United States Patent [19]

Chiabrandy

[11] **3,875,812**

[45] **Apr. 8, 1975**

[54] **FEEDER DRIVE**

[75] Inventor: **Robert E. Chiabrandy**, Burlington, Vt.

[73] Assignee: **General Electric Company**, Burlington, Vt.

[22] Filed: **Apr. 4, 1973**

[21] Appl. No.: **347,754**

Related U.S. Application Data

[62] Division of Ser. No. 206,774, Dec. 10, 1971, Pat. No. 3,766,824.

[52] **U.S. Cl.** **74/88;** 74/575; 74/577

[51] **Int. Cl.** **F16h 27/02**

[58] **Field of Search** ..... 74/88, 30, 578, 577, 89/33 BC, 33 CA

[56] **References Cited**

UNITED STATES PATENTS

1,075,311	10/1913	Beck	74/578
1,375,135	4/1921	Dean	74/30
1,381,046	6/1921	Winegarden	74/30
2,276,913	3/1942	Ashworth	74/578
2,821,861	2/1958	Dunn	74/30
3,596,556	8/1971	Montana	89/33 SF

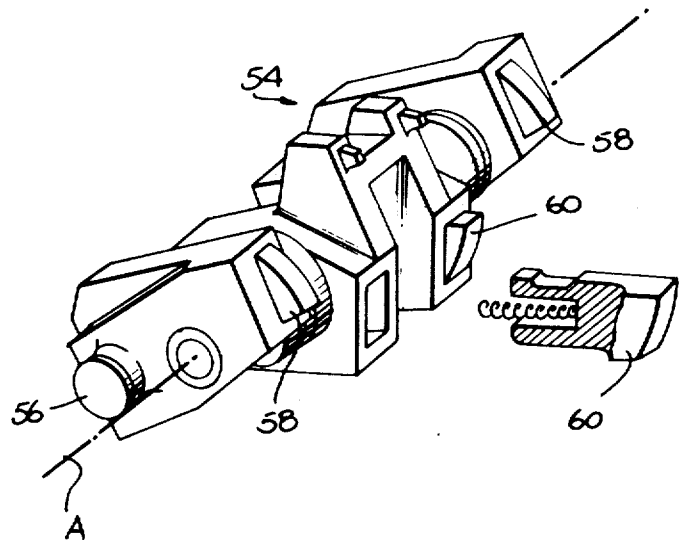
Primary Examiner—Wesley S. Ratliff, Jr.

Attorney, Agent, or Firm—Bailin L. Kuch

[57] **ABSTRACT**

Machine gun feeder drive is provided with two oppositely driven pawls, each for driving a ratchet, which ratchet has the same number of teeth as the feeder sprocket, and which pawls have the midpoints of their respective strokes, with respect to the axis of the driven ratchet as viewed in a plane normal to said axis, separated by an angular distance equivalent to an odd number of half-tooth spaces of the driven ratchet. The aforementioned feature causes the drive mechanism to have the characteristic that it may be assembled at any initial position, and will, at the end of one complete cycle of the driving pawls, have been moved into properly synchronized position.

6 Claims, 10 Drawing Figures



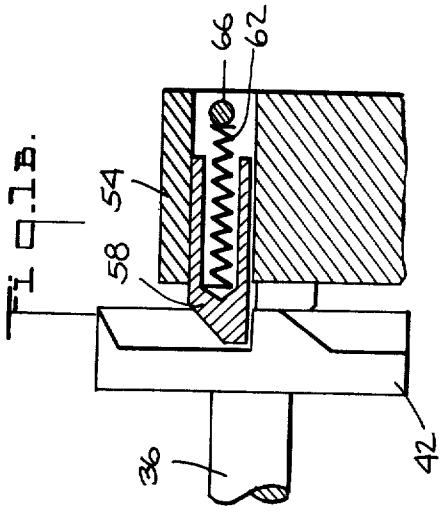


Fig. 1B.

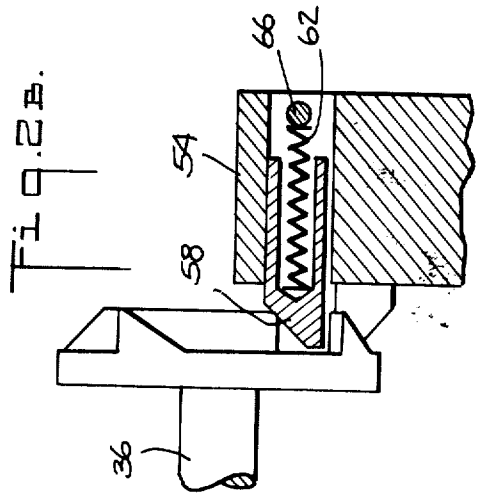


Fig. 2B.

