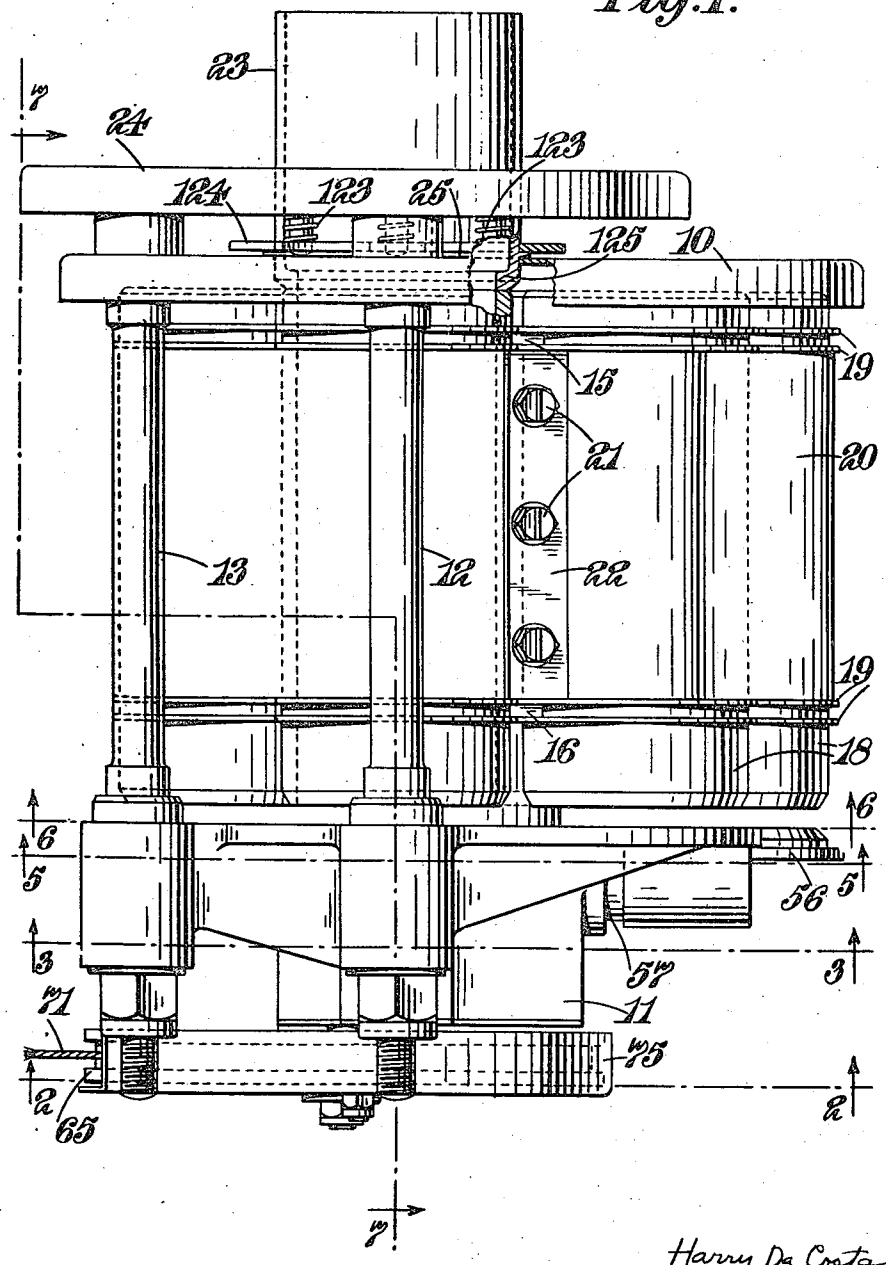
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CARTRIDGE FEED AND FIRING MECHANISM

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Fig. 1.



