May 28, 1935. B. E. BALDUF 2,002,517

ANTIVIBRATION BOAT CONSTRUCTION

Filed June 20, 1931 4 Sheets-Sheet 1

Fig-1

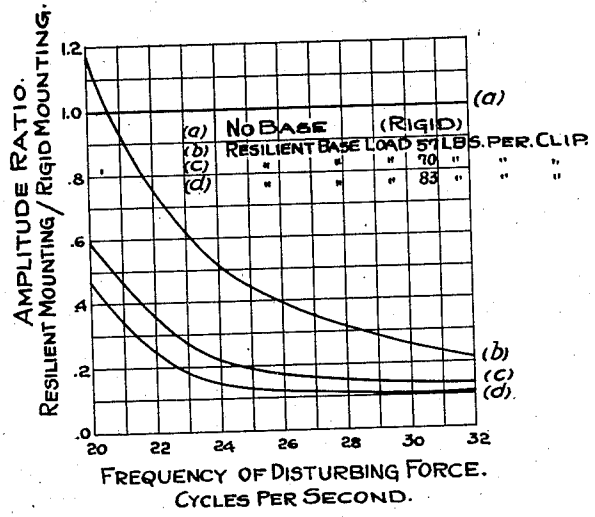
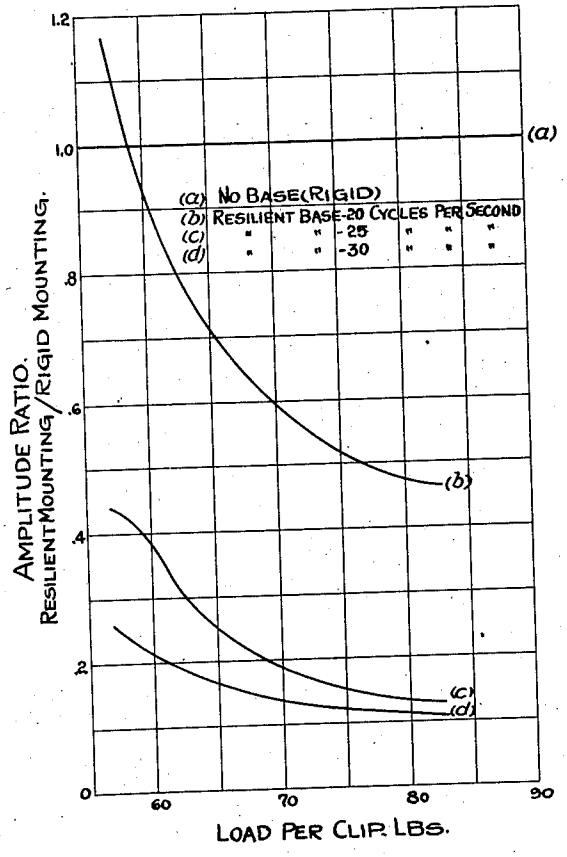


Fig-1A



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Fig-2A

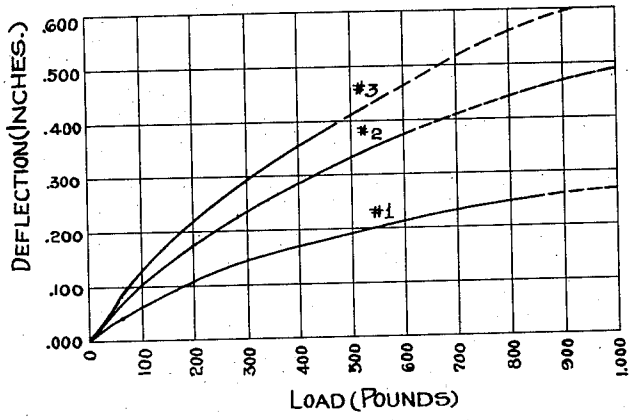
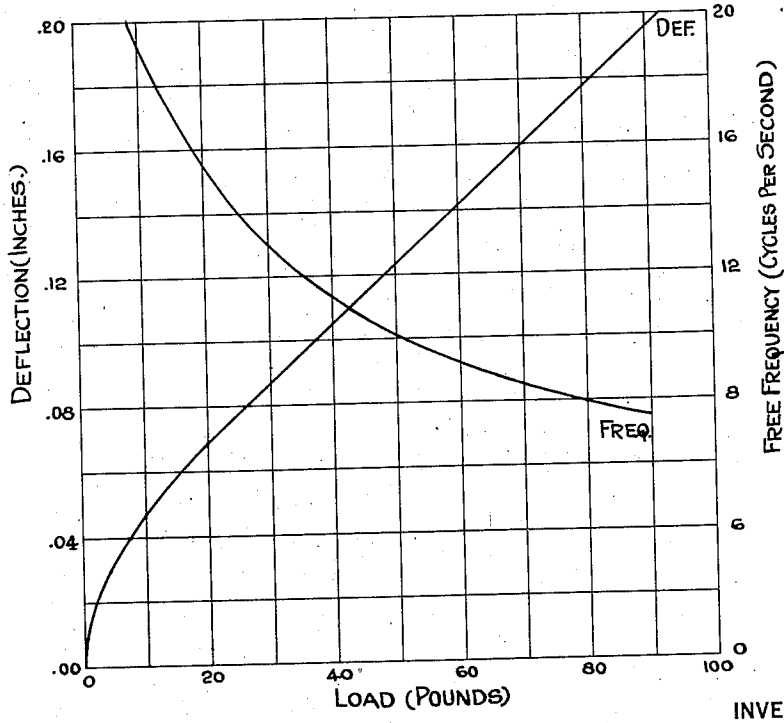


Fig-2



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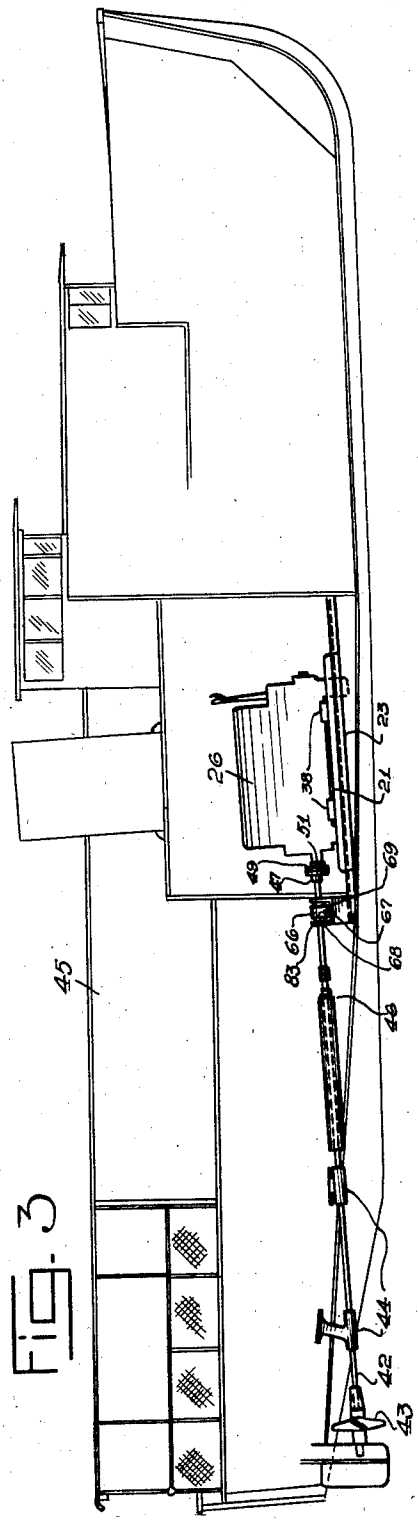


Fig. 3

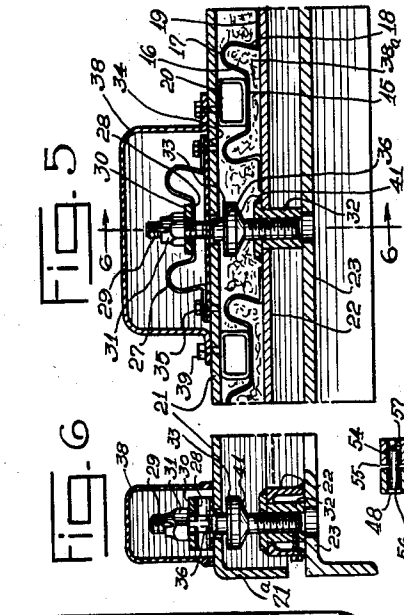


Fig. 5

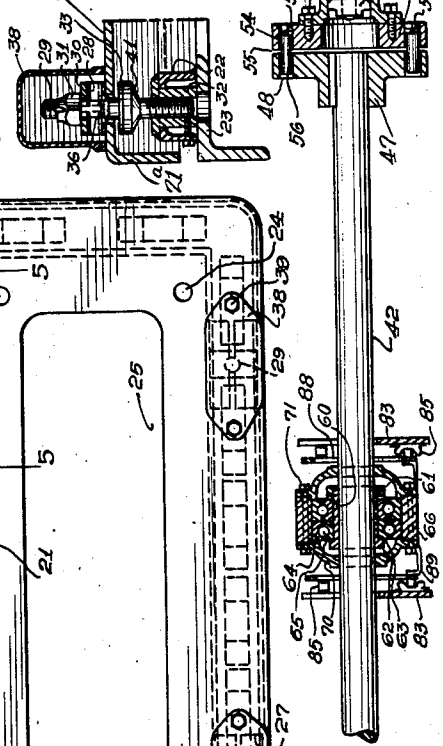


Fig. 7

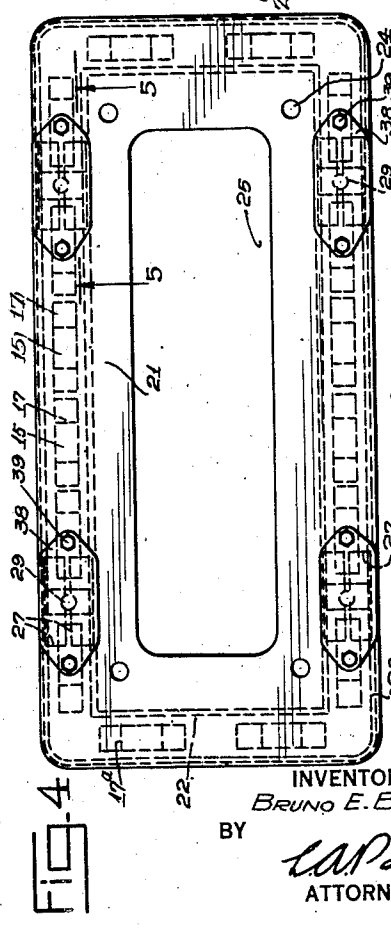


Fig. 4

Fig. 6

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Fig. 8

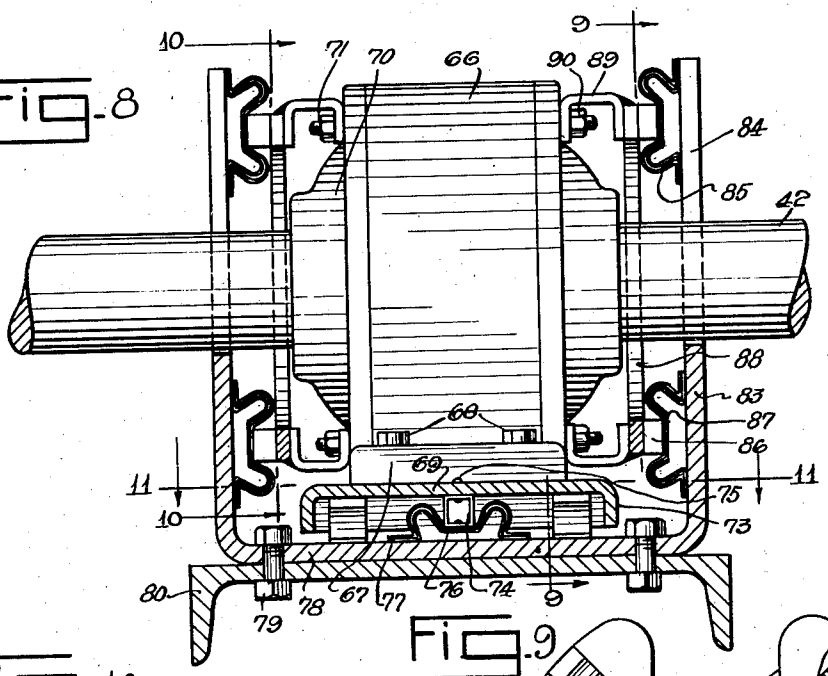


Fig. 9

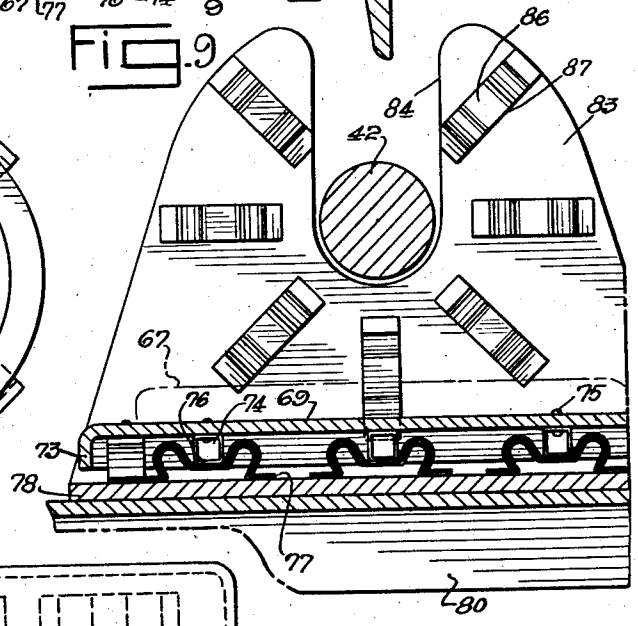


Fig. 10

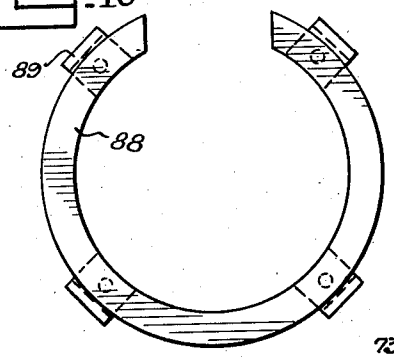
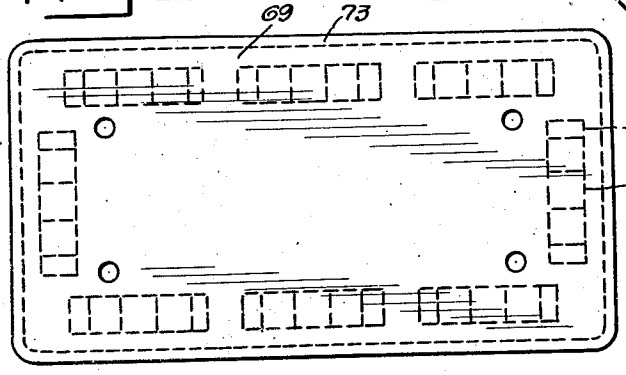


Fig. 11



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Patented May 28, 1935 2,002,517

UNITED STATES PATENT OFFICE

2,002,517

ANTIVIBRATION BOAT CONSTRUCTION

Bruno E. Balduf, Chicago, Ill., assignor to United States Gypsum Company, Chicago, Ill., a corporation of Illinois

Application June 20, 1931, Serial No. 545,706

6 Claims. (Cl. 115—34)

This invention relates to the construction of boats of the type such as that employing motors or engines for screw propeller actuation, and has reference more particularly to a boat construction in which the moving parts, such as the motor and the thrust bearing on the propeller shaft are resiliently connected to the boat frame in order to eliminate vibration of said frame.

In my co-pending application, Serial No. 340,121 filed February 15, 1929, to issue as Patent No. 1,811,250 on June 23, 1931, of which this application is a continuation in part, I have described a spring clip especially effective in sound reducing construction. I now find that this general type of spring clip can be used to advantage in marine construction for eliminating the vibration of the boat frame due to the moving parts.

Reference is to be had to the accompanying drawings forming a part of this specification, in which

Fig. 1 and 1A are graphical charts showing experimental curves derived by dynamical methods showing the relation of the amplitude ratio of 20 gauge spring clips to the frequency of the disturbing force and the load carried by each clip,

Fig. 2 is a graphical chart showing an experimental curve derived by static methods showing the relation between the load on a 20 gauge spring clip and deflection together with a curve determined mathematically showing the relation between the load on the spring and its natural frequency.

Fig. 2A is a graphical chart showing load deflection curves on a 20 gauge two leaf spring clip and each of its leaves, obtained by static methods,

Fig. 3 is a sectional elevation of a boat embodying my improved anti-friction device,

Fig. 4 is a plan view of a resilient base for supporting the motor or engine of a boat,

Fig. 5 is a sectional elevation through the resilient devices forming a part of the motor base taken on line 5—5 of Fig. 4,

Fig. 6 is a sectional elevation through the motor base taken on line 6—6 of Fig. 5,

Fig. 7 is a sectional elevation through the devices associated with the propeller shaft,

Fig. 8 is a sectional elevation through the resilient thrust bearing used on the propeller shaft,

Fig. 9 is a sectional elevation taken on line 9—9 of Fig. 8,

Fig. 10 is an elevation taken on line 10—10 of Fig. 8,

Fig. 11 is a plan view of the resilient base taken on line 11—11 of Fig. 8.

The resilient clip as described in my aforementioned co-pending application, comprises a central saddle member 15 which has opposite, upwardly sloping arms 16 formed at the upper end into resilient loops 17. Downwardly extending legs 18 are formed on the loops 17 and these legs terminate in clip ends 19 which preferably extend outwardly in a plane different from but parallel to the saddle member 15.

The saddle member 15 may be secured by spot-welding, riveting or the like, to a tubular rib 20 which is preferably rectangular in cross-section and is of sufficient thickness so that a supporting plate 21 secured to the upper surface of said rib, is spaced apart a sufficient distance above the loops 17 to allow the free deflection thereof. The clip ends 19 are secured to a rigid channel base frame 22 by spot-welding or the like, so as to form a strong foundation for supporting the motor of the boat. The frame 22 may also include a lower frame angle bar 23 which is welded to the frame 22 and cooperates therewith to make a rigid construction. The plate 21 is preferably rectangular in shape and is provided with peripheral stiffening angle flanges 21a and bolt holes 24 so that the motor can be securely bolted to said plate 21. A central rectangular opening 25 is provided in the plate 21 to give clearance for the crank-case of the motor 26. Most of the spring clips extend in a series along each of the frame members 22 and angle bars 23, said clips being turned edgewise toward the axis of the propeller shaft to be described, so as to give lateral stability and rigidity in one direction in a horizontal plane but still permit vertical movement of the motor 26. However, end clips 17a may be used if desired, said end clips being turned at right angles to the clips along the sides, thus giving rigidity in both horizontal directions.

I have found that the main spring clips operates at the highest efficiency from a sound and vibration insulating standpoint, when they are loaded with a particular and rather limited range of loading. I, therefore, find it desirable in many instances to place a load upon the spring clip in addition to the load occasioned by the weight of the motor. For this purpose of auxiliary loading, I utilize auxiliary spring clips 27 of the same general shape as the main spring clips. The auxiliary clip 27 has a saddle member 28 through which passes a set bolt 29. A washer 30 is placed on top of the saddle mem-

ber 28, and a nut 31 is threaded onto the set bolt 29 above said washer. The lower part of the set bolt 29 is threaded to engage an internally threaded bushing 32 which is preferably welded between the plates 22 and 23. The auxiliary spring clip 27 has its outstanding ends resting upon a connecting plate 34 which in turn rests upon the plate 21, tap bolts 35 serving to securely attach the clip ends and plate 34 to the plate 21. Micrometer indicator marks 36 are provided on the shank of the bolt 29 at about the level of the plate 34 so that when the nut 31 is tightened down, the amount of deflection of the main spring clips can be accurately determined by the number of said micrometer marks 36 extending above the top surface of the plate 34. A cover 38 is preferably secured above each of the auxiliary spring clips 27 by means of bolts 39, so that said cover prevents dirt and liquids from getting in around the spring clips, but yet is readily removable for changing the adjustment of the auxiliary spring clip 27. A material 38a of low density, such as fibrous material impregnated with oil or asphalt, is preferably put in the space around the main spring clips to reduce drum action and prevent deterioration of metal parts.

In some cases where the center of gravity of the motor 26 is comparatively high above its base, it is desirable to have a means of locking down the motor in position to prevent any deflection of the clips, whenever the necessity arises, as in making repairs, etc. For this reason I may provide an annular flange or shoulder 41 on the bolt 29 intermediate plate 21 and bushing 32, said flange preferably having a lead washer 42 on its upper surface to contact with the lower face of the plate 21 when nut 31 is tightened down to a considerable extent. When said nut is tightened down completely, the main spring clips are deflected to their maximum extent and the bottom of plate 21 will rest on the lead washer 33 to give a solid base for the motor.

One of the principal sources of vibration in a boat is due to the vibrating and thrusting action of the propeller shaft upon the boat frame. In order to overcome this source of vibration, I provide a thrust bearing on the propeller shaft which is resiliently attached to the framework of the boat by my improved spring clips. The propeller shaft 42 upon which the thrust bearing is mounted, is provided with a propeller 43 and is supported by a bearing hanger 44 secured to the frame of the boat 45. The shaft 42 passes into the boat at a slight inclination to the horizontal through a stuffing box 46 of usual design. The inner end of the shaft 42 is provided with a flexible coupling comprising an annular flange 47 rigidly keyed or otherwise secured to the end of said shaft 42. Near the outer periphery of the flange 47, a plurality of annular holes 48 are formed in said flange with the axes of said holes extending parallel to the axis of the shaft 42. A companion flange 49 is secured by means of bolts 50 to a flanged sleeve 51 which is secured by nut 52 and a suitable key to the end of a shaft 53 leading to the crankshaft of the motor. A plurality of holes 54 are provided in the flange 49 to register with the holes 48. The two flanges 47 and 49 are spaced apart to form a clearance space 55 for permitting slight axial movement of shaft 42 relative to shaft 53 under the action of my resilient thrust bearing to be hereinafter described. A pin 56 of laminated steel, passes through each of the holes 48 and 54, said pins being provided with a groove 57 at one end to receive an annular snap ring 58 for retaining said pins in position. Due to the laminated character of the pins 56, said laminations will deflect slightly when the load of the motor is applied to the shaft 42 and allow a slight rotary movement of the flange 49 relative to the flange 47, thus overcoming the vibration of starting and stopping.

The thrust bearing proper consists of a sleeve 60 which is shrunk in place on the shaft 42 and secured thereto by means of dowel pins. One end of said sleeve 60 is threaded to receive a nut 61 and the other end of said sleeve is provided with an annular shoulder 62. A pair of ball races 63 are shrunk upon the outside of the sleeve 60 and secured firmly together between the nut 61 and shoulder 62. A pair of annular companion ball races 64 are provided with balls 65 so that said balls are free to roll between ball races 63 and 64. The ball races 64 are pressed in place and secured in an annular housing casting 66 having outstanding flanges 67 on its lower side, which are secured by bolts 68 to a base plate 69. Housing covers 70 are secured to the housing bracket 66 by means of bolts 71, said covers having central openings adapted to loosely fit the shaft 42.

The base plate 69 has downwardly extending stiffening flanges 73 formed around its outer periphery, and tubular ribs 74 are secured to the lower side of the plate 69, as by rivets 75. Each of the ribs 74 rest on the saddle member 76 of a multiple leaf spring clip composed of two or more superimposed spring clips, such as those shown in Fig. 9. The outstanding clip ends 77, are secured to a U-shaped bracket 78 which in turn is secured by bolts 79 to a channel member 80 or other suitable structural shapes, the latter being rigidly secured to the framework of the boat. The advantage of using the multiple leaf spring clip is that a comparatively heavy load can be carried with but a few spring clips. These multiple leaf spring clips have different radii on their resilient loops 81 so that said loops are spaced apart and act independently one from the other. The smaller the radius of these loops, the less resilient the spring will be and therefore, the natural frequency of the different leaves of the spring will vary and the composite result can be adjusted to any predetermined extent by the proper selection of gauge of metal and radius of the loops.

The U-shaped bracket 78 has a pair of upstanding legs 83 which are provided with slots 84 for removably receiving the shaft 42. A plurality of multiple leaf spring clips 85 have their ends secured to the inside faces of the bracket legs 83, and friction blocks 86 are secured to their saddle members 87. An arcuate ring 88 is provided with U-shaped rigid clips 89 which are secured by bolts 90 to each of the cover plates 70. Each of the rings 88 contact with the blocks 86 and serve to deflect the spring clips 85 when the shaft 42 is vibrated axially due to the rotation and thrust of the propeller. Since the spring clips 85 are arranged on both sides of the thrust bearing, the vibration of the propeller shaft will be absorbed by said spring clips whether the boat is going forward or is in reverse. As seen in Fig. 9, the spring clips 85 are preferably arranged around a semi-circle

whose radius is substantially equal to the radius of the rings 88. The rings 88 thus slide along the block 86 when the lower spring clips 76 are deflected in a vertical direction.

In operation, the vibration of the motor 26 is taken up by the spring clip positioned under the ribs 20, and a load in addition to the weight of the motor 26 is placed on said main spring clips by means of the auxiliary clips 27. The load on the main spring clips is adjusted by rotating the nut 31 on bolt 29. During an emergency, such as making repairs, etc., the nut 31 may be screwed down completely so that the bottom of plate 21 rests rigidly upon the lead washer 33, thus putting the main spring out of operation. The vibration of the propeller shaft 42 is taken up by the ball bearing thrust bearing shown in Figs. 5 and 8, which transmits the thrust of the shaft 42 through rings 88 onto blocks 86 and spring clips 87, which are supported by legs 83 of the U-shaped bracket 78. Vertical vibration of the thrust bearing is taken up by the spring clips 76. Slight axial movement of shaft 42 due to deflection of the spring clip 87 is permitted, due to the clearance space 55 between the flexible coupling flanges 47 and 49. Laminated pins 56 loosely connect said flanges 47 and 49 to permit a yielding rotating movement of one flange relative to the other flange.

It should be understood that much the same principles as herein described can be applied to resiliently support other machinery carried by a boat, such as pumps, compressors, refrigerating machinery, etc.

I would state in conclusion that while the illustrated examples constitute a practical embodiment of my invention, I do not wish to limit myself precisely to these details, since manifestly, the same may be considerably varied without departing from the spirit of the invention as defined in the appended claims.

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

1. In a resilient construction for boats, a motor supporting element, a plurality of flat spring clips secured to said element, said clips being also secured to the frame of said boat and being arranged to reduce the transmission of vibration from said motor to said boat frame, and a material of low density in the space around said spring clips.

2. In a resilient construction for boats, a rigid boat frame, a vibrating part, and spring clips having portions thereof secured to said frame and part, said clips comprising a plurality of superimposed, independently acting leaves and integral loops, said leaves and loops being in face to face abutting relation near the center thereof but being out of contact one with another for a substantial distance.

3. In a resilient construction for boats, a boat frame, a propeller shaft, means for rotating said shaft, a thrust bearing supporting said shaft on said frame, and a plurality of spring clips having central saddle sections and integral loops, said clips being interposed between said thrust bearing and said frame so as to reduce the transmission of vibration from said shaft to said frame.

4. In a resilient construction for boats, a boat frame, a propeller shaft, means for rotating said shaft, a thrust bearing supporting said shaft on said frame, and a plurality of multiple leaf spring clips interposed between said thrust bearing and said frame, said leaves having integral, independently, acting loops and being adapted to reduce the transmission of vibration from said shaft to said frame.

5. In a resilient construction for boats, a boat frame, a propeller shaft, means for rotating said shaft, a thrust bearing supporting said shaft on said frame, and resilient, flat, spring clips associated with said thrust bearing for permitting vertical movement of said shaft relative to said boat frame.

6. In a resilient construction for boats, a boat frame, a propeller shaft, means for rotating said shaft, a thrust bearing supporting said shaft on said frame, and resilient, flat, spring clips associated with said thrust bearing for permitting both vertical and axial movement of said shaft relative to said frame.

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