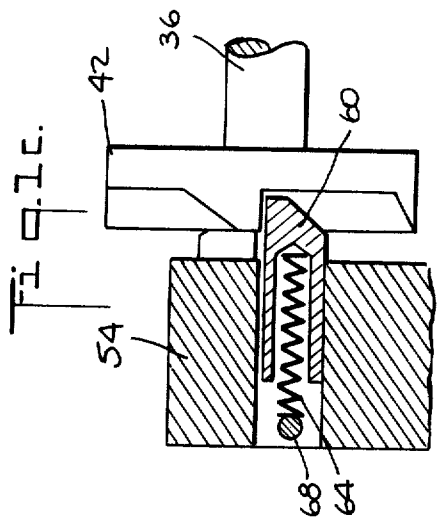


Fig. 1C.

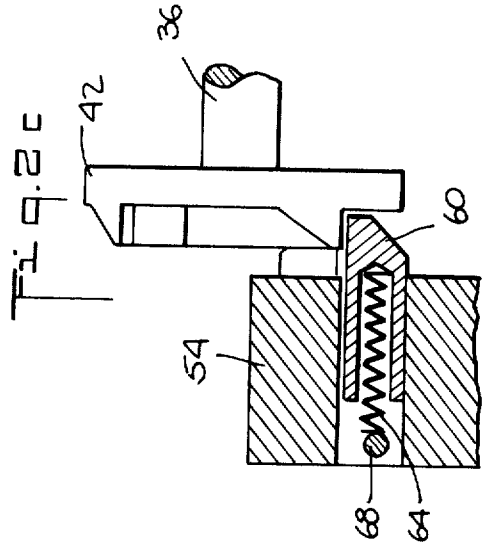


Fig. 2C

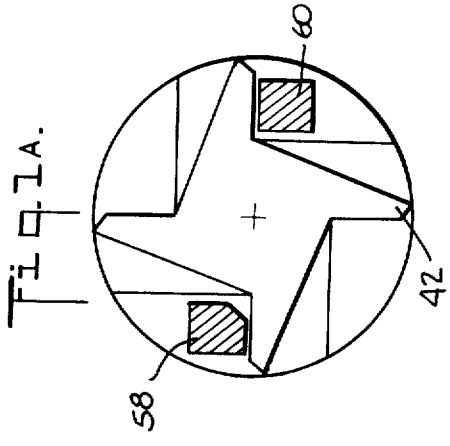


Fig. 1A.

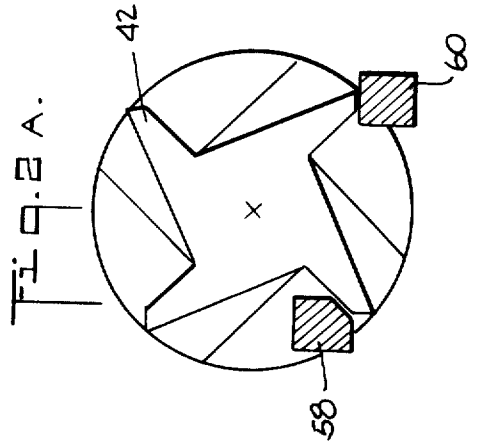


Fig. 2A.

Fig. 3A.