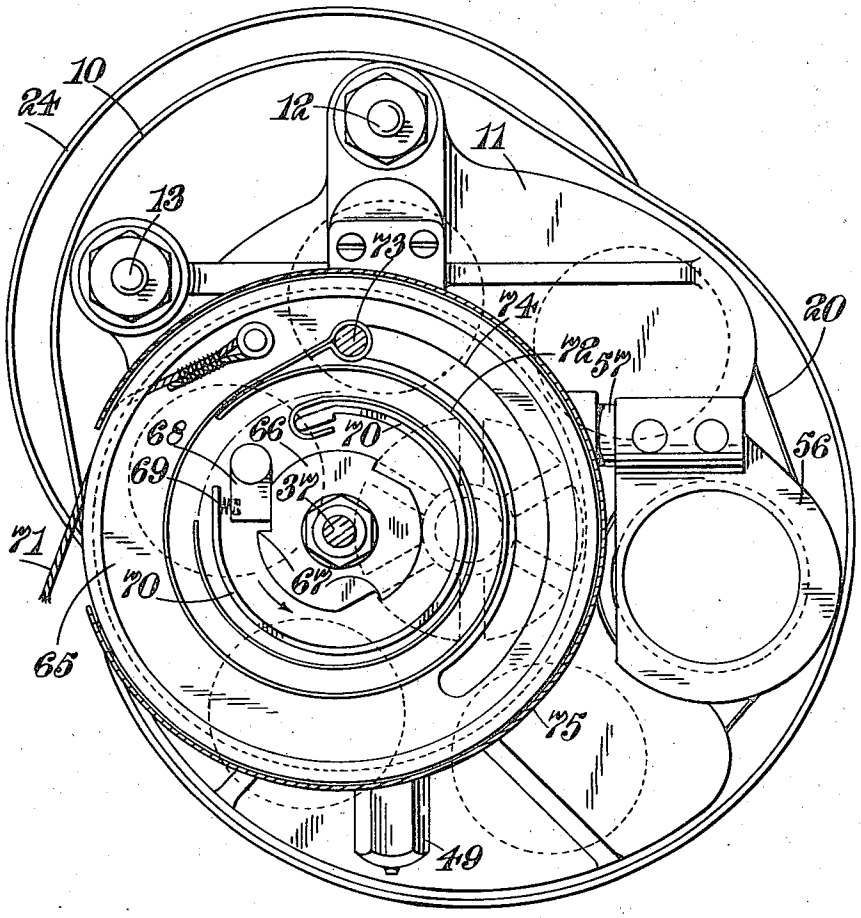
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by his attys
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CARTRIDGE FEED AND FIRING MECHANISM

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Fig. 2.



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CARTRIDGE FEED AND FIRING MECHANISM

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Fig. 3.

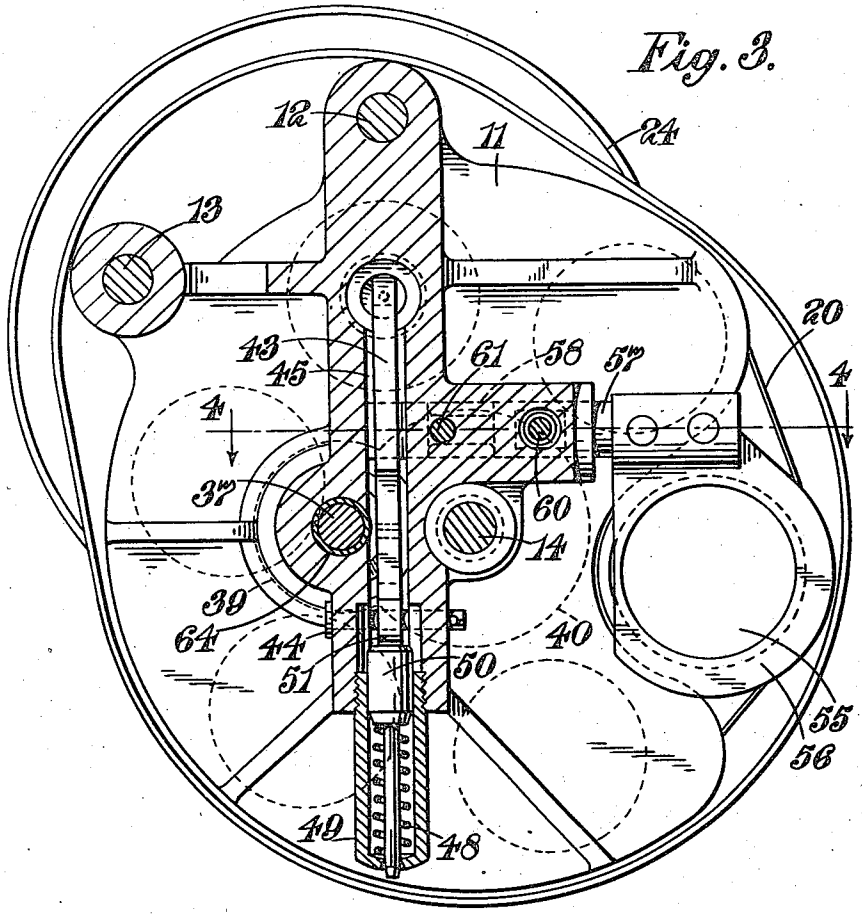
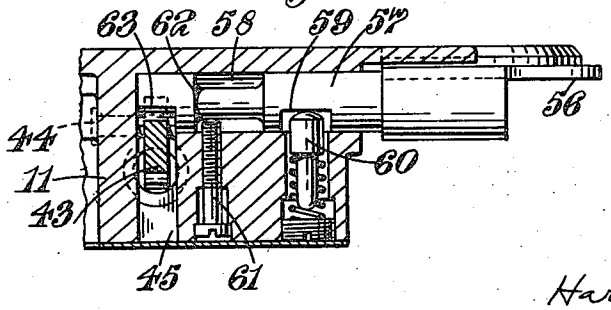


Fig. 4.



