Nov. 9, 1965 E. J. RYAN 3,216,544

CLUTCH DEVICE OF SPRAG TYPE

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Fig. 1

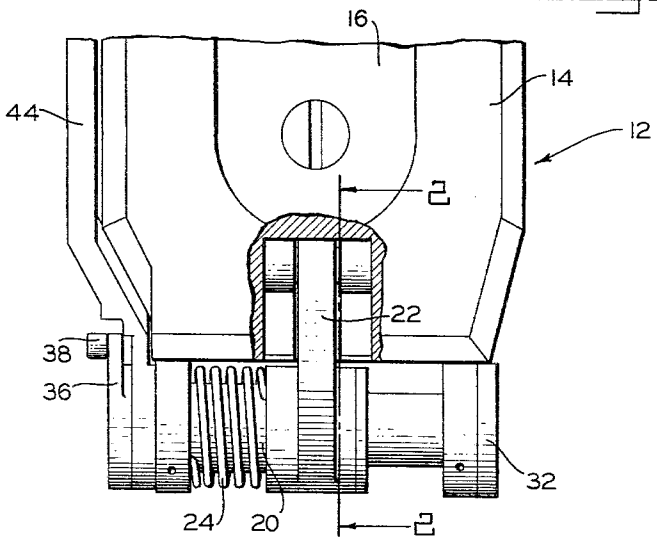
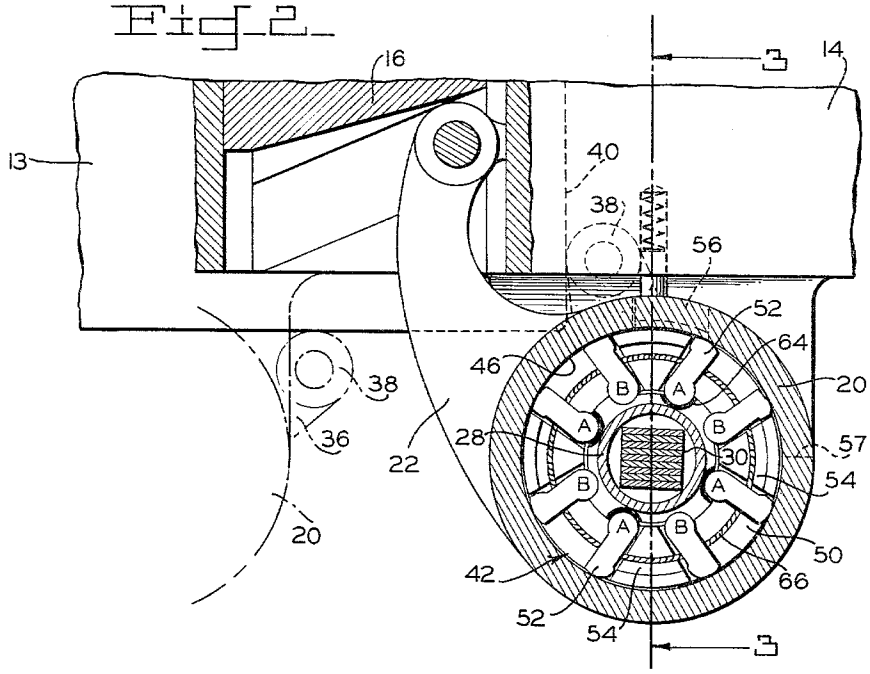


Fig. 2



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Fig. 3.