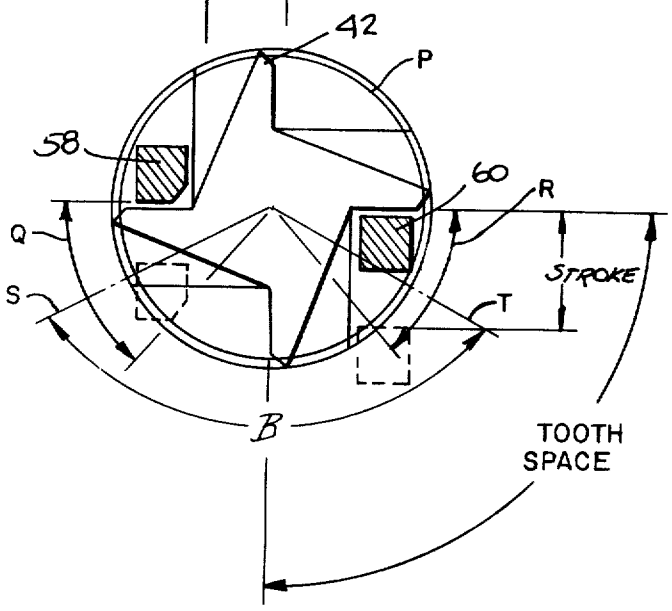
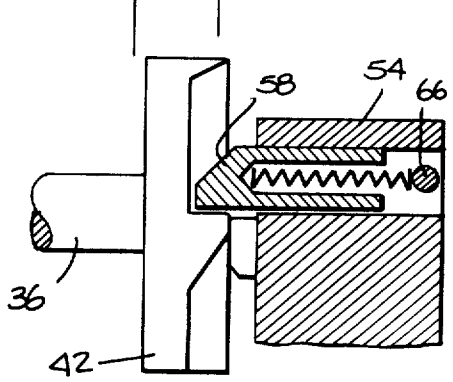


Fig. 3B.



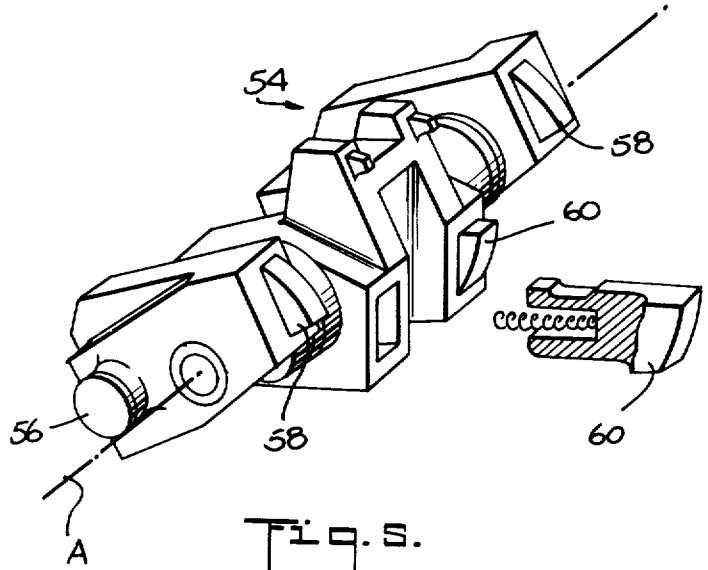


Fig. 5.