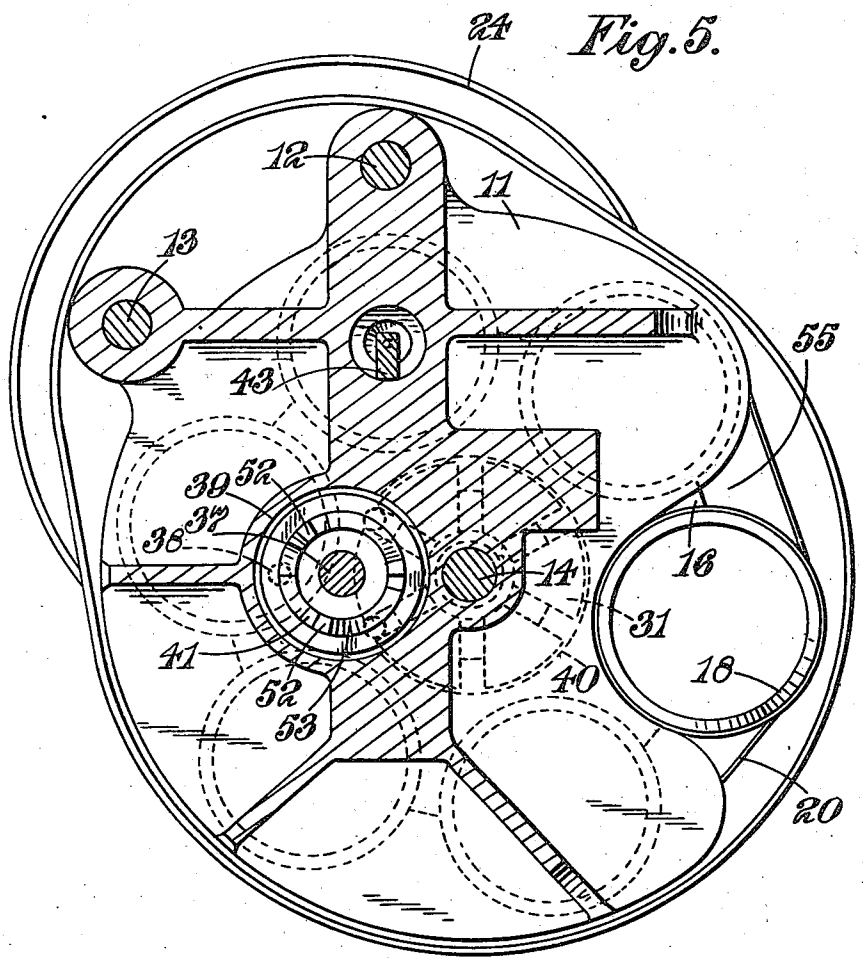
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CARTRIDGE FEED AND FIRING MECHANISM

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Fig. 5.



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CARTRIDGE FEED AND FIRING MECHANISM

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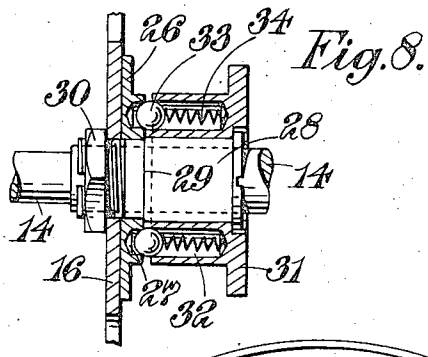


Fig. 8.

