

Oct. 31, 1944.

W. F. DAY

2,361,385

POWER TURRET

Filed Aug. 25, 1942

3 Sheets-Sheet 1

FIG. 1.

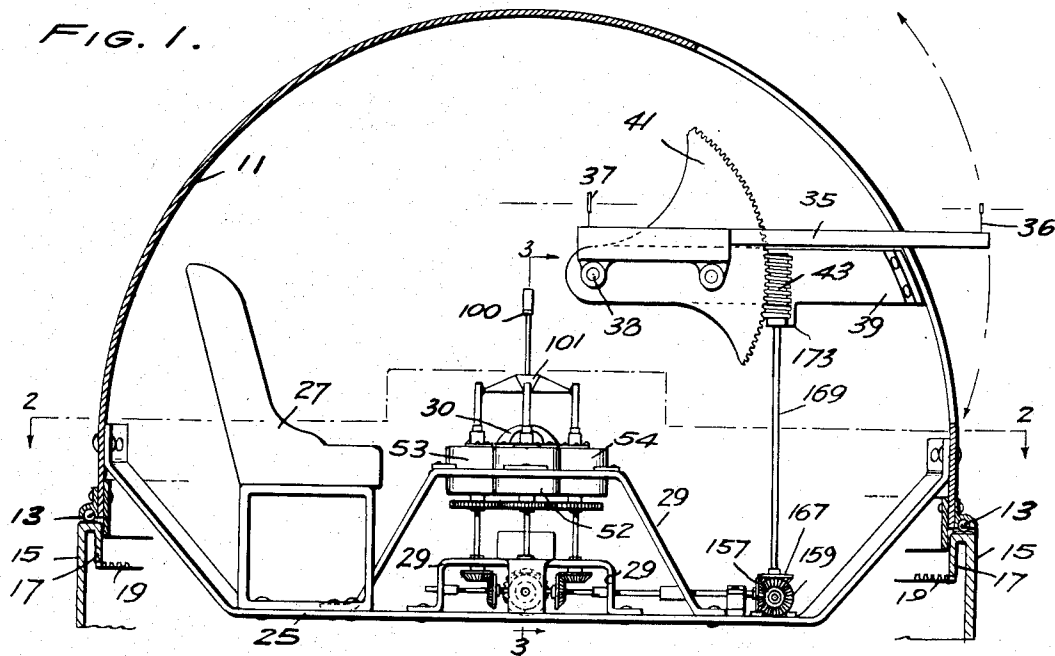
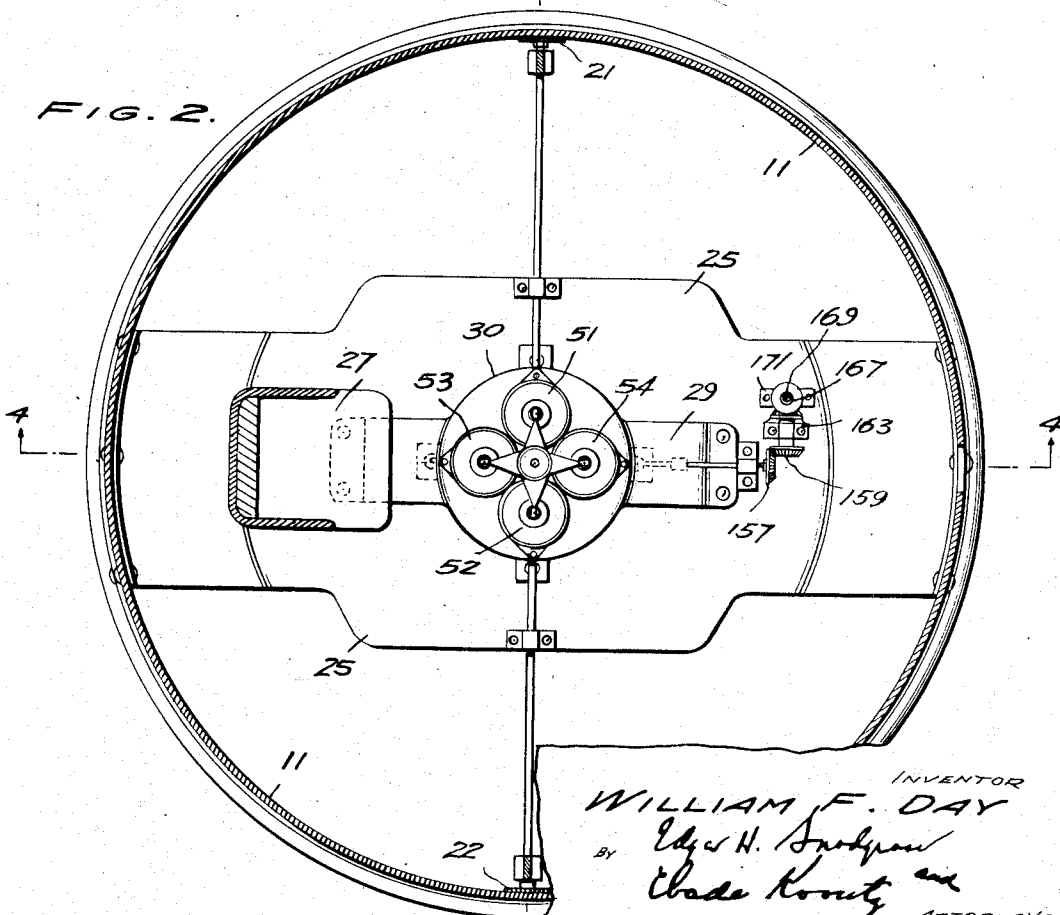


