July 16, 1957 R. J. KOPF ET AL 2,799,108

CARTRIDGE EXTRACTORS

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FIG. 1.

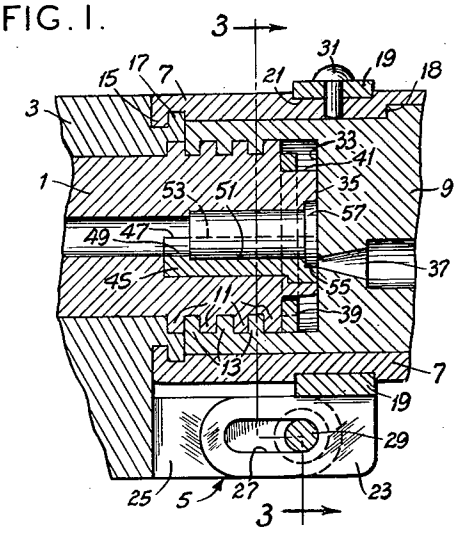

FIG. 2.

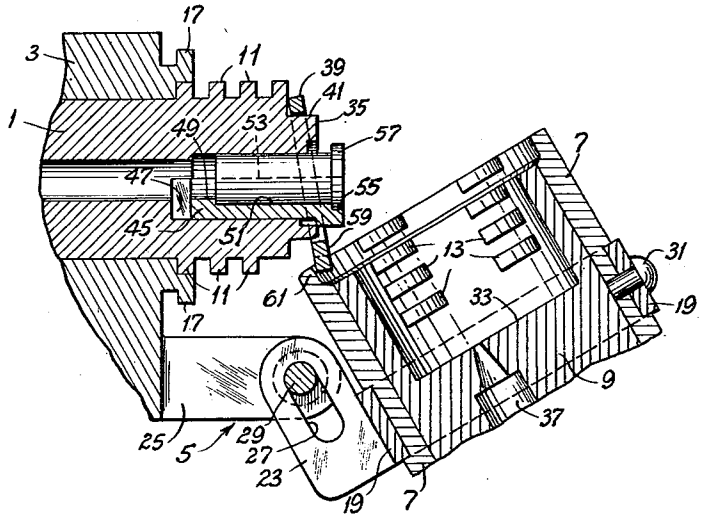

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FIG. 4.

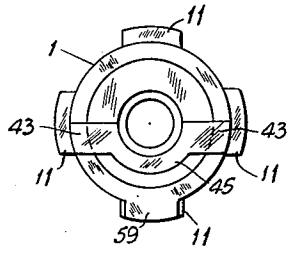


FIG. 5.

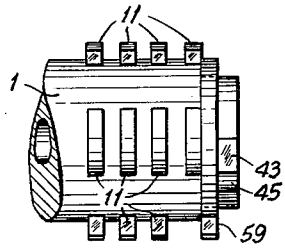


FIG. 3.

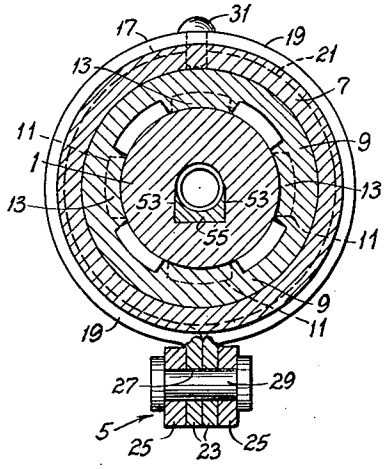
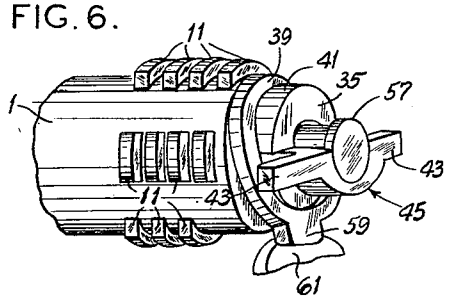


FIG. 6.