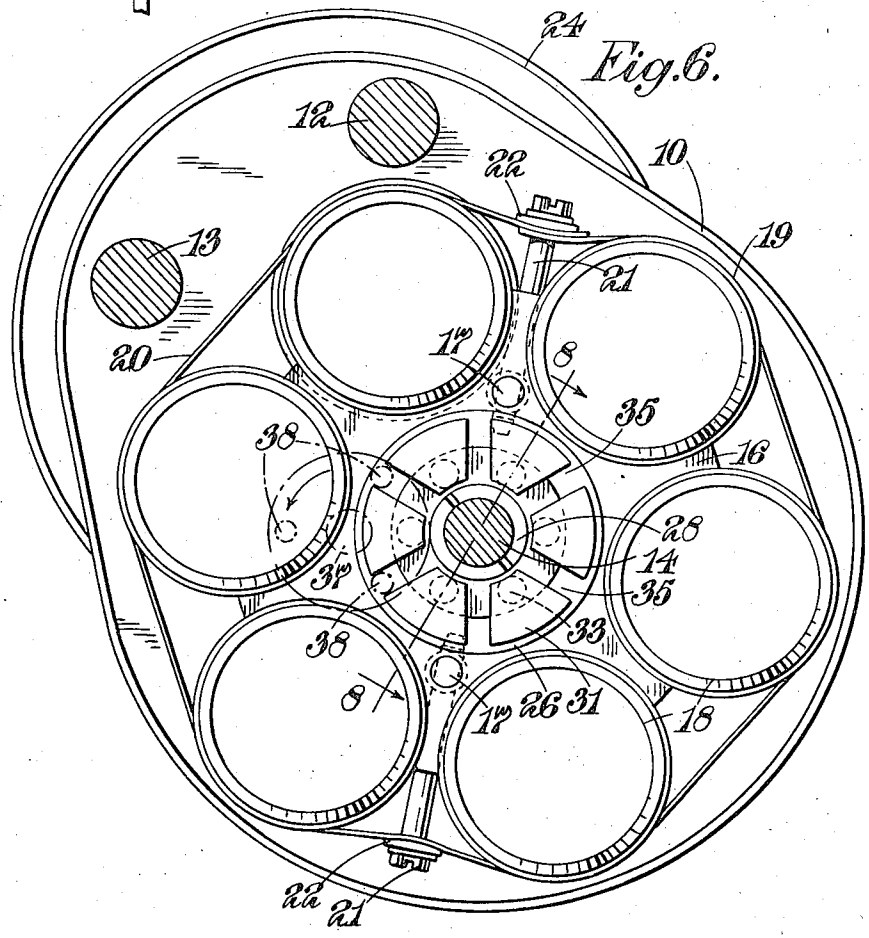


Fig. 6.

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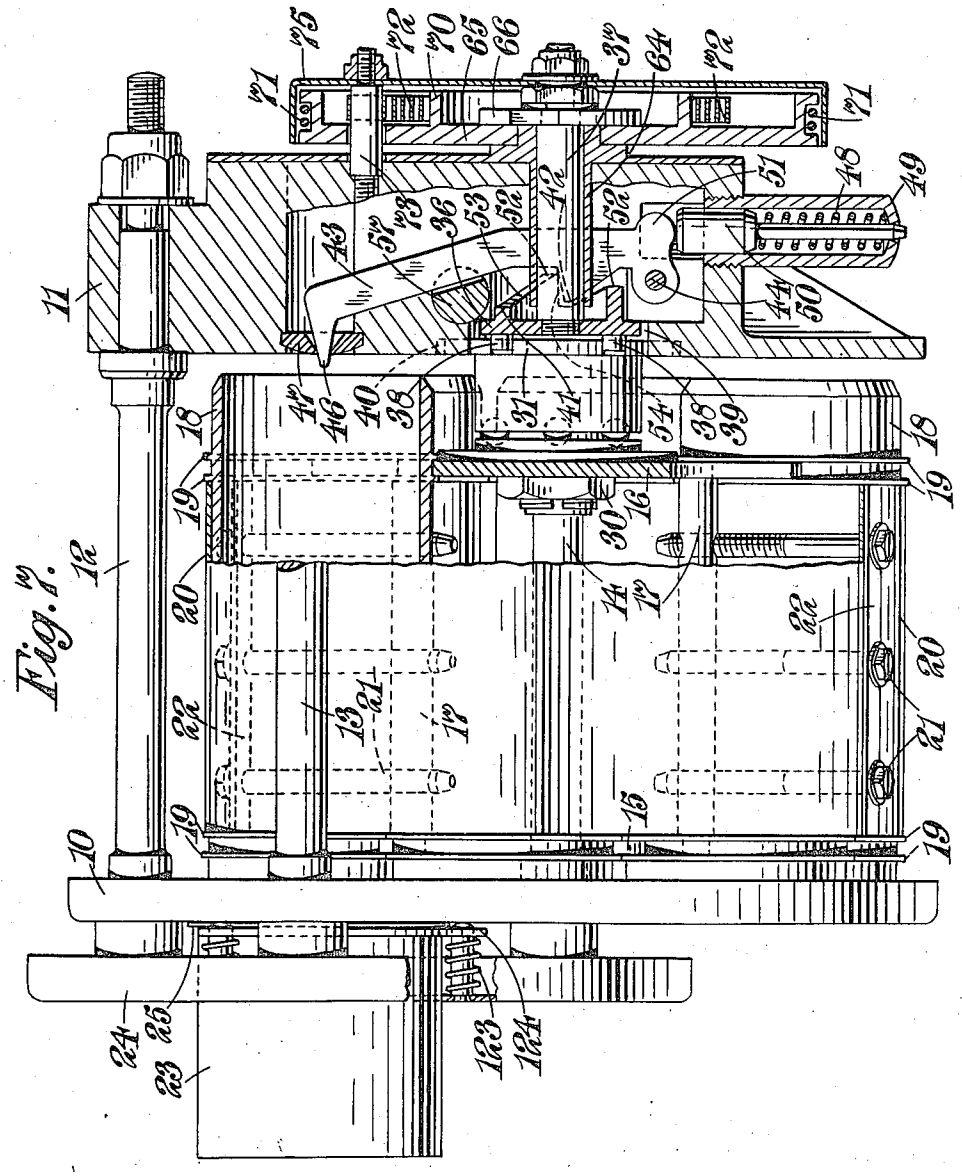


Fig. 6.