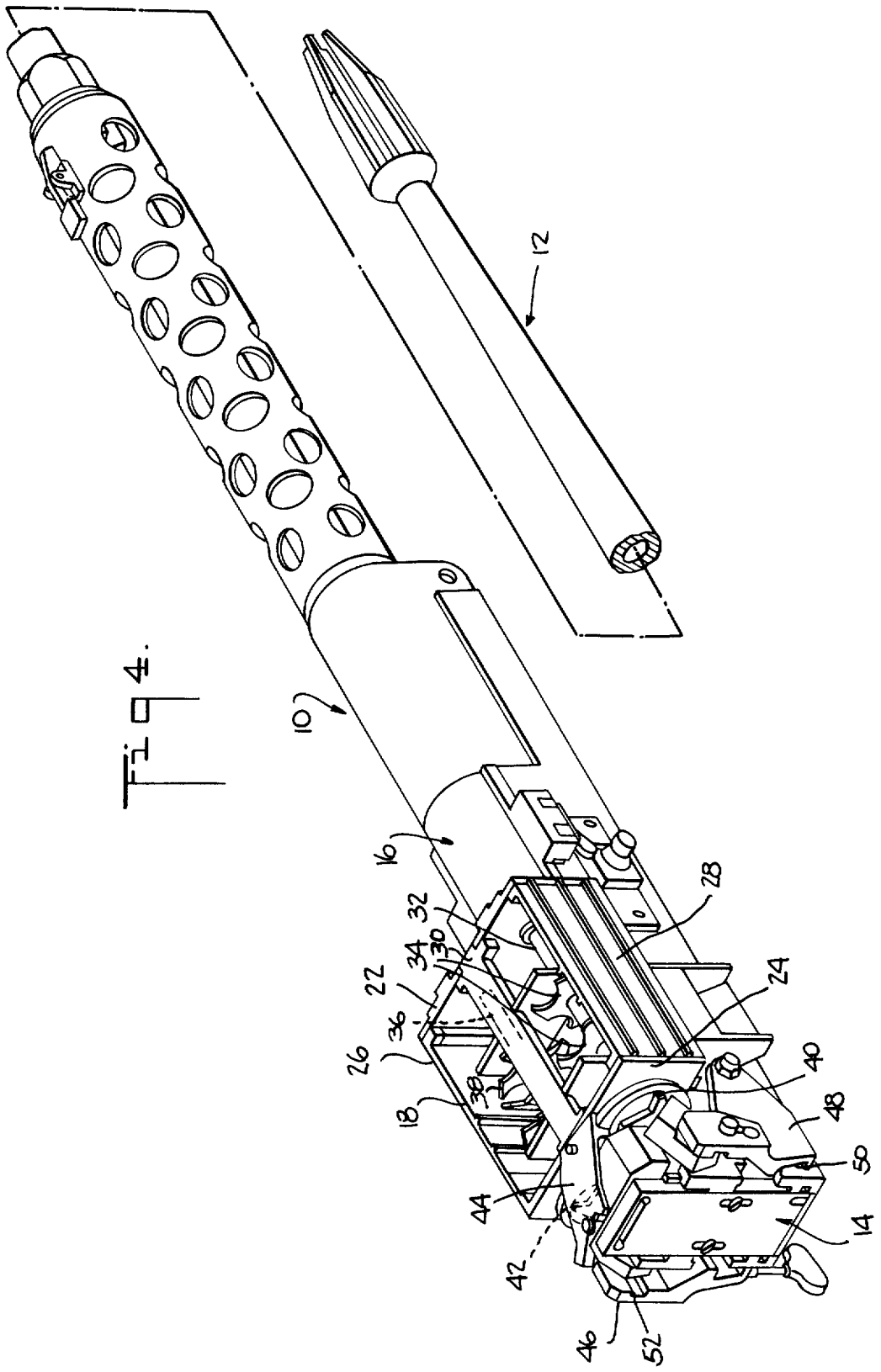


Fig. 4.

FEEDER DRIVE

This is a division of application Ser. No. 206,774, filed Dec. 10, 1971, now U.S. Pat. No. 3,766,824, issued Oct. 23, 1973.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to automatic and semiautomatic guns having a reciprocating breech which drives a cartridge feed mechanism.

2. Description of the Prior Art

A machine gun having a crank shaft driving a feeder, and a linkage coupling the shaft to the barrel extension, whereby gun recoil rotates the shaft to drive the feeder one increment in the feed direction and gun counterrecoil rotates the shaft to drive the feeder another increment in the feed direction, is disclosed by A. L. Montana in U.S. Patent No. 3,596,556, issued Aug. 3, 1971. Specifically, a ratchet mechanism is used to operate the feeder sprockets, which are advanced approximately one-half of a tooth pitch during gun recoil and the remainder of the full tooth pitch during counterrecoil. In order to accomplish this function, a ratchet having twice as many teeth as the number of teeth on the feeder sprocket is utilized. While this design admirably fulfills its purpose, it is possible, if the feeder is improperly assembled to the gun, or if a short counterrecoil stroke occurs which fails to complete the drive of the feeder through its one-half tooth rotation, that the two drive pawls for the ratchet wheel will reverse their functions and continue to drive the feeder into a nonsynchronous position, leading to an interruption of gun function. It may be noted that exemplary spring driven and overrunning clutch type drives are shown in U.S. Pat. Nos. 3,277,787, 3,417,657, and 2.821,887.

BRIEF SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide an autosynchronizing ratchet drive for a gun of the type shown in U.S. Pat. No. 3,596,556, supra, which is immune to mis-timing due to a short recoil stroke, and is substantially idiot-proof in assembly.

A feature of this invention is the provision of two oppositely driven pawls, each for driving a ratchet, which ratchet has the same number of teeth as the feeder sprocket, and which pawls have the midpoints of their respective strokes, with respect to the axis of the driven ratchet as viewed in a plane normal to said axis, separated by an angular distance equivalent to an odd number of half-tooth spaces of the driven ratchet. The aforementioned feature causes the drive mechanism to have the characteristic that it may be assembled at any initial position, and will, at the end of one complete cycle of the driving pawls, have been moved into properly synchronized position.