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CARTRIDGE EXTRACTORS

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Application April 16, 1954, Serial No. 423,556

8 Claims. (Cl. 42—25)

This application relates generally to apparatus for firing cartridges, and more particularly, to extractors for use where extremely high breech pressures are encountered.

In the operation of powder-actuated tools, for example, it would be desirable to provide for breech pressures as high as and higher than seventy-five thousand pounds per square inch while using conventional cartridge cases, particularly rim-fire cartridges. Heretofore, this has not been feasible because of the extraction difficulties that arise when such pressures are developed.

The conventional claw type of extractor requires an extractor cut or recess in the breech of the barrel, with the result that the case is in part unsupported and may rupture under high pressure or be so weakened as to separate during extraction. The barrel-segment type of extractor provides better support, but as heretofore known, extends only a short distance lengthwise of the chamber. Those experienced in the art have believed that the forward transverse edge of the extractor should lie near the rim of the case so that the forward portion of the chamber is circumferentially complete, but such a construction is not too satisfactory under conditions of very high pressure, there being a transverse irregularity in the wall of the chamber beneath the case and the area of contact between case and extractor being necessarily limited.

It may be noted that these difficulties become acute when rim-fire cartridges are used, as this type of case must be formed of soft metal. Accordingly, it is an object of the invention to provide an improved extractor particularly adapted for apparatus utilizing rim-fire cases at pressures higher than those heretofore considered practical.

Briefly, a barrel-segment type of extractor is recessed within the barrel of the device for axial movement, but the extractor extends substantially to and preferably beyond the mouth of the case. When practical, the forward end of the extractor is formed with an inwardly projecting lip, which overhangs the mouth edge of the case. With this arrangement, the case is fully supported; there is no transverse irregularity between the walls of the case and chamber; and the case is engaged by the extractor over a considerable portion of its area.

Other features of the invention will be in part apparent from and in part pointed out in the following detail description taken in connection with the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of the breech portion of a powder-actuated tool embodying the invention, the breech being closed;

Fig. 2 is a view similar to that of Fig. 1, but with the breech opened;

Fig. 3 is a cross section taken on the line 3—3 of Fig. 1;

Fig. 4 is an end view of the barrel shown in Fig. 1;

Fig. 5 is a side elevation of the barrel with the extractor in its innermost position; and

Fig. 6 is a perspective view of the barrel shown in Fig. 5, but with the extractor in its retracted position.

Initially, it will be understood that in powder-actuated

tools, the cartridge is the weak link. The chamber and bolt can be made to handle pressures much higher than those that the case can withstand, yet the case is essential, not only from the viewpoint of convenience, but also because of its obturating action. As maximum pressure is approached before the fastener starts to move, the case expands into tight engagement with the wall of the chamber to seal against rearward escape of gas. Most existing devices require that the case then contract as the pressure drops so as to permit easy extraction. When the breech pressure is excessive, however, the case will rupture, unless properly supported, or it will fail to contract sufficiently to permit easy extraction, and in most instances, the maximum permissible breech pressure of the device is determined by the failure of the extractor to perform reliably above that pressure.

Conventional extractors may be considered as falling into one of two basic classes. In one form, a radially-displaceable claw is attached to the bolt or breech block so as to slip over the head of the case into engagement with the rim as the breech is closed, the claw functioning to withdraw the case from the chamber when the breech is opened. In the other type of extractor, an axially-movable part forms a segment of the rear face of the barrel so that when the breech is closed, the cartridge rim is forced against the rear face of the barrel, including the extractor segment; and when the breech is opened, a cam moves the extractor segment rearwardly to withdraw the case.