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CARTRIDGE FEED AND FIRING MECHANISM

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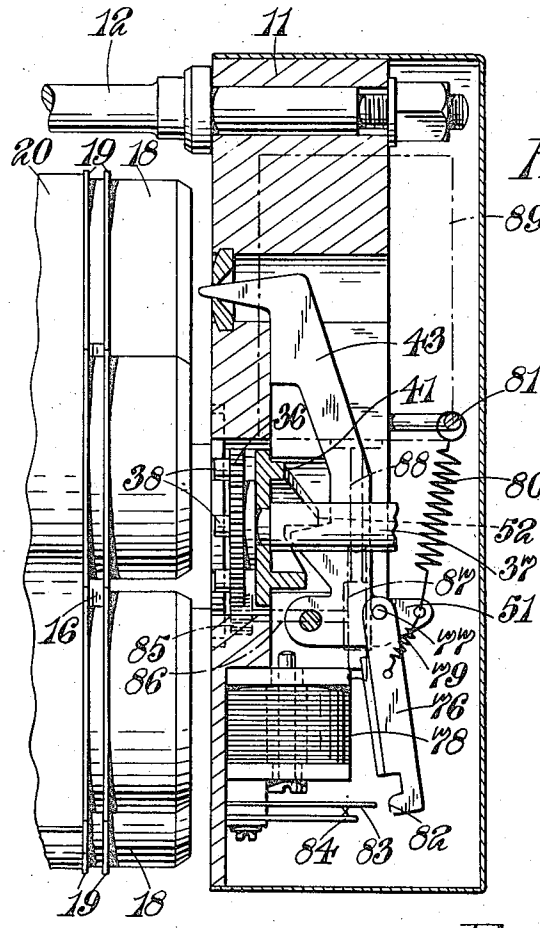


Fig. 9.

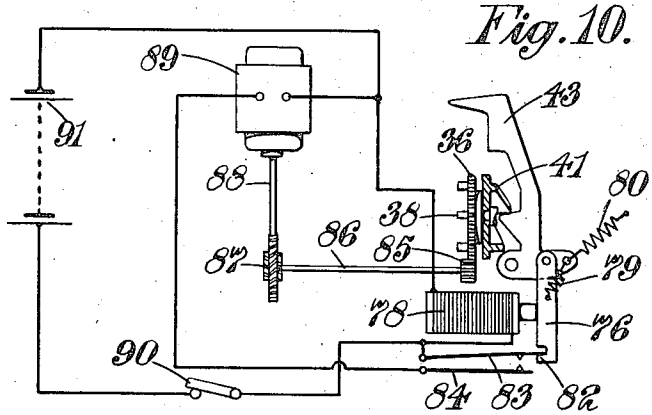


Fig. 10.

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UNITED STATES PATENT OFFICE

2,356,304

CARTRIDGE FEED AND FIRING MECHANISM

Harry da Costa, Ilford, England, assignor to The Plessey Company Limited, Ilford, Essex, England, a British company

Application January 25, 1941, Serial No. 375,967
In Great Britain September 11, 1939

11 Claims. (Cl. 89—13)

This invention relates to feed and firing mechanisms for signal cartridges, cartridge flares, engine starters and like cartridge firing apparatus.

According to the present invention there is provided a feed and firing mechanism as aforesaid comprising a rotary cartridge magazine and the rotary driving means for the cartridge magazine and operating through a step-by-step transmission device to bring the cartridges successively into firing position, a firing hammer and means operated by the rotary driving means for actuating the firing hammer between steps in the movement of the magazine. The step-by-step transmission device for the magazine preferably comprises a Geneva drive and the firing hammer is conveniently spring-loaded for movement to fire a cartridge and is withdrawn against the action of the spring by a rotary cam driven by the said rotary driving means. A feature of the invention consists in that the cam is directly interconnected with the driving element of the step-by-step transmission device for the magazine for rotation therewith. The cam and the step-by-step transmission device are preferably so inter-related that the firing hammer is released by the cam to fire a cartridge at the completion of a feeding movement of the magazine.

In one form the rotary driving means comprises a ratchet device for rotating the driving element of the step-by-step transmission device by successive identical operations for firing cartridges in succession. This ratchet device conveniently comprises a ratchet wheel which is rigid with the driving element of the step-by-step transmission device and a rotatably mounted operating member having a pawl engaging with the ratchet wheel. In this form the mechanism is suitable for manual operation by means of a cable secured to the operating member for turning it against the action of a spring.

In another form the rotary driving means comprises an electric motor and means is provided automatically to open the motor circuit on a firing movement of the hammer taking place. For the control of the motor there is preferably provided normally closed electric contacts in the motor circuit, an operating member for the contacts and an electro-magnet energised through a control switch in the motor circuit for moving the operating member into a position for opening the contacts, which operating motor is connected to the firing hammer so as to be moved thereby to open the contacts on a firing movement of the hammer taking place.

A further feature of the mechanism consists in that a frame member carrying the magazine has a charging opening with a movable cover and this cover is coupled to means for lifting the firing hammer clear of the cartridges to permit rotation of the magazine for re-loading. The magazine is preferably coupled to the driven member of the step-by-step transmission device through an over-ridable dog-clutch for the purpose of permitting rotation of the magazine for re-loading and to properly position the magazine with respect to the driven member of the step-by-step transmission device for rotation of the magazine by the rotary driving means in firing the cartridges.