BRIEF DESCRIPTION OF THE DRAWING

These and other objects, features, and advantages of the invention will be apparent from the following specification thereof, taken in conjunction with the accompanying drawing in which:

FIGS. 1A, 1B and 1C are end, left and right views of a pawl and ratchet wheel assembly embodying this invention which may be incorporated into a gun of the type shown in U.S. Pat. NO. 3,596,556, supra, showing

the driving pawls at the upper extreme of their operating strokes;

FIGS. 2A, 2B and 2C are similar views showing the driving pawls at the lower extreme of their operating strokes;

FIGS. 3A, and 3B are similar views showing the midpoints of the operating strokes of the driving pawls;

FIG. 4 is a perspective view of a gun of the type shown in U.S. Pat. No. 3,596,556; and

FIG. 5 is a perspective view of the crank carrying the driving pawls.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A gun adapted to incorporate this invention is shown in greater detail in U.S. Pat. No. 3,596,556. Briefly, as seen in FIG. 4, the gun includes a stationary receiver 10; a barrel and barrel extension assembly 12; a bolt, a bolt accelerator, and a buffer and a sear assembly, not visible; a backplate assembly 14; a locking cam assembly 16, a feeder assembly 18; two barrel recoil spring assemblies, not shown; and a bolt recoil spring assembly, not shown.

The feeder assembly 18 includes a front wall 22, a rear wall 24, a left wall 26, a right wall 28, a top plate 30 and a bottom plate, not visible, having a central cartridge-passing slot therein. A right shaft 32 having two four-tooth sprockets 34 is journaled through the front and rear walls, and a mirror symmetric left shaft 36 with two four-tooth sprockets 38 is similarly provided. A right four-tooth ratchet wheel 40 is splined to and longitudinally movable on the right shaft 32, and a left four-tooth ratchet wheel 42 is splined to and longitudinally movable on the left shaft 36. A crank assembly 44 is coupled to the wheels 40 and 42 to alternatively move one wheel forward on its respective shaft, and the other wheel aft on its respective shaft.

A left feed cam plate 46 and a right feed cam plate 48 are respectively pivotally mounted to the left and right side walls of the rear portion of the receiver. Each cam plate has a respective cam slot 50 to receive a respective drive roller, not visible, mounted on the barrel extension. Each cam plate has a travel limiting slot which receives a limit pin fixed to the respective side wall. Each cam plate also has a cam slot 52 for oscillating about an axis A a crank shaft 54 which is journalled through the side walls of a receiver and which has end cam pins 56 respectively mating with the two cam slots 52. The crank shaft carries two, outer, spring loaded, downwardly driving pawls 58 and two, inner, spring loaded, upwardly driving pawls 60 for driving the feeder assembly. Alternatively, the left pawls 58 and 60 can engage and drive the left ratchet wheel 42, or the right pawls 58 and 60 can engage and drive the right ratchet wheel 40.

It is apparent, that if an odd number of teeth are provided on the feeder sprocket, and, therefore, an odd number of teeth are provided on the ratchet wheel, these two driving pawls, the centers of whose driving strokes lie in a plane which includes the axis of the ratchet wheel, cannot reverse their roles, since, except when the feeder is in a synchronous position, only one drive pawl can find a ratchet tooth available at any point in its operating cycle. Such a drive assembly, therefore, is an autosynchronizing feeder drive.

When spaced limitations make it impractical to use an odd number of teeth on the feed drive ratchet, how-

ever, the mechanism can still be made auto-synchronizing by displacing the driving pawls so that the midpoints of their respective strokes with respect to the axis of the drive ratchet as viewed in the plane normal to said axis are separated by an angular distance equivalent to an odd number of half-tooth spaces of the drive ratchet wheel.

This is accomplished by either raising or lowering the feed drive rocker shaft axis of oscillation A, so that it does not lie in the plane which includes the axis of the feeder shafts **32, 36.**

Such a driving mechanism is shown in FIGS. **1** and **2.** FIGS. 1A, 1B and 1C show the driving pawls **58** and **60** at the upper extreme of the rocker shaft operating stroke and FIGS. 2A, 2B and 2C show the pawls at the lower extreme of the rocker shaft operating stroke. FIGS. 3A and 3B illustrate the principle that the midpoints of the operating strokes of the two driving pawls are separated by an angular distance equal to an odd number of half-tooth spaces. For the four-tooth ratchet shown (driving a four-tooth sprocket) the angle B is 135°, or one and one-half ratchet tooth spaces.

