April 22, 1924. 1,491,423

R. H. RICE

SUPPORTING MEANS FOR TURBINE DRIVEN UNITS AND THE LIKE

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Fig. 1.

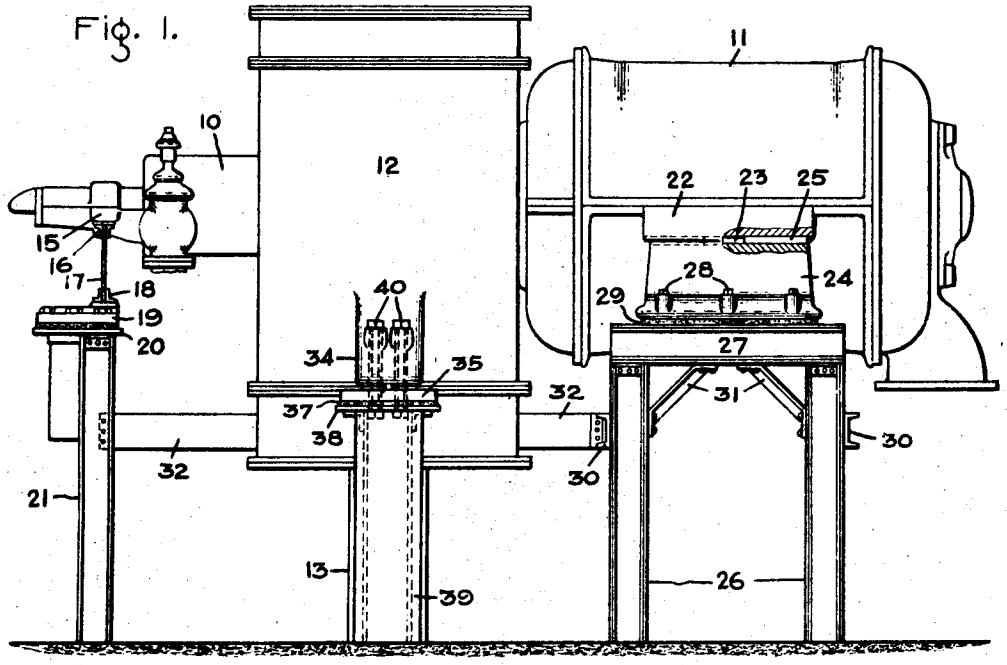
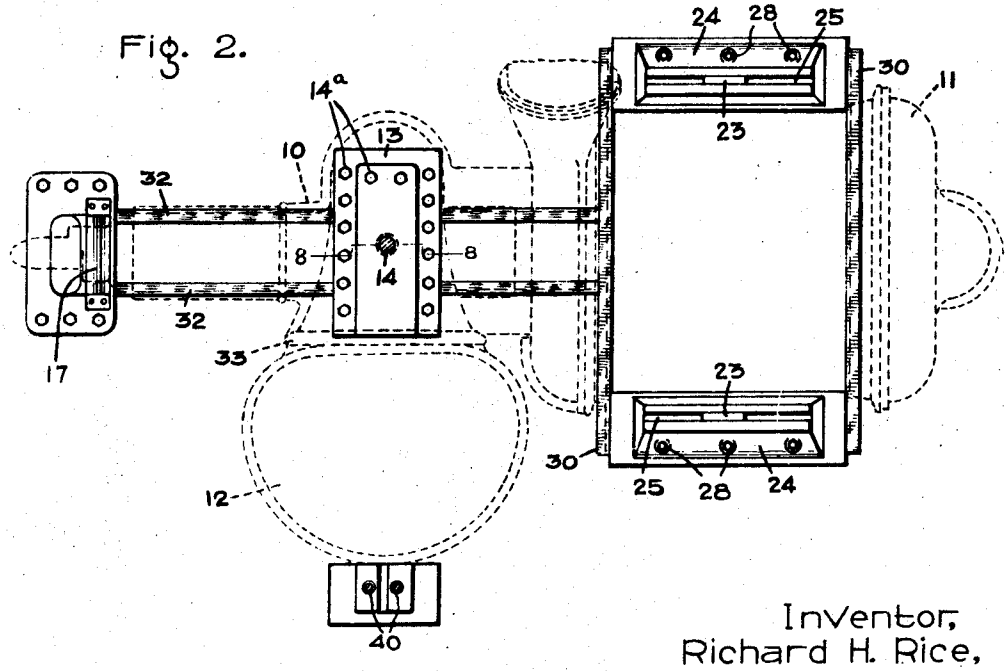


Fig. 2.



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Fig. 3.

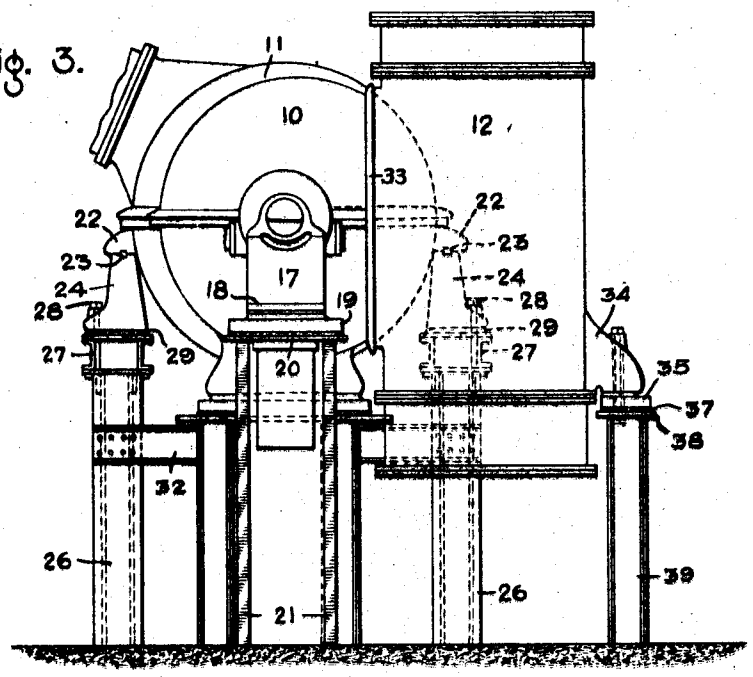


Fig. 4.

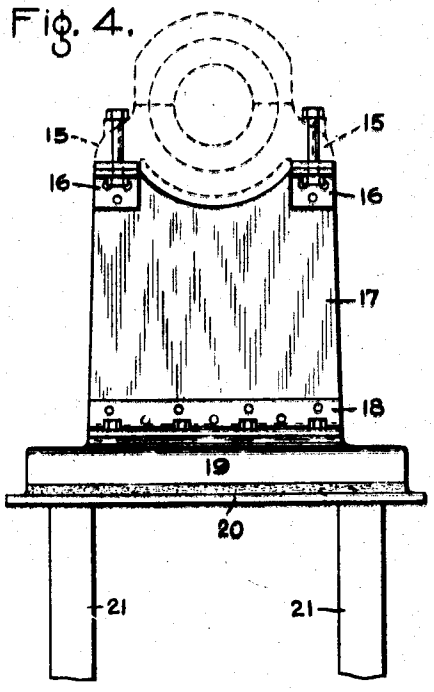


Fig. 6

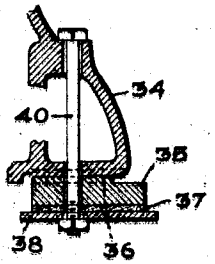
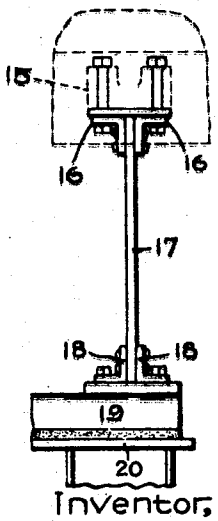


Fig. 5.



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Fig. 7.

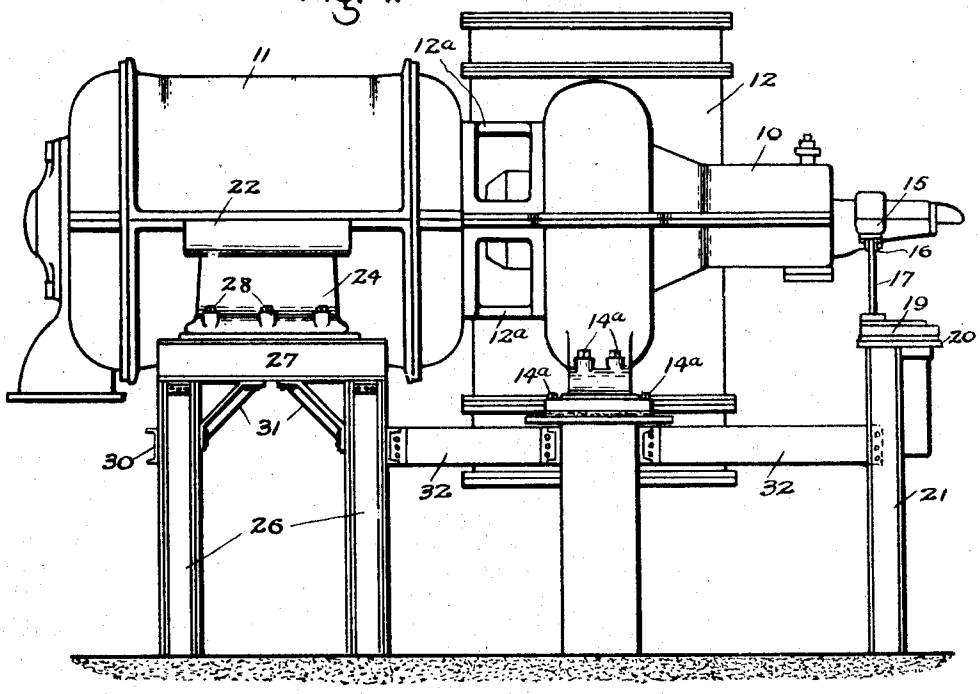
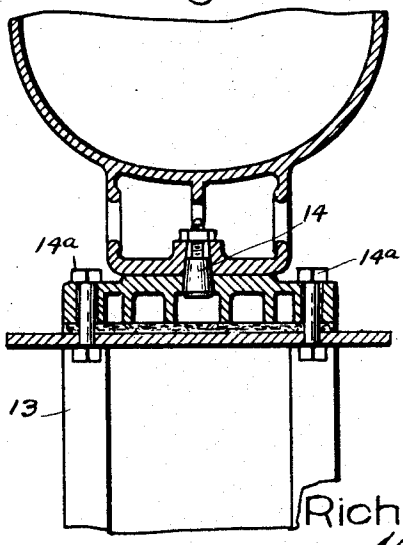


Fig. 8.



Inventor,
Richard H. Rice,
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Att'y.

Patented Apr. 22, 1924. 1,491,423

UNITED STATES PATENT OFFICE.

RICHARD H. RICE, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SUPPORTING MEANS FOR TURBINE-DRIVEN UNITS AND THE LIKE.

Application filed October 17, 1918. Serial No. 258,589.

To all whom it may concern:

Be it known that I, RICHARD H. RICE, a citizen of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Supporting Means for Turbine-Driven Units and the like, of which the following is a specification.

The present invention relates to supporting means for machine installations where the machine or machines become heated during operation and expand thus effecting a movement on their foundation.

The object of my invention is to provide an improved supporting means or supporting arrangement for such machines, and for a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the present instance I have illustrated my invention in connection with a turbine driven compressor set, the turbine having a condenser bolted directly to its exhaust opening, as my invention has special utility in connection with such a set, but it will be understood that this is only one example and that the invention is not limited thereto.

In the drawing, Fig. 1 is a side elevation of a turbo-compressor set embodying my invention; Fig. 2 is a top plan of the support, a turbine, compressor and condenser being shown in dotted lines thereon; Fig. 3 is an end view looking toward the turbine end of the unit; Fig. 4 is a view on a large scale of the support for the high pressure end of the turbine, Fig. 5 is a view similar to Fig. 4 but taken at right angles thereto; Fig. 6 is a section through a supporting foot for the condenser; Fig. 7 is a side elevation of the set viewed from the side opposite to that of Fig. 1, and Fig. 8 is a detail sectional view taken on line 8—8, Fig. 2.

Referring to the drawing, 10 indicates an elastic fluid turbine, 11 a centrifugal compressor driven thereby, and 12 a condenser. The turbine casing and compressor casing are connected to each other by suitable girders 12^a forming a rigid frame and the condenser is bolted directly to the exhaust opening of the turbine. The turbine, compressor and condenser are thus rigidly connected together and may be regarded as a single rigid structure.

Now, according to my invention the set as a whole is supported at an intermediate point and preferably at about its center on a main foundation 13 and it is fastened to such foundation by a central dowel 14 and suitable bolts 14^a, the openings in the set for bolts 14^a being sufficiently oversize to permit of expansion of the set relative to the foundation 13. In the set illustrated the foundation 13 is located under the turbine casing at its low pressure end. This forms the main support for the set. The set as a whole cannot move relative to foundation 13 being held by central bolt 14 but it can expand in all directions from the bolt 14 as a center sliding on the foundation. On each side of the central foundation or support 13 the set is provided with end supports and the arrangement is such that the ends can move longitudinally relative to such supports. By this means the set is free to expand axially from the center in either direction.

In the present instance the high pressure end of the turbine casing is provided with two supporting feet 15, one on each side, which are bolted to brackets 16 carried on the upper end of a flat plate 17. The plate 17 which may be formed of boiler plate for example, is more or less flexible in an axial direction and has right angle brackets 18 at its lower end by means of which it is fixed to a sole plate 19 which in turn is grouted to a foundation plate 20 supported on suitable beams 21. By this arrangement when the turbine end of the set expands axially, the plate 17 will flex or bend to permit such movement to take place. Plate 17 however, is rigid in a cross wise direction and holds the end of the turbine against torsional or twisting movement or against sidewise movement. In other words, plate 17 is rigid in every direction except parallel to the axis of the turbine.

The compressor casing is provided on opposite sides with supporting feet 22 which rest on short keys 23 carried by sole plates 24. The supporting feet 22 are located close to a horizontal plane through the axial center line of the compressor so that when

the compressor expands radially such expansion will take place both above and below the center line so as not to affect the shaft alignment. Both the feet 22 and the sole plates 24 are provided with keyways 25, Fig. 2, in which the keys 23 are located and the arrangement is such that keys 23 hold the feet 22 slightly spaced from sole plates 24 so the compressor casing can rock in a vertical plane on its support, the keys 23 serving as a fulcrum. It is for this reason that the keys 23 are made quite short. The compressor casing can also move longitudinally of the sole plates 24, sliding either forward or backward thereon. Sole plates 24 may be supported on any suitable foundation, and the arrangement is such that they can spread laterally to permit the compressor to expand in such direction by the necessary amount. It will be appreciated, of course, that the total amount of expansion laterally under the most extreme conditions is small and it has been found by calculations and tests that a construction as shown has sufficient flexibility to readily take care of the expansion met with in actual practice. In the present instance they are supported on a frame work comprising standards 26 upon which are cross bars 27 to which the sole plates 24 are fastened by bolts 28 and grouting 29. The standards 26 are tied together by beams 30 and the structure is strengthened by braces 31. The framework, as just described, is tied to the supporting beams 21 by beams 32, thus forming a complete rigid framework for supporting the two ends of the set.

The condenser 12 as already stated is on the one side bolted directly to the exhaust opening of the turbine casing as indicated at 33 in Figs. 2 and 3. On its other side it is provided with a foot 34, which is supported on a sole plate 35, a key 36, Fig. 6 being provided to keep the condenser from twisting on sole plate 35 but at the same time allowing it to slide thereon toward and away from the central fastening means 14 for the set. The sole plate 35 is grouted at 37 to a plate 38 carried on a pier 39 and the foot 34, sole plate 35 and plate 38 are further fastened together by bolts 40 which hold the foot 34 against vertical movement relative to its support. As best shown in Fig. 6, the openings in foot 34, sole plate 35 and plate 38 through which the bolts 40 pass are of greater diameter than the bolts so as not to interfere with any sliding movements of the foot 34 on sole plate 35. The pier 39 is preferably formed of suitably shaped angle beams and it may be more or less flexible particularly in a crosswise direction to permit of outward movement of foot 34 due to expansion of the condenser casing.

With the above described arrangement it will be seen that the set is fixed rigidly only at one central intermediate point, viz, at the dowel 14 and that it is free to expand in all directions away from such bolt. At the same time the set is held against any twisting movements which would distort the casings and throw the shaft bearings out of alignment. The turbine casing is free to expand radially in all directions and it can expand longitudinally due to the flexible supporting plate 17. The compressor casing also is free to expand radially and it can expand and move longitudinally sliding on sole plates 24. The compressor casing can also tilt or rock slightly on keys 23 as fulcrums to take care of any difference in the rate of expansion of the turbine casing and compressor casing. For example, the turbine casing may expand more rapidly and to a greater extent than the compressor casing and when this occurs the structure permits the compressor casing to tilt in a vertical plane on the short keys 23 as a fulcrum. Of course the amount of any tilting movement of this character met with in actual practice is small and would not be sufficient to effect to any appreciable extent the clearances in the turbine or driven machine, the alignment of the parts being maintained by the frame of the set, that is the casings and their fastenings 12a. The condenser casing likewise can expand freely as is obvious. With this arrangement therefore the casings can expand and contract under temperature changes without setting up stresses in the various parts. Since the casings of the set are free to expand in all directions from the central dowel pin 14, no strains due to expansion and contraction will be set up in the casings and hence there can be no derangements or damages from such cause.

As will be clear from a consideration of the foregoing, my invention may be carried out in connection with various machine installations the illustration given being only an example. For example, the invention can be carried out also in connection with turbo-generator sets, and it will be understood that the compressor 11 is to be taken as typical of any machine.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The combination with a set comprising a turbine and a driven machine rigidly connected together, of a main support for the set located between its ends, and under the turbine, means supporting the turbine at its outer end which is adapted to yield in

the direction of the axis of the set, and means supporting the driven machine centrally of its two sides and on which said machine is adapted to rock in a vertical plane.

2. The combination with a set comprising a turbine and a driven machine rigidly connected together, of a main support for the set located between its ends and under the turbine, means supporting the turbine at its outer end which is adapted to yield in the direction of the axis of the set, and means supporting the driven machine centrally of its sides and on which said machine is adapted to slide axially.

3. The combination with a set comprising a turbine and a driven machine rigidly connected together, of a main support for the set located between its ends and under the turbine, means supporting the turbine at its outer end which is adapted to yield in the direction of the axis of the set, and means supporting the driven machine centrally of its sides and on which said machine is adapted to rock in a vertical plane and to slide axially.

4. The combination with a set comprising a turbine and a driven machine rigidly connected together, of a main support for the set located between its ends, a flexible plate arranged crosswise of the turbine on which the outer end of it is supported, and means supporting the other end of the set upon which such end may move axially.

5. The combination with a set comprising a turbine, a driven machine rigidly connected thereto and a condenser fastened to the turbine, of a main support for the set located centrally thereof and under the turbine, means yieldable in the direction of the axis of the turbine for supporting the end of the turbine, means supporting the driven machine on which it may move axially, and means supporting the condenser which permits it to freely expand.

6. The combination with a set comprising a turbine and a driven machine rigidly connected together, of a main support for the set located between its ends and comprising a central dowel which holds the set from movement as a unit, and means supporting the ends of the set which permits such ends to expand in the direction of the axis of the set.

7. The combination with a set comprising a turbine and a driven machine rigidly connected together, of a main support for the set located between its ends and comprising a central dowel which holds the set from movement as a unit, a flexible plate arranged crosswise of the turbine upon which the outer end of the turbine is supported, and means supporting the other end of the set.

8. The combination with a set comprising a turbine and a driven machine, said driven machine being located at the low pressure end of the turbine and rigidly connected thereto to form with the turbine a rigid unit, of a main support for the set located under the low pressure end of the turbine to which the set is rigidly connected against movement as a whole, means supporting the high pressure end of the turbine which is yieldable in the direction of the axis of the set and is rigid in a direction transversely thereto, and means supporting the driven machine.

In witness whereof, I have hereunto set my hand this 14th day of October 1918.

RICHARD H. RICE.