June 13, 1950 H. KONET 2,511,273

ERECTING MECHANISM FOR GYRO VERTICALS

Filed Feb. 14, 1947

Fig. 1

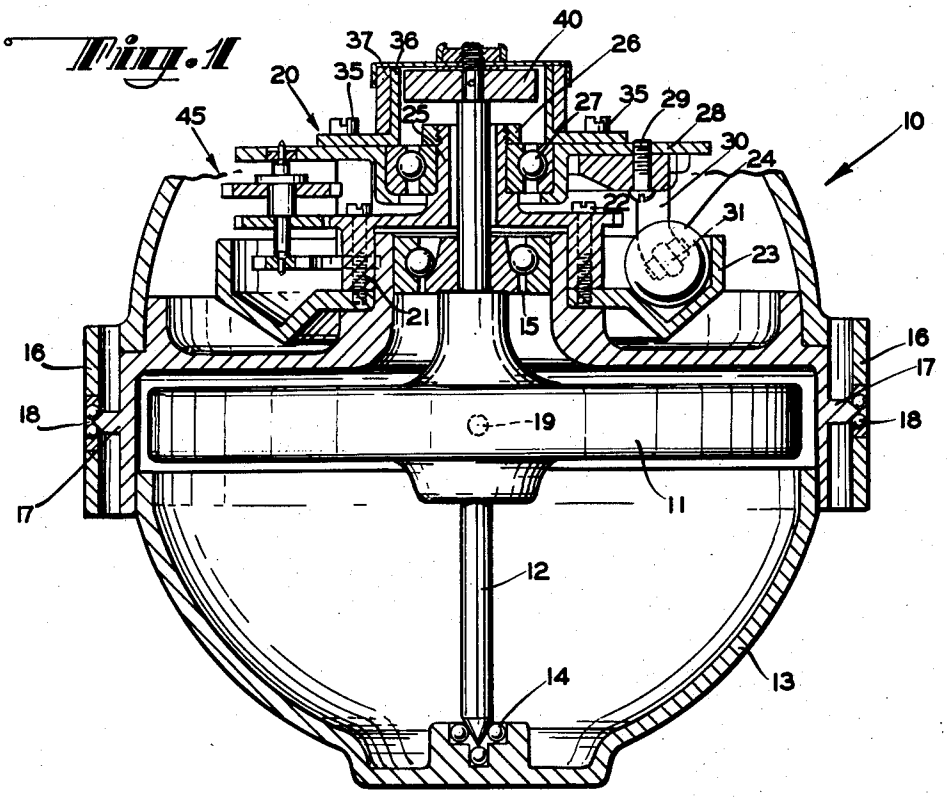


Fig. 2

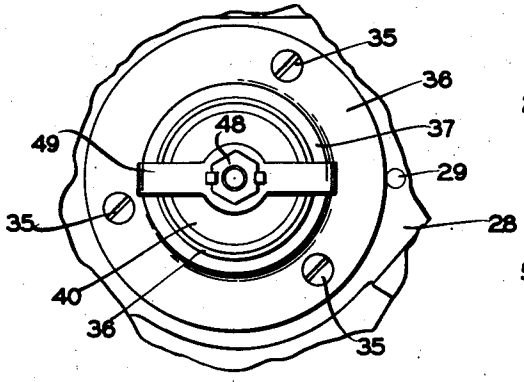


Fig. 3

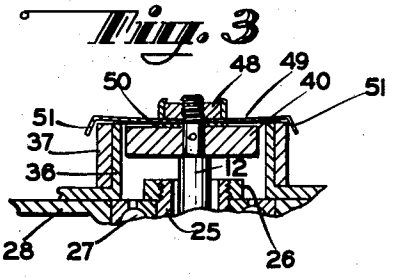
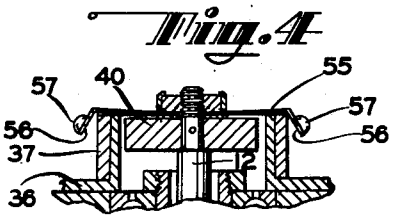


Fig. 4



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ERECTING MECHANISM FOR GYRO VERTICALS

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11 Claims. (Cl. 74—5.44)

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This invention relates to gyroscopic devices of the gyro-vertical type, and more particularly to an erecting system for bringing the gyro rotor spin axis to a vertical position when the gyro-vertical is initially placed in operation.