FIG. 2.



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FIG. 3.

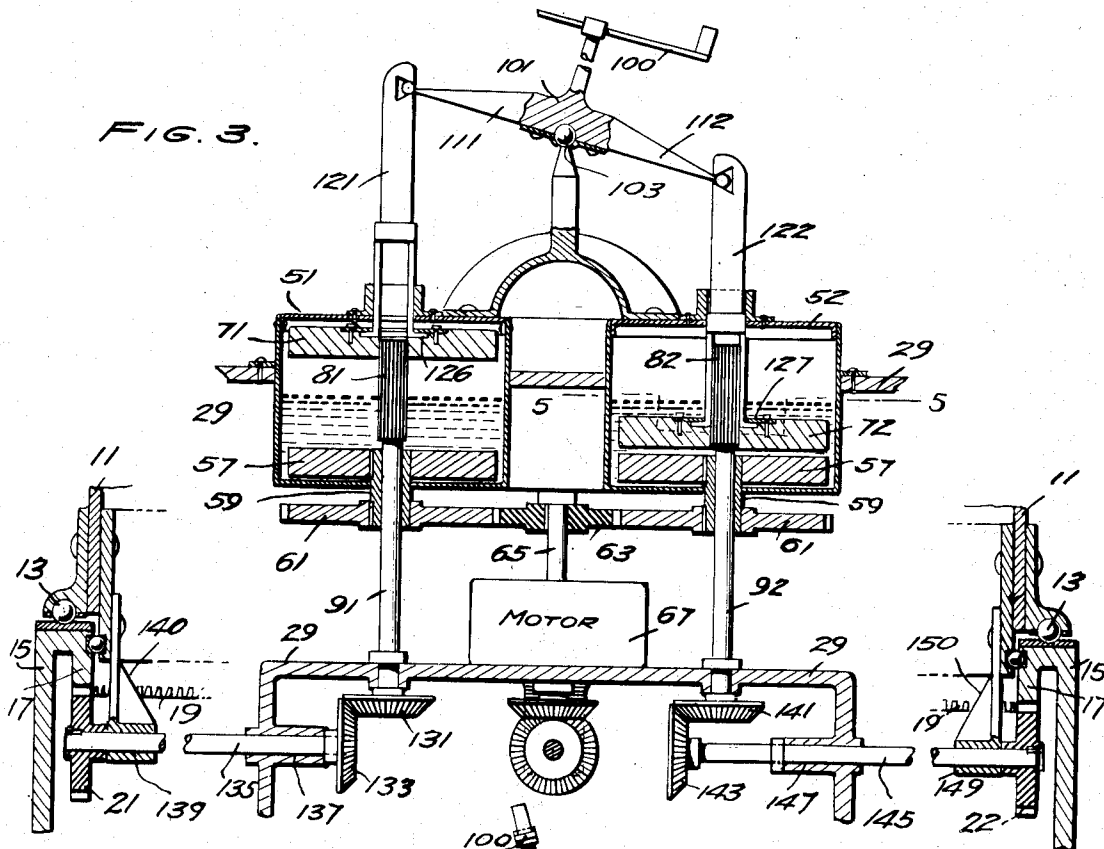
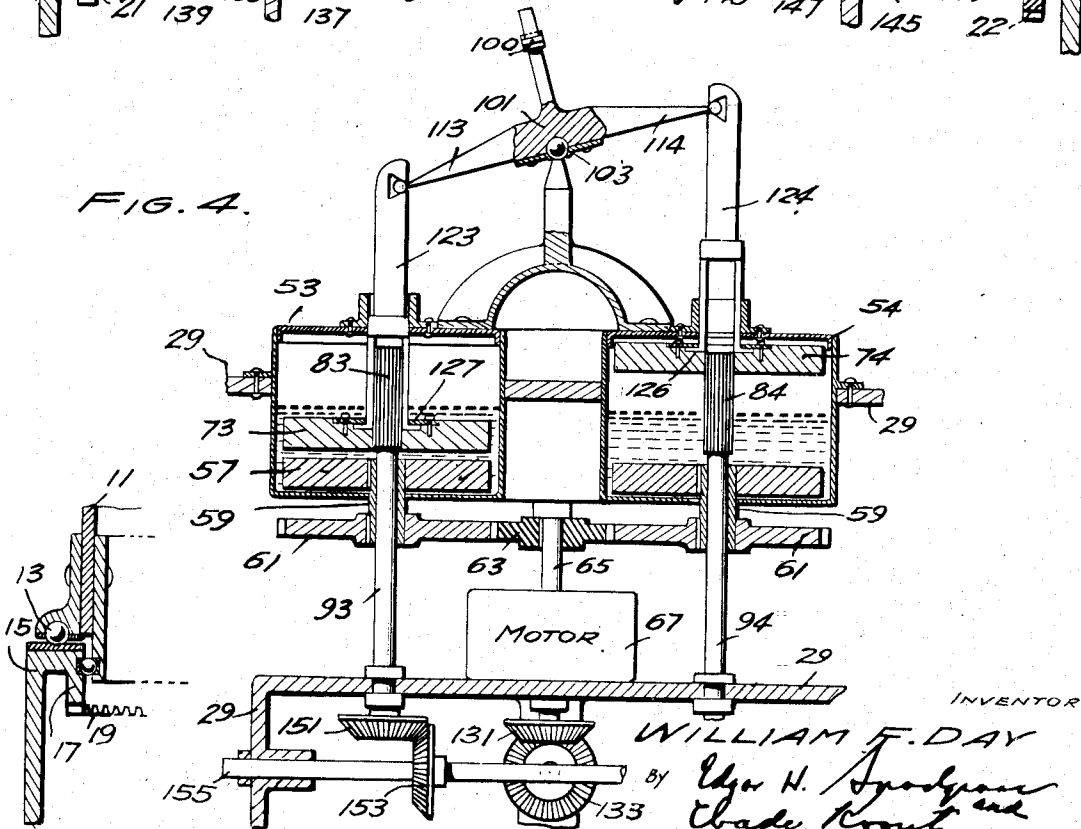


