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GYROSCOPIC ROTOR FRAME

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Fig. 1.

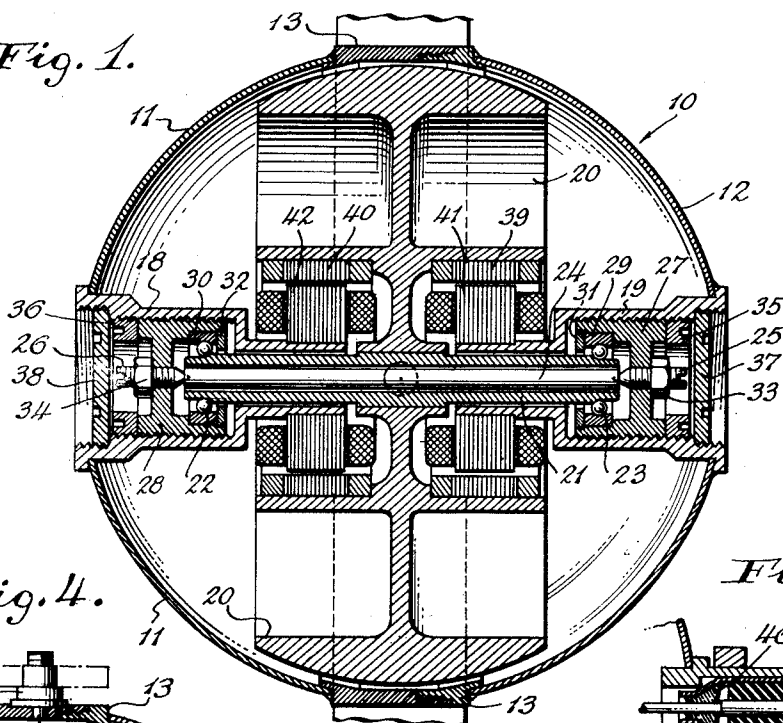


Fig. 3.

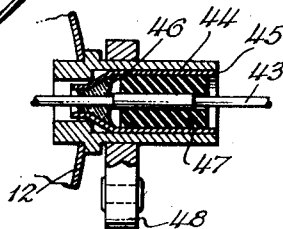


Fig. 4.

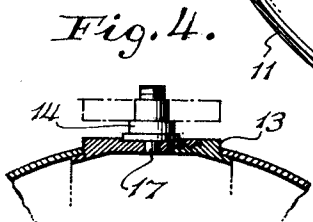
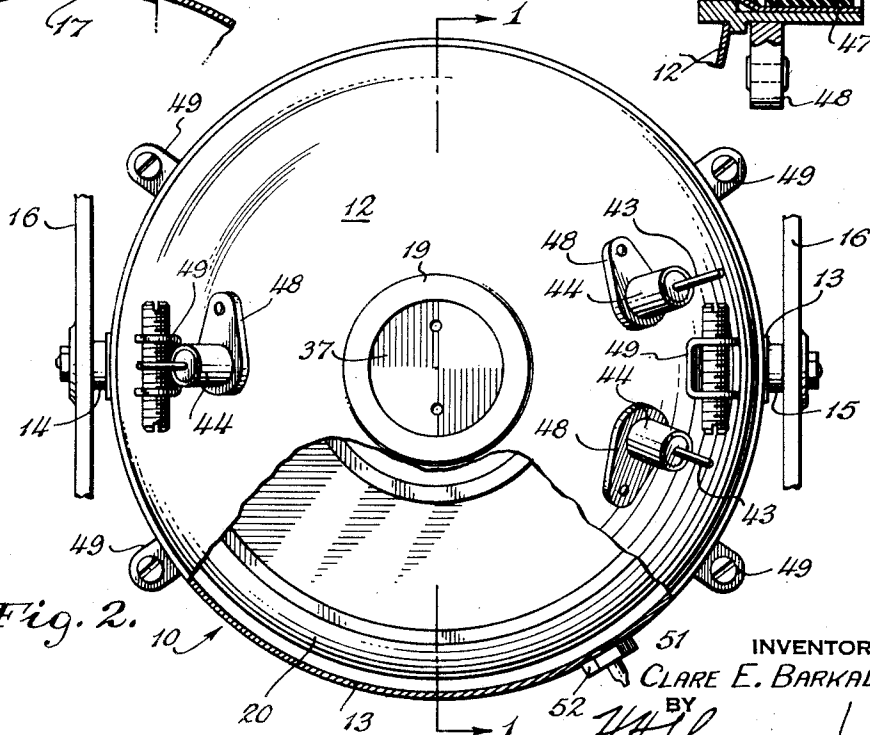


Fig. 2.



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GYROSCOPIC ROTOR FRAME

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3 Claims. (Cl. 74—5)

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This invention relates to frames for supporting gyroscopic rotors.

One of the features of the invention resides in the provision of a structure of this character comprising a closed thin hollow spherical metallic shell formed of two interfitting hemispherical parts. Heretofore, full or partial shells of this geometrical shape have been employed to provide a covering for the main rotor supporting structural frame. Such coverings provided symmetrical surfaces adapted to carry indicia. The coverings were suitably fastened to the exterior of the main rotor supporting structure. In the present instance, the shell per se provides the structural frame for supporting the gyroscopic rotor. A shell of this type has the structural advantages over known closed types of frames of lighter weight, of not being subject to uneven internal stresses with changes in air pressure exteriorly of the shell, and of being similarly symmetrical relative to the spin axis of the rotor that it supports as well as its precession axis. In addition to the above, the closed shell per se provides a structural member of sufficient strength and rigidity to support a gyroscopic rotor.

A further feature of the invention resides in the rotor frame structure combination of a thin spherical shell and a spaced pair of oppositely disposed bearing mountings connected to the respective hemispherical parts to project radially within the shell.

Another feature of the invention resides in the provision of a thin hollow spherical metallic shell having two hemispherical parts with interfitting portions connected thereto providing a circumferential band of greater thickness than the shell.

Other features, advantages and structural details of the invention will be apparent from the following description when read in connection with the accompanying drawing, wherein,

Fig. 1 is a sectional view of a rotor frame constructed in accordance with the present invention taken on line I—I, in Fig. 2;

Fig. 2 is an end elevation of the improved frame;

Fig. 3 is an enlarged detail sectional view of one of the electrical lead connections on the frame, and

Fig. 4 is a sectional view showing the connection between one of the trunnions and the spherical frame.

With reference to the drawing, the improved rotor frame is shown to include a thin spherical shell indicated generally at 10 formed of two substantially hemispherical parts 11 and 12 that are joined by a suitable screw threaded connection.

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The thickness of the frame at the connection of the parts 11 and 12 is heavier than the main body of the shell to provide a circumferential band or ring 13 thereon to which a pair of oppositely disposed trunnions 14 and 15 are suitably connected exteriorly of the shell. As shown in Fig. 1, the trunnions 14 and 15 engage suitable bearings in a gimbal ring such as shown in part at 16. The interfitting portions of the respective hemispherical shells 11 and 12 form the ring or circumferential band 13 of the frame. Band 13 is of greater thickness than the main body of the shell to provide for the connection between the parts 11 and 12 as well as to provide an area sufficiently strong to connect the trunnions thereto. As shown in Fig. 4, trunnion 14 is provided with a projecting part 17 that fits an opening in the part of ring 13 included in hemispherical shell 11. The trunnions are mounted in such a manner that the connection is permanent and air-tight.

The frame further includes a spaced pair of oppositely disposed bearing mountings indicated at 18 and 19 that project radially within the shell 10 and include axial openings that extend substantially through the shell. Shell 10 is preferably made of a metal such as steel to provide sufficient strength and rigidity to support a gyroscopic rotor therein. As the shell is thin, the weight of the same is lighter than conventional type closed or open frames made of relatively thick metal. Known types of frames are ribbed or reinforced to obtain necessary structural rigidity which increases the weight of the same. In the improved frame, no internal or external ribbing or reinforcing is necessary due to the inherent rigidity of a sphere. As the weight of the improved frame is decreased over known type of frames for a gyroscope of the character shown, the quality of merit of the device, or the ratio of the angular momentum of the gyroscopic rotor to the weight of the rotor plus the weight of the frame supporting the same, is materially increased.

In the improved frame shown, the mountings 18 and 19 may be formed as a part of the shell by connecting the parts by a copper brazing operation. This secures the noted parts with the openings in the shell provided for the mountings arranged in concentric relation with the axial openings in the mountings for the bearings. The bearing mountings 18 and 19 project radially within the shell 10 to support the gyroscopic rotor to spin about a diametric axis within the shell with the center of gravity of the rotor coincident with the geometrical center of the shell. As shown in Fig. 1, the tubular bearing mount-

ings 18, 19 are of greater thickness than the thickness of the thin spherical shell 10.

The gyroscopic rotor of the frame structure is indicated at 20. This element is rotatably supported in the shell with its center of gravity at the center of the spherical shell. The gyroscopic rotor mounted in the improved frame is provided with an axially open shaft 21 that engages the spaced ball bearings 22 and 23 in the respective mountings 18 and 19. The axial spacing between the bearings is maintained constant and unaffected by temperature changes during operation by means of a shaft mounting arrangement such as particularly described and claimed in U. S. Letters Patent No. 2,353,139, dated July 11, 1944, to Lennox F. Beach. This construction includes an axially positioned strut 24 of approximately the same length as the shaft 21 made of a material having approximately the same temperature coefficient of expansion as the shaft. The means connecting the strut 24 and respective mountings 19 and 18 is shown in the present instance to include the threaded pins 25, 26 and a pair of axially adjustable pieces 27, 28 that in the arrangement shown are connected to the respective mountings by threaded engagement. The outer races 29 and 30 for bearings 23 and 22 respectively are fixedly held in the respective pieces 27 and 28 by means of lock nuts 31 and 32. Locking nuts 33 and 34 are provided for the respective pins 25 and 26. Further lock nuts 35 and 36 are utilized to hold the adjustable pieces 27 and 28 in the proper positions in the mountings 19 and 18 so that the bearings 23 and 22 are located within the shell at equal axial distances from the center of the shell to properly position the gyroscopic rotor 20. In accordance with the teachings of the hereinbefore noted patent, the pins 25 and 26 are initially adjusted to place the strut 24 under compression. In the finished assembly of the frame, the axial openings in the bearing mountings 19 and 18 are closed by means such as the threaded plugs indicated at 37 and 38.

In accordance with the invention, the gyroscopic rotor 20 of the improved frame is spun by an electric motor having a pair of corresponding electrical rotors 39 and 40 included in the gyroscopic rotor and similar or corresponding electric stators 41 and 42 that are fixedly mounted on extending portions of the respective bearing mountings 19 and 18. The motor shown is of the polyphase induction type having separate three phase wound stators and separate electric rotors of identical size and shape. The electrical rotors 39 and 40 are mounted in a flanged portion of the gyroscopic rotor 20, the arrangement being such that the same are located at equal distances along the spin axis of the gyroscopic rotor 20 to either side of the geometrical center of the shell 10. The electrical stators 41 and 42 are similarly mounted on the bearing mountings 19 and 18, respectively, so the same are located at equal distances along the spin axis to either side of the center of the improved frame.

Electrical energy from a suitable source of alternating current (not shown) is supplied to the stators of the electric motor within the frame by way of three suitable leads 43. These leads, as shown in Figs. 2 and 3, enter the shell through individual plugs 44 that are shown in cylindrical form. The plugs 44 enter suitable openings in the shell 10 and may be silver soldered or otherwise connected to the shell. The lead in wires

43 at the plugs 44 are made of a glass sealing alloy as is the tubular insert 45 in the plugs so that a glass seal 46 may be provided as shown to connect the parts and insure an air-tight fit. An insulating member 47 serves the purpose of holding the wires 43 firmly in the plugs 44. Plates 48 formed as part of the plugs 44 are also provided to anchor the leads exteriorly of the plugs.

Balancing means for the improved frame is provided in the form of a plurality of symmetrically arranged threaded U-shape lugs suitably mounted on the exterior of the shell 10 as indicated at 49. Each of the lugs 49 engages a suitable adjustable balancing screw. Only six of the provided eight balancing screws appear in Fig. 2 of the drawing.

In the finished unit the threaded connections between the parts 11 and 12 and the plugs 37 and 38 are sealed, as for example, with soft solder. The air is then evacuated from the closed frame by suitable external suction applying means (not shown) through a tube formed as a part of a threaded nipple 52 fixedly connected and sealed to the shell 10. When the proper vacuum is attained the tube 51 is pinched to form an air-tight joint as shown in Fig. 2. The finished frame is air-tight or hermetically closed.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departure from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A gyroscopic rotor frame composed of a thin hollow spherical metallic shell having two hemispherical parts with interfitting portions connected thereto providing a circumferential band of greater thickness than the shell, a spaced pair of oppositely disposed bearing mountings connected to the respective hemispherical parts to project radially within the shell, and a gyroscopic rotor supported within said shell by said bearing mountings to spin about an axis concentric with the axis of the circumferential band.

2. A gyroscopic rotor frame composed of a thin hollow spherical metallic shell having two hemispherical parts with interfitting portions connected thereto providing a circumferential band of greater thickness than the shell, a pair of exterior oppositely disposed trunnions mounted on the band portion of the shell, a spaced pair of oppositely disposed bearing mountings connected to the respective hemispherical parts to project radially within the shell, and a gyroscopic rotor supported within said shell by said bearing mountings to spin about an axis normal to the axis defined by said trunnions.

3. A gyroscopic rotor frame composed of a thin hollow spherical metallic shell having two hemispherical parts with interfitting portions connected thereto providing a circumferential band of greater thickness than the shell, a spaced pair of oppositely disposed tubular bearing mountings of greater thickness than the shell connected to the respective hemispherical parts to project radially within the shell, and a gyroscopic rotor supported within said shell by said bearing mountings to spin about an axis concentric with the axis of the circumferential band.

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