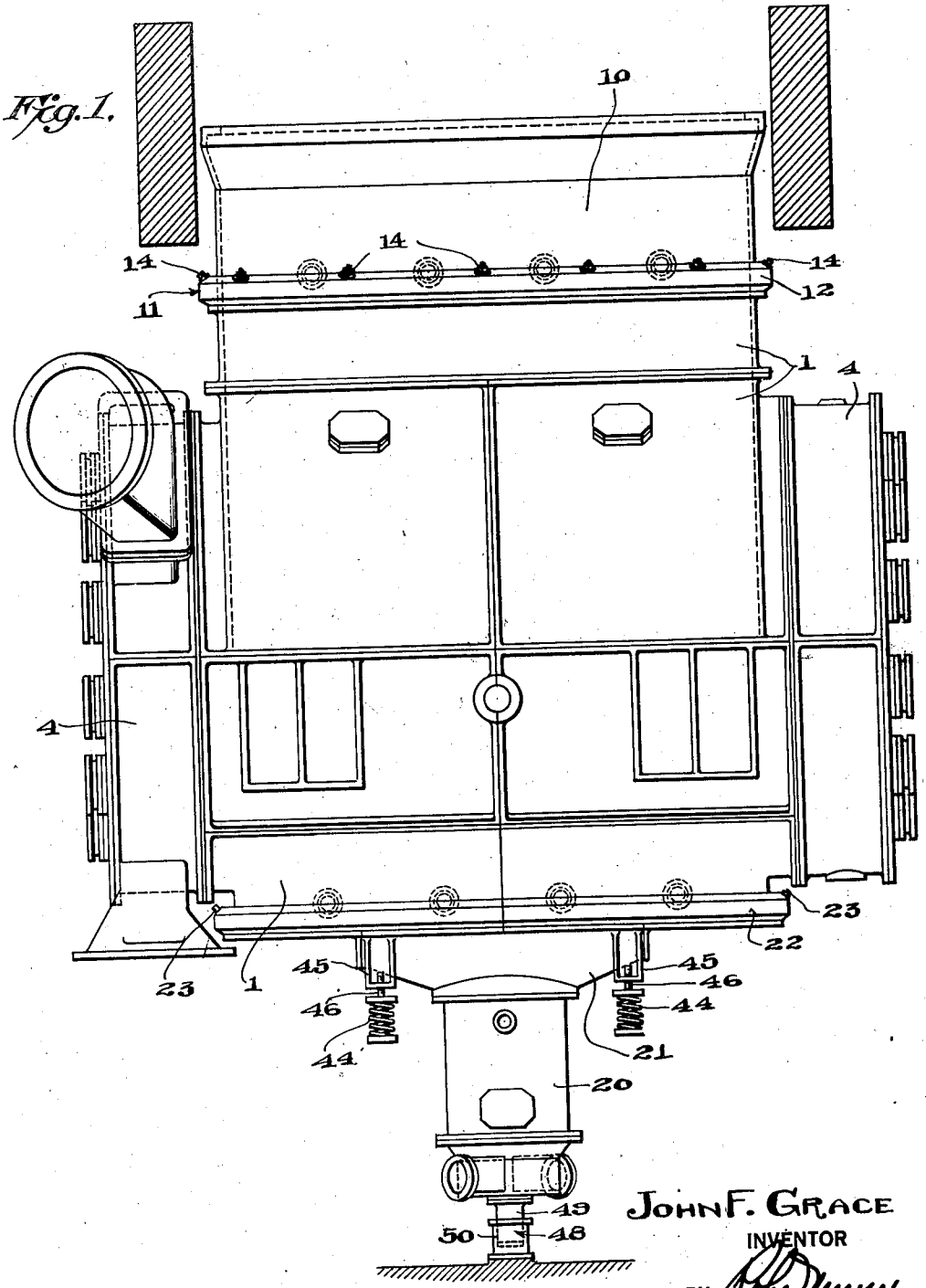
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STEAM CONDENSER

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Fig. 1.



