A multi-stage trigger mechanism for a firearm having a trigger body that is pivotally mounted to the receiver of a firearm having a pivotally moveable spring-urged hammer having a trigger hook and a hammer hook. A disconnector is pivotally mounted to the trigger body and has a spring retainer securing a disconnector spring to the disconnector. The disconnector has a hook member defining a timing surface that serves to delay hammer reset and provides enhanced trigger hook engagement to prevent doubling during firing activity.
TWO-STAGE TRIGGER MECHANISM FOR FIREARMS

BACKGROUND OF THE INVENTION

[0001] Field of the Invention

[0002] The present invention relates generally to firearms, particularly firearms having trigger assemblies that are cocked or made ready for firing by rearward movement of a bolt or bolt carrier within a receiver mechanism of a firearm. More particularly, the present invention concerns a two-stage trigger mechanism having a first stage that is activated by movement of a trigger member by application of a desired first stage manual trigger force and a second stage that is activated by further movement of the trigger member by application of a desired second stage manual force. This invention also concerns the provision of angulated surfaces on the disconnector of the trigger mechanism to provide for dual stage operation and to minimize any potential for fired round doubling.

[0003] Description of the Prior Art

[0004] Every firearm has historically been provided with a trigger mechanism to provide the user with the capability for simple and efficient control of firearm discharge. Multi-stage trigger mechanisms are well known in the art, as exemplified by U.S. Pat. No. 7,600,338 of Geissele. This patent discloses a two stage trigger mechanism that is designed particularly for M16 or AR15 type semi-automatic rifles which are widely utilized by the United States Military and by the public. Some commercially available multi-stage trigger mechanisms are adjustable, such as taught by U.S. Pat. Nos. 6,131,324 of Jewell, 5,501,134 and 5,881,485 of Milazzo. Some adjustable multi-stage trigger mechanisms suffer from the uncertainty of adjustment screws or set screws which can become loose or move during firing activity, thereby changing the operational character of the trigger mechanisms. U.S. Pat. No. 8,074,393 of Geissele also evidences a multi-stage trigger mechanism having a sear face that can be adjusted and having a disconnector spring that can also be adjusted by means of a spring force adjustment screw.

SUMMARY OF THE INVENTION

[0005] It is a principal feature of the present invention to provide a novel multi-stage trigger mechanism for rifles such as M16 or AR15 type semi-automatic rifles as well as a wide variety of other rifles and firearms which are provided with a coil type disconnector spring having an end portion that is interposed between the disconnector and trigger body and is secured to the disconnector so as to be moveable with the disconnector during operation of a trigger mechanism.

[0006] It is another feature of the present invention to provide a novel multi-stage trigger mechanism having a trigger body to which is pivotally mounted an elongate spring urged disconnector and having a disconnector stop member projecting from the trigger body and serving to ensure against pivotal over-travel of the disconnector as cycling of the trigger mechanism occurs.

[0007] It is also a feature of the present invention to provide a disconnector geometry that ensures holding the hammer down longer during reset, thereby creating significantly more engagement between the hammer hook and the trigger hook.

[0008] Briefly, the various objects and features of the present invention are realized through the provision of a multi-stage trigger mechanism that is designed particularly for tactical firearms, such as the M-16 military version and the AR-15 civilian version and is well adapted for firing control of many other types of firearms. The invention is discussed herein particularly as it relates to M-16 and AR-15 tactical rifles. This type of firearm incorporates a lower receiver which is pivotally mounted to an upper receiver, as is well known. The lower receiver defines an internal compartment within which a trigger mechanism is mounted for firing control of a torsion spring urged hammer that is pivotally mounted within the lower receiver compartment.

[0009] The trigger mechanism of the present invention incorporates a trigger body member which is pivotally mounted to the receiver of the firearm and is urged toward its safe position by means of a torsion spring having a pair of torsion loops that are located about pivot bearings of the trigger body. The trigger body defines a trigger sear hook that is engaged by a sear hook of a spring urged hammer that is also pivotally mounted to the receiver of the firearm.

