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GYRO-CONTROL MECHANISM

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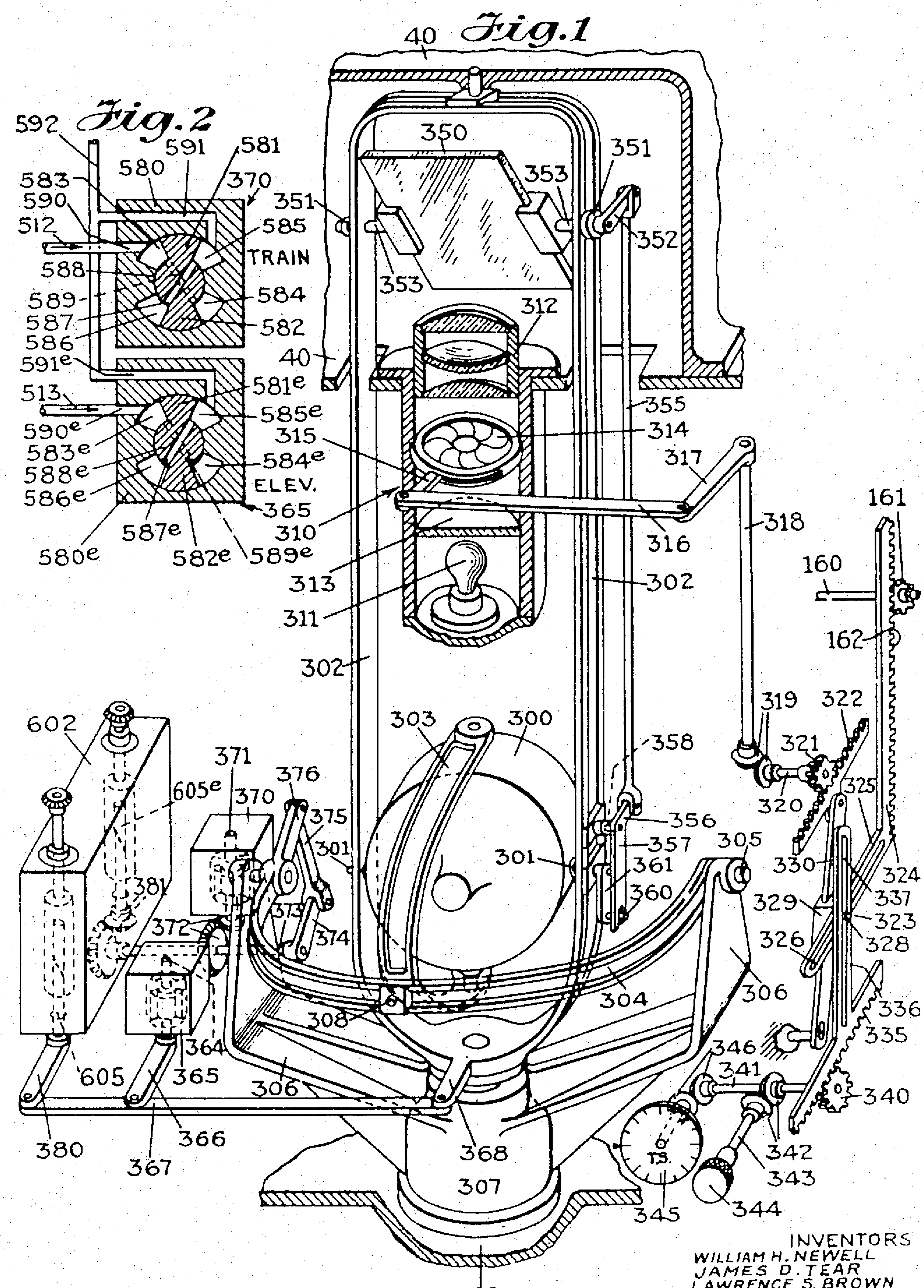

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GYRO-CONTROL MECHANISM

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4 Claims. (Cl. 74—5.4)

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This invention relates to gyro-control mechanism for gun mounts and has for an object the provision of novel and improved features of construction and operating characteristics for applying precessing forces to the gyroscope and for controlling hydraulic follow-up mechanism from the gyroscope.

This application is a division of the co-pending application of Newell, Tear and Brown, Serial No. 534,330 filed May 5, 1944 for Automatic gun control system.

Although the novel features which are believed to be characteristic of this invention are pointed out more particularly in the claims appended hereto, the nature of the invention will be better understood by referring to the following description, taken in connection with the accompanying drawings in which a specific embodiment thereof has been set forth for purposes of illustration.

In the drawings,

Fig. 1 is a diagrammatic view showing a gyroscope and control mechanism embodying the present invention; and

Fig. 2 is a sectional detail view of the torque motors for applying precessing force to the gyroscope.

Certain specific terms are used herein for convenience in referring to various details of the invention. These terms, however, are to be given an interpretation commensurate with the state of the art.

The gyro-control apparatus comprises a gyroscope 300 of standard construction including a casing which is attached by trunnions 301 to a train gimbal frame 302 and by a pivoted ball 303 to an elevation gimbal 304. The elevation gimbal 304 is mounted by trunnions 305 in a bracket 306 which is fixed to a pedestal 307 attached to the box 40. The train gimbal frame 302 is pivotally mounted at its lower end in the pedestal 307 and at its upper end in the box 40 for rotation about a vertical axis. The ball 303 is connected to the elevation gimbal 304 by a pin 308.

A collimator unit 310 is mounted on the box 40 within the train gimbal frame 302 and in alignment with the vertical axis about which the train gimbal frame rotates.

The collimator unit 310 comprises a lamp 311 and a collimator lens system 312 which is arranged to direct the rays from the lamp 311 vertically upward. Interposed between the lamp 311 and the lens system 312 is a diffusing glass 313 and an iris diaphragm 314 which is adjustable in opening by means of an arm 315 to which a link 316 is pivotally attached.

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The link 316 is also pivotally attached to an arm 317 carried by a shaft 318 which is connected through bevelled gears 319, shaft 320 and pinion 321 to a rack 322 which constitutes the output element of a range divider mechanism 323. One of the input elements of the range divider 323 comprises an L-shaped member 324 having as one leg the rack 162 which is driven by the pinion 161 of a range shaft 160 and having as the other leg a horizontal arm 325 provided with a slot 326 within which a pin 328 slides. The pin 328 is carried on a sleeve 329 which slides on a pivoted arm 330 connected to the rack 322. The other input member to the range divider comprises a rack 335 having a vertical arm 336 provided with a slot 337 in which the pin 328 slides. The rack 335 is actuated to represent target size by a pinion 340 mounted on a shaft 341 which is adjusted through bevelled gears 342 by means of a shaft 343 and an adjusting knob 344 which is accessible from the front of the box 40. A target size dial 345 is driven by the shaft 341 through bevelled gears 346. The dial 345 is visible from the front of the box 40. The adjusting knob 344 is adapted to be adjusted in accordance with the known size of the target.

It is well known that with a stadia type range finder the range of the target is proportional to the width or size of the target divided by the subtended angle. The divider mechanism 323 performs this division. The position of the rack 322 represents the angle subtended by the target. The opening of the iris 314 is controlled from rack 322 to be proportional to the position of rack 322. The position of the range shaft 160 is adjusted by the gunner so that the image of the iris which he sees just encompasses the target. Having set the proper target size or width on the dial 345 the correct range will be introduced into the computing mechanism by shaft 160. For short ranges the time of flight may be considered as proportional to the range. Therefore, the value introduced into the deflection computing mechanism by shaft 160 may be considered as representing time of flight (T).

Immediately above the collimator is a mirror 350 mounted on trunnions 353 by which it is pivoted to the train gimbal frame 302 in bushings 351 for tilting movement about a horizontal axis and controlled by an arm 352 which is attached to one of the trunnions 353. This mirror is partially silvered so as to be transparent and at the same time to reflect rays striking it from the collimator lens system 312. The mirror 350 is moved by the gyroscope 300 through a linkage comprising a link 355 pivotally connected to the arm 352 and to arm 356 of equal length. Arm 356 constitutes one arm of a bell crank lever having a second arm 357. The bell crank lever is pivoted on a trunnion 358 mounted on the frame 302 and is actuated by a pin 360 engaging a slot in the end of an arm 357 and carried on an arm 361 attached to the trunnion 301 of the gyro-housing. The arm 361 is equal in length to the spacing between the gyro-trunnion 301 and the bell crank trunnion 358. By this arrangement the tilting movement of the gyro-housing about a horizontal axis produces a pivotal movement of the mirror 350 through one-half of the angle of movement of the gyroscope, so that the rays from the collimator 310 as reflected by the mirror always remain parallel to the spin axis of the gyroscope.

The precessing force for causing the gyroscope 300 to precess in elevation is applied through the shaft 364 of a hydraulic elevation precessing motor 365 to be described having an arm 366 attached to a link 367 which, in turn, is attached to an arm 368 carried by the train gimbal frame 302.

The train precessing force is applied by a train precessing motor 370 to be described, through a shaft 371, bevelled gears 372, shaft 373, arm 374, link 375 and arm 376 which is attached to the elevation gimbal 304.

Movement of the train gimbal frame 302 in train which corresponds to movement in train of the spin axis of the gyro 300, is transferred by the link 367 to an arm 380 attached to the train shaft 605 of a hydraulic follow-up valve mechanism 602. Movement of the spin axis of the gyro 300 in elevation is transferred from the elevation gimbal 304 through the shaft 373 and bevelled gears 381 to the elevation shaft 605*e* of the follow-up valve mechanism. The mirror 350 is positioned in an upper projection of the box in the line of sight of the observer.

Control pressures *Pt* and *Pe* derived from a suitable source are supplied to the train and elevation precessing force motors 370 and 365 by the ducts 512 and 513 respectively. The motor 370 comprises a block 580 having two arcuate chambers in which vanes 581 and 582 are positioned. These vanes separate the arcuate chambers into *Pt* chambers 583 and 584 and P_1 chambers 585 and 586. The P_1 chambers are in communication through a passage 587 in the hub 588 carrying the vanes 581 and 582. The *Pt* chambers 583 and 584 are likewise in communication through a passage 589 in said hub. The chamber 583 communicates through a passage 590 in the block 580 with the *Pt* duct 512. The chamber 585 communicates through a passage 591 in block 580 with a duct 592 which communicates with a suitable source of pressure P_1. When the pressure *Pt* equals the pressure P_1 the pressures in the various chambers of the motor 370 are balanced and no precessing torque is applied by the motor. If, however, the pressure *Pt* varies from the pressure P_1, a corresponding torque is produced which is applied to the shaft 371 and thence through the bevelled gears 372 and the linkage mechanism above described to the elevation gimbal 304, to apply a torque to the gyroscope 300 which causes the same to precess about its vertical axis. The rate of precession thus produced corresponds to the force supplied. Hence the rate of train of the gyroscope is proportional to the pressure *Pt*.

The elevation precessing force motor 365 is similar to the motor 370. The corresponding parts

have accordingly been given corresponding reference characters with the suffix "*e*" to indicate elevation precession force. In a manner similar to that above described, a torque is produced in the hub 588*e* which is applied by the shaft 364 to the link 367. This link applies the torque to the train gimbal frame 302 which causes the gyroscope 300 to precess in elevation.

Although a specific embodiment of the invention has been shown for purposes of illustration, it is to be understood that the invention is capable of various adaptations as will be readily apparent to a person skilled in the art. The invention is only to be limited in accordance with the scope of the following claims.

What is claimed is:

1. A gyro-control mechanism comprising a gyroscope, a train gimbal frame carrying said gyroscope for movement in train, an elevation gimbal connected to move in elevation with said gyroscope, a precession torque motor including a rotor, hydraulic means supplying pressure to exert a rotational force on said rotor, means including mechanical linkages connecting said rotor to turn in response to movement of said train gimbal frame, said mechanical linkages being adapted to transfer torque from said rotor to said frame to cause said gyroscope to precess in elevation, a second precession torque motor including a rotor, and means including mechanical linkages connecting said second rotor to turn in response to movement of said elevation gimbal, said second mechanical linkages being adapted to apply torque from said second rotor to said elevation gimbal to cause said gyroscope to precess in train.

2. A gyro-control mechanism comprising a gyroscope, a train gimbal frame carrying said gyroscope for movement in train, an elevation gimbal connected to move in elevation with said gyroscope, a precession torque motor including a rotor mounted for movement about an axis parallel to the axis of said train gimbal frame, hydraulic means supplying pressure to exert a torque on said rotor, a link connecting said rotor to turn with said train gimbal frame and also to transfer said torque to said frame to cause said gyroscope to precess in elevation, a second precession torque motor including a rotor, and means connecting said second rotor to turn in response to movement of said elevation gimbal and also to apply torque from said second rotor to said elevation gimbal to cause said gyroscope to precess in train.

3. A gyro-control mechanism comprising a gyroscope, a train gimbal frame carrying said gyroscope for movement in train, a precession torque motor including a rotor mounted for movement about an axis parallel to the axis of said train gimbal frame, hydraulic means supplying pressure to exert a torque on said rotor, and means connecting said rotor to turn with said train gimbal frame and also to transfer said torque force from said rotor to said frame to cause said gyroscope to precess in elevation.

4. A gyro-control mechanism comprising a gyroscope, a train gimbal frame carrying said gyroscope for movement in train, an elevation gimbal connected to move in elveation with said gyroscope, a precession torque motor including a rotor, ducts to supply hydraulic pressure to said motor to exert a rotational force on said rotor, means connecting said rotor to turn in response to movement of said train gimbal frame and also to transfer torque from said rotor to said frame to cause said gyroscope to precess in elevation,

a second precession torque motor including a rotor, means connecting said rotor to turn in response to movement of said elevation gimbal and to apply torque from said second rotor to said elevation gimbal to cause said gyroscope to precess in train, and follow-up means including rotatable shafts actuated with the respective precession motors to follow the movements of said train gimbal frame and of said elevation gimbal respectively.

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