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STEAM CONDENSER

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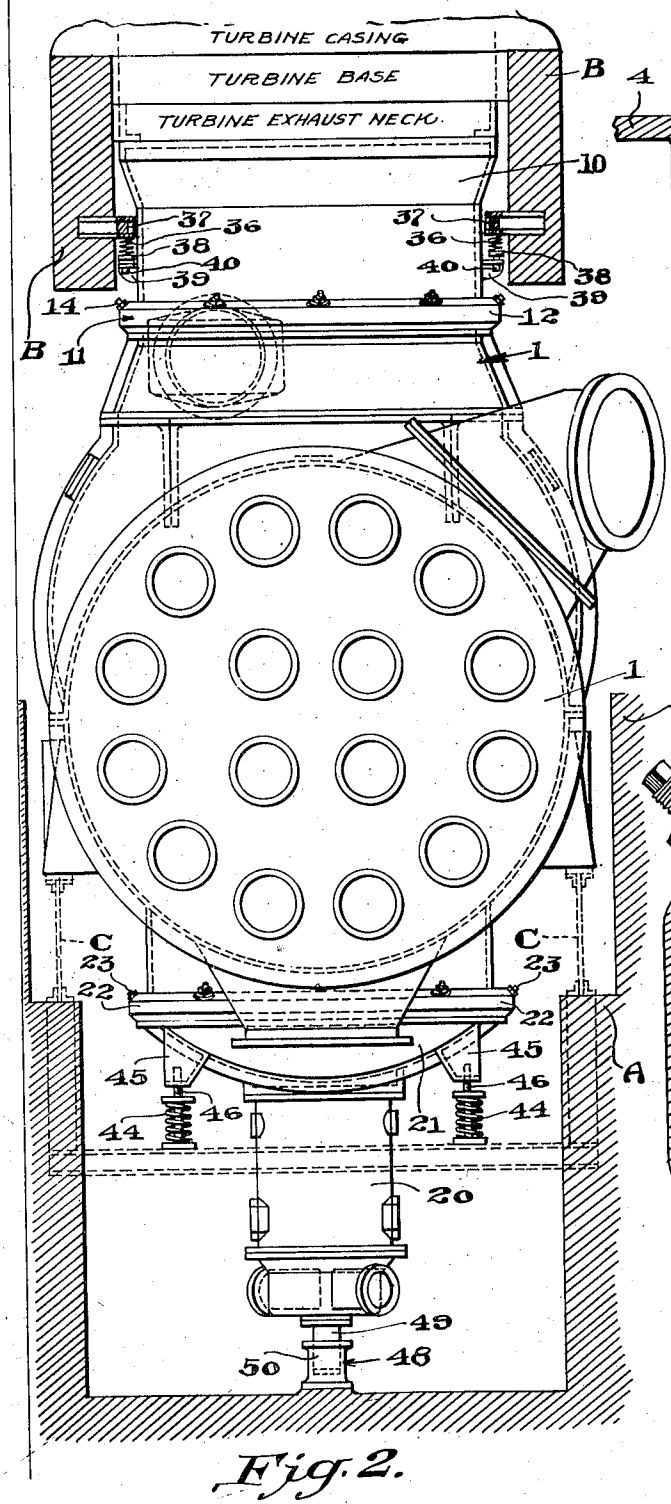


Fig. 2.

Fig. 3.

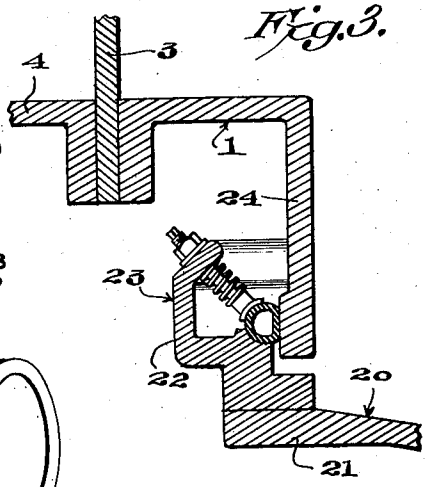
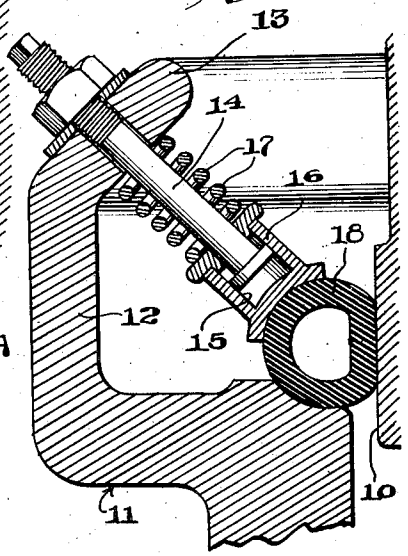


Fig. 8.