The principle may be more clearly observed by considering the ratchet wheel and the driving pawls as elements which act in a polar coordinate system whose pole is located at the axis of the ratchet wheel, since the effective strokes of the driving pawls are functions of the shapes of the contacting surface, as well as functions of the movement of the pawls. If a pitch circle P is assumed for reference purposes in FIG. 3A, we may observe the vertical strokes of the driving pawls **58** and **60** as their respective angular equivalents Q and R. The midpoints of said angular equivalents of the driving strokes are seen to lie on rays S and T, and to be separated by an angle B, said angle B being equivalent to, in this embodiment, one and one-half tooth spaces of the ratchet wheel.

In FIGS. 1A, 1B, 1C, 2A, 2B, 2C the ratchet wheel **42** is supported by the shaft **36** which extends to drive the ammunition feed sprockets **38.** Aft of the ratchet wheel is the drive pawl supporting member, which is the rocker shaft **54,** which by the action of the gun mechanism is caused to move upward during the counter-recoil motion of the gun mechanism, and downward during the recoil stroke of the gun mechanism. Mounted on the rocker shaft are two driving pawls, the left pawl **58** and the right pawl **60,** which are urged against the toothed face of the ratchet wheel **42** by springs **62** and **64** respectively in cooperation with retaining means **66** and **68.**

Thus it will be seen that the mechanism is autosynchronous, since the driving pawls cannot reverse their functional roles even if the ratchet wheel is placed in an initial out-of-time position.

Generally, the proper function of the feeder requires only that it be in proper synchronism with the bolt at the end of the recoil stroke.

In an ideal ratchet drive mechanism in which a portion of the feeder drive is accomplished during recoil and the remainder during counter-recoil, the sum of the strokes of the two driving pawls would be precisely equal to one tooth pitch of the driven ratchet, and the centers or midpoints of the strokes of the two pawls would be separated by precisely an odd integer multiple of one-half ratchet tooth spaces.

In a real ratchet mechanism, however, mechanical errors in positions and dimensions of component parts, as well as intentional deviation from the rule that the mid-points of the strokes of the driving pawls are separated by precisely an odd integer multiple of one-half tooth spaces can be accommodated by an increase in the length of stroke of either or both of the driving pawls. In no case, however, may the stroke of the pawl which drives during gun recoil be increased to as much as one tooth of the ratchet, nor may the stroke of the pawl which drives during gun counter-recoil be increased to as much as two teeth of the ratchet. Should either stroke be increased beyond the aforementioned limit, it would become possible for the drive mechanism to attempt to drive a round of ammunition beyond the ramming position in the feeder following a random positioning of the mechanism after assembly and loading. The drive mechanism would be jammed, in the case of a feeder with positive cartridge stops at the ramming position, or would eject a round of live ammunition from the feeder should no such stops be present.

There is, therefore, a wide range over which the strokes of the driving pawls can be varied without interfering with the intent of this invention.

While a preferred embodiment has been herein shown and described, it will be obvious that certain changes in the form and arrangement of the parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention with the scope of the appended claims.

What is claimed is:

1. An auto-synchronizing drive assembly, comprising:

a cyclically reciprocating driving means having a recoil stroke and a counter-recoil stroke within each cycle;

a unidirectionally driven means coupled to and driven by said driving means;

said driven means having a plurality of teeth spaced apart by a uniform angular tooth pitch;

said driving means having:

a first element having a stroke for engaging and driving, during said recoil stroke, one of said plurality of teeth of said driven means a first angular distance in a first direction, and

a second element having a stroke for engaging and driving, during said counter-recoil stroke, another one of said plurality of teeth of said driven means a second angular distance in said first direction;

the mid-point of said stroke of said first element being spaced from the mid-point of said stroke of said second element by a angular distance equal to an odd integer multiple of half-tooth pitches of said driven means;

said driving means driving said driven means up to one tooth pitch during the initial cycle, and one tooth pitch during each subsequent cycle.