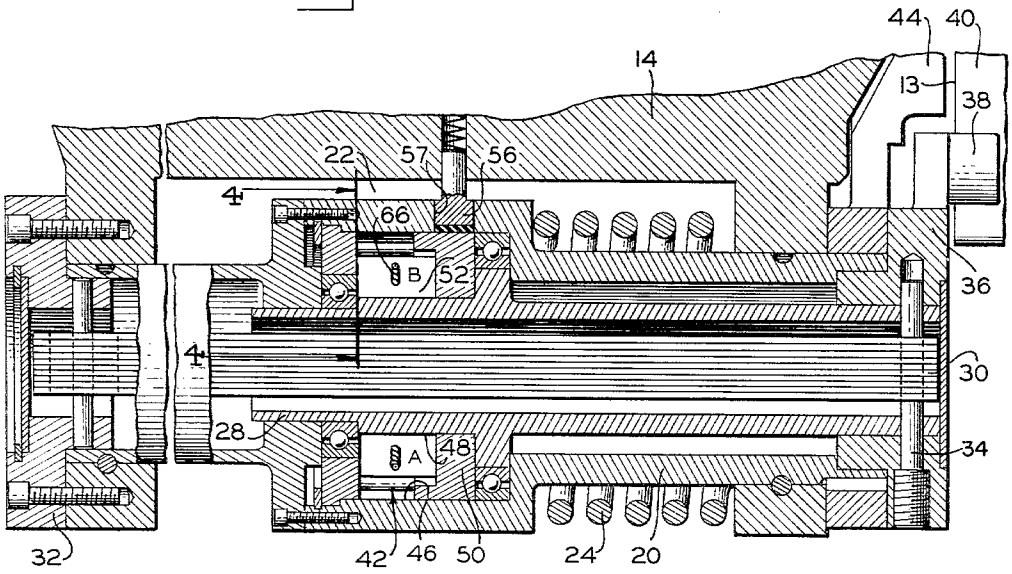


Fig. 4.

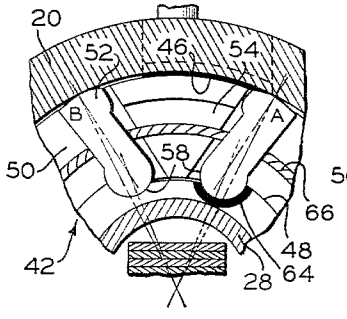


Fig. 5.

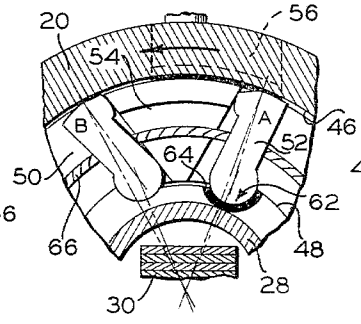


Fig. 6.

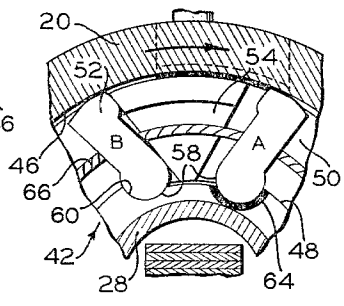


Fig. 7.

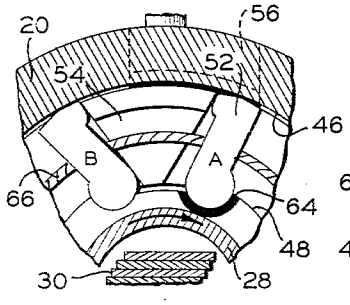
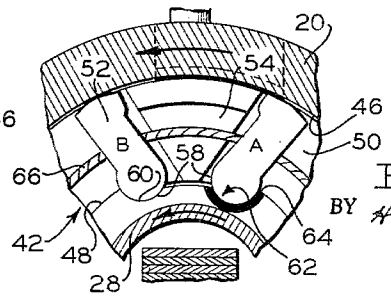


Fig. 8.



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CLUTCH DEVICE OF SPRAG TYPE

Edward J. Ryan, Colonie, N.Y., assignor to the United States of America as represented by the Secretary of the Army

Filed Oct. 1, 1963, Ser. No. 313,133
3 Claims. (Cl. 192—45.1)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to clutches and pertains more particularly to clutches of the sprag type.