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STEAM CONDENSER

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Fig. 4.

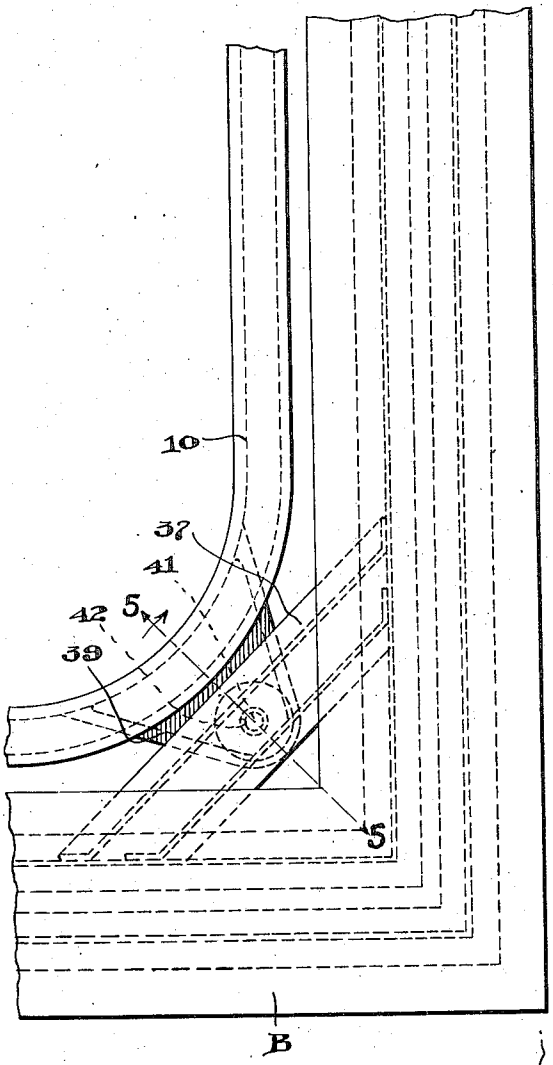
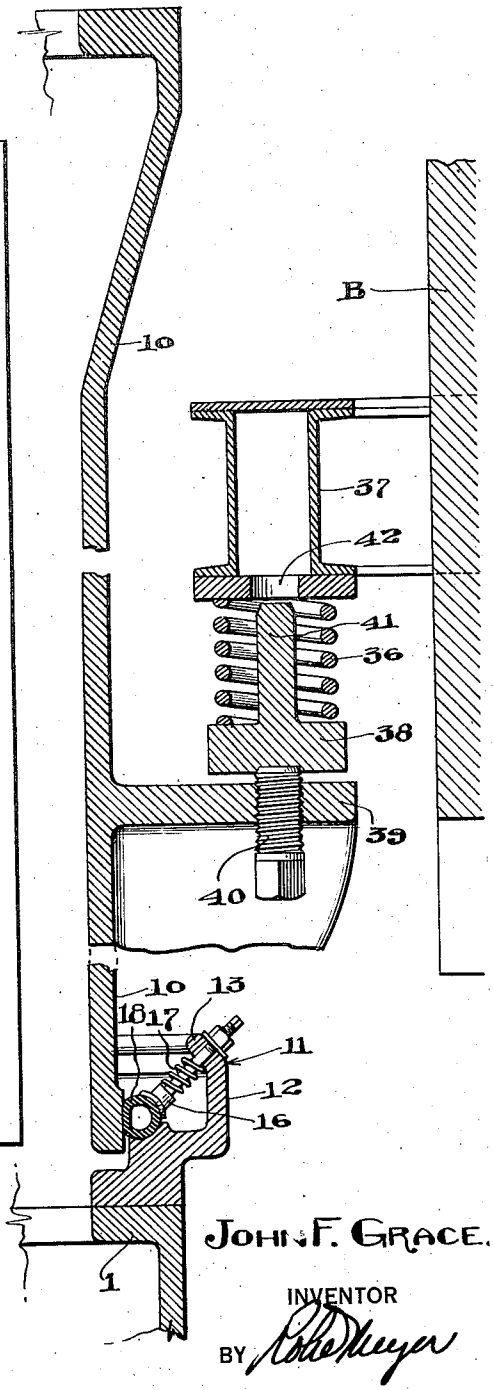


Fig. 5.