FIG. 4.



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FIG. 5.

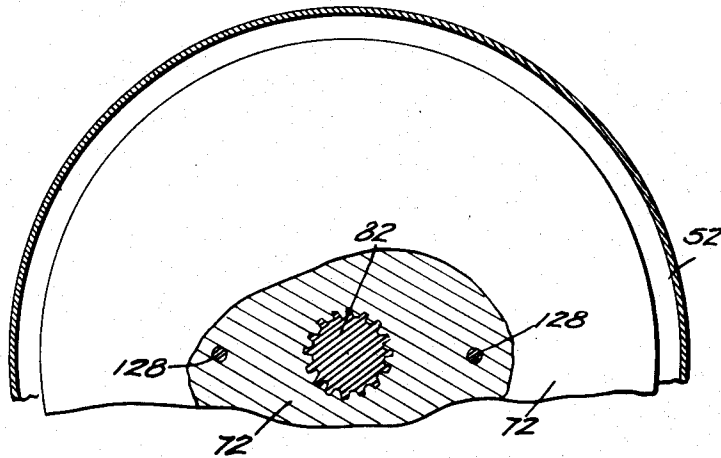
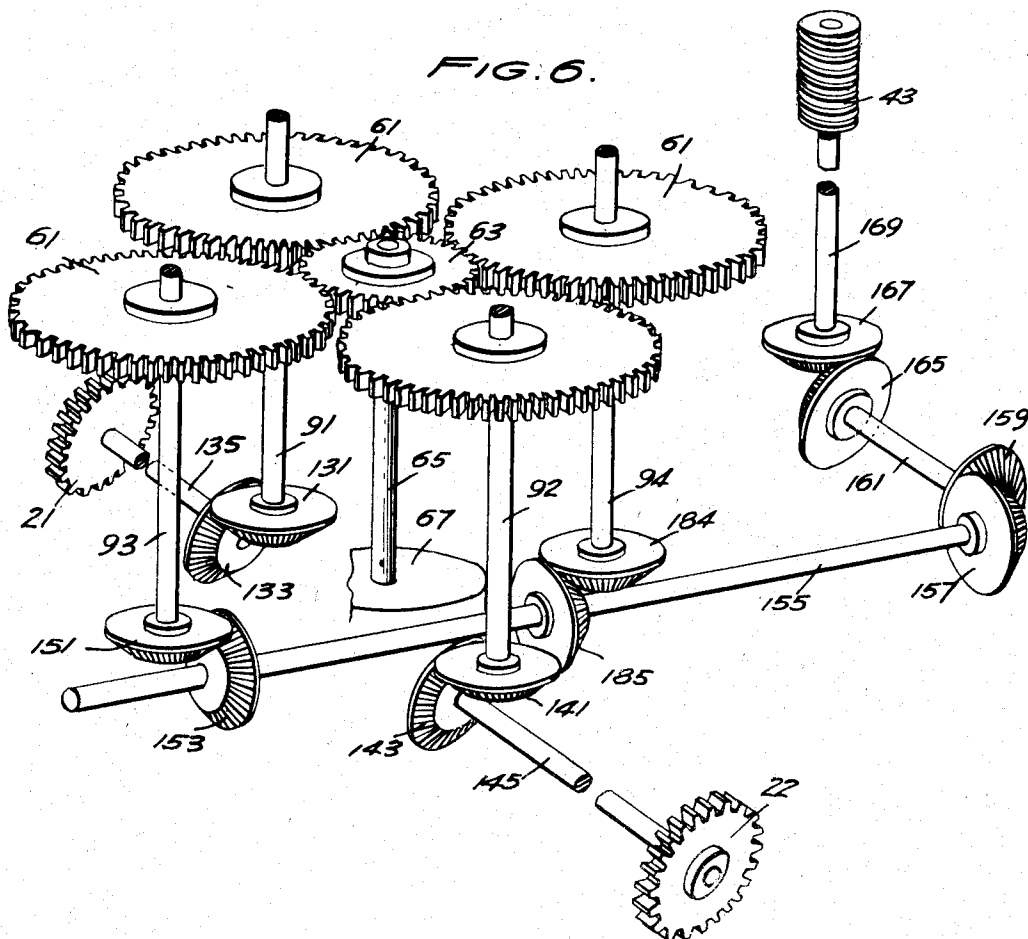