The claw type of extractor is best adapted to a bolt action, and while the bolt action is very strong, the claw type of extractor is comparatively weak. This is so because the barrel must be cut away to accommodate the extractor, thereby leaving a portion of the case without support and hence subject to rupture. Also, the extractor hook or claw is usually spring biased rather than positively locked to the case, and hence tends to slip off the rim if the case does not pull easily from the chamber.

The barrel-segment type of extractor affords better support for the cartridge, but its use has been limited to relatively weak hinge actions. Also, it has been customary to form the extractor piece in a manner such that it takes up only a relatively small portion of the firing chamber, the transverse forward edge of the extractor being located near the rear of the case, with the result that a transverse irregularity appears in the wall of the chamber beneath the cartridge and the cartridge is engaged over a rather limited portion of its area.

In any event, attempts to operate at relatively high breech pressures, as for example, pressures in excess of seventy-five thousand pounds per square inch, have been hindered by extractor failures, and this has been so especially when the cartridge is of a rim-fire type. Rim-fire cases are relatively inexpensive to make and therefore particularly desirable in powder-actuated tools, but their field of use has been restricted. The explanation is that a rim-fire case must be of soft metal (usually copper) so that the rim will crush and ignite the primer under impact of the firing pin, whereas center-fire cases may be made of tougher and more resilient brass, only the primer itself being encased in soft copper. Being inherently weak, the rim-fire type of case is more likely to rupture if not fully supported. Also, the soft metal does not contract properly when subjected to considerable pressure. Instead, the case becomes sealed or frozen into the irregularities of the chamber so that considerable extraction force is required. This tendency to freeze is especially aggravating inasmuch as the soft metal of the case is easily torn, the extractor tending to tear through the rim or separate the entire head.

Referring now to the drawings, there is shown the

breech portion of a cartridge-firing device embodying the invention. In order to simplify the disclosure, only those details of the structure relevant to the invention are described, but it will be understood that the illustrated section would form a part of a complete powder-actuated tool, such as that disclosed in our copending application Serial No. 355,034, filed May 14, 1953, of which this application is a continuation-in-part.

This tool includes barrel and receiver assemblies which open by means of a hinge connection, but a bolt-action type of breech closure is also incorporated. A barrel **1** is mounted in a housing **3**, which is hinged at **5** to a receiver **7**. This receiver in turn contains a bolt or breech block **9**, which locks directly onto the barrel. More particularly, the barrel **1** telescopes within a recess in the block **9** and has external lugs **11**, which engage with internal lugs **13** formed in the bolt recess. Similar lugs **15** and **17** are provided to lock the barrel housing **3** to the receiver **5**. Partial rotation of the barrel assembly **1** and **3** relative to the receiver assembly **7** and **9** uncouples the lugs to permit initial opening of the breech by relative axial movement of these parts, and in this respect, the device possesses the high strength of a bolt action.

If desired, and as explained in the aforementioned application, the inner elements **1** and **9** may be arranged for rearward movement as a unit within their housing sections **3** and **7**, but the barrel **1** should be locked against rotation within its housing **3** and the bolt **9** should be locked against rotation within its housing **7**. This may be accomplished in various ways, as by splines (not shown). Also, it will be understood that springs (not shown) would be provided in the manner described in the aforementioned application to bias the bolt forwardly against a shoulder **18**, so that the bolt would be held in a forwardmost position during closing of the breech, while permitting rearward movement upon application of force to the muzzle of the barrel.

The hinge connection **5** between the barrel housing and receiver is designed to permit rotary unlocking of these parts followed by axial and then swinging separation. A hinge ring **19** encompasses the receiver **7** within an annular groove **21**. A pair of ears **23** project forwardly from the ring **19** between a pair of brackets **25**, which extend rearwardly from the barrel housing **1**. A pivot pin **29** is carried by the brackets through elongate openings **27** in the ears **23**, thus permitting limited axial or telescoping separation of the receiver relative to the barrel.

To open the breech, the receiver **7** is first rotated over a limited arc (determined by a stud **31**) within the ring **19** to disengage both sets of locking lugs. The receiver is then pulled away from the barrel housing in an axial direction to clear the bolt from the barrel, the pivot pin **29** moving to the other end of the slotted openings **27**, whereupon the receiver may swing down to expose the breech.

When the breech is closed, the bolt face **33** is brought up against the breech **35** of the barrel. The bolt face is substantially flat but for an opening **37** for the firing pin (not shown), and is of a diameter corresponding to the outer diameter of the barrel lugs **11**. The breech **35** is also flat but is of a reduced diameter, the reduction being somewhat less than that of the inner diameter of the barrel lugs in order to accommodate an extractor lifting ring **39**. This lifting ring **39** is of an outer diameter equal to or slightly less than the inner diameter of the barrel lugs **11**, so that the lugs **13** on the breech will clear the ring. The reduced section of the barrel extends from the breech **35** an amount such as to leave a portion **41** projecting rearwardly from the ring, and this projecting portion **41** accommodates a pair of opposed lugs **43**, which overlie the ring.

These lugs **43** form a part of an extractor **45**, which is recessed at **47** within the barrel and which is mounted for relative axial movement with respect to the barrel. As best shown in Fig. 3, the cartridge case is transversely embraced over a segment corresponding to half the circumference. Otherwise, the extractor extends longitudinally the length of the firing chamber, and it may be formed with a lip **49** which overhangs the mouth edge of the cartridge case **51**. The inner face of the extractor thus defines a substantial part of the firing chamber. The cross-sectional shape of the recess **47** and the extractor **45** may be rectangular, so that the recess may be easily milled in the barrel, and in that event, the side walls **53** (Fig. 3) may be approximately tangential with the circumference of the chamber. Both the breech and extractor are counterbored at **55** to recess the rim **57** of the cartridge case, thus providing a strong support for the case. Also, the rear portion **41** of the barrel is recessed to accommodate the lugs **43** of the extractor when the breech is closed (Fig. 5).

As best shown in Figs. 4 and 6, the lifting ring **39** is formed with a projecting lip **59**, which is aligned with one set of the barrel lugs **11**, and the barrel may have a lug removed adjacent the ring to provide for clearance.

In operation, the breech is opened by rotating the receiver to disengage lugs **13** and **15** from the barrel lugs **11** and **17**; in which event, the lugs **13** are also cleared from the lip **59** of the lifting ring, thus permitting the receiver to be drawn rearwardly. When the receiver is then hinged back upon the pin **29**, the mouth-edge portion **61** of the receiver engages the lip **59** to pry the lifting ring rearwardly, as shown in Fig. 2. The ring, in turn, engages the extractor lugs **43**, thus causing the extractor to be drawn rearwardly and expose the rim **57** of the case. The case can then be easily removed and a new cartridge loaded.

From the foregoing, it will be apparent that the extractor of this invention is readily constructed and simple in operation. Moreover, positive extraction is assured inasmuch as the case is engaged over a substantial portion of its area by the extractor. The case itself is supported at all points, so that high-powered charges may be used without danger of case rupture during firing or case tearing during extraction.

Preferably, the extractor is used with a combination bolt and hinge breech action as disclosed, but this is not essential. Additional variations and modifications will be apparent to those skilled in the art. For example, it may be desirable to eliminate the forward lip **51** on the extractor, when the bore of the barrel is of the same diameter as that of the firing chamber. Elimination of this lip would then permit breech loading of fasteners of a diameter equal to that of the cartridge case. Also the cross-sectional shape of the extractor may be varied, although it is desirable that the fit of the extractor with the barrel be relatively close in order to minimize gas leakage. With the shape disclosed in Fig. 3, the expansion of the case at the instant of firing will drive the lower portion of the extractor into sealing engagement with the barrel and may also bend the side portions **53** into similar sealing engagement with the barrel.