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BY Robert Sawyer

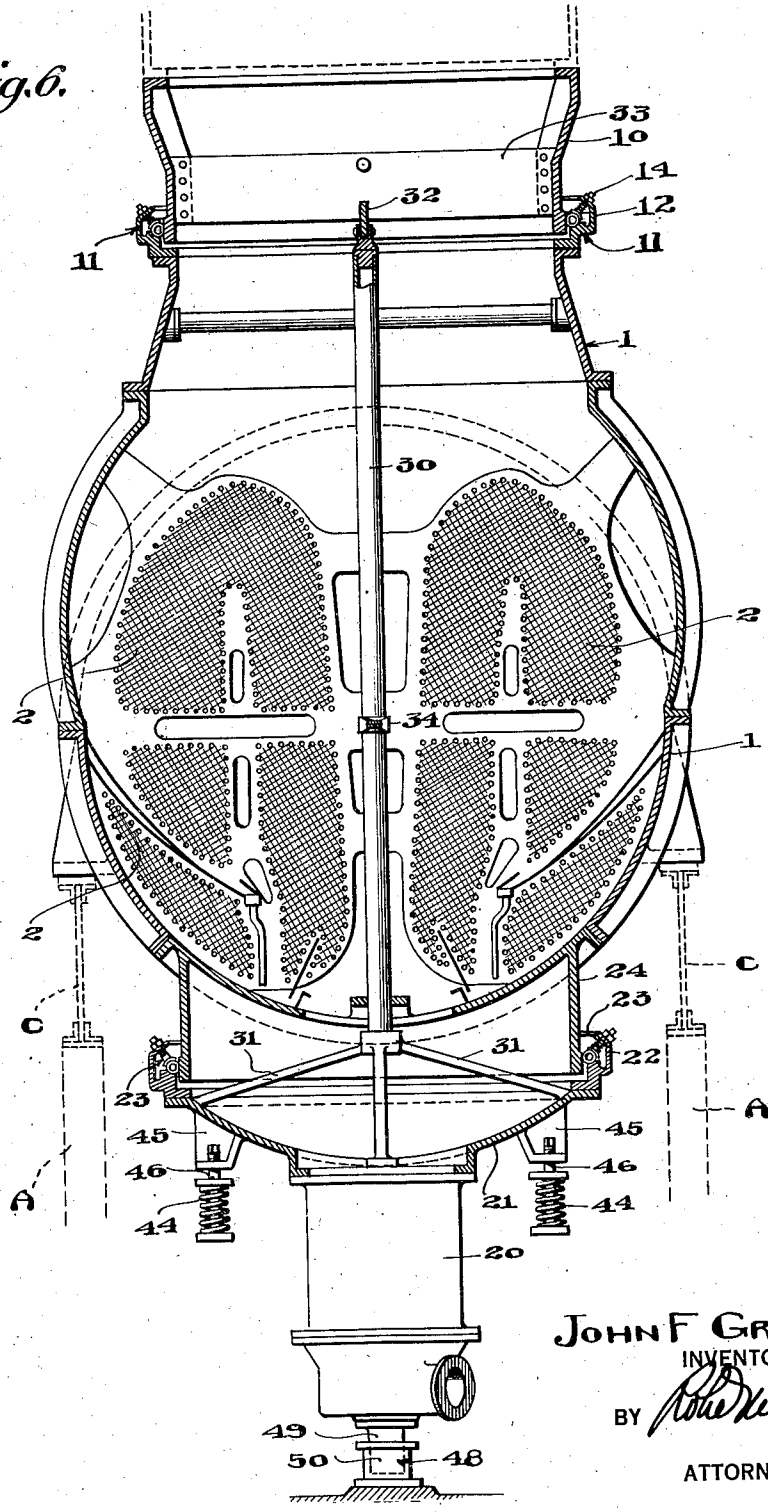
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STEAM CONDENSER

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Fig. 6.