It is the object of this invention to provide a clutch whereby one of two rotary members is free to move relative to the other in both directions and the second member is free to move respective to the first member in one direction but, when rotated in the opposite direction, is engaged with the first member for transfer of torque thereto.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings in which:

FIG. 1 is a view of the rear end of a cannon partially sectioned to clearly disclose the structure of the breechblock actuating crank;

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

FIG. 3 is a view taken along line 3—3 of FIG. 2;

FIG. 4 is an enlarged view taken along line 4—4 of FIG. 3 showing the relationship of the parts of the cltuch when the breech is closed;

FIG. 5 is a view similar to FIG. 4 but showing the relationship of the clutch parts during manual opening of the breech;

FIG. 6 is a similar view but showing the relationship of the clutch parts when the breechblock is driven to the closed position;

FIG. 7 is a similar view but showing the relationship of the clutch parts when the beechblock opening spring is energized during recoil of the cannon; and

FIG. 8 is a similar view but showing the relationship of the clutch parts when the breechblock is driven closed.

Shown in the figures is a cannon **12** which is conventionally mounted on a mount **13** for translational displacement in recoil and counterrecoil strokes. Cannon **12** includes a breech ring **14** and a breechblock **16** which are slidingly mounted therein for vertical displacement between an upper breech closed position and a lower breech open position. Breechblock **16** is releasably latched in the breech open position by conventional extractor means (not shown) which are arranged to be tripped to release the breechblock by a round when inserted through breech ring **14** into the cannon's firing tube.

Breechblock **16** is vertically displaced by an actuating mechanism, which includes a tubular shaft **20** journaled in breech ring **14**, and a crank **22**, which is integral with such shaft and which is cammingly engaged with breachblock **16**, as shown in FIG. 2, so that rotation of the crank is converted to translational displacement of the breechblock. Referring to FIG. 2, rotation of crank **22** in a clockwise direction raises breechblock **16** and rotation of the crank in a counterclockwise position lowers the breechblock. A coil-type torsion spring **24** is coiled around shaft **20** and is operationally disposed between breech ring **14** and breechblock **16** so as to be energized when the breechblock is lowered to the breech open position so as to utilize the stored energy in raising the breechblock to the breech closed position.

Housed inside shaft **20** is a drive mechanism which includes a torque tube **28** journaled in the shaft and a multileaf torsion spring **30** housed within the torque tube. Spring **30** drives breechblock **16** to the breach open position and is designed to store sufficient energy to overpower spring **24**, which drives the breechblock to the closed position, so that such spring **24** is wound up by spring **30** when the breechblock is lowered. One end of spring **30** is anchored to breech ring **14** by means of a collar **32** while the opposite end is fixed to torque tube **28** by a pin **34** which also extends into the hub of an arm **36** mounted on the torque tube so that the arm is fixed thereto as shown in FIG. 3. Arm **36** carries a roller **38** which is contactable with a cam surface **40** arranged on mount **13** so as to be contacted by the roller during initial recoil travel of cannon **12** to convert translational displacement thereof to rotation of the arm in a counterclockwise direction. Rotation of arm **36** energizes spring **30** and, as roller **38** approaches the end of cam surface **40**, a latch (not shown) secures torque tube **28** to retain the spring in the energized position.

The energy in spring **30** is used to drive breechblock **16** to the breech open position and wind spring **24**, during counterrecoil travel of cannon **12** through a clutch **42**, to be more fully described hereinafter. Crank **22** and arm **36** are so arranged that, when cannon **12** moves into battery and breechblock **16** into the breech closed position, roller **38** contacts cam surface **40** to stop rotation of torque tube **28** approximately 3° before crank **22** completes its stroke for a reason to be explained hereinafter.