The firing chamber per se is not interrupted in a transverse direction, the lines of interruption at **53** being longitudinal instead. Contrary to expectation, the fact that these interruptions extend the length of the case does not result in any serious complication in leakage.

Although one embodiment has been disclosed in detail, it is to be understood that the invention is not limited thereto, but the drawings and description thereof are to be understood as being merely illustrative. It is realized that many modifications and variations will present themselves to those skilled in the art without departing from the spirit of this invention or the scope thereof as set forth in the appended claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In cartridge-firing apparatus comprising a barrel

having locking lugs and a bolt-action type of receiver assembly having cooperating lugs, said barrel being formed with a chamber; the improvement comprising an axially-movable extractor element recessed within and forming a part of said chamber, said extractor having a lip engaged by said receiver assembly upon opening of the breech to actuate said extractor, said lip being aligned with said barrel lugs to clear with the receiver lugs upon opening of the breech.

2. Apparatus as set forth in claim 1, further including a lifting ring encircling said barrel adjacent the breech rearwardly of the barrel lugs, said lifting ring being of an outer diameter less than the inner diameter of the barrel lugs, and having a radially-projecting lip aligned with said barrel lugs.

3. Apparatus as set forth in claim 1, further including a hinge connection between said receiver assembly and barrel, said hinge connection permitting relative rotary movement between the barrel and receiver assembly and also relative axial movement.

4. Apparatus as set forth in claim 3, wherein said receiver assembly is mounted for rotary movement within an encircling member, said encircling member being secured to a hinge element, a cooperating hinge element for said barrel, and a slot and pin lost-motion connection between said hinge elements.

5. In cartridge-firing apparatus having a barrel formed with a firing chamber, and a cooperating receiver assembly having a bolt movable axially relative to the barrel and formed with locking lugs rotatable with respect to the barrel; the improvement that comprises an extractor segment recessed within the breech of the barrel so as to form a part of the firing chamber, said extractor segment being axially movable from the barrel to extract a cartridge and having a radially-projecting lip, and means on the receiver assembly engageable behind the extractor lip when the locking lugs are rotatably disengaged preparatory to axial opening of the breech and thereafter actuating said extractor as the breech is opened.

6. In cartridge-firing apparatus having a barrel and receiver assembly movable axially relative to one another; the improvement that comprises said receiver assembly having a breech bolt formed with locking lugs which are rotatably engaged to lock the breech, an extractor segment recessed within the barrel for axial movement relative thereto, said barrel and extractor segment each forming a part of a firing chamber, and cooperating means on said extractor segment and said receiver assembly adapted for axial cooperation with one another when the breech bolt is rotated to disengage the locking lugs and unlock the breech preparatory to axial opening thereof, said means cooperating to actuate the extractor as the breech is opened.

7. In cartridge-firing apparatus having a receiver and a barrel mounted for axial movement relative to the receiver, the barrel being formed with a firing chamber; the improvement in an extractor comprising an axially movable element recessed within the barrel and forming a part of the chamber, a lifting ring circling the barrel adjacent the breech end thereof, said extractor having a lug overlying said lifting ring, and means on the receiver engaging said lifting ring upon opening of the breech to actuate said extractor element.

8. A powder-actuated apparatus having in combination a forepart including a barrel and a rear part including a breech block and firing pin, a hinge connecting said forepart and said rear part, an extractor segment recessed within said barrel with axial movement relative thereto, said extractor segment forming part of a firing chamber for receiving a cartridge, interlocking elements on said fore and rear parts for locking the fore part and rear part in firing position, said interlocking elements being relaitvely movable axially of the barrel between a position whereat movement about said hinge is prevented and another position whereat said movement of said hinge is permitted, said extractor having an actuator disposed in the path of movement of said rear part when the latter is moved about said hinge, and said actuator being disposed clear of the path of the relative movement in the axial direction of said fore part, whereby movement of said ejector occurs only upon movement about said hinge and movement about said hinge depends upon precedent movement in the axial direction.

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