2. An auto-synchronizing drive assembly, comprising:

a cyclically rocking driving means having a recoil stroke and a counter-recoil strike within each cycle;

a unidirectionally driven ratchet means coupled to and driven by said driving means;

said ratchet means having a plurality of teeth angularly spaced apart on an axis of rotation by a uniform tooth pitch;

said driving means having:

a first element having a stroke for engagement and driving, during said recoil stroke, one of said plurality of teeth of said ratchet means a first angular distance in a first direction, and

a second element having a stroke for engaging and driving, during said counter-recoil stroke, another one of said plurality of teeth of said ratchet means a second angular distance in said first direction;

the mid-point of said stroke of said first element being spaced from the mid-point of said stroke of said second element by an included angle, having its apex coincident with said axis of rotation of said ratchet means, equal to an odd integer multiple of half-tooth pitches of said ratchet means;

said driving means driving said ratchet means up to one tooth pitch during the initial cycle, and one tooth pitch during each subsequent cycle.

3. An auto-synchronizing drive assembly, comprising:

a cyclically reciprocating driving means having a recoil stroke and a counter-recoil stroke within each cycle;

a unidirectionally driven means coupled to and driven by said driving means;

said driven means having a plurality of teeth spaced apart by a uniform tooth pitch;

said driving means having:

a first element having a stroke for engaging and driving, during said recoil stroke, one of said plurality of teeth of said driven means a first angular distance in a first direction, and

a second element having a stroke for engaging and driving, during said counter-recoil stroke, another one of said plurality of teeth of said driven means a second angular distance in said first direction;

the stroke of said first element being less than one tooth pitch and the stroke of said second element being less than two tooth pitches;

said driving means driving said driven means up to one tooth pitch during the initial cycle, and one tooth pitch during each subsequent cycle.

4. An auto-synchronizing drive assembly, comprising:

a cyclically rocking driving means having a recoil stroke and a counter-recoil stroke within each cycle;

a unidirectionally driven ratchet means coupled to and driven by said driving means;

said ratchet means having a plurality of teeth angularly spaced apart on an axis of rotation by a uniform tooth pitch;

said driving means having:

a first element having a stroke for engaging and driving, during said recoil stroke, one of said plurality of teeth of said ratchet means a first angular distance in a first direction, and

a second element having a stroke for engaging and driving, during said counter-recoil stroke, another one of said plurality of teeth of said ratchet means a second angular distance in said first direction;

the stroke of said first element being less than one tooth pitch and the stroke of said second element being less than two tooth pitches;

said driving means driving said ratchet means up to one tooth pitch during the initial cycle, and one tooth pitch driving each subsequent cycle.

5. An auto-synchronizing drive assembly, comprising:

a cyclically reciprocating driving means having a recoil stroke and a counter-recoil stroke within each cycle;

a unidirectionally driven means coupled to and driven by said driving means;

said driven means having a plurality of teeth spaced apart by a uniform angular tooth pitch;

said driving means having:

a first element having a stroke for engaging and driving, during said recoil stroke, one of said plurality of teeth of said driven means a first angular distance in a first direction, and

a second element having a stroke for engaging and driving, during said counter-recoil stroke, another one of said plurality of teeth of said driven means a second angular distance in said first direction;

the mid-point of said stroke of said first element being spaced from the mid-point of said stroke of said second element by a angular distance approximating an odd integer multiple of half-tooth pitches of said driven means, and the stroke of said first element being less than one tooth pitch and the stroke of said second element being less than two tooth pitches;

said driving means driving said driven means up to one tooth pitch during the initial cycle, and one tooth pitch during each subsequent cycle.

6. An auto-synchronizing drive assembly, comprising:

a cyclically rocking driving means having a recoil stroke and a counter-recoil stroke within each cycle;

a unidirectionally driven ratchet means coupled to and driven by said driving means;

said ratchet means having a plurality of teeth angularly spaced apart on an axis of rotation by a uniform tooth pitch;

said driving means having:

a first element having a stroke for engaging and driving, during said recoil stroke, one of said plurality of teeth of said ratchet means a first angular distance in a first direction, and

a second element having a stroke for engaging and driving, during said counter-recoil stroke, another one of said plurality of teeth of said ratchet means a second distance in said first direction;

the mid-point of said stroke of said first element being spaced from the mid-point of said stroke of said second angular element by an included angle, having its apex coincident with said axis of rotation of said ratchet means, approximating an odd integer multiple of halftooth pitches of said ratchet means, and the stroke of said first element being less than one-tooth pitch and the stroke of said second element being less than two-tooth pitches;

said driving means driving said ratchet means up to one tooth pitch during the initial cycle, and one tooth pitch during each subsequent cycle.

* * * * *