Oct. 19, 1943. H. F. SCHMIDT ET AL 2,332,172

REDUCTION GEARING APPARATUS

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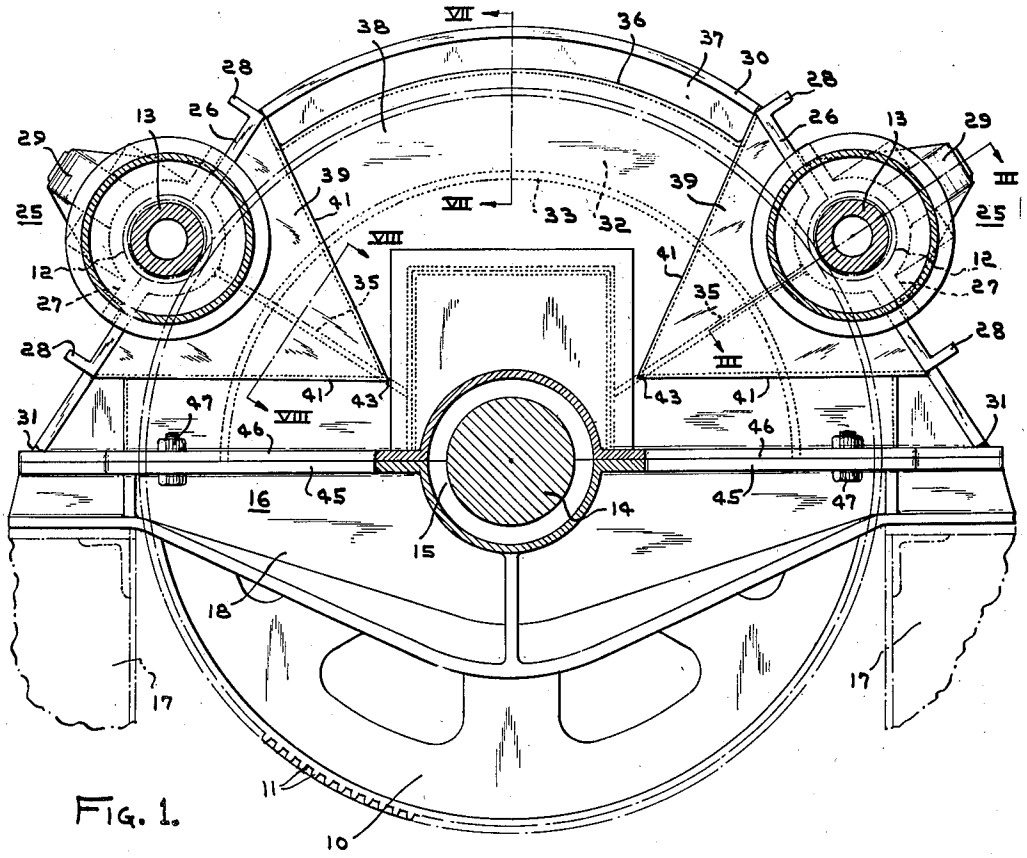


FIG. 1.

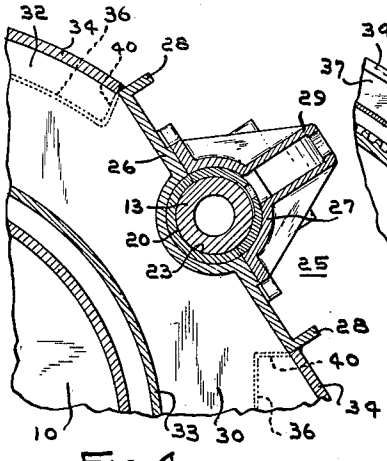


FIG. 4.

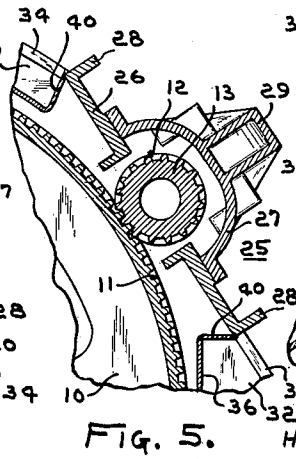


FIG. 5.

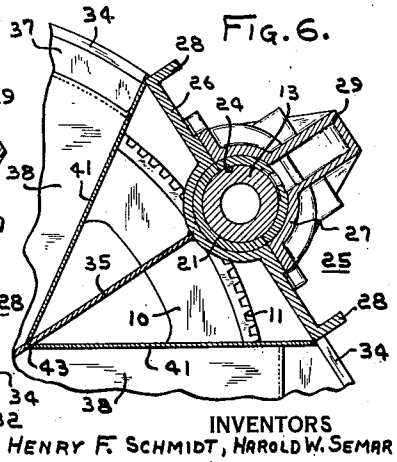


FIG. 6.

INVENTORS
HENRY F. SCHMIDT, HAROLD W. SEMAR
AND IRA SHORT.
BY
A. B. Rossi
ATTORNEY

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REDUCTION GEARING APPARATUS

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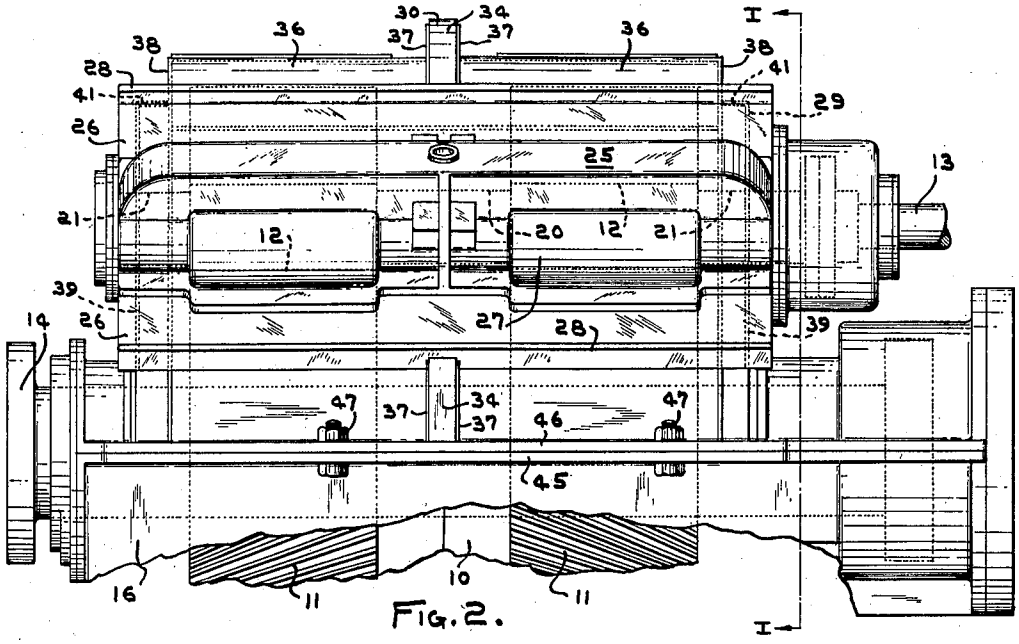


FIG. 2.

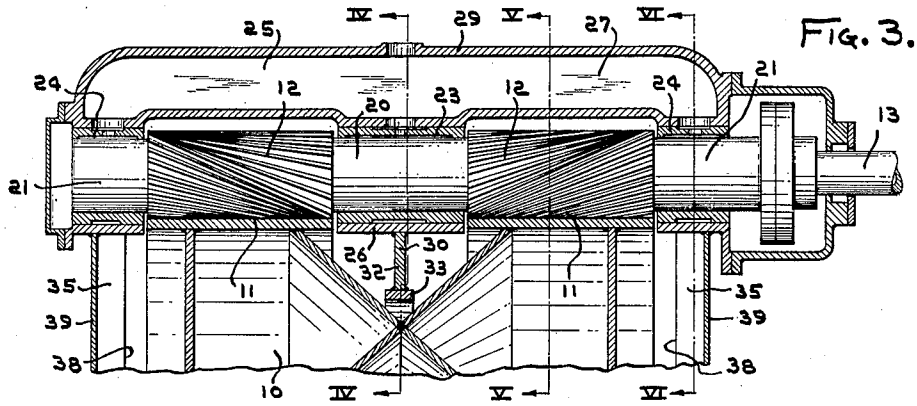


FIG. 3.

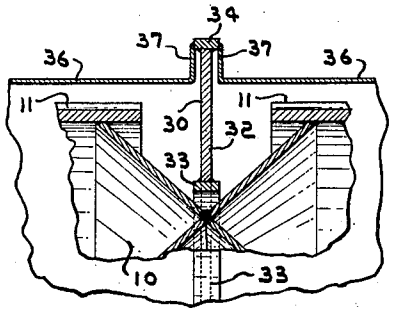


FIG. 7.

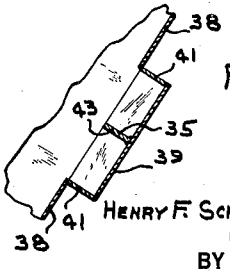


FIG. 8.

INVENTORS
HENRY F. SCHMIDT, HAROLD W. SEMAR
AND IRA SHORT.
BY
A. B. Rivers
ATTORNEY

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2,332,172

REDUCTION GEARING APPARATUS

Henry F. Schmidt, Lansdowne, Harold W. Semar, Drexel Hill, and Ira Short, Prospect Park, Pa., assignors to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application September 25, 1942, Serial No. 459,664

6 Claims. (Cl. 74—410)

This invention relates to reduction gearing, more particularly of the marine propulsion type, and it has for an object to provide apparatus of this character having the advantages of simplicity and economy of construction of the fixed bearing type combined with that of self-alignment of the floating frame type.

A further object of the invention is to provide a reduction gear wherein the driven gear is carried by a main frame and the pinion or pinions meshing therewith are carried by pinion frames, each pinion frame being attached at its middle to an arch extending over the driven gear and secured at its lower ends to the main frame and the terminal portions of the pinion frame being connected to the gear bearings by struts arranged in the line of centers of the meshing gear and pinion, together with casing means cooperating with the frames and with the arch to enclose the gearing and constructed and arranged to provide for tangential movement of each pinion in order that tooth alignment of the latter with respect to the gear may be maintained.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is an end elevation of the improved gearing with parts shown in section and taken along the line I—I of Fig. 2;

Fig. 2 is a fragmentary side elevational view of the gearing;

Fig. 3 is a sectional view taken along the line III—III of Fig. 1;

Figs. 4, 5, and 6 are sectional detail views taken along the lines IV—IV, V—V, and VI—VI, respectively, of Fig. 3; and

Figs. 7 and 8 are sectional detail views taken along the lines VII—VII and VIII—VIII, respectively, of Fig. 1.

As shown in the drawings, the gearing includes a driven gear 10 adapted to be connected to any suitable element to be driven, for example, a ship's propeller. The gear has a pair of rims provided with opposed helical teeth 11, 11 meshing with rows of opposed helical teeth 12, 12 of the pinion 13. While, as shown in Fig. 1, there are two pinions 13 arranged above the horizontal plane of the gear axis and to either side of the vertical plane thereof, it is to be understood that the invention is applicable to arrangements employing one or more pinions.

The gear 10 has journal portions 14 fitting bearings 15 carried by the main frame, at 16, the latter comprising any suitable side structures 17 and crossbeam structures 18 providing a bedplate or foundation carrying the bearings 15 and adapted to support the gear cover and the pinion frames in the manner to be described.

Each pinion has a middle journal portion 20 and end journal portions 21, 21 cooperating, respectively, with a middle bearing 23 and end bearing 24, 24 carried by a pinion frame, at 25.

Each pinion frame is constructed and arranged so as to have adequate stiffness in tangential and radial planes. To this end, each frame is comprised by a baseplate 26 which is relatively wide in a tangential direction and by a cap member or structure 27 having the necessary depth in a radial direction to give stiffness in radial and tangential planes.

Preferably, each baseplate 26 has side flanges 28 giving additional strength and stiffness in a tangential direction and the cap member 27 has a portion 29 extending outwardly so as to give the necessary radial stiffness.

Each pinion frame, at 25, is attached at its middle to an arch beam 30 extending over the gear and arranged between the rows of teeth 11, 11 thereof, the lower ends of the arch beam being firmly anchored, as indicated at 31, to the main frame, at 16. The arch beam is preferably of fabricated construction, it being comprised by an arcuate web 32 having inner and outer flanges 33 and 34 welded thereto. The web 32 is disposed radially with respect to the gear and the pinion.

The arch is formed to provide seats for the middle portions of the pinion frames, at 25. To this end, the outer flange 34 has a section thereof corresponding to the width of the baseplate 26 removed and the web is shaped to fit the inner surface of the baseplate, as shown in Figs. 3 and 4. Having in this way formed the arch with seat portions for the pinion frames, the latter are welded both to the outer flange 34 and to the web 32 of the arch.

The end portions of each pinion frame, that is, the portions thereof carrying the bearings 24, are connected by tension struts 35 to the gear bearings 15, the struts being arranged in the axial plane of the gear and of the pinion.

The structure so far described supports the gearing, withstands all operating stresses, and provides for tangential movement of the pinions in order to maintain tooth alignment of the latter with respect to the gear. The main frame or bedplate construction, at 16, supports the

weight of all parts and resists various forces involved. Separation of each pinion from the gear is resisted by the tension struts **35** and by the arch **30**, and the pinion torque is resisted by the arch.

Both the arch **30** and the tension struts **35** are constructed and arranged to provide for the necessary angular or tilting movement of each pinion frame, at **25**, to maintain tooth alignment. To this end, it will be noted that the tension struts **35** are relatively wide in an axial direction and relatively thin in a radial direction, whereby they have the necessary flexibility in the direction required for movement of the pinion frame. As described, the arch **30** has a section whose moment of inertia with respect to an axis parallel to the gear axis is relatively large and has a moment of inertia at right angles thereto which is relatively small. Therefore, the arch has considerable radial stiffness, while being capable of flexing laterally to permit of the necessary angular movement of the pinion frame to maintain tooth alignment.

Casing elements cooperate with the main frame, at **16**, the pinion frames, at **25**, and with the arch **30** in order to enclose the gearing. As shown, longitudinal casing elements **36** have their adjacent ends formed with outwardly-extending flanges **37** welded to the outer flange **34** of the arch and the outer ends of the longitudinal plates are joined to end plates **38**. In order that the gearing may be enclosed while permitting of self-aligning movement of the pinion frames, it is necessary that the casing shall have flexible portions permitting of this movement. Therefore, the tension struts **35** are positioned so as to extend outwardly beyond the outer face of the end plates **38** and triangular plates **39** are connected to the inner surfaces of the pinion frames at the outer ends thereof and extend inwardly so that their apices are arranged in axial planes of the gear and the pinion, each plate **39** preferably fitting flush against the outer edge of its adjacent tension strut **35**.

The longitudinal wall elements **36** have portions **40** (Fig. 5) arranged in axial planes and connected to the sides of the baseplate at either side of the arch **30** and each triangular plate **39** is connected to the end plate **38** by portions **41** also arranged in axial planes. Thus, it will be seen that the casing portions **40** and **41** are properly disposed so as to flex to accommodate self-aligning movement of the pinion frame.

Preferably, the flexible casing portions **40** and **41** not only are arranged in axial planes but also in planes which pass through the apices of the triangular plates **39**. Therefore, while the triangular casing structure at each end of each pinion frame is comparatively rigid, it is, at the same time, flexibly connected to the main body of the casing, and as the triangular plates **39** and the radial planes of the flexible portions **40** and **41** have a common apical axis, it will be apparent that, in operation, each triangular structure will rock about the apices at **43**.

The structure has so far been described from the point of view of supporting moving parts in proper relation, of resisting working faces, providing alignment accommodation and enclosing the gearing. As it is customary with apparatus of this kind to provide a housing made up of a main portion or body and a cover detachably connected thereto, the main frame, at **16**, comprises an essential part of such main portion or body and it is provided with a horizontal flange or seat **45** with which mates the cover flange **46**. The lower ends of the arch and the lower edges of longitudinal and end plates are attached to the flange **46**, and the bolts **47** constitute the means by which the flanges are secured together and thereby the lower ends of the arch are anchored to the main frame, at **16**.

While the invention has been shown in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What is claimed is:

1. In a reduction gear, gearing comprising a meshing pinion and gear, a main frame, bearings for the gear carried by the main frame, a pinion frame, bearings for the ends of the pinion carried by the pinion frame, tension members connecting the pinion and gear bearings and providing for movement of the pinion frame and of the pinion carried thereby in a tangential plane to align the pinion teeth with the gear teeth, and wall elements cooperating with the main frame and with the pinion frame to complete the enclosure for the gearing, said wall elements including portions capable of flexing to accommodate for said movement of the pinion frame and the pinion in a tangential plane.

2. In a reduction gear, gearing comprising a meshing pinion and gear, a main frame, bearings for the gear carried by the main frame, an arch beam extending over the gear midway of the length of the latter and having its ends attached to the main frame, a pinion frame attached at its middle to the arch beam, end and intermediate bearings for the pinion carried by the pinion frame, tension members connecting the end pinion bearings to the gear bearings and providing for movement of the pinion frame and the pinion carried thereby in a tangential plane, and wall elements cooperating with the main and pinion frames and with the arch beam to complete the enclosure for the gearing, said wall elements including portions capable of flexing to accommodate for said movement of the pinion frame and pinion in a tangential plane.

3. The combination as claimed in claim 2 wherein the section of the arch beam has a relatively large moment of inertia with respect to an axis parallel to the pinion and gear axes and a relatively much smaller moment of inertia with respect to an axis at right angles thereto in order that the beam may be relatively stiff in a radial direction and flexible in a direction transverse thereto.

4. In a reduction gear, gearing comprising a meshing pinion and gear; a main frame; bearings for the gear carried by the main frame; an arch beam extending over the gear midway of the length of the latter and having its ends attached to the main frame; a pinion frame having its middle attached to the arch beam; end and intermediate bearings for the pinion carried by the pinion frame; tension members connecting the pinion end bearings to the gear bearings; and wall means cooperating with the main and pinion frames and with said arch beam to form an enclosure for the gearing; said wall means including main longitudinal and end plates, triangular plates joined to the ends of the pinion frame and having their apices directed inwardly and in the plane of the pinion and gear mem-

ber axes, and connecting portions joining the side edges of the pinion frame to the longitudinal plates and the converging side edges of the triangular plates to the side end plates; said connecting portions being arranged in planes parallel to the pinion and gear axes and those joined to the side edges of the pinion frame having their planes extending transversely with respect to the tangential plane of the latter.

5. In a reduction gear, gearing comprising a meshing pinion and gear; a main frame; bearings for the gear carried by the main frame; an arch beam extending over the gear midway of the length of the latter and having its ends attached to the main frame; a pinion frame having its middle attached to the arch beam; end and intermediate bearings for the pinion carried by the pinion frame; tension members connecting the pinion end bearings to the gear bearings; and wall means cooperating with the main and pinion frames and with said arch beam to form an enclosure for the gearing; said wall means including main longitudinal and end plates, triangular plates joined to the ends of the pinion frame and having their apices directed inwardly and in the plane of the pinion and gear member axes, and connecting portions joining the side edges of the pinion frame to the longitudinal plates and the converging side edges of the triangular plates to the side end plates; said connecting portions being arranged in planes which are parallel to the gear and pinion member axes and which include the apices of the triangular plates in order that they may afford flexibility accommodating for movement of the pinion frame and pinion in a tangential plane.

6. In a reduction gear, gearing comprising a meshing pinion and gear, a main frame, bearings for the gear carried by the main frame, an arch beam extending over the gear midway of the length of the latter and having its ends attached to the main frame, said arch beam having a section whose radial depth dimension is relatively much greater than its transverse width dimension to provide for radial stiffness and lateral flexibility, a pinion frame attached at its middle to the arch beam, end and intermediate bearings for the pinion carried by the pinion frame, tension struts connecting the pinion and bearings to the gear bearings, each of said struts having a section of a larger dimension in a direction parallel to the pinion and gear axes than in a direction at right angles thereto, and wall means cooperating with the main and pinion frames and with said arch beam to enclose the gearing, said wall means including portions which are flexible to accommodate for movement of the pinion frame and pinion in a tangential plane.

HENRY F. SCHMIDT.
HAROLD W. SEMAR.
IRA SHORT.