during return prior to being locked for the firing of the next round would be unable to slide through the member that is fast with the barrel. For this purpose the firearm is equipped with a coupling element which during rearward motion and return slides on the cam face of a cam rail that is fixed in the breech casing. The cam face of the rail is inclined for a given part of its length in order to push the coupling element as it travels up this slope into a position for coupling the breechblock and the breechblock carrier together. A level part of the cam face keeps the coupling element in coupling position during the continued rearward and forward motions of breechblock and breechblock carrier. This firearm has the drawback that the sloping part of the cam face is very steep, so that the forces applied by the coupling elements to the rail are considerable, liable to cause permanent distortion and to damage the interengaging parts, so that these must be replaced fairly often.

It is an aim of the invention to eliminate this shortcoming.

An automatic firearm according to the invention comprises a mechanism for coupling a breechblock carrier to a breechblock, said breechblock carrier and breechblock both being axially movable in a breech casing, said mechanism including a coupling element displaceable in the breechblock carrier and adapted to engage a groove in the breechblock, a cam face that is inclined with respect to the direction of displacement of the breechblock inside the breech casing and adapted to support the coupling element which engages the groove in the breechblock and remains in engaging position when the breechblock carrier moves to the rear, a second cam face which is level throughout its length is disposed in the breech casing for supporting the coupling element during the forward motion of the breechblock carrier and for keeping the coupling element in a coupling position, and means for transferring the coupling member from the first to the second cam face and back again from the second face to the first cam face.

The invention is illustrated by way of example in the drawings in which:

FIG. 1 is a longitudinal section of part of an automatic firearm according to the invention (breech mechanism in firing position);

FIG. 2 and 3 are details of FIG. 1, on a larger scale;

FIG. 4 is a similar section to FIG. 1 showing the breech mechanism in a different position;

FIG. 5 is a detail of FIG. 4 on a larger scale;

FIG. 6 is a section taken on the line VI—VI in FIG. 5;

FIG. 7 is a section on the line VII—VII in FIG. 5;

FIG. 8 is the breech mechanism in another functional position;

FIG. 9 is a section on IX—IX in FIG. 3;

FIG. 10 is a section on X—X in FIG. 9;

FIG. 11 is a section on XI—XI in FIG. 3;

FIG. 12 is a section on XII—XII in FIG. 8, and

FIG. 13 is a perspective view of the cam rails of the automatic firearm of the preceding figures.

With reference to FIGS. 1, 2 and 3 a breech casing 1 is secured to the cradle of a gun mounting in a manner not shown. A barrel 2 is slidably movable in a sleeve 3 of the casing 1. The barrel 2 is yieldingly supported from the gun mounting as described and illustrated for example in British Pat. No. 1,226,918. A round 87 comprising a projectile 86 and a cartridge case 85 is shown inserted into the breech of the barrel. A sleeve 4 is attached by engaging threads to the breech end of the barrel 2. The sleeve 4 is provided with an inwardly projecting annular flange 5 which is spaced apart from a rearward face 6 of the barrel, and which has faces 7, 8 normal to the axis of the barrel 2.

As can be seen in FIG. 11 slots 9 are cut parallel to the axis of the barrel and at equidistant intervals into the inside circumference of the flange 5. The slots are all of the same width. The lands between the slots 9 form teeth 10 which are of lesser width than the slots. A breechblock carrier 11 is slidably mounted inside the casing 1. The breechblock carrier 11 is biased to a forward position by a spring 12 which bears against a rear wall 13 of the casing 1. Attached to the wall 13 is a housing 14 containing a buffer 15. A head 16 of the breechblock carrier 11 contains a forwardly open bore 17 which is in axial alignment with the barrel 2, and contains a cylindrical breechblock 18 which is rotatable and slidable within the bore. The breechblock 18 has an outwardly projecting annular flange 19 whose outer radius is less than the radial distance of the base of the slots 9 in the sleeve 4 from the barrel axis. The annular flange 19, as can be seen by reference to FIG. 6 is formed with the same number of slots 20 and teeth 21 as there are slots 9 and teeth 10 in the flange 5 of the sleeve 4 and they are of similar width.