A further feature of the mechanism consists in that the magazine comprises a plurality of cartridge chambers assembled on a rotatable carrier and secured thereon by means of a strap passing around the assembly of cartridge chambers.

According to a further feature of the invention there is provided a muzzle movable lengthwise in line with a cartridge chamber of the magazine in the firing position and spring means for urging the muzzle into engagement with the end of the cartridge chamber. Another feature of the invention consists in the provision of a muzzle which has an enlarged bore terminating with a neck of less diameter at its inner end for the purpose of producing a gaseous back pressure operative on the muzzle pressing it against the end of the cartridge chamber to effect a seal therewith when a cartridge is fired.

One specific construction of a gun for firing recognition signal cartridges and embodying the invention is shown by way of example in the accompanying drawings, in which:

Figure 1 is a plan of the gun constructed for manual operation;

Figure 2 is an end elevation partly in section on line 2—2 of Figure 1;

Figure 3 is a section on line 3—3 of Figure 1;

Figure 4 is a detail view and is a section on line 4—4 of Figure 3;

Figure 5 is a section on line 5—5 of Figure 1;

Figure 6 is a section on the line 6—6 of Figure 1;

Figure 7 is an elevation partly in section on line 7—7 of Figure 1;

Figure 8 is a detail view of the over-ridable dog-clutch;

Figure 9 is an elevation partly in section show-

ing a modification for electrical operation, and Figure 10 is a circuit diagram.

Referring to Figures 1 to 8 of the drawings, the rotary magazine is carried by a rigid frame formed of a front plate 10 and a rear plate 11, interconnected by stays 12, 13 and 14, the stay 14 constituting a spindle on which the magazine rotates. The magazine comprises two spiders 15 and 16 connected by bars 17, the spiders being formed with a scalloped periphery to receive six cartridge chambers 18. These cartridge chambers are formed with a pair of ribs 19 at each end in which the spiders are located. A metal strap 20 passes around the assembly of cartridge chambers and serves to hold them secured to the spiders. The strap 20 is placed under tension by means of studs 21 passing through stiffening strips 22 and the strap 20 and screw-threaded in the bars 17. For the firing position each cartridge chamber 18 is positioned in line with an opening in the front plate 10 in which is located a muzzle 23 carried also in an opening in an outer plate 24 mounted on the plate 10. The muzzle is movable lengthwise in the openings in the plates 10 and 24 and is pressed inwardly by means of springs 123 bearing on a thrust plate 124 resting against a flange 25 on the muzzle. The inward movement of the muzzle is restricted by the flange 25 coming to rest on the plate 10. The muzzle is of larger internal diameter than the cartridge chamber and is formed with a neck 125 of smaller diameter and conveniently of the same diameter as the cartridge chamber. Thus when a cartridge is fired a gaseous back pressure is produced on the muzzle serving to press it against the end of the cartridge chamber to effect a seal.

On the spider 16 there is secured an index plate 26 formed with a plurality of equally spaced recesses 27. A bearing sleeve 28 has a shoulder 29 bearing on the index plate 26 and is secured to the spider 16 by means of a nut 30 screw-threaded on this sleeve. A member 31 is rotatably mounted on the sleeve 28 and has recesses 32 spaced in the same way and opposite to the recesses 27 in the index plate 26. Balls 33 carried in the recesses 32 are pressed outwardly by means of springs 34 to engage in the recesses 27 so as to provide an over-ridable ball clutch or index device giving a definite location of the magazine with respect to the member 31 so long as the balls 33 remain engaged in the recesses 27 of the index plate.

The member 31 constitutes the driven member of a Geneva drive for the magazine and is formed with six equally spaced radial slots 35, as shown more particularly in Figures 5 and 6. The driving member of this Geneva drive consists of a disc 36 carried on a rotatably mounted spindle 37 offset from the stay 14 and having three equally spaced laterally extending pins 38 arranged to enter into the slots 35. The driving and driven elements of the Geneva drive are carried in recesses 39 and 40 respectively in the rear plate 11.

The driving element 36 of the Geneva drive is formed with a cam face 41 co-operating with a nose 42 on a firing hammer 43. The firing hammer 43 is mounted on a pivot pin 44 for movement in a cross-slot 45 in the rear plate 11. The firing hammer 43 is urged towards the firing position, as shown in Figure 7, in which a hammer point 46 projects through a ferrule 47 in the rear plate 11, by means of a spring 48 located in a housing 49 secured to the rear plate 11 and bearing on a plunger 50 which in turn bears on a heel 51 of the firing hammer.

The cam face 41 has three equally spaced projections 52, each consisting of a gradual rise 53 at the leading side and a steep drop 54 at the trailing side of the projection.

In the normal at-rest position of the mechanism the nose 42 of the firing hammer lies immediately behind the steep drop 54 of a cam projection, as shown in Figure 7, so that the firing pin 46 is in the fully projected position. Also, two pins 38 of the Geneva drive are engaged in slots 35, as shown in Figure 6. For operating the mechanism the spindle 37 is turned through one-third of a revolution. During this movement the firing hammer is raised by the sloping surface 53 of the next cam projection 52. The spindle 37 is coupled to the magazine through a 2 to 1 gear-ratio by means of the Geneva drive so that the rotation of the spindle 37 turns the magazine through one-sixth of a revolution to bring the next cartridge chamber into line with the firing point. When this position is reached the nose of the firing hammer passes over the projection 52 of the cam and the hammer is projected forwardly by the spring 48 to fire the cartridge. The Geneva drive is such that the rate of movement of the magazine is zero, or substantially zero, at the position of a cartridge chamber for firing, so that when a firing operation is initiated the firing point 46 is freed from the cartridge before the magazine commences to move. In place of the Geneva drive shown in the drawings other forms of Geneva drive may be employed to provide the step-by-step transmission, for instance, a Geneva stop motion may be provided having interfitting and sliding stop surfaces, especially should it be desired to increase the rest period of the magazine between each feeding step.

The ends of the cartridge chambers 18 are masked by the rear plate 11 which has an opening 55 for re-loading purposes, this opening coinciding with one of the cartridge chambers 18 when another of them is in the firing position. The opening is provided with a cover 56 which is carried on a spindle 57 rotatable in a bore 58 in the rear plate 11, as shown in Figures 3 and 4. The spindle is retained in the bore 58 by means of a stud 61 in the rear plate and engaging behind a shoulder 62 of the spindle. The spindle is formed with a flat 59 with which engages a spring-loaded plunger 60 serving resiliently to retain the cover 56 in the closed position. The spindle 57 is provided with a transverse recess 63 so arranged that when the cover is closed this recess receives the hammer when in its firing position. When the cover is lifted for re-loading purposes the spindle 57 is turned so as to lift the hammer 43 and thus retract the firing point 46 to permit the magazine to be rotated without the cartridges fouling the firing point. The over-ridable dog clutch constituted by the index plate 26 of the engaging balls 33 transmits the drive to the magazine without slipping. For loading purposes, however, the magazine is rotated without operating the firing mechanism by causing the index plate 26 to override the balls 33 but is subsequently set in correct relationship with the cam surface 41 by the re-engagement of the balls 33 with the recesses of the index plate.

The spindle 37 is rotatably mounted in a sleeve 64 carried by the rear plate 11. The sleeve extends beyond the outer surface of the rear plate 11 and constitutes a bearing for a rotatable disc-like operating member 65. At the outer side of this operating member a ratchet wheel 66 is secured on the spindle 37. The ratchet wheel 66

has three equally spaced teeth 67 co-operating with a pawl 68 pivoted on the operating member and urged towards the ratchet wheel by means of a spring 69 interposed between the pawl and an abutment 70 on the operating member. The operating member is arranged to be turned by means of a cable 71 against the action of a coiled return spring 72, this spring being anchored at one end over an end of the abutment 70 and at the other end on a stud 73 secured in the rear plate 11. The stud 73 projects through an arcuate slot 74 in the operating member 65, the length of this slot determining the limit of movement of the operating member through a distance somewhat greater than one-third of a revolution. A fixed cover 75 for the operating member is located by passing over the outer end of the spindle 37 and is fixed in position on the stud 73. Thus, for operation of the mechanism the cable 71 is pulled to turn the operating member so that by means of the pawl 68 and ratchet wheel 66 the spindle 37 is turned through one-third of a revolution. The cable 71 being allowed to return the operating member 65 falls back under the action of the spring 72 preparatory to a subsequent similar operation of the mechanism in which the pawl 68 engages the next tooth 67 and the ratchet wheel 66.

In the modified arrangement shown in Figures 9 and 10, the mechanism is operated electrically. In this case a contact operating member consisting of an arm 76 is pivoted at 77 on the heel 51 of the firing hammer 43. This operating member constitutes an armature for an electro-magnet 78 and is normally held away from the magnet by a spring 79. The firing hammer is propelled by a tension spring 80 connected between the heel 51 and an anchorage 81 on the rear plate 11. The arm 76 is formed with a nose 82 for operating a pair of contacts 83, 84.

The driving member 36 is in this case formed as a gear-wheel but it is integral, as in the preceding construction, with the cam face 41. This gear-wheel is in mesh with a pinion indicated at 85 carried on a spindle 86 which is coupled by means of a worm and wormwheel indicated at 87 with the spindle 88 of an electric motor indicated at 89. As shown in Figure 10, the motor 89 is connected in series with the contacts 83 and 84 and a control switch 90 across a battery 91, and the electro-magnet 78 is connected in parallel with the motor 89 and the contacts.