FIG. 6.



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UNITED STATES PATENT OFFICE

2,361,385

POWER TURRET

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Application August 25, 1942, Serial No. 456,032

12 Claims. (Cl. 89—41)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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 power operated machine gun turrets for airplanes.

The object of the invention is to provide an improved hydraulic power unit for airplane machine gun turrets, the unit being compact, light in weight, and simply operable by a single control to rotate the turret and vary the angle of elevation of the machine gun, the construction being such that either of these movements may be accomplished alone, or they may be accomplished simultaneously.

The invention consists in the power unit mechanism and control hereinafter described, and illustrated in the accompanying drawings showing a preferred embodiment of the invention, and in which:

Fig. 1 is a vertical longitudinal sectional view through a machine gun turret provided with a power unit embodying the invention;

Fig. 2 is a horizontal sectional view through the turret of Fig. 1, taken on line 2—2 thereof;

Fig. 3 is a transverse vertical sectional view, on an enlarged scale, of the power unit of Figs. 1 and 2, taken on line 3—3 of Fig. 1;

Fig. 4 is a longitudinal vertical sectional view, on the same scale as Fig. 3, of the power unit, taken on line 4—4 of Fig. 2;

Fig. 5 is a fragmentary horizontal sectional view, on an enlarged scale, taken on line 5—5 of Fig. 3, further illustrating the mounting of one of the hydraulically driven clutch members of the power unit; and

Fig. 6 is a perspective view, on an enlarged scale, of the hydraulic driving and driven gearing for rotating the turret and for varying the angle of elevation of the machine gun.

Referring in detail to the drawings, and particularly to Figs. 1 and 2, the machine gun turret 11 is mounted on a circular antifriction bearing 13 for rotation about its vertical axis on a fixed turret support 15. The fixed interior depending annular flange 17 of the support provides the circumferential series of teeth forming ring gear 19 with which a pair of turret-carried power driven gears 21 and 22 cooperate for rotating the turret as hereinafter described.

On the turret floor 25 is mounted the gunner's seat 27, in front of which is suitably supported, as by the frame members 29, the hydraulic power unit of the present invention, designated as a whole by the reference numeral 30.

The machine gun 35, having the front sight 36 and rear sight 37, is pivotally mounted at 38 on the machine gun supporting bracket 39 secured to the turret 11. The gear segment 41 is fixed to the machine gun, and is provided with worm gear teeth meshing with the worm 43, by which the segment is actuated to vary the gun angle of elevation as hereinafter described.

The power unit of the present invention includes four hydraulic clutch units, 51, 52, 53 and 54. The clutch units 51 and 52 are operated to cause rotation of the turret and the clutch units 53 and 54 are operated to vary the gun elevation.

Each clutch unit includes a cylinder partly filled with liquid, such as oil. Submerged in the oil, at the bottom of each cylinder, is a constantly rotating driving clutch disc 57 keyed to a sleeve 59 rotatably mounted in the bottom of the cylinder and having its lower end, projecting downwardly from the cylinder, keyed to a constantly running driven gear 61. The four driven gears 61 (Fig. 6) are spaced concentrically about, and each is in mesh with, a constantly running motor driven center gear 63 mounted on the shaft 65 of an electric motor 67. All the gears 61 are thereby kept constantly rotating in the same direction. By these means the oil partly filling each cylinder is maintained in continuous rotation.

The clutch units 51, 52, 53 and 54 are provided, respectively, with the upper or driven clutch discs 71, 72, 73 and 74, each of which may, as hereinafter described, be submerged in the rotating oil of its cylinder to be driven thereby, and each of which in normal or inoperative position of all the units lies stationary just above its oil surface.

Each of the driven clutch discs is vertically movable on a spline gear, to which it communicates its rotary motion when the clutch disc is submerged in the rotating oil. The spline gears 81, 82, 83 and 84 are, respectively, fixed to, or form parts of, the vertical shafts 91, 92, 93 and 94, each of which extends rotatably through one of the sleeves 59 into its cylinder.

Each upper clutch disc is moved vertically on its spline by one of four manually actuated spider arms. For this purpose a control handle 100, provided at each end with a vertical hand grip, is fixed to the spider 101 which has a ball and socket mounting 103 on the power unit for universal rocking, and having the four spider arms 111, 112, 113 and 114 for controlling the clutch units 51, 52, 53 and 54, respectively. The spider arms 111, 112, 113 and 114 have at their outer ends ball and socket connection, respectively,

with the vertically movable upper clutch disc actuating rods 121, 122, 123 and 124.

As shown in Figs. 3 and 4, each actuating rod extends downwardly into its appropriate cylinder, has its lower end flanged as at 126 and is rotatably connected to its clutch disc by a securing plate 127 overlying the rod end flange and secured, as by machine screws 128 to its clutch disc. The lower ends of the rods are open to receive the spline gears when the rods are depressed to submerge their respective clutch discs in the rotating oil.

It will be apparent that with the construction described, only one of the pair of clutch discs 71 and 72 can be submerged in rotating oil at one time; and only one of the pair of clutch discs 73 and 74 can be submerged at one time. As before indicated, clutch discs 71 and 72 of clutch units 51 and 52 are actuated to cause rotation of the turret in one direction or the other, and clutch discs 73 and 74 of clutch units 53 and 54 are actuated to increase or decrease the angle of elevation of the machine gun.

Referring first to the turret rotating means, Figs. 3 and 6, shaft 91 whose lower end is rotatably mounted in frame 29, has fixed thereto the bevel gear 131, meshing with a bevel gear 133 fast on a horizontal shaft 135, rotatably mounted at 137 in the frame 29 and at 139 in bracket 140 carried by turret 11, and having keyed to its outer end the gear 21 above referred to, in mesh with the fixed ring gear 19.

Similarly, shaft 92 has fixed to its lower end bevel gear 141 in mesh with a bevel gear 143 keyed to the inner end of horizontal shaft 145, rotatably mounted at 147 in the frame 29 and at 149 in bracket 150 carried by turret 11 and having keyed to its outer end the gear 22 in mesh with the fixed ring gear 19 at a point diametrically opposite gear 21.

Referring now particularly to Fig. 3, the motor drive, clutch units and gearing are arranged so that when the gunner depresses the right hand grip of control handle 100, the turret will turn to the right, and depression of the left hand-grip of the control handle will cause rotation of the turret to the left.

For this purpose, the motor driven gear 63 rotates all the clutch unit gears 61 clockwise as viewed from above in Fig. 6, which causes corresponding rotation of all the driving clutch discs 57 and consequently of the oil in all the clutch unit cylinders.

Therefore, depression of the control handle to the right, as shown in Fig. 3, will cause driven clutch disc 72 to rotate clockwise as viewed from above, and this rotation will be communicated by shaft 92 to the bevel gear 141. Consequently, viewing the outer face of gear 22, this gear will be given a clockwise movement, and turn the turret to the right, as viewed from above, with respect to the fixed ring gear 19 on turret support 15.

During this turret movement, gear 21 opposite gear 22 continues in mesh with the fixed ring gear 19, and because of turret movement caused by gear 22, gear 21 will itself be rotated in mesh with the ring gear, in a clockwise direction as viewed from the outer face of the gear 21. This rotation will, through shaft 135, be communicated to bevel gear 133, which will rotate bevel gear 131, shaft 91, and upper clutch disc 71 counterclockwise as viewed from above. At this time, however, the upper clutch disc 71 is held raised above the surface of the oil, as shown in Fig. 3. Upon restoration of the handle 100 to horizontal

position, driven clutch disc 72 will be lifted above the oil surface and turret rotation will cease.

Similarly, depression of the control handle to the gunner's left will cause rotation of the turret to the left, as viewed from above. Immersion of the driven clutch disc 71 in the oil will cause it to rotate clockwise with the oil; gear 22 will be rotated by turret movement with respect to the fixed ring gear 19, and upper clutch disc 72 will be given a counterclockwise rotation above the oil surface.

Referring now to the clutch unit connections for varying the gun angle of elevation, and particularly to Figs. 4 and 6, as shown in Fig. 4 the parts are in the positions they occupy when the gunner has rocked the hand grips of the control handle toward him, to increase the angle of elevation of the machine gun.

This movement of the control handle submerges driven clutch disc 73 in the clockwise rotating clutch unit oil, and thereby gives the clutch disc 73, shaft 93 and the bevel gear 151 keyed to its lower end a clockwise rotation as viewed from above.

Bevel gear 151 is in mesh with bevel gear 153 on a horizontal shaft 155 rotatably mounted (Fig. 4) in the frame 29 and having bevel gear 157 keyed to its outer end. Bevel gear 157 meshes with bevel gear 159 keyed on one end of a short horizontal intermediate shaft 161 rotatably mounted in a bracket 163 on turret floor 25 and having keyed to its other end a bevel gear 165. Gear 165 meshes with a bevel gear 167 keyed on the lower end of a vertical worm shaft 169 rotatably mounted in lower bracket bearing 171 and in upper bearing 173 on the machine gun supporting bracket 39. Fixed on the upper end of shaft 169 is the worm 43 in mesh with the teeth of machine gun elevating and depressing gear segment 41 above described.

By these means, the rotation of bevel gear 151 as viewed from above communicates to worm shaft bevel gear 167, worm shaft 169 and worm 43 a counterclockwise rotation as viewed from above. This rotation of the worm feeds the gear segment 41 upwardly about pivot 38 and thereby elevates the machine gun.

During this movement, the intermediate bevel gear 185 keyed on shaft 155 is rotated clockwise as viewed from the left hand side of Fig. 6. Gear 185 meshes with bevel gear 184 keyed to the lower end of shaft 94, and accordingly drives gear 184, shaft 94 and upper clutch disc 74 in a counterclockwise direction as viewed from above. Disc 74 is at this time above its oil surface, as shown in Fig. 4.

To depress the machine gun, the gunner rocks the control handle away from him, thereby lifting upper clutch disc 73 on its spline and submerging clutch disc 74 in the oil of clutch unit 54 rotating clockwise.

From the foregoing description it will be apparent that clutch disc 74, shaft 94 and bevel gear 184, rotating clockwise as viewed from above, will cause rotation of bevel gear 185, shaft 155 and bevel gear 157 in a clockwise direction as viewed from the left in Fig. 6, which results in clockwise rotation of the worm 43, as viewed from above, to rock the gear segment 41 downwardly about pivot 38 and depress the machine gun.

During this movement, shaft 155 rotates bevel gear 153 counterclockwise as viewed from the left in Fig. 6, which causes counterclockwise rotation of bevel gear 151, shaft 93 and upper

clutch disc 73 as viewed from above, but at this time the clutch disc 73 is held in raised position above the surface of the oil rotating clockwise in clutch unit 53.

With the construction described, it will be apparent that due to the ball and socket mounting of the control handle 100, the turret may be rotated in one direction or the other while the angle of elevation of the machine gun is being increased or decreased. For this purpose the gunner moves downwardly the right or left end of the control handle 100 and at the same time, by the vertical hand grips, tilts the spider 101 toward or away from him.

What is claimed is:

1. In a rotatable machine gun turret assembly having a machine gun pivotally mounted in the turret, means for rotating the turret and varying the angle of elevation of the machine gun comprising a power unit including two pairs of hydraulic clutches arranged in a square pattern within the turret with the clutches of each pair diametrically opposite in position to each other, gearing connected to the members of one pair for rotating the turret, gearing connected to the members of the other pair for rocking the machine gun vertically about its pivot to increase and decrease its angle of elevation, and a universally rockable control handle at the center of the pattern and having pairs of oppositely extending arms, the arms of one pair being connected to the members of one pair of hydraulic clutches, and the arms of the other pair being connected to the members of the other pair of hydraulic clutches.

2. In a rotatable machine gun turret assembly having a machine gun pivotally mounted in the turret, a gunner's station in the turret, and means for rotating the turret and varying the angle of elevation of the machine gun comprising a pair of turret controlling hydraulic clutches, one arranged to the right and the other to the left of a point in front of the gunner's station, a pair of gun elevation controlling hydraulic clutches, one rearwardly and the other forwardly of the said point, gearing connected to the first named pair of clutches for rotating the turret, gearing connected to the second named pair of clutches for varying the angle of elevation of the machine gun, and means for operating one clutch of each pair simultaneously comprising a universally pivoted control handle concentric with the said point and having pairs of oppositely extending clutch control arms, the arms of one pair extending to right and left of the point and connected one to each turret controlling clutch, the arms of the other pair extending rearwardly and forwardly respectively of the point and connected one to each gun elevation controlling clutch.

3. In a rotatable machine gun turret assembly having a machine gun pivotally mounted in the turret, means for rotating the turret and varying the angle of elevation of the machine gun comprising a power unit including two pairs of hydraulic clutches within the turret and arranged in a square pattern with the clutches of each pair diametrically opposite in position to each other, each clutch having a housing partly filled with liquid, a driving member submerged therein, the driving members rotating the liquid of all of said clutches continuously in the same direction, a driven member in each clutch housing normally above the liquid surface, gear-

ing connected to the driven members of one pair of clutches for rotating the turret, gearing connected to the driven members of the other pair of clutches for varying the angle of elevation of the machine gun, and means for submerging in its clutch liquid to drive its gearing, one driven member only of each clutch pair simultaneously, comprising a universally rockable control handle at the center of the pattern and having pairs of oppositely extending arms, the arms of one pair being connected to the driven members of one pair of clutches, and the arms of the other pair being connected to the driven members of the other pair of clutches.

4. In a rotatable machine gun turret assembly having a machine gun pivotally mounted in the turret, a gunner's station in the turret, and means for rotating the turret and varying the angle of elevation of the machine gun comprising a pair of turret controlling hydraulic clutches, one arranged to the right and the other to the left of a point in front of the gunner's station, a pair of gun elevation controlling hydraulic clutches, one rearwardly and the other forwardly of the said point, each clutch having a housing partly filled with liquid, a driving member submerged therein, the driving members rotating the liquid of all of said clutches continuously in the same direction, a driven member in each clutch housing normally above the liquid surface, gearing connected to the first named pair of clutches for rotating the turret, gearing connected to the second named pair of clutches for varying the angle of elevation of the machine gun, and means for operating one clutch of each pair simultaneously comprising a universally pivoted control handle concentric with said point and having pairs of oppositely extending clutch control arms, the arms of one pair extending to right and left of the point and connected one to each turret controlling clutch, the arms of the other pair extending rearwardly and forwardly of the point and connected one to each gun elevation controlling clutch.

5. In a rotatable machine gun turret assembly having a machine gun pivotally mounted in the turret, a gunner's station in the turret, and means for rotating the turret and varying the angle of elevation of the machine gun comprising a pair of turret controlling hydraulic clutches, one arranged to the right and the other to the left of a point in front of the gunner's station, a pair of gun elevation controlling hydraulic clutches, one rearwardly and the other forwardly of the said point and in line with the gunner's station, each clutch having a housing partly filled with liquid, a driving member submerged therein, a constantly running electric motor for continuously rotating all of said driving members, the driving members rotating the liquid of all of said clutches continuously in the same direction, a driven member in each clutch housing normally above the liquid surface, gearing connected to the driven members of the first-named pair of clutches for rotating the turret, gearing connected to the driven members of the second named pair of clutches for varying the angle of elevation of the machine gun, the meshing gearing being permanently in mesh and on submerging of one driven member of a pair of clutches causing the other driven member of that pair to rotate above its liquid surface in a direction opposite that of the liquid, and means for operating one clutch of each pair simultaneously comprising a universally pivoted control handle con-

centric with the said point and having pairs of oppositely extending clutch control arms, the arms of one pair extending to right and left of the point and connected one to each turret controlling clutch, the arms of the other pair extending rearwardly and forwardly respectively of the point and connected one to each gun elevation controlling clutch.

6. A power turret assembly comprising a turret, a fixed turret support including a ring gear encircling the turret, a gun pivotally mounted in the turret, a power unit including two pairs of hydraulic clutches within the turret and arranged in a square pattern with the clutches of each pair diametrically opposite in position to each other, gearing connected to the clutches of one pair to be driven thereby and engaged with the ring gear for rotating the turret relative thereto, gearing connected to the clutches of the other pair to be driven thereby and operatively engaged with the gun for moving the latter in elevation, the clutches and connected gearing of each pair being opposite with respect to each other as to the direction of movement imparted thereby, and a universally rockable control handle mounted centrally of the clutches and connected with all of the clutches for selectively controlling the operation thereof.

7. A power turret assembly comprising a turret, a fixed turret-mount supporting the turret for movement in train and including a ring gear encircling the turret, a gun mounted in the turret for movement in elevation, a gunner's station in the turret, a pair of turret-controlling hydraulic clutches and a pair of gun-controlling hydraulic clutches within the turret and arranged in a square pattern centered about a point in front of the gunner's station with the clutches of each pair diametrically opposite in position to each other, the turret-controlling clutches being positioned to the right and left respectively of the station and the gun-controlling clutches being forwardly of and in line with the station, gearing engaged with the ring gear and connected with the turret-controlling clutches to be driven thereby for moving the turret in train, gearing operatively engaged with the gun and connected with the gun-controlling clutches to be driven thereby for moving the gun in elevation, the clutches and connected gearing of each pair being opposite with respect to each other as to the direction of drive imparted thereby, a clutch-operating spider between and connected to all of the clutches and having universal movement about a pivot at the center of the pattern for selectively operating the clutches, and a handle on said spider for moving the same.

8. A power turret assembly comprising a turret, a fixed turret-mount supporting the turret for movement in train and including a ring gear encircling the turret, a gun mounted in the turret for movement in elevation, a power unit including two pairs of hydraulic clutches within the turret and arranged in a square pattern with the clutches of each pair diametrically opposite in position to each other, each clutch having an actuating rod, gearing engaged with the ring gear and connected with the clutches of one pair to be driven thereby for moving the turret in train, other gearing operatively engaged with the gun and connected with the clutches of the other pair to be driven thereby for moving the gun in elevation, the clutches and connected gearing of each pair being opposite with respect to each other as to the direction of drive imparted there-

by, and a control handle mounted for universal movement about a pivot at the center of the clutch pattern and connected to the actuating rods of the clutches for moving the rods to operate the clutches selectively.

9. A power turret assembly comprising a turret, a fixed turret-mount supporting the turret for movement in train and including a ring gear encircling the turret, a gun mounted in the turret for movement in elevation, a gunner's station in the turret, a pair of turret-controlling clutches and a pair of gun-controlling clutches within the turret and arranged in a square pattern forwardly of the gunner's station with the clutches of each pair diametrically opposite in position to each other, the turret-controlling clutches being positioned to the right and left respectively of the station and the gun-controlling clutches being forwardly and rearwardly respectively of the turret-controlling clutches and in line with the station, each clutch having rotatable driving and driven members with a coupling liquid therebetween for transmitting the motion of the driving member to the driven member, a motor centered between the clutches and connected with the clutch driving members for simultaneously rotating the same, gearing engaged with the ring gear and connected with the driven members of the turret-controlling clutches to be driven thereby for moving the turret, other gearing operatively engaged with the gun and connected with the driven members of the gun-controlling clutches to be driven thereby for moving the gun, the clutches and connected gearing of each pair being opposite with respect to each other as to the direction of drive imparted thereby, and a clutch-controlling member connected to the driven members of all the clutches and tiltable universally about a central pivot concentric with the clutch pattern for moving the clutch driven members selectively into and out of the clutch liquid.

10. A power unit for a turret-mounted gun operable to move the turret and gun in train and elevation respectively, comprising a pair of turret-controlling clutches and a pair of gun-controlling clutches arranged in a square formation with the clutches of each pair diametrically opposite to each other, each clutch having rotatable driving and driven members and a coupling liquid therebetween for transmitting the motion of the driving member to the driven member, the latter member being movable into and out of the liquid, a motor geared to the driving members of the clutches and operable to rotate said members simultaneously with corresponding rotation of the liquid, turret-operating gearing transmissions and gun-operating gearing transmissions connected with the driven members of the turret-controlling clutches and the gun-controlling clutches respectively to be driven thereby for moving the turret and gun in train and elevation, the clutches and connected gearing transmissions of each pair being opposite with respect to each other as to the direction of drive they impart to the turret or gun moved thereby, and a universally pivoted control handle mounted centrally of the clutches and connected with the driven members thereof for moving the latter selectively and alternately to cause only one member of a pair to be submerged in the clutch liquid at one time.

11. A power transmitting device comprising a non-rotatable liquid-containing housing, a rotatable sleeve mounted in the bottom of the hous-

ing and extending downwardly therefrom, a motor operatively connected with the downward extension of the sleeve for rotating the latter, a driving clutch disc submerged in the clutch liquid and fixed to the sleeve to be rotated therewith for imparting corresponding rotation to the liquid, a rotatable power-takeoff shaft extending into the housing through the sleeve, a spline gear fixed to the shaft within the housing and extending above and below the surface of the liquid, a clutch disc movable on the spline gear to and from positions above and below the surface of the liquid and adapted to be rotated by the liquid when submerged therein, said movable clutch disc being operatively associated with the spline gear for communicating its rotary motion thereto, and control means connected with the movable clutch disc and operable to move the latter into and out of the clutch liquid.

12. A power transmitting device comprising a 20

non-rotatable liquid-containing housing, a liquid-driving member submerged in the liquid of the housing, means for rotating the liquid-driving member to impart corresponding rotation to the liquid, a rotatable spline gear within the housing and extending above and below the surface of the liquid, a power-takeoff shaft operatively associated with the spline gear to be rotated therewith, a liquid-driven member movable on the spline gear to and from positions above and below the surface of the liquid and adapted to be rotated by the liquid when submerged therein, said liquid-driven member being operatively associated with the spline gear for communicating its rotary motion thereto, and control means connected with the liquid-driven member and operable to move the latter on the spline gear to and from positions above and below the surface of the liquid.

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