Breechblock **16** may be operated manually by a lever **44** which is rotatingly mounted on shaft **20** outside of breech ring **14** and which is releasably connected to the shaft by a conventional latch means (not shown). To facilitate hand operation of breechblock **16**, it is necessary that shaft **20** be free to rotate relative to torque tube **28** when breechblock **16** is lowered so that spring **30** will not be energized and thereby add to the manual efforts. It is also necessary, during automatic operation of cannon **12**, that torque tube **28** is rotated free of shaft **20** to energize spring **30** during recoil travel of cannon **12** but is engaged with the shaft during counterrecoil travel of the cannon to transfer the energy in such spring to the shaft for moving breechblock **16** to its breech open position.

This required interrelationship of movement between shaft **20** and torque tube **28** is made possible by clutch **42** which is of sprag type. Clutch **42** includes an outer race **46** formed around the inside of shaft **20**, an inner race **48** formed concentric thereto around the outside of torque tube **28**, a sleeve **50** mounted for free rotation between the inner and outer races, and a plurality of sprags **52** arranged in pairs each consisting of an A sprag and a B sprag located between the inner and outer races for sprag engagement therebetween. Sleeve **50** is provided with a plurality of fingers **54** which respectively extend between the A and B sprags in each pair thereof and which are triangular in configuration and are arranged symmetrical to the radius of outer race **46** with one of the apexes directed towards the geometric center of shaft **20**. A sprags are located adjacent the sides of the fingers **54** which lead, when sleeve **50** is rotated in a clockwise direction, and B sprags are adjacent the sides of the fingers which lead when the sleeve is rotated in a counterclockwise direction. A spring-biased pad **56** is mounted in breech ring **14**, as shown in FIG. 3, so as to extend through a slot **57** in shaft **20** to bear frictionally against sleeve **50** to act as a drag against the free displacement thereof respective to sprags **52**.

Each of the sprags **52** is provided with a semicylindrical base **58** which is rotatingly received by a matingly con-

toured recess in inner race **48**. The recesses, which the bases **58** of B sprags, are formed directly in inner race **48** as noted at **60**. The recesses, which receive bases **58** of the A sprags, are formed by a cylindrical cut **62** in inner race **48** and an insert **64** of resilient material, such as rubber, which lines such cut. Inserts **64** are designed so as to be compressed sufficiently to permit displacement of A sprags over center. A garter spring **66** biases the outer ends of the sprags **52** into contact with outer race **46** for sprag engagement therewith.

The operation of cannon **12** is as follows: Starting with breechblock **16** in the breech closed position, the parts of clutch **42** are shown in FIG. 4 wherein the A and B sprags are shown in contact with outer race **46** through the bias of garter spring **66** without interference by fingers **54**. Now referring to FIG. 5, breechblock **16** is actuated to the breech open position for loading cannon **12** by latching lever **44** to shaft **20** and manually rotating the lever in a counterclockwise direction. Before shaft **20** is rotated by lever **44**, A sprags are biased into contact with outer race **46** through the bias of garter spring **66**. When shaft **20**, and therefore outer race **46**, is rotated, the resistance of torque tube **28**, and therefore inner race **48**, to movement, because of spring **30**, the jamming force produced by rotation of the shaft by the A sprags causes inserts **64** to be compressed and thereby permit the A sprags to be pivoted over center respective to the inner and outer races and against fingers **54**. Fingers **54**, in turn, push against the B sprags holding them out of contact with outer race **46**. During continued rotation of lever **44**, breechblock **16** is lowered and spring **24** is wound. When breechblock **16** reaches breech open position, it is latched therein by the extractors (not shown) according to conventional design.

A round (not shown) is then inserted into the firing tube through breech ring **14** causing the extractors (not shown) to be tripped for release of breechblock **16**. Breechblock **16** is then free to be driven to the breech closed position by spring **24** which rotates shaft **20** and, therefore, crank **22** in a clockwise direction. Referring to FIG. 6, as shaft **20** is rotated, A sprigs are forced over center, permitted by the compression of inserts **64**, but, because of the drag effect of pad **56** against sleeve **50**, fingers **54** are held pressed against B sprags preventing displacement of the B sprags, against garter spring **66**, back into contact with outer race **46**, whereby shaft **20** freewheels respective to torque tube **28** and, consequently, spring **30** is isolated from the displacement of breechblock **16** by spring **24** the weaker of the two springs.

When the chambered round is fired, cannon **12** recoils. As cannon **12** begins its recoil stroke, roller **38** contacts cam surface **40** causing arm **36** and, therefore, torque tube **28** to rotate in a clockwise direction. Referring to FIG. 7, as torque tube **28** is rotated in a clockwise direction, A sprags are pulled over center, by compression of inserts **64**, against fingers **54**. Fingers **54**, in turn, are pushed against B sprags which have been displaced by movement of torque tube **28**. Therefore, torque tube **28** is free to be rotated respective to shaft **20** for energizing spring **30**. When roller **38** reaches the end of cam surface **40**, torque tube **28** is latched against counterrotation by energized spring **30** and cannon **12** continues to its full recoil length.

As cannon **12** approaches battery position during the counter recoil stroke, the latch not shown) holding torque tube **28** is automatically released according to conventional design, so that the torque tube is free to be rotated by spring **30** in the counterclockwise direction. Referring to FIG. 8, the counterclockwise rotation of torque tube **28** is transferred to shaft **20** by B sprags, which have sprag engagement therebetween, causing counterclockwise rotation of the shaft, and therefore crank **22**, to drive breechblock **16** to the breech open position. Approximately 3° before crank **22** completes its rotation, roller **38** contacts cam surface **40** to stop rotation of torque tube **28** while shaft **20** continues to complete the displacement of breechblock **16** to the breech open position. This 3° rotation of shaft **20** relative to torque tube **28** is sufficient to drive A sprags over center and against fingers **54**. Thus, B sprags are held out of contact with outer race **46**, ready for the closing sequence of breechblock **16** as hereinbefore described. Breechblock **16** is latched in a breech open position by the extractors (not shown) as when opened manually. Another round is then inserted and the cycle is completed.

From the foregoing it is seen, because of the unique design of clutch **42**, that shaft **20** is rotatable in both directions relative to torque tube **28** and that the torque tube is rotatable in one direction relative to the shaft but is engaged for transfer of torque in the other direction.

Although a particular embodiment of the invention has been described in detail herein, it is evident that many variations may be devised within the spirit and scope thereof and the following claims are intended to include such variations.

I claim:

1. A clutch of sprag type including a first rotary member, an outer race formed in said first rotary member, a second rotary member, an inner race formed on said second rotary member concentric to said outer race, a plurality of sprags arranged in pairs between said inner and outer races for sprag engagement therebetween so as to transfer torque from one of said rotary members to the other in both directions, a garter spring arranged for biasing said sprags into sprag engagement between said inner and outer races, and means controlling the engagement of said sprags with said outer race so that said first rotary member is rotatable relative to the second rotary member in both directions and said second rotary member is rotatable relative to said first rotary member in one direction while engaging said first rotary member to transfer a torque thereto in the other direction, said means including a resilient mounting for one of said sprags in each of said pairs thereof designed to permit displacement of said one of said sprags over center relative to said inner and outer races.

2. The clutch as defined in claim **1** and wherein said means includes a sleeve mounted between said first and second rotary members for free rotation respective thereto, a finger extending from said sleeve between said said sprags in each pair thereof, said finger being arranged to transfer displacement of said one of said sprags in the respective pair to the other one of said sprags therein so that the other one of sprags is moved out of sprag engagement between said inner and outer races, and drag means applied against said sleeve to restrain displacement thereof respective to said sprags for holding said other one of said sprags out of sprag engagement between said inner and outer races.

3. The clutch as defined in claim **1** and including recesses formed in said inner race for respectively receiving one end of each of said sprags so that the opposite end thereof is pivotal into sprag engagement with said outer race, and wherein said resilient mounting comprises an insert of compressible material arranged to line said recess for compression by said one of said sprags in each of said pairs thereof so that said one of said sprags is displaceable over center relative to said inner and outer races.

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