The breechblock 18 has an axial bore 22 of varying diameter which is in alignment with the gun barrel axis. A firing pin 23 is fixed in the head 16 of the breechblock carrier 11 and projects into the bore 22 in the breechblock 18. The breechblock 18 is further provided with a transverse bore 24 which perpendicularly intersects the longitudinal axis of the breechblock. This bore 24 contains a pin 25 which is pivotably mounted on and located by the firing pin 23 which passes through it. Referring to FIG. 7 the two ends of the pin 25 each project into one of two cam slots 26 on diametrically opposite sides of the breechblock axis. These

cam slots are machined into the wall of the breechblock carrier head 16. The rear parts 27 of the slots 26 are parallel to the axis of the breechblock 18, whereas their forward parts are inclined to this axis. The centers of the two circular forward ends of the slots 26 are located on a line that intersects the axis of the breechblock 18 at an angle to the horizontal.

As shown in FIGS. 4, 5 and 7 a groove 56 is machined into the breechblock 18 normal to its longitudinal axis. The base 57 of this groove 56 is flat and parallel to the longitudinal axis of the breechblock 18 and the angle between sides 58 of the groove and the base is obtuse. The plane of symmetry of the groove 56 contains the axis of the bore 24 which extends at an acute angle to the base 57 of the groove 56.

Again referring to FIGS. 1 and 2 a sleeve 29 is positioned around part of the barrel 2. This sleeve 29 has an outwardly projecting flange 30 which can slide with the sleeve 3 of the casing 1. The sleeve 29 is further formed with a downwardly projecting arm 31 which contains a bore 32 parallel to the barrel axis which receives the forward end of a cylindrical pushrod 33. The pushrod 33 has an axial bore 34 closed at its forward end by a plug 35. A nozzle 36 is positioned in the wall of the barrel 2. A channel 37 for diversion of gas from the barrel passes through the nozzle 36 and leads perpendicularly to the barrel axis from the barrel interior to further bores 38, 39 through the arm 31 and the wall of the pushrod 33.

A sleeve 40 is attached to one wall of the casing 1 and attached by threads to a cylinder 41 which has a closed forward end 42, and which is supported by a holder 43 attached to the casing 1. The sleeve 40 and the cylinder 41 are both coaxial with the pushrod 33. A piston 44 is attached to a rod 45 and slidably disposed inside the cylinder 41. The piston rod 45 is held in a bore in the rear end 46 of the sleeve 40 and projects further back through this bore. A stack of annular springs 47 is located inside the annular chamber surrounding the piston rod 45 inside the cylinder 41 and bears against the inside of the rear end 46 of said sleeve. The piston rod 45 has a central bore 48 which is closed by a plug 49. A pin 50 passes through the plug 49 and projects into two slots 51 machined into the walls of the piston rod 45 in the rear end 46 of the sleeve 40. The piston 44 is forwardly biased by a spring 52 contained in the bore 48 and retained by the plug 49. The closed forward end 42 has a bore 53 coaxial with the cylinder 41. This bore slidably contains the rear end of the pushrod 33. For sealing the cylinder 41 sealing rings 91 are inserted into annular grooves in the bore 53. A bore 54 which passes through the wall of the cylinder 41 communicates with the annular chamber 55 between the stack 47 of annular springs and the forward end of the cylinder.

With reference to FIGS. 3 and 9 cam rails 59, 60 are affixed to the inside of the side walls of the casing 1. These cam rails are separately shown in FIG. 13. The cam rail 59 has two mutually perpendicular faces 61, 62. The face 61 is normal to the vertical plane of symmetry of the barrel, whereas the face 62 is at an acute angle with said plane. The cam rail 60 has a face 63 which is at the same level as the face 61 of the cam rail 59. Another face of the rail 60 is parallel to the face 63 but at a lower level. The two faces 63, 64 are connected

by a ramp 65. A face 66 normal to the face 63 extends to the rear of the face 62 of the cam rail 59 and makes an acute angle with the vertical plane of symmetry of the barrel. The rail 60 has an extension 67 having a face 68 which is parallel to and above the face 64. The extension 67 has two further faces 69, 89 which make obtuse angles with the face 68. The forward end of the face 61, is situated between the line of intersection of the ramp 65 with the face 63 and the extension 67 a short distance away from the latter.