In the normal at-rest position the parts are located in the manner shown in Figure 9 in which the contacts 83 and 84 are closed. For operation of the mechanism the control switch 90 is closed, thus completing a circuit through the electro-magnet 78 and through the motor 89. On the magnet being energised the arm 76 is attracted and the nose 82 is engaged on the end of the contact 83. The motor rotates the driven element 36 of the Geneva drive so that the cam surface lifts the firing hammer 43. The arm 76 is in consequence moved lengthwise so that the nose 82 is engaged behind the contact 83. By the firing movement of the hammer the arm 76 is displaced and as the nose 82 is engaged behind the contact 83, this contact is separated from the co-operating contact 84, as shown in Figure 10, thus opening the circuit of the motor 89. The electro-magnet 78 remains energised while the control switch 90 remains closed. When the control switch is opened to de-energise the electro-magnet 78 the arm 76 is retracted by the spring 79 and the contacts 83 and 84 are again closed in readiness for a subsequent firing operation. It will be seen therefore that the control switch 90 has to be closed for each firing operation and opened before the next firing operation can be initiated.

Whereas the invention for example in the specific form hereinbefore described with reference to the accompanying drawings, is especially adapted for firing signal cartridges, flares or the like, it is also applicable for firing cartridges for other purposes, including the production of high gas pressures for pressure-operated devices, such as starters for internal-combustion engines.

I claim:

1. A feed and firing mechanism for signal and like cartridge-firing apparatus comprising in combination a frame, a cartridge-magazine having a plurality of cartridge-chambers and rotatable about a fixed axis in said frame, a driving spindle, a driving member carried thereby and comprising the driving element of a Geneva transmission device, the driven element of which is mounted to rotate with the cartridge-magazine about an axis spaced from that of the driving spindle, a firing hammer spring-loaded towards the firing position, a rotary hammer-actuating cam-member also rotatable on said driving spindle and having a plurality of cams so proportioned in number to the gear ratio of the Geneva transmission device that the firing hammer will operate successively on cartridges contained in the said cartridge chambers as the same are brought into the firing position and while the cartridge-magazine is held stationary by the transmission device, and driving means for the driving spindle.

2. A feed and firing mechanism according to claim 1, in which the driving means for the driving spindle comprises a motor for imparting continuous rotation to the spindle in combination with means to control the operation of the motor.

3. A feed and firing mechanism according to claim 1 in which the driving means for the driving spindle comprises a driving spring, a pawl and ratchet mechanism coupling the driving spring to the driving spindle in order to impart under the action of the spring a uni-directional drive to the spindle, and rotatable winding means to load the spring and to impart this load through the spring to the pawl and ratchet device to turn the driving spindle.

4. A feed and firing mechanism according to claim 1 in which the driving means for the driving spindle comprises a ratchet wheel rigid with the driving spindle, a ratchet carrying member rotatable about the axis of the driving spindle, a driving spring, one end of which is anchored to the ratchet carrying member, and the other of which is anchored to a fixed stop, and means to turn the ratchet carrying member to load the spring.

5. A feed and firing mechanism according to claim 1 in which the driving means for the driving spindle comprises a ratchet wheel rigid with the driving spindle, a ratchet carrying member rotatable about the axis of the driving spindle, a driving spring, one end of which is anchored to the ratchet carrying member, and the other end of which is anchored to a fixed stop, means to turn the ratchet carrying member to load the spring, and means to limit the degree of angular movement imparted to the ratchet carrying member during the loading of the spring.

6. A feed and firing mechanism according to

claim 1 in which the driving means for the driving spindle comprises an electric motor carried on the said frame, and means coupling the electric motor to the driving member of the Geneva transmission mechanism.

7. A feed and firing mechanism according to claim 1 in which the driving means for the driving spindle comprises an electric motor carried on the same frame, means coupling the electric motor to the driving member of the Geneva transmission mechanism, a motor energizing circuit, a normally closed circuit interrupting switch in the motor energizing circuit, and means operatively connecting the firing hammer with said interrupting switch to open the circuit by a firing movement of the hammer.

8. A feed and firing mechanism according to claim 1 in which the driving means for the driving spindle comprises an electric motor carried on the said frame, means coupling the electric motor to the driving member of the Geneva transmission mechanism, a motor energizing circuit, a normally closed circuit interrupting switch in the motor energizing circuit, and means operatively connecting the firing hammer with said interrupting switch, said operative connection comprising an electromagnet, an armature therefor pivoted to the hammer to swing into and out from engagement with the interrupting switch, an energizing circuit for the electromagnet, and a switch for controlling the last-named energizing circuit.

9. A feed and firing mechanism according to claim 1 having an opening in the frame for charging the magazine chambers, a movable cover for said opening and mounted independently of the firing hammer, and means coupled to said cover for lifting the firing hammer clear of the cartridges in the magazine when the cover is opened.

10. A feed and firing mechanism according to claim 1 having an opening in the frame for charging the magazine chambers, a movable cover for said opening and mounted independently of the firing hammer, means coupled to said cover for lifting the firing hammer clear of the cartridges in the magazine when the cover is opened, and an overridable positioning clutch between the Geneva transmission device and the rotary magazine.

11. A feed and firing mechanism according to claim 1 in which the cartridge chambers are assembled on a carrier formed with radial recesses in which portions of the peripheries of the chambers are received, in combination with a strap passing round the chambers to secure them in the carrier recesses.

HARRY DA COSTA.