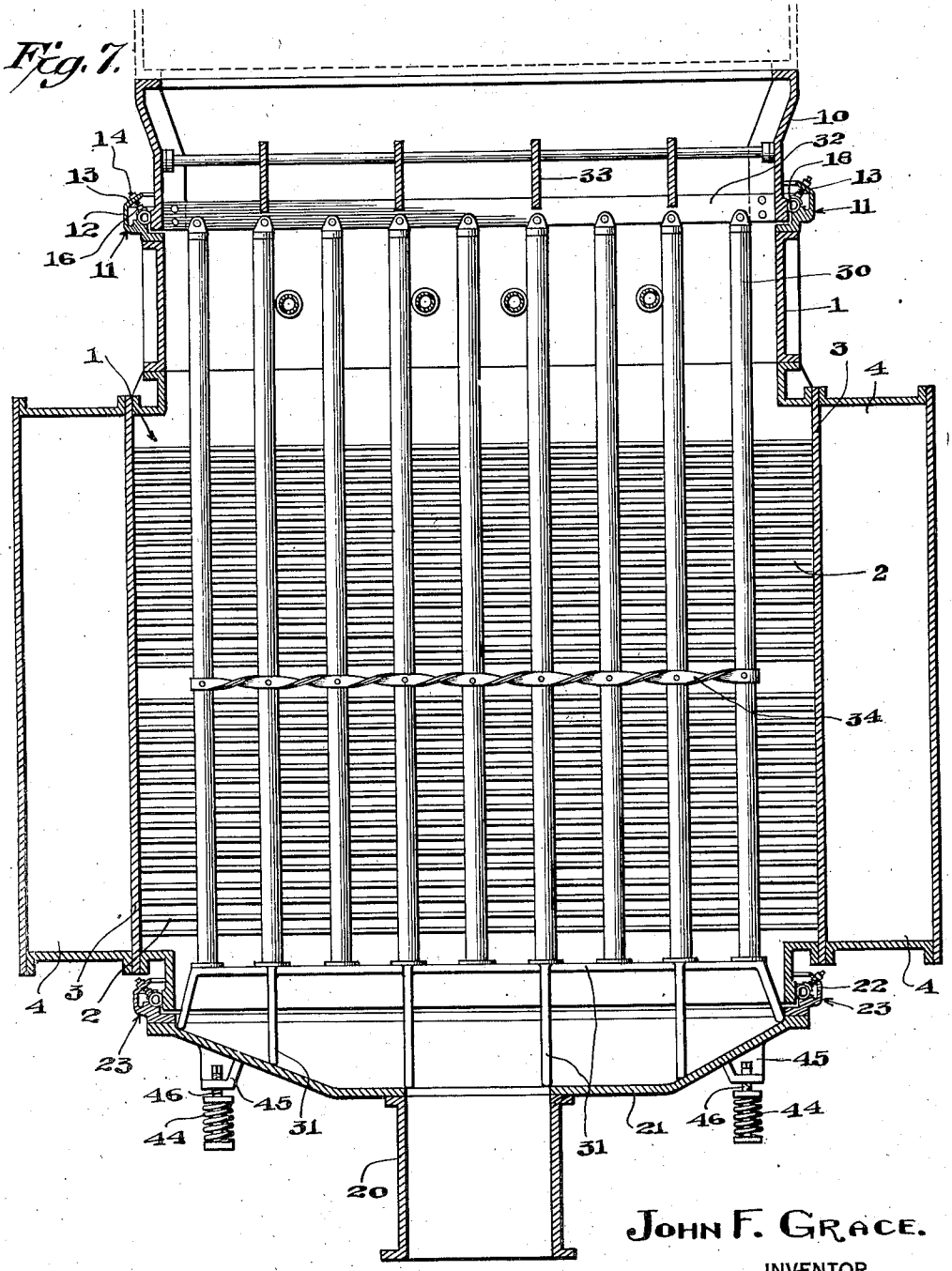
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Fig. 7.



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UNITED STATES PATENT OFFICE

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STEAM CONDENSER

Application filed December 12, 1928. Serial No. 325,625.

This invention relates to steam condensers of the surface type, and an object of the invention is to provide a condenser structure and mounting which will produce a uniform load upon the foundation, at all times and during all operating conditions of the condenser and which will relieve the variable load upon the foundation due to varying vacuum in the condenser.

Another object of the invention is to provide a condenser structure which will reduce to a minimum the weight to be suspended from the exhaust neck of the turbine and the turbine support; one which embodies means for balancing atmospheric thrust; and one which also includes adjustable means for varying the down-pull of the exhaust inlet and hot well or condensate reservoir upon a turbine supporting structure.

More specifically, the invention comprises a condenser embodying a condenser shell, an exhaust steam inlet member, condensate reservoir or hot well, expansion or yielding joints between the exhaust steam inlet member and condenser shell and between the condensate reservoir and condenser shell, as well as providing rigid columns connecting the steam inlet member and condensate reservoir for distributing and balancing atmospheric pressures upon these two elements of the condenser structure. Means are also provided for regulating the down-pull on the turbine supporting structure, as well as suitable means for steadying the structure to prevent undue lateral vibration but permit the necessary vertical movement.