[0010] A disconnector member is pivotally mounted to the trigger body and is urged by a disconnector spring to a position for engagement of the hammer engaging cam surface geometry thereof with an angulated cam surface of the trigger member. The cam surface of the disconnector has a substantially straight surface portion that is engaged by the sear projection of the hammer member. The disconnector geometry also includes an angulated surface portion that establishes a hammer timing surface of greater length than is conventional, which holds the hammer down longer during reset. This feature creates more engagement between the hammer hook and the trigger hook and has the effect to preventing the trigger mechanism from inadvertently permitting doubling when the trigger is operated during firing activity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] So that the manner in which the above recited features, advantages and objects of the present invention are attained and can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to the preferred embodiment thereof which is illustrated in the appended drawings, which drawings are incorporated as a part hereof.

[0012] It is to be noted however, that the appended drawings illustrate only a typical embodiment of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0013] In the Drawings:

[0014] FIG. 1 is an isometric illustration showing the lower receiver of an M-16 or AR-15 tactical rifle in broken line and showing a trigger and hammer mechanism embodying the principles of the present invention mounted within the lower receiver;

[0015] FIG. 2 is a side elevation view showing the trigger and hammer mechanism of FIG. 1 in greater detail;

[0016] FIG. 3 is an isometric illustration showing the multi-stage trigger and hammer mechanism of FIG. 2 and showing the side and top portions thereof;

[0017] FIG. 4 is an enlarged section view showing the relationship of the hammer hook and trigger hook and the disconnector mechanism of this invention;

[0018] FIG. 5 is a side elevation view of the disconnector of FIG. 4 showing the angulated disconnector surfaces for control of hammer and trigger reset; and
FIG. 6 is a fragmentary elevation view showing a portion of the disconnector structure of FIG. 5 and emphasizing disconnector surface area enhancement for timing of hammer movement.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0020] Referring now to the drawings and first to FIG. 1, a lower receiver of an M-16 or AR-15 tactical rifle is shown generally at R and defines an internal compartment C within which a multi-stage trigger mechanism embodying the principles of the present invention is shown generally at 10. The multi-stage trigger mechanism incorporates a trigger body 12 having a trigger projection 14 defining a curved trigger engagement surface 16 to which is applied manual force of the user's finger to discharge the firearm. The trigger body defines a pivot aperture 18 which extends through bearing or bushing projections 20 and 22 that project from opposite sides of the trigger body. A pivot pin 24, also referred to as a trigger pin, is positioned within the pivot aperture 18 and serves to establish pivotal mounting of the trigger body 12 to the receiver of a firearm.

[0021] Opposite end portions of the trigger pin 24 project axially beyond the axial end portions of the bearing members 20 and 22 and are engaged within pivot pin receptacles of a firearm receiver 23, thus pivotally mounting the trigger body to the firearm receiver. A rear end portion of the trigger body 12 defines a trigger rotation limit projection 26 having a downwardly facing curved surface 28 that establishes essentially linear contact with a trigger stop surface 30 of the firearm receiver 23, preventing further clockwise pivotal rotation of the trigger body as shown in FIG. 2.

[0022] The bearing or bushing projections 20 and 22 are of generally cylindrical configuration and also serve as trigger spring mount projections that encircle and provide support for circular loop portions of a torsion type trigger spring 32. A U-shaped portion 34 of the trigger spring 32 extends about a forward end portion of the trigger body, forwardly of the trigger projection 14, and continuously applies rotational spring force to the trigger body 12. The trigger spring has a pair of reaction projections 36 and 38 that contact portions of the firearm receiver and serve to apply a torsion spring load to the trigger spring. The reaction projections are placed under load during trigger assembly so that the torsion spring loops apply clockwise rotational force to the trigger body as shown in FIG. 2 to maintain the trigger rotation limit projection 26 in contact with the trigger stop surface 30.