The breechblock carrier 11, as illustrated in FIGS. 3 and 9 contains a socket 70 which opens into the bore 17 in the breechblock carrier head 16. The axis of this socket lies in the vertical plane of symmetry of the barrel. The breechblock carrier 11 is further provided with two slots 71. The center planes of these slots coincide with a plane which is perpendicular to the vertical plane of symmetry of the barrel and contains the axis of the socket 70.

A locking pin 72 is movable in the socket 70 and has a curved head 73 extending across its entire diameter. The width of the head 73 is less than the diameter of the locking pin 72 and the flanks 74 make obtuse angles with the end face 75 of the pin. The locking pin 72 has a slot 76 which has a plane of symmetry coincident with the plane of symmetry the slots 71 in the breechblock carrier 11. The slot 76 is lower than the slots 71, the difference in height being equal to the distance in level between the planes containing the faces 63 and 64 of the cam rail 60. A slipper 77 has the same cross section as the slot 76 in the locking pin 72 and is axially slidably together therewith. At one end the slipper 77 has a face 78 which is parallel to the face 61 of the cam rail 59. The slipper 77 has a projection 79 of octagonal section. The height of this projection 79 corresponds to the distance between the face 64 on the cam rail 60 and the face 68 on the extension 67 on this rail. The slipper 77 is further formed with two notches 80, 81, normal to its longitudinal axis and having a semicircular cross section. A pin 82 is located in a bore in the locking pin 72 and biased towards the breechblock carrier by the thrust of a spring 83 bearing against the bottom of the socket 70 in the breechblock carrier 11. The pin 82 has an axial extension 84 with a rounded head which projects through a bore 88 in the locking pin 72.

The manner in which the illustrated automatic firearm functions is as follows:

Referring to FIGS. 1, 2 and 3 the breechblock carrier 11 is in its foremost position at the instant of ignition of the round 87 in the chamber of the barrel 2. In this position the breechblock carrier bears with the front face of its head 16 against the rear face 8 of the sleeve 4. Moreover, the front end face of the breechblock carrier 11 also bears against the rear end of the piston rod 45 of the piston 44 which is itself urged by the thrust of its spring 52 against the front end 42 of the cylinder 41. The rear end of the pushrod 33 makes contact with the piston 44. As shown in FIG. 11 the radial planes of symmetry of the teeth 10 and 21 of respectively the sleeve 4 and the breechblock 18 are in register. The breechblock 18 which bears against the base of the round 87 is thus locked to the barrel 2 which supports it from the rear. The ends of the pin 25 are contained in the rear portions 27 of the slots 26 in the breechblock carrier 11.

The thrust of the spring 83 is transmitted to the locking pin 72 by the pin head 84 which engages the notch 80 in the slipper 77. Hence the head 73 of the locking pin bears against the breechblock 18. The extension 79 of the slipper 77 rests in front of the extension 67 of the cam rail 69 on face 64 (FIGS. 3, 9). The two end faces of the slipper 77 are located between the side of the front part of the cam rail 59 and the side face which defines the outer edge of the cam face 64 of cam rail 60.

The gas pressure which builds up after ignition of the propellant charge in the round 87 acts rearwardly on the cartridge case 85 and on the breechblock 18 and thus on the barrel 2 which is rearwardly accelerated and moves in the stationary sleeve 3 of the casing. Consequently the pushrod 33 applies a rearward thrust to the piston 44 and the latter via the piston rod 45 drives the breechblock carrier 11 to the rear. The extension 79 of the slipper 77 slides along the face 64 of the cam rail 60 underneath face 68 of the extension 67. When the projectile 86 clears the nozzle 36 in the barrel 2 the gas escapes through the channels 37, 38, 39 of respectively the nozzle, the extension 30 and the pushrod 33 and after first reaching the piston 44 enters the cylinder chamber 55. Hence the piston 44 and the breechblock carrier 11 which has so far moved in synchronism with the barrel 2 are additionally accelerated. The piston 44 therefore moves away from the pushrod 33 and the head 16 of the breechblock carrier 11 moves to the rear relatively to the breechblock 18. The ends of the pin 25 at first slide along the rear ends 27 of the slots 26.

When the projectile 86 leaves the barrel 2 and only the remaining gas pressure acts via the empty cartridge case 85 on the breechblock 18, the sloping sides of the front portion 28 of the slots 26 move into co-operation with the ends of the pin 25. The pin 25 is therefore forced in turn, causing the breechblock 18 to turn about its axis and its teeth 21 to ride peripherally across the width of the teeth 10 of the sleeve 4. At the end of its stroke the piston 44 strikes the stack of annular springs 47 and is thus braked (FIG. 2), whereas the breechblock carrier 11 continues to move to the rear. Since the piston 44 is now to the rear of the bore 54 any gas still inside the cylinder chamber 55 is vented to the outside and the piston 44 can be driven back into its starting position by the thrust of the spring 52. When during its rearward motion the breechblock carrier 11 parts company with the piston rod 45 (FIGS. 4, 5) the locking pin 72 is located behind the extension 67 of the cam rail 60 and its longitudinal axis lies in the plane of symmetry of the slot 56 in the breechblock 18 (FIG. 7). When the ends of the pin 25 strike the forward end of the slot 26 in the breechblock carrier 11 the breechblock 18 will have been turned sufficiently for the planes of symmetry of its teeth 21 to coincide with the planes of symmetry of the slots 9 in the sleeve (FIG. 6). The breechblock is thus unlocked from the barrel 2. The base 57 of the groove 5 is then normal to the vertical plane of symmetry of the barrel. Furthermore, the face 90 of the extension 79 on the slipper will be located at the junction of the face 64 with the ramp 6 on the cam rail 60. The remaining gas pressure transmitted by the breechblock 18 causes the ends of the pin 25 to be pushed against the sides of the forward sloping parts 28 of the slots 26, additional drive being thus im-

parted to the breechblock carrier 11. The reactive forces generated by the sides of the slots operate to impart a turning motion to the pin 25. The pin 25 cannot turn together with the breechblock 18 and a lengthwise displacement of the breechblock in relation to the breechblock carrier 11 cannot take place because the sides of the teeth 21 of breechblock 18 are locked by the sides of the teeth 10 on the sleeve 4 during the further common motion of the breechblock 18 and the breechblock carrier.

During this motion of the breechblock carrier 11 the slipper sliding with its extension 79 up the ramp 65 of the cam rail 60 and the locking pin 72 are lifted. Before the teeth 21 of the breechblock 18 completely leave the slots 9 the extension 79 of the slipper reaches its highest elevation on the line of intersection of the ramp 6 and the face 63. The head 73 of the locking pin 72 will now engage the groove 56 in the breechblock 18. During the further backward movement the extension 79 rides against the face 66 of the cam rail 60, thus displacing the slipper 77 towards the other cam rail 59. This results in the head 84 of the pin 82 being disengaged from the notch 80 in the slipper against the pressure of its spring 83 and engaging the other notch 81. The face 78 of the slipper 77 will therefore ride onto the face 61 of the cam rail 59.

After striking the buffer 15 the breechblock carrier rebounds together with the breechblock 18, introducing a fresh round 87 into the barrel 2 which is already in its normal position having completed its return in the meantime. When during the ensuing forward motion the front end face of the breechblock 18 coincides with the plane of the base 8 of the cartridge case (FIG. 8) the end of the slipper 77 begins to ride along the face 62 of the cam rail 59. Consequently the slipper 77 will be displaced again towards the other cam rail 60 and the head 84 of the pin 82 will be disengaged from the notch 81 in the slipper 77. Whereas the teeth 21 of the breechblock 18 slide through the slots 9 in the sleeve 4 and thus prevent the breechblock 18 from rotating and from being longitudinally displaced with respect to the breechblock carrier 11, the face 78 of the slipper 77 moves away from the edge of face 66 of the cam rail 59 and the head 84 of the pin 82 engages the notch 80 in the slipper 77. At the same time the extension 79 of the slipper 77 runs against the inclined face 69 of the extension 67 of the cam rail 60 and is thereby depressed. The locking pin 72 participates in this movement and withdraws its head 73 from the groove 56, thus uncoupling the breechblock carrier 11 from the breechblock 18.

During the continued forward motion of the breechblock carrier 11 and the breechblock 18 the locking pin 72 is retained in position by virtue of the face 68 of the cam rail extension 67 covering the extension 79 of the slipper 77. At the end of its return motion the front end face of the breechblock 18 strikes the rear end face of the barrel 2 and stops, whereas the breechblock carrier 11 continues to move. Consequently the extension 79 of the slipper clears the face 68 and allows the head 73 of the locking pin 72 to be forced by the spring 83 back against the breechblock 18. Furthermore, the pin 25 and the breechblock 18 are again rotated about the breechblock axis until the planes of symmetry of the teeth 21 and 10 on the

breechblock 18 and the sleeve 4 are in register (FIG. 11), in which position the breechblock 18 is again locked to the barrel 2. At the end of the return motion of the breechblock carrier 11 when the pin 25 is in the portions 27 of the slots 26, the point of the firing pin 23 hits the percussion cap of the cartridge (FIG. 3) and the front end face of the head 16 of the breechblock carrier 11 strikes the sleeve 4. Hence all the parts that have moved during the interval between two consecutive rounds have re-assumed the positions shown in FIG. 1.

What I claim is:

1. An automatic firearm comprising a breechblock carrier, a breechblock, a mechanism for coupling said breechblock carrier to said breechblock, a breech casing, in which said breechblock and breechblock carrier are axially movable, a first cam rail and a second cam rail adjacent said first cam rail, said cam rails being fixed to said breech casing, said first cam rail comprising a front end flat face and a rear end flat face at a higher level, both flat faces being connected by a sloping ramp, said ramp being responsible for coupling said mechanism at a first place during displacement of the breechblock, said first cam rail comprising a first face for transverse displacement of said mechanism for coupling, said first face making an arcuate angle with respect to the direction of displacement of said breechblock carrier, said second cam rail comprising a flat face throughout its whole length, which is at the same level as the rear end flat face of said first cam rail and a second face for transverse displacement of said mechanism for coupling, said second face being adjacent to the front end flat face of said first cam rail and being responsible for decoupling said mechanism at a

second place during displacement of said breechblock, said coupling mechanism being alternatively in contact with one of said cam rails.

2. An automatic firearm to claim 1 in which said mechanism for coupling comprises a groove in said breechblock, a coupling pin displaceable in said breechblock carrier to engage said groove, a slipper transversely displaceable through said coupling pin and rides alternatively on one of said cam rails.

3. An automatic firearm according to claim 1 in which said first cam rail is formed with an extension which has a face parallel to the front end flat face and a sloping portion at each end.

4. An automatic firearm according to claim 2 comprising a socket in the breechblock carrier for the reception of a spring which is supported by the breechblock carrier, a pin in said socket biased by the thrust of said spring and which has a head connected therewith through a central bore in said socket to engage corresponding notches in said slipper when the latter is transversely displaced.

5. An automatic firearm comprising a breechblock carrier, a breechblock, a mechanism for coupling said breechblock carrier to said breechblock, a breech casing in which said breechblock and breechblock carrier are axially movable, a first cam rail and a second cam rail adjacent to said first cam rail, said cam rails being fixed to said breech casing, said first cam rail causing a coupling of said mechanism at a first place during displacement of said breechblock, said second cam rail causing a decoupling of said mechanism at a second place during displacement of said breechblock, said coupling mechanism being alternatively in contact with one of said cam rails.

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