A gyro-vertical requires considerable time when first set in operation to erect the spin axis thereof into its vertical position. Various expedients have been considered for erecting the rotor axis and to maintain the same in its vertical position. Two types of gyro erecting systems are in general use; the pendulum controlled reaction jet system and the rolling ball system wherein a carriage mounted on the gyro-vertical is rotated by the gyro rotor but at a reduced speed; the carriage controlling the movement of a ball rolling in a circular track. The latter type of erecting system is disclosed in the United States Patent No. 2,159,118, issued to Robert Alkan on May 23, 1939.

An object of my present invention is to provide an erecting system with means materially reducing the time required initially to erect the gyro rotor spin axis by decreasing the time elapsed before applying the erecting torque to the gyro rotor, and by increasing the frequency with which the erecting torque is applied to the gyro rotor.

Another object of my invention is to provide in an Alkan erecting system, frictional means for driving the carriage of said system directly from the gyro-rotor shaft, said means including centrifugal responsive means for releasing the drive by the rotor shaft when the rotational speed of the shaft reaches a predetermined value.

A further object of this invention is to provide a simple, compact, and rugged device for a gyro-erecting system which shall be automatic in its operation, positive in its action, and be practical and efficient to a high degree in use.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

This invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter described, and of which the scope of application will be indicated in the appended claims.

I accomplish the several objects of my invention by providing a booster spring for an Alkan erecting system. The booster spring is fixed to the gyro rotor shaft and is rotated therewith. The spring frictionally engages the upper edges of the magnetic drag cup of the carriage for rotating the same upon rotation of the gyro

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shaft. The carriage of the erecting system will thus be rotated directly by the rotor shaft, the speed of the carriage being limited by the usual escapement mechanism

In setting a gyro-vertical in operation, the speed of the rotor must be increased gradually. As a result, present day erecting systems require some ten to fifteen minutes to erect the spin axis of the rotor to a vertical position. By the addition of my booster spring, the erecting torques produced by the carriage are applied as soon as the gyro rotor is set spinning, with the result that I am able to erect a gyro-vertical in less than two minutes.

The increasing speed of the gyro rotor will cause centrifugal force to act upon the booster spring, whereupon the spring will be flexed. The frictional engagement of the spring and carriage will thus be broken, permitting the normal driving means for the carriage to take over.

In the accompanying drawings I have shown two of the various possible illustrative embodiments of my invention in which

Figure 1 is a vertical section of a gyro-vertical, portions of which are shown in elevation, illustrating a booster spring in conjunction with an Alkan erecting system.

Figure 2 is a fragmentary plan view of the gyro-vertical.

Figure 3 is cross sectional view illustrating the action of the booster spring when the gyro rotor spins at a predetermined speed, while

Figure 4 is a view similar to Figure 3 of a second embodiment of my invention.

Referring now in detail to the drawings, 10 designates a gyro vertical having a rotor 11 adapted to spin about a vertical axis. Said rotor is made integral with or fixed to a shaft 12 journalled within the casing 13, as in a bearing 14 in the lower part of the casing, and in a bearing 15 fixed in the upper part of the casing. The casing 13 is pivoted in the usual manner for angular displacement about a horizontal axis normal to the spin axis, in a gimbal ring 16 as by two trunnions 17 on said casing journaled in the bearings 18 of said gimbal ring. The gimbal ring 16 in turn is pivotally mounted for angular displacement about a second horizontal axis normal to the first axis by means of a second gimbal ring (not shown), the second axis being indicated in the drawings by the phantom-lined trunnion 19 (Figure 1).

An erecting system 20 is provided for the gyro vertical 10 for erecting and maintaining the spin axis of the rotor 11 in a vertical position.

The erecting system 20 is mounted to the top of the gyro casing 13 by a bell-bottomed sleeve 21 fixed to the casing by screws 22. Supported between the lower portion of sleeve 21 and the upper portion of casing 13 is a circular track 23 carrying a freely rolling ball 24. Fixed to the upper portion 25 of the sleeve by a threaded retainer 26 is a bearing 27. Rotatably mounted on said bearing is a carriage 28 having fixed thereto as by screw 29, a depending arm 30 provided at its lower end with a small roller 31. The depending arm 30 and a stop (not shown) fixed to said carriage form a cage for the ball 24 for controlling the free movement of the ball upon tilt of the spin axis and for applying the necessary torque for erecting the rotor as more fully described in the aforesaid United States Patent No. 2,159,118.

Fixed to the upper part of the carriage 28, as by screws 35, is a cup or sleeve 36 made of a highly conductive but non-magnetic material such as copper or aluminum. A sleeve cover 37 is placed about the cup 36.

Magnetic means are provided for rotating the carriage 28 at a slower rate of speed than that of the rotor.

To this end a small permanent magnet rotor 40 is fixed to the upper end of shaft 12. Rotation of the shaft 12 will cause eddy currents to be induced in the cup 36 by the rotation of the magnet 40. The reaction of the magnetic field of the magnet with the fields of the induced eddy-currents will cause rotation of the cup 36 in the same direction as that of the rotor 40, but at a slower speed. The carriage 28 will thus be rotated to move the ball 24 in the circular track for producing the necessary torque to erect the gyro rotor spin axis, as more fully described in the aforesaid patent.

An escapement mechanism indicated generally at 45, and fully described in my copending application, now abandoned for Gyro erecting mechanism bearing Serial No. 519,025 and filed on January 20, 1944, permits the carriage 28 to be rotated at a substantially constant rate.

With the rotor 11 at rest, the casing 13 is angularly displaced about the axes 17—17 and 19—19. In setting the rotor spinning, the erecting mechanism 20 will cause a torque to be applied to the rotor tending to erect the spin axis thereof to a vertical position. In erecting systems used heretofore, the time required to bring the gyro rotor up to rated speed and to erect the spin axis to a vertical position is considerable, ranging from some ten to fifteen minutes.

Means is now provided whereby the gyro spin axis may be erected to a vertical position in less than two minutes.

To this end there is provided a leaf spring 49, herein referred to as a booster spring, fixed to the upper end of the rotor shaft 12 as by locknut 43, and separated from the drag cup magnet 40 by a washer 50. The lower surface of the booster spring rests upon the upper edges of the drag cup 36 and the sleeve 37. The ends 51 of the spring are bent over and dependent, the inner surfaces of said ends engaging the outer surface of the sleeve 37.

By virtue of its physical connection with rotor shaft 12, the booster spring 49 will be rotated therewith as soon as the rotor is set spinning. Due to the frictional engagement of the spring with the top edges of the drag cup and sleeve, and the outer surface of the sleeve, the carriage 28 will be rotated with the rotor shaft 12. The

erecting mechanism 20 thus applies the torque required for the erection of the spin axis immediately upon setting the rotor in motion. As is well known, the drag cup device forming a part of the erecting system will rotate the carriage 28 at a very slow rate of speed when the rotor is first set spinning. The forces exerted on the rotor by the ball 24 of the erecting system will not be applied until some time after the rotor operation is begun; the necessary erecting torque being applied at infrequent intervals. With the addition of the booster spring 49 to the erecting system 20, the carriage 28 is rotated at rated speed (limited by the escapement 45) to permit the ball 24 to apply the necessary erecting torque for erecting the spin axis to its vertical position.

As the rotor speed increases, centrifugal force will act upon the ends 51 of the booster spring. At a predetermined speed, less than rated rotor speed, the ends 51 are caused to fly outwardly due to the centrifugal force acting thereon. As a result, the booster spring will be flexed upwardly (Figure 3) to break the frictional engagement thereof with the drag cup 36 and sleeve 37. The erecting mechanism will then operate in the normal manner by the action of the drag cup to maintain the rotor spin axis in a vertical position with the rotor spinning at rated speed.

In Figure 4 I have shown a second embodiment of my invention in which a booster spring 55 is fixed to the rotor shaft 12; the dependent ends 56 of said spring being provided with small weights 57. In this embodiment, the frictional engagement of the booster spring 55 will be broken sooner than in the example hereinbefore described, due to the centrifugal force acting upon the weighted dependent ends.

It will thus be seen that there is provided an erection system in which the several objects of this invention are achieved, and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiments above set forth, it is to be understood that all matter herein set forth, or shown in the accompanying drawings is to be interpreted as illustrative, and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. In a gyro vertical having an erecting mechanism for maintaining the rotor spin axis in a normally vertical position when the rotor is spinning at a predetermined speed, a member driven by the rotor and frictionally engaging the erecting mechanism only when the rotor speed is less than the predetermined speed to operate the erecting mechanism for creating erecting moments about the spin axis to erect the rotor axis to its vertical position.

2. In a gyro vertical having an erecting mechanism for maintaining the rotor spin axis in a normally vertical position when the rotor is spinning at a predetermined speed, a resilient member frictionally engaging and driving the erecting mechanism only when the rotor speed is less than the predetermined speed to operate the erecting mechanism for creating erecting moments about the spin axis to erect the rotor axis to its vertical position.

3. In a gyro vertical having an erecting mechanism for maintaining the rotor spin axis in a normally vertical position when the rotor is

spinning at a predetermined rate comprising a rotatable carriage rotating at a normal speed less than the predetermined rate of the rotor, a member driven by the rotor and frictionally engaging the carriage to rotate the same at its normal speed only when the rotor is spinning at a speed less than its predetermined speed for creating erecting moments by the rotation thereof to erect the rotor axis to its vertical position.

4. In a gyro vertical having an erecting mechanism for maintaining the rotor spin axis in a normally vertical position when the rotor is spinning at a predetermined speed comprising a carriage rotatable by the rotor at a constant normal speed less than the rotational speed of the rotor, a member driven by the rotor frictionally engaging the carriage to rotate the same at its constant normal speed only when the rotor is spinning at a speed less than its predetermined speed for creating erecting moments by the rotation of said carriage to erect the rotor axis to its vertical position.

5. In a gyro vertical having an erecting mechanism for maintaining the rotor spin axis in a normally vertical position when the rotor is spinning at a predetermined rate comprising a carriage rotatable by the rotor at a constant normal speed less than the rotational speed of the rotor, a resilient, elongated member fixed to the rotor shaft and frictionally engaging the carriage to rotate the same at its constant normal speed when the rotor is spinning at a speed less than its predetermined speed for creating erecting moments by the rotation of said carriage to erect the rotor axis to its vertical position.

6. In a gyro vertical having an erecting mechanism for maintaining the rotor spin axis in a normally vertical position when the rotor is spinning at a predetermined rate comprising a carriage rotatable by the rotor at a constant normal speed less than the rotational speed of the rotor, a resilient, elongated member fixed to the rotor shaft and frictionally engaging the carriage to rotate the same at its constant normal speed when the rotor is spinning at a speed less than its predetermined speed for creating erecting moments by the rotation of said carriage to erect the rotor axis to its vertical position, the drive of said member being released when the rotor speed approaches its predetermined rotational speed.

7. The combination with a gyro vertical having an erecting mechanism for maintaining the rotor spin axis in a normally vertical position comprising a carriage rotatable by the rotor at a constant speed less than the rotational speed of the rotor, of a resilient elongated member fixed to the rotor shaft having dependent ends, said member and said ends frictionally engaging said carriage to rotate the same when the rotational speed of the rotor is less than a predetermined speed.

8. The combination with a gyro vertical having an erecting mechanism for maintaining the rotor spin axis in a normally vertical position comprising a carriage rotatable by the rotor at a constant speed less than the rotational speed of the rotor, of a resilient elongated member fixed to the rotor shaft having dependent ends, said member and said ends frictionally engaging said carriage to rotate the same when the rotational speed of the rotor is less than a predetermined speed, said member being flexed by centrifugal force acting upon the dependent ends to release said carriage when the rotational speed of the rotor reaches a predetermined speed.

9. The combination with a gyro vertical having an erecting mechanism for maintaining the rotor spin axis in a normally vertical position comprising a carriage rotatable by the rotor at a constant speed less than the rotational speed of the rotor, of a resilient elongated member fixed to the rotor shaft having dependent ends, said member and said ends frictionally engaging said carriage to rotate the same when the rotational speed of the rotor is less than a predetermined speed, and weighted members for said dependent ends, said resilient member being flexed by centrifugal force acting upon the dependent weighted ends to release said carriage when the rotational speed of the rotor reaches a predetermined speed.

10. The combination with a gyro vertical having a spinning rotor and an erecting mechanism driven by said rotor for normally maintaining the rotor spin axis in a substantially vertical position when the rotor has attained a predetermined speed, of a booster control for assuming primary operation of said erecting mechanism in response to initial operation of said rotor from a non-operating condition where its speed is less than said predetermined speed.

11. The combination with a gyro vertical having a spinning rotor and an erecting mechanism driven by said rotor for normally maintaining the rotor spin axis in a substantially vertical position when the rotor has attained a predetermined speed, of a booster control operated by said rotor for assuming primary operation of said erecting mechanism in response to initial operation of said rotor from a non-operating condition where its speed is less than said predetermined speed, and means responsive to said predetermined rotor speed for overpowering said booster control whereby said rotor assumes primary control of said erecting mechanism.

HENRY KONET.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,159,118	Alkan	May 23, 1939
2,300,548	Hamilton	Nov. 3, 1942
2,370,904	Kimball	Mar. 6, 1945