With these objects in view, the invention consists in various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a steam condenser of the preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Fig. 1 is a side elevation of the improved condenser.

Fig. 2 is an end elevation of the condenser.

Fig. 3 is an enlarged detailed section illustrating the expansion or yielding joint between the condensate reservoir and the condenser shell.

Fig. 4 is a fragmentary top plan of the exhaust inlet member and turbine supporting foundation.

Fig. 5 is a vertical section on the line 5—5 of Fig. 4.

Fig. 6 is a vertical cross section through the condenser.

Fig. 7 is a vertical longitudinal section through the condenser.

Fig. 8 is an enlarged detailed section of the expansion or yielding joint structure.

Referring more particularly to the drawings, the improved condenser structure comprises the condenser shell or body 1, which is of approved construction and has the water circulating tubes 2 thereon. The tubes 2 are supported by the tube heads 3, and serve to circulate the cooling or condenser water from the water boxes 4 of the condenser through the steam condensing space, as is usual in steam condensers of the surface type.

The exhaust steam from a turbine (not shown) is directed into the condensing space within the shell 1 of the condenser through the exhaust steam inlet member 10, which receives the steam from the turbine exhaust. In the present invention, the exhaust steam inlet member 10 is connected by means of a yieldable or expansion joint 11 with the condenser shell 1, as clearly shown in Figs. 5, 6, 7 and 8 of the drawings.

The expansion or yieldable joint structure 11 may be of any approved construction; however, a particular type of such a joint is illustrated in the drawings and comprises an annular bracket 12, which has an inclined upper edge portion 13 through which bolts 14 extend, at suitable spaced intervals. The bolts 14 have their heads slidably positioned in the bores 15 of pressure heads 16. Springs 17 engage between the pressure heads 16 and the angled edges of the bracket 12, for urging the pressure heads 16 against the flexible member 18. The flexible member 18 is illustrated as of substantially hose-like formation, being constructed of a rubber composition or other suitable material and it yieldably, but firmly, engages the brackets 12 and

the outer surface of the exhaust inlet member 10 so as to provide a yieldable fluid tight connection between the exhaust inlet member 10 and the condenser shell 1.

The hot well or condensate reservoir 20 is of any approved construction and it receives the condensed steam from the condenser, such condensate being withdrawn from the hot well or condensate reservoir 20, for any suitable purpose, preferably for return through the boilers (not shown) of a power plant for reconversion into steam.

The hot well or condensate reservoir 20 has a connector or top member 21 rigidly connected thereto, which is of equal cross sectional area with the exhaust inlet member 10, as clearly shown by particular reference to Figs. 6 and 7 of the drawings. The top member or connector 21, which serves to connect the hot well 20 with the condenser casing 1, has an annular flange 22 about its upper edge, which forms a part of an expansion or yieldable joint structure 23, similar in construction with the expansion or yieldable joint structure 11, so as to provide a yieldable fluid tight connection between the hot well 20 and the depending flange 24, which is formed on the condenser shell 1 for the purpose of providing this expansion joint and permitting provision of the equal, cross sectional areas of the top member 21 and the steam inlet member 10.

The condenser shell 1 is bolted or rigidly supported from the foundation structure A, in any suitable manner, such as by I-beams C, so as to provide rigid support for the condenser, and the provision of the yieldable or expansion joint 11 between the condenser shell 1 and the steam inlet member 10, relieves the turbine support B of the relatively great weight of the condenser, and the water circulating therethrough, reduces to a minimum the weight to be suspended from the exhaust neck of a turbine and materially reduces vibration of the condenser and the consequent wear on the tubes and their packing.

The exhaust inlet member 10 has a plurality of columns 30 connected thereto, which extend through the condenser casing or shell 1 and are rigidly connected to a spider-like construction 31 at their lower ends, which is in turn rigidly connected to the connector or top member 21 of the hot well 20. The spider-like member 31 provides for distribution of the the connection between the columns 30 and the top member 21, while distribution of the connection between the columns 30 and the exhaust inlet member 10 is provided through suitable beams 32 and 33. The columns are tied together so as to prevent undue independent movement or vibration, by a suitable brace 34. As clