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CONDENSER SUPPORT

Filed Nov. 25, 1940

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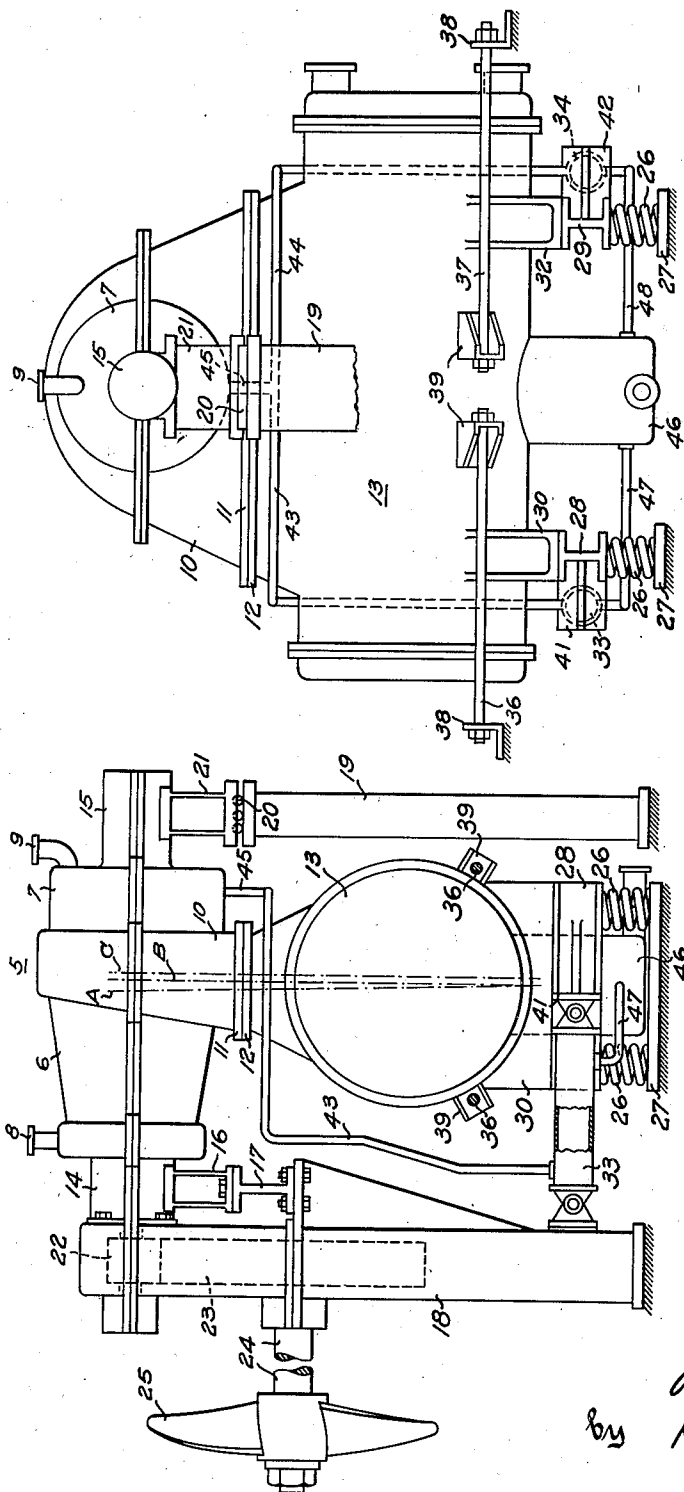


Fig. 2

Fig. 1

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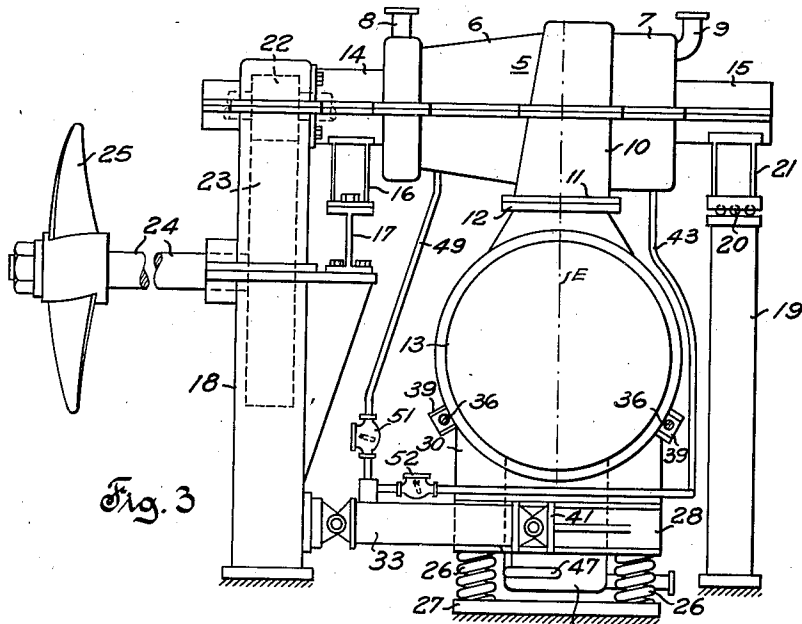


Fig. 3

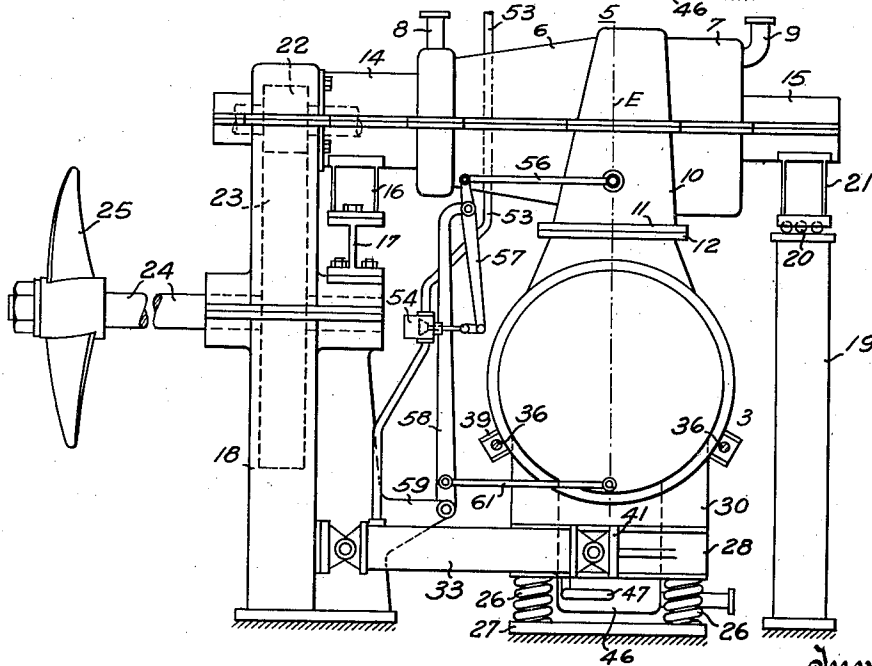


Fig. 4

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2,265,612

CONDENSER SUPPORT

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9 Claims. (Cl. 60—95)

This invention relates generally to supporting arrangements for condensers and other devices secured to the casing of an elastic fluid turbine or other structure which becomes heated to a relatively high temperature during normal operation. More specifically the invention relates to an improved supporting arrangement of this type which is particularly adapted for use on power driven marine and land vehicles.

In this connection, a common arrangement for supporting elastic fluid condensers has been to fixedly support the prime mover or turbine casing at one end, preferably the fluid inlet end, leaving the other end, which is slidably mounted on a suitable support, free to move as the turbine casing expands and contracts and to suspend the condenser from the exhaust end of the turbine casing by means of a rigid connection therewith. In numerous arrangements, the condenser is additionally supported on springs or the like disposed between the bottom portion of the condenser and an underlying fixed support so as to reduce the stress imparted to the turbine casing by the weight of the condenser and so as to permit the condenser to move as the turbine casing expands and contracts.

However, the known supporting arrangements have not been entirely satisfactory, particular reference being had to turbine driven vehicles, as the movement of the vehicle has in many instances caused the turbine casing adjacent its point of connection with the condenser to deform sufficiently to effect contact between stationary and moving parts, usually between the stationary and moving blades, thereby causing material damage which generally requires complete shutdown of the turbine in order to make the necessary repairs. Attempts to overcome this inherent defect in the known constructions have been made by using relatively long resilient tie rods having one end connected to the condenser and the other end connected to a fixed structure, but these attempts have not been successful due to the fact that if the tie rods are made sufficiently resilient to permit the condenser to move as the turbine casing expands and contracts, they also permit swaying or other movements of the vehicle to move the condenser relative to the turbine casing, thereby producing the destructive deformation above mentioned.

The primary object of this invention is to provide an improved and inexpensive supporting arrangement operative to prevent a destructive degree of relative movement between a structure which expands and contracts in response to vari-

ations in the temperature thereof and a device which is secured to said structure and to a fixed support.

Another object of this invention is to provide an improved and inexpensive arrangement for supporting a device secured to a structure which expands and contracts in response to variations in the temperature thereof in that the device is additionally supported by a fixed means operative to prevent the expansion and contraction of the structure from unduly stressing the connecting and proximate portions of the said structure and device.

Still another object of this invention is to provide an improved and inexpensive supporting arrangement for vehicle power plants in that a device which is secured to a prime mover is additionally supported by a fixed means operative to prevent expansion and contraction of the prime mover and/or movements of the vehicle from unduly stressing the connecting and proximate portions of the said prime mover and device.

A further object of this invention is to provide an improved and inexpensive arrangement for supporting in combination a structure which expands and contracts in response to variations in the temperature thereof and a device which is secured to said structure in that a portion of said device remote from said structure is connected to a fixed support by a substantially rigid member which is caused to expand longitudinally an amount commensurate with and parallel to the longitudinal movement of that portion of the structure to which the device is secured.

The invention accordingly consists of the various features of construction, combinations of elements and arrangements of parts as more fully pointed out in the appended claims and in the detailed description, in which:

Fig. 1 is a view in side elevation of a prime mover and condenser combination embodying the invention;

Fig. 2 is an end view of the combination shown in Fig. 1;

Fig. 3 is a view in side elevation of a similar combination embodying a modified construction; and

Fig. 4 illustrates still another modification.

Referring to Figs. 1 and 2 of the drawings, it is seen that the illustrated prime mover comprises a marine turbine unit 5 including ahead and astern or reverse turbine sections 6 and 7, respectively. The turbine sections 6 and 7 are provided with separate motive fluid inlets 8 and 9,

respectively, and with a common exhaust portion or conduit 10 having a flanged portion 11 adapted for connection with the flanged inlet portion 12 of a condenser 13. The coacting flanged portions 11 and 12 are preferably removably secured together by any suitable means, such as bolts (not shown). The turbine unit 5 is supported on axially spaced bearings 14 and 15 which may be formed integral with the turbine unit casing as shown. The bearing 14 is provided with a base portion 16 which is rigidly secured to the bracket 17 which in turn is rigidly secured to the pedestal structure 18. The bearing 15 is supported for axial movement on the pedestal 19 by means of rollers 20 carried by the base portion 21 of the bearing 15. In order to conserve space in marine installations, the pedestal 17 may be specially designed to house reduction gearing comprising a driving pinion 22 and a driven gear 23 which establishes a driving connection between the turbine unit 5 and the propeller shaft 24 on which is secured the propeller 25.

In order to prevent the weight of the condenser from unduly stressing the exhaust conduit 10 and the associated portions of the casing enclosing the turbine unit 5, the condenser is additionally supported on groups of springs 26 which engage the base rails 28 and 29 secured to the condenser brackets 30 and 32, respectively, and which are mounted on the fixed supports 27. A movement of the condenser relative to the casing of the turbine unit and toward either of the supporting pedestals 18 and 19 may be produced by the rolling and/or pitching movements of the ship or other vehicle in which the turbine unit is mounted, and the resultant stress has in some instances deformed the turbine casing sufficiently to bring the stationary and moving blades into engagement. Consequently, in order to prevent such movements of the condenser and the damage inherently produced thereby, the lower portion of the condenser is connected to a substantially rigid structure, such as the pedestal 18, by means of two rigid hollow struts 33 and 34. Preferably two or more of the rigid struts are employed to effect this result, although in some instances a single strut may be sufficient. The condenser is also preferably anchored against transverse movements with respect to the longitudinal axis of the turbine unit by means of two pairs of oppositely extending, relatively long, resilient tie rods 36 and 37. Each tie rod has one end secured to a fixed support 38 and its other end secured to a bracket 39 attached to the midportion of the condenser 13 so as to permit the condenser to freely expand longitudinally in either direction with respect to its midportion. The use of long resilient tie rods also permits the condenser to freely expand transversely with respect to its longitudinal axis and with respect to said tie rods.

The rigid hollow struts 33 and 34 are connected in hinged relation with the pedestal 18 and with the brackets or flanges 41 and 42 which extend laterally from the rails 28 and 29, respectively, at longitudinally spaced points disposed adjacent the longitudinal axis of the condenser. The hollow struts 33 and 34 each has its interior connected at spaced points with an intermediate stage of the astern turbine section 7 by means of pipes 43 and 45 and 44 and 45, respectively, and with the hot well 46 of the condenser 13 by means of pipes 47 and 48, respectively. Consequently, when the astern turbine

section 7 is operating, steam at the desired temperature will flow into and heat the hollow struts 33 and 34, and the condensate formed therein will flow into the hot well 46. The admission of steam into the hollow struts 33 and 34 and the resultant heating thereof effects a longitudinal expansion of the struts commensurate with the temperature of the entering steam and with the length of the struts and since the struts each has one end secured to a fixed structure, the pedestal 18, the longitudinal expansion thereof will move the condenser 13 toward the pedestal 19 in substantially parallel relation with respect to the longitudinal axis of the turbine unit 5. This movement of the condenser which may have to be as much or more than 0.06 of an inch in order to compensate for the longitudinal expansion of the turbine unit casing, will, of course, flex and stress the resilient tie rods 36 and 37.

With respect to the longitudinal expansion of the turbine unit casing, it should be obvious since the end of the casing embodying the bearing 14 is fixedly secured to the pedestal 18 and since the opposite end thereof is slidably mounted on the pedestal 19, that the turbine casing is free to expand longitudinally in the direction of the pedestal 19 and that as the casing becomes heated during normal operation, longitudinal expansion will take place in the direction indicated. Consequently, unless means are provided (1) which will move the condenser in the same direction a distance commensurate with the longitudinal movement of that portion of the turbine unit casing to which the condenser is secured or (2) which will permit such a relative movement of the turbine unit casing without unduly stressing the connecting and proximate portions of the turbine unit casing and condenser, the expansion of the turbine unit casing will unduly stress said portions and will in time cause serious damage to the turbine unit and/or the condenser. In this connection, a combination of means (1) and (2) has been found entirely satisfactory with respect to turbine units having dissimilar ahead and reverse sections mounted on the same shaft or spindle since the longitudinal expansion of the casing enclosing the turbine unit is considerably greater when the reverse section is operating than it is when the ahead section is operating. For example, the longitudinal expansion of the casing of a 4,000 H. P. marine turbine unit of this type driven by steam at a temperature of 740° F., produced a maximum longitudinal movement of that portion of the casing to which the condenser is secured of 0.1 of an inch when operating with the reverse section, and only 0.043 of an inch when operating with the ahead section. This difference in the degree of expansion and movement of the casing is attributed to the fact that the ahead section usually has several more rows of moving blades than does the reverse section and that during the operation of the respective sections the temperature and the density of the motive fluid leaving the ahead section is considerably less than that leaving the astern section. Consequently, the ahead section idles in a hotter and denser medium than does the astern section and as a result the friction heating effected by the moving blades of the idling section is considerably greater when the ahead section is idling than it is when the astern section is idling.

Referring particularly to Fig. 1, it is seen that the difference in the degree of expansion and

movement of the turbine unit casing when operating with the ahead section and when operating with the reverse section, is used in effecting a combination of said means (1) and (2) by dimensioning the strut members 33 and 34 so that when the turbine unit casing is thoroughly heated by the operation of the ahead section, the position of the condenser is such that a reference plane which extends through the condenser and transversely with respect to the longitudinal axis of the turbine unit is disposed at right angles with respect to a horizontal plane (see dot and dash line B); so that when said casing is relatively cool, the position of the condenser is such that said reference plane is then inclined toward the bearing 14 and pedestal 18 (see dot and dash line A); and so that when the turbine casing is heated by the operation of the ahead section and when the struts 33 and 34 are heated and the turbine casing is further heated by the operation of the reverse section, points on the turbine casing and on the condenser lying within said reference plane (see dot and dash line B) are moved in parallel relation equal distances in the same direction (see dot and dash line C). In other words, when the astern section is operating, the longitudinal expansion of the heated struts 33 and 34 is commensurate with and parallel to the movement of that portion of the turbine casing to which is secured the flanged inlet portion 12 of the condenser 13, and as a result, said reference plane is at all times maintained at right angles with respect to a horizontal plane as is indicated by the dot and dash line C.

The movement of the turbine unit casing relative to the condenser which is indicated by the degree of inclination of the dot and dash line A and which is permitted by the hinged connections between the struts 33 and 34 and the flanges or brackets 41 and 42, respectively, does, of course, stress the connecting and proximate portions of the turbine casing and condenser to some degree. However, when such stressing takes place, the casing is relatively cool and can therefore safely withstand a much higher degree of stress than it can when hot. Moreover, the degree of relative movement is small, and when the operation of the unit is initiated, the turbine casing heats rapidly and as a result, the relative displacement between the connecting portions of the turbine casing and condenser rapidly decreases with a corresponding reduction in stress until the reference plane assumes the normal position indicated by line B.

Referring to Fig. 3, in which the turbine unit and condenser arrangement is identical to that previously described and in which like numerals are used to designate the same or similar parts, it is seen that this modified construction differs from that shown in Figs. 1 and 2 in that each hollow strut (only strut 33 is shown) has its interior also connected to an intermediate stage of the ahead turbine section 6 by means of the pipe 49 which includes a check valve 51, in that the pipe 43 is also provided with a check valve 52, and in that the dimensions of the hollow strut 33 are such that when the turbine unit is shut down and the turbine unit casing and the condenser are relatively cool, a reference plane which extends through the condenser and transversely with respect to the longitudinal axis of the turbine unit is disposed at right angles with respect to a horizontal plane, as indicated by dot and dash line E, and that when either the ahead or the reverse section is operating, steam enters

the hollow strut 33 and effects a longitudinal expansion thereof which is commensurate with and parallel to the movement of that portion of the turbine unit casing to which is secured the flanged inlet portion 12 of the condenser 13. Check valves 51 and 52 are employed to prevent a flow of steam from the operating section through the pipes 43 and 49 and into the idling section.

The longitudinal expansion of the hollow strut 33 which is necessary in order to at all times maintain the reference plane E disposed at right angles with respect to a horizontal plane as stated in the preceding paragraph and in connection with the description of Figs. 1 and 2, can be effected by properly correlating the dimensions of the strut with the temperature of the heating steam employed and with the relative movement between the turbine unit casing and the condenser which would be present under the various operating conditions selected or contemplated. These determining factors can be readily calculated or otherwise determined by any one skilled in the art and a further analysis of this problem is not deemed necessary for a complete understanding of the invention.

Referring to Fig. 4, in which the turbine unit and condenser arrangement is also identical to that of Figs. 1 and 2, and in which like numerals are used to designate the same or similar parts, it is seen that this modification differs from that shown in Fig. 3 in that the steam for heating each hollow strut (only the strut 33 is shown) is obtained from any suitable source, such as a boiler (not shown) through a pipe 53 which includes a regulating valve 54, and in that the valve 54 is automatically actuated to vary the flow of steam to the hollow strut 33 so as to at all times effect a longitudinal expansion thereof in the direction of the pedestal 19 which is substantially equal and parallel to the movement of that portion of the turbine unit casing to which is secured the flanged inlet portion 12 of the condenser 13. In other words, a reference plane which extends through the condenser and transversely with respect to the longitudinal axis of the turbine unit and which is designated by the dot and dash line E is always maintained at right angles with respect to a horizontal plane as described in connection with Fig. 3.

The means for effecting the automatic actuation of the valve 54 comprises a lever 56 having one end pivotally secured to that portion of the turbine unit casing to which is connected the flanged inlet portion 12 of the condenser 13 and its other end pivotally connected with one end of a link 57 which in turn has its other end connected with the valve 54, a lever 58 having one end pivotally secured to a fixed bracket 59 and its other end pivotally connected with the link 57 at a point intermediate its ends, and a lever 61 having one end pivotally secured to the lower end of the condenser 13 and its other end pivotally connected with the lever 53 at a point intermediate its ends. Preferably, the levers 56 and 61 are connected to the turbine unit casing and to the condenser, respectively, at points which lie substantially within the reference plane designated by the dot and dash line E. The lever and link arrangement is such that as the turbine unit casing becomes heated and expands and thus moves the point to which the lever 56 is secured toward the pedestal 19, the link 57 pivots about its point of connection with the lever 53 and opens the valve 54 to admit steam to the hollow

strut 33 which in turn becomes heated and expands and thus moves the condenser and the point to which the lever 61 is pivotally secured toward the pedestal 19 in substantially parallel relation with respect to the movement of the corresponding end of the lever 56. This movement of the lever 61 effects a clockwise turning movement of the lever 58 about its point of pivotal connection with the fixed bracket 59 which in turn effects a counterclockwise turning movement of the link 57 about its point of pivotal connection with the lever 56 and a closing movement of the valve 54.

Thus it is seen that the opening and closing movements of the valve 54 and consequently the heating and expansion of the hollow strut 33 are controlled by that portion of the turbine unit casing to which is secured the lever 56 moving relative to that portion of the condenser to which is secured the lever 61; that the reference plane represented by the dot and dash line E will always be maintained at right angles with respect to a horizontal plane; and that therefore longitudinal movements of the turbine unit casing will not stress the connecting and proximate portions of the turbine unit casing and condenser.

The invention is disclosed as applied in various ways to a marine type elastic fluid turbine unit to which is secured the usual condenser, but it should be understood that the invention is generally applicable to all types of machines and structures having secured to a part thereof a device which upon movement of said part results in stresses being set up in said part and/or in said device, and that therefore it is not desired to limit the invention to the exact details of construction and mode of operation herein shown and described, as various modifications within the scope of the appended claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In combination, a prime mover exhausting a condensable heated fluid during normal operation and having axially spaced ahead and reverse sections enclosed in a casing fixedly supported at one end, a means movably supporting the opposite end of said casing so as to permit longitudinal movements in response to the expansion and contraction of the said casing, a condenser secured to the portion of said casing intermediate the said ahead and reverse sections and in communication with the exhaust portions thereof, an elongated member connecting a portion of said device remote from said prime mover casing with a fixed support so that when said casing is heated by the operation of said ahead section, the position of said condenser is such that a reference plane, which extends through said condenser and transversely with respect to the longitudinal axis of said prime mover, is disposed at right angles with respect to a horizontal plane and so that when said casing is relatively cool, the position of said condenser is then such that said reference plane is inclined toward the said fixed end of the prime mover casing, and connections effective when said reverse section is operating to conduct heated fluid in heat exchanging relation with said member so as to effect a longitudinal expansion thereof sufficient to maintain the said condenser in a position such that during the operation of said reverse section said reference plane is disposed at right angles with respect to said horizontal plane.

2. In combination, a structure which expands

and contracts in response to variations in the temperature thereof, a first means fixedly supporting one end of said structure, a second means movably supporting the opposite end of said structure so as to permit longitudinal movements in response to the expansion and contraction of the said structure, a device secured to said structure at a point remote from said fixed end, a member connecting a part of said device remote from said structure with a fixed support so that the expansion and contraction of said member tends to move said device in parallel relation with respect to the longitudinal axis of said structure, a conductor operative to convey a fluid in heat exchanging relation with respect to said member, and a control associated with said conductor and structure and operative in response to a condition which changes in accordance with increases and decreases in the temperature of the structure to vary the quantity of fluid passing in heat exchanging relation with respect to the said member and thereby effect a longitudinal expansion and contraction thereof commensurate with and in the same direction as the longitudinal movements of that portion of the structure to which the said device is secured.

3. In combination, a structure which expands and contracts in response to variations in the temperature thereof, a first means fixedly supporting one end of said structure, a second means movably supporting the opposite end of said structure so as to permit longitudinal movements in response to the expansion and contraction of the said structure, a device secured to said structure at a point remote from said fixed end, a member connecting a part of said device remote from said structure with a fixed support so that the expansion and contraction of said member tends to move said device in parallel relation with respect to the longitudinal axis of said structure, a conductor operative to convey a fluid in heat exchanging relation with respect to said member, a control operative to vary the quantity of fluid passing in heat exchanging relation with respect to the said member, and means rendering said control operative as said structure expands and contracts to vary the quantity of fluid passing in heat exchanging relation with respect to the said member so as to effect a longitudinal expansion and contraction thereof commensurate with and in the same direction as the longitudinal movements of that portion of the structure to which the said device is secured.

4. In combination, a structure which expands and contracts in response to variations in the temperature thereof, a first means fixedly supporting one end of said structure, a second means movably supporting the opposite end of said structure so as to permit longitudinal movements in response to the expansion and contraction of the said structure, a device secured to said structure at a point remote from said fixed end, a member connecting a part of said device remote from said structure with a fixed support so that the expansion and contraction of said member tends to move said device in parallel relation with respect to the longitudinal axis of said structure, a conductor operative to convey a fluid in heat exchanging relation with respect to said member, a control operative to vary the quantity of fluid passing in heat exchanging relation with respect to the said member, and means operatively connecting said control to said structure at a point remote from said fixed end and to said device at a point remote from said struc-

ture so that a relative longitudinal movement of the said points to which said control is connected effects a variation in the quantity of fluid passing in heat exchanging relation with respect to the said member.

5. In combination, a condensing turbine having a casing fixedly supported at one end, means movably supporting the opposite end of said casing so as to permit longitudinal movements in response to the expansion and contraction of the said casing, a condenser secured to and supported in part by a portion of said casing remote from said fixed end, a substantially rigid member having one end secured to a portion of said condenser, which is remote from that portion secured to said casing and having its opposite end secured to a fixed support so that the expansion and contraction of said member moves said condenser in parallel relation with respect to the longitudinal axis of the turbine, and means for effecting an expansion and contraction of said member which is commensurate with and in the same direction as the longitudinal movement of that portion of the said casing which provides a support for and to which the condenser is secured.

6. In combination, a condensing turbine having a casing fixedly supported at one end, means movably supporting the opposite end of said casing so as to permit longitudinal movements in response to the expansion and contraction of the said casing, a condenser secured to and supported in part by a portion of said casing remote from said fixed end, an elongated and substantially rigid member having one end secured to a portion of said condenser, which is remote from that portion secured to said casing and having its opposite end secured to a fixed support so that the expansion and contraction of said member moves said condenser in parallel relation with respect to the longitudinal axis of the turbine, means for effecting an expansion and contraction of said member which is commensurate with and in the same direction as the longitudinal movement of that portion of the said casing which provides a support for and to which the condenser is secured, and a pair of oppositely extending relatively long resilient tie rods disposed transversely with respect to the longitudinal axis of the turbine and with respect to the longitudinal axis of said member and having their adjacent ends secured to a portion of said condenser adjacent the connection with said member and having their opposite ends secured to fixed supports.

7. In combination, a condensing turbine having a casing fixedly supported at one end, means movably supporting the opposite end of said casing, a condenser operatively suspended beneath and supported in part by a portion of said casing intermediate the ends thereof, a substantially rigid member connecting the lower portion of said condenser with a fixed support so that the expansion and contraction of said member tends to move the bottom portion of said condenser in parallel relation with respect to the longitudinal axis of the turbine, and means for effecting an expansion and contraction of said member which is commensurate with and in the same direction as the longitudinal movement of that portion of the said casing to and from which the condenser is connected and suspended.

8. In combination, a prime mover exhausting

a condensible fluid during normal operation and having axially spaced ahead and reverse sections enclosed in a casing fixedly supported at one end, means movably supporting the opposite end of said casing so as to permit longitudinal movements in response to the expansion and contraction of the said casing, said casing having an intermediate exhaust portion operatively associated with said ahead and reverse sections, an elongated condenser supported in part by said casing by having its mid portion secured to the exhaust portion of said casing with its longitudinal axis disposed transversely with respect to the longitudinal axis of the prime mover, an elongated member connecting the mid portion of said condenser at a point which is remote from that secured to said casing with a fixed support so that the expansion and contraction of said member tends to move said condenser in parallel relation with respect to the longitudinal axis of said prime mover, conducting means operative to convey a portion of the motive fluid passing through said prime mover in heat exchanging relation with respect to said member and then into said condenser so as to effect a movement of said member which is commensurate with and in the same direction as the longitudinal movement of that portion of the casing to which the mid portion of the condenser is secured, and a pair of oppositely extending relatively long resilient tie rods disposed transversely with respect to the longitudinal axis of the prime mover and with respect to the longitudinal axis of said member and having their adjacent ends secured to the mid portion of said condenser at a point remote from said casing and having their opposite ends secured to fixed supports.

9. In combination, a condensing turbine having axially spaced ahead and reverse sections enclosed in a casing fixedly supported at one end, means movably supporting the opposite end of said casing so as to permit longitudinal movements in response to the expansion and contraction of the said casing, said casing having an intermediate exhaust portion operatively associated with said ahead and reverse sections, a condenser operatively secured to and supported in part by the exhaust portion of said casing, a substantially rigid hollow member connecting a portion of said condenser remote from said casing with a fixed support so that when said casing is heated by the operation of said ahead section, the position of said condenser is such that a reference plane which extends through said device and transversely with respect to the longitudinal axis of the turbine, is disposed substantially at right angles with respect to a horizontal plane, and so that when the turbine is idle and said casing is relatively cool the position of said device is such that said reference plane is inclined toward the said fixed end of the casing, and fluid conducting means connecting an intermediate portion of said reverse section, said hollow member and said condenser in series flow relation so as to pass elastic fluid through said hollow member at a temperature sufficient to effect a longitudinal expansion thereof which is commensurate with and in the same direction as the longitudinal movement of that portion of the turbine casing to which the condenser is secured.

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