[0023] A hook-like trigger sear 40 projects upwardly from the trigger body 12 and defines a downwardly facing trigger sear surface 42 that is engaged by a hammer sear hook 44 of a hammer member 46. The hammer member 46 defines an upwardly facing hammer sear surface 45 that is disposed for engagement with the trigger sear surface 42 to secure the hammer against pivotal firing pin striking movement. The hammer member 46 is pivotally mounted to the firearm receiver by a hammer pin 48 that extends crosswise through a pivot aperture 50 of the hammer. The hammer member defines a safety sear notch 57 that is disposed for engagement by an abrupt end corner 39 of the trigger body member 12 to provide a safety sear for preventing the trigger from inadvertent resetting rotation before the hammer is reset by its torsion springs.

[0024] Bearing or bushing members 52 and 54 of the hammer member 46 are encircled by loops 56 of a torsion type hammer spring 58. The hammer spring 58 defines a U-shaped portion 60 having spring arms 59 that extend from each of the spring loops 56. The hammer spring 58 also has a pair of spring arms that engage end portions of the hammer pin or engage the outer cylindrical surfaces of the oppositely projecting bearing or bushing members 52 and 54. These spring arms are yielded during assembly to provide a continuous rotational force on the trigger member. As the hammer member is pivotally moved to its set or cocked position by rearward movement of the bolt carrier or bolt of the firearm the torsion force of the trigger spring is increased substantially, so that release of the hammer by trigger actuation will permit the trigger spring to drive the hammer member pivotally forward. The hammer strikes the firing pin of the firearm with sufficient force to deform the metal of the primer of a cartridge within the cartridge chamber of the firearm barrel, igniting the primer and causing the powder of the cartridge to become ignited and generate cartridge gas pressure that propels a bullet from the cartridge through the rifled bore of a barrel.

[0025] A disconnector member 62 is pivotally mounted to the trigger body 12 by a pivot pin member 64 and has its pivotal movement limited by the downwardly facing stop surface 65 of a disconnector stop member 66 that projects upwardly from the trigger body 12. The trigger body defines a disconnector recess 63 that is formed in part by spaced pivot support flanges 67 which have pivot openings receiving the pivot pin 64. The disconnector also defines a transverse pivot opening or bore through which the pivot pin 64 extends. To ensure an interference fit of the pivot pin 64 within the disconnector, a transverse slit 69 is formed in the disconnector and intersects the transverse pivot bore 71 within which the pivot pin 64 is received. This feature permits the pivot pin to be press-fitted within the transverse pivot bore 71, yielding the metal structure at each side of the slit 69, thereby establishing a firm non-rotatable relation of the pivot pin with the disconnector structure. If desired, a roll pin defining a lateral slit may also achieve an immovable interference fit with the transverse passage or bore 71 of the disconnector.

[0026] A portion of the disconnector is received between the spaced support flanges of the trigger body 12 to provide for stability of hammer movement during firing and return rotation. The disconnector defines a disconnector hook 68 having a hammer engagement surface cam surface 84 that is engaged by first and second stage trigger activity. An angled surface 70 of the disconnector that is disposed for engagement with an angled surface 72 of a disconnector projection 73 of the hammer member 46. The rounded nose 67 of the disconnector projection 73 has contact with the surface 84 of the disconnector hook 68 as discussed in detail in connection with FIG. 5. Engagement of the surface 70 of the disconnector member and the surface 72 of the hammer establishes the first stage of trigger movement during which the hammer is out of engagement with the disconnector member and is then engaged and retained by the downwardly facing hammer sear surface 42 of the hook-like trigger sear 40 of the trigger body member during pivotal return of the hammer after firing activity has taken place.

[0027] The disconnector also defines an end surface 88 that extends from the surface 84 and is oriented in angular relation with the surface 84. The purpose of the angled end surface 88 is to provide the angled surface 70 of the disconnector with maximum length so that it serves as a timing surface to
cause return delay of the hammer sufficiently to minimize the potential for inadvertent doubling or automatic fire of the firearm.

[0028] The trigger body 12 defines a disconnector spring pocket 74 within which the lower end portion of a disconnector spring 76 is received. The disconnector spring 76 is preferably a coil type compression spring; however it may conveniently take the form of a leaf spring, wave spring, or any other suitable type of spring that tends to rotate the disconnector in the counterclockwise direction as shown in FIG. 2. The lower portion of the disconnector defines an undercut spring retainer member 78 that defines a spring receptacle 80 within which the upper coil portion of the disconnector spring is mounted to the disconnector. The upper portion of the spring 76 may be essentially threaded into an upper spring receptacle 77, shown in broken line in FIG. 4 to permit adjustment of the spring force acting on the disconnector member. Thus, the disconnector spring is mounted to and travels with the disconnector and can be adjustable to increase or decrease its spring force.

[0029] The undercut spring retainer member 78 maintains the upper coil of the disconnector spring centered within the spring receptacle and thus ensures that the disconnector spring cannot become inadvertently misaligned. Thus, the force of the disconnector relative to the hammer surface 72 is efficiently maintained so that the trigger pull forces at each of the operational stages of the trigger mechanism always have the same feel to the user of the firearm.

[0030] Lever 82 is aligned with a safety marking on the lower receiver. To permit firing activity the safety lever 82 is rotated, typically about 45° counter-clockwise, to a “semi” marking on the receiver. This rotation moves the safety surface of the shaft 80 to a position that is clear of the trigger body and permits sufficient pivotal movement of the trigger body for firing when the user of the firearm applies manual force to the surface 16 of the trigger 14.

[0031] With reference to FIG. 5, the hook portion 68 of the disconnector member 62 defines a relatively long second stage hammer engaging cam surface 84 having substantially straight sections 86 and 88 that have angular intersection at 90°. This feature causes the hammer engagement surface 70 of the disconnector to have a greater length than usual, this greater length being established by the disconnector surface increment 92 that is identified in broken line. This feature establishes greater or longer duration surface engagement between the hammer hook and trigger hook, thus causing the hammer to be held down longer during reset, as compared with conventional trigger mechanisms with straight hammer engaging hook surfaces. The second stage of trigger operation occurs when the cam surface 84-86 of the disconnector hook comes into contact with the hammer projection 73. This hammer delay is characterized as a timing sequence during hammer return which establishes greater surface to surface engagement of sear surfaces 42 and 45 of the trigger and hammer sears and prevents inadvertent doubling or automatic fire. The trigger mechanism will release the hammer for spring urged rotation and cartridge firing before the angulated disconnector surface 88 is reached by hammer movement along the cam surface 84 of the disconnector hook 68. Thus, the angulated surface 88 is not intended to be contacted by the hammer projection 73 and is provided for the primary purpose of ensuring the maximum length of the disconnector hook cam surface 70 to provide for hammer delay during reset.

[0032] Operation

[0033] The two-stage firing mechanism of the present invention will begin its cycle of operation with the trigger mechanism being in the condition shown in FIG. 3, with the hammer sear surface 45 of the hammer 46 being in surface to surface engagement with the trigger sear surface 42 of the of the trigger sear member 40. At this stage of trigger operation the hammer engaging surface 84 disconnector hook 68 will be clear of the disconnector engaging projection 73 of hammer member 46. The rear portion of the disconnector member 62 will be in engagement with the downwardly facing stop surface 65 of the disconnector stop member 66 and can only be moved pivotally downward against the bias of the disconnector spring 76 about the pivot pin 64.

[0034] The user of the firearm will then apply manual finger force on the curved surface 16 of the trigger, this force being in the range of about two pounds to overcome the bias of the torsion springs 32 and causing rotation of the trigger body 12 about the pivot pin 24 and also causing rotation of the disconnector member 62 about the trigger pivot pin 24 and causing the hammer engaging surface 84 of the disconnector hook 68 to come into contact with the disconnector engaging projection 73 of the hammer 46. At this point in the firing process the sear surfaces 42 and 45 will have sufficient surface to surface engagement that the firearm remains safe will not accidentally discharge. When this contact is made, the resistance of the disconnector caused by the disconnector spring will add to the force or pull that is experienced by the firearm user, indicating that the first stage of trigger operation has been completed and that a greater finger force must be applied, i.e., the second stage, in order to achieve hammer release for striking the firing pin and firing a round. This additional finger force is typically in the range of about an two pounds, but can be more or less according to the design of the trigger mechanism.

[0035] When second stage resistance is encountered, the additional force will overcome the resistance of the disconnector spring 76, causing the disconnector to move about its pivot 64 and allowing further surface to surface movement of the sear surfaces 42 and 45 to occur. Only minute movement of these sear surfaces is necessary to achieve trigger break and release the hammer for its spring urged pivotal movement to strike the firing pin of the firearm. The second stage trigger activity will occur while the sear projection 73 is in contact with the cam surface 84 of the disconnector and before the sear projection reaches the angulated or offset surface portion 88 of the disconnector hook 68.

[0036] As mentioned above particularly in connection with FIGS. 4 and 6, the disconnector hook 68 has an angular surface 88 having the purpose of providing the angulated surface 70 with sufficient length to be engaged by the surface 72 of the hammer 46 during hammer return after firing activity and to establish sufficient hammer reset delay to provide much more sear surface engagement of the sear surfaces 42 and 45 preventing the occurrence of doubling or automatic firing activity. After the foregoing trigger and hammer activity has occurred, the trigger mechanism will have been reset for another semi-automatic firing sequence.

[0037] In view of the foregoing it is evident that the present invention is one well adapted to attain all of the objects and features hereinabove set forth, together with other objects and features which are inherent in the apparatus disclosed herein.

[0038] As will be readily apparent to those skilled in the art, the present invention may easily be produced in other specific
forms without departing from its spirit or essential characteristics. The present embodiment is, therefore, to be considered as merely illustrative and not restrictive, the scope of the invention being indicated by the claims rather than the foregoing description, and all changes which come within the meaning and range of equivalence of the claims are therefore intended to be embraced therein.

I claim:

1. A multi-stage trigger mechanism for a firearm, comprising:
   a trigger body having a mounting pin mounting said trigger body to the receiver of a firearm having a pivotably moveable spring-urged hammer having a trigger hook and a hammer hook, said trigger body defining a spring receptacle;
   a disconnector being pivotally mounted to said trigger body and defining a spring retainer structure; and
   a disconnector spring having a first portion thereof mounted to said spring retainer structure and having a second portion thereof disposed within said spring receptacle, said disconnector spring being moveable with said disconnector and applying spring force to said disconnector and said trigger body.

2. The multi-stage trigger mechanism of claim 1, comprising:
   said disconnector spring being a coil type compression spring having generally circular first and second ends;
   said spring retainer being a spring retainer projection having an undercut portion defining a spring opening and retaining said first end of said coil type compression spring.

3. The multi-stage trigger mechanism of claim 1, comprising:
   a disconnector stop member being defined by said trigger body and having a stop surface limiting spring urged pivotal movement of said disconnector relative to said trigger body.

4. The multi-stage trigger mechanism of claim 1, comprising:
   a trigger rotation limit projection being defined by said trigger body and being disposed for contact with a firearm receiver and preventing over-rotation of said trigger body.

5. The multi-stage trigger mechanism of claim 1, comprising:
   a hammer engaging cam surface being defined by said disconnector; and
   a disconnector seat being defined by said disconnector and having a hammer engagement cam surface and a disconnector seat projection establishing a hammer return cam surface of sufficient length to hold said hammer down sufficiently to prevent following, a portion of said hammer engagement cam surface being a second stage cam surface.

6. The multi-stage trigger mechanism of claim 5, comprising:
   said hammer engaging cam surface being of substantially planar configuration; and
   said disconnector seat projection establishing a surface disposed in angular relation with said hammer engaging cam surface.

7. The multi-stage trigger mechanism of claim 1, comprising:
   a pair of spaced disconnector mount flanges being defined by said trigger body and having apertures formed therein; and
   a pivot pin extending through said apertures of said spaced disconnector mount flanges and through said disconnector member and mounting said disconnector for pivotal movement about said pivot pin.

8. The multi-stage trigger mechanism of claim 5, comprising:
   said disconnector having a hammer contact surface and a timing surface having intersection with said first surface and being disposed in angular relation with said hammer contact surface, said angular timing surface causing said hammer contact surface of said disconnector to be of sufficient length to hold said hammer down during return for a sufficient period of time to prevent doubling during firing activity.

9. A multi-stage trigger mechanism for a firearm, comprising:
   a trigger body having a mounting pin mounting said trigger body to the receiver of a firearm having a pivotably moveable spring-urged hammer having a trigger hook and a hammer hook and defining a hammer seat surface and defining a disconnector engaging projection;
   a disconnector being pivotally mounted to said trigger body and having a disconnector hook defining a disconnector cam surface disposed for engagement by said disconnector engaging projection of said hammer hook, said disconnector cam surface being of substantially straight configuration;
   a disconnector spring having force transmitting engagement with said disconnector and said trigger body and urging said disconnector pivotally toward said trigger hook;
   a disconnector hook cam surface being defined by said disconnector hook and being engaged by said disconnector engaging projection of said hammer hook and being engaged by said disconnector cam surface achieving delay of hammer reset and preventing doubling of firing activity during use.

10. The multi-stage trigger mechanism of claim 9, comprising:
    2. The multi-stage trigger mechanism of claim 1, comprising:
       said disconnector spring being a coil type compression spring having generally circular first and second ends;
       said spring retainer being a spring retainer projection having an undercut portion defining a spring opening and retaining said first end of said coil type compression spring.

11. The multi-stage trigger mechanism of claim 9, comprising:
    a disconnector stop member being defined by said trigger body and having a stop surface limiting spring urged pivotal movement of said disconnector relative to said trigger body.

12. The multi-stage trigger mechanism of claim 9, comprising:
a trigger rotation limit projection being defined by said trigger body and being disposed for contact with a firearm receiver and preventing over-rotation of said trigger body.

13. The multi-stage trigger mechanism of claim 9, comprising:
   a hammer engaging cam surface being defined by said disconnector; and
   a disconnector sear being defined by said disconnector and having a hammer engagement cam surface and a disconnector sear projection establishing a hammer return cam surface of sufficient length to hold said hammer down sufficiently to prevent following, a portion of said hammer engagement cam surface being a second stage cam surface.

14. The multi-stage trigger mechanism of claim 13, comprising:
   said hammer engaging cam surface being of substantially planar configuration; and
   said disconnector sear projection establishing a surface disposed in angular relation with said hammer engaging cam surface.

15. The multi-stage trigger mechanism of claim 9, comprising:
   a pair of spaced disconnector mount flanges being defined by said trigger body and having apertures formed therein; and
   a pivot pin extending through said apertures of said spaced disconnector mount flanges and through said disconnector member and mounting said disconnector for pivotal movement about said pivot pin.

16. The multi-stage trigger mechanism of claim 9, comprising:
   said disconnector having a hammer contact surface and a timing surface having intersection with said first surface and being disposed in angular relation with said hammer contact surface, said angular timing surface causing said hammer contact surface of said disconnector to be of sufficient length to hold said hammer down during return for a sufficient period of time to prevent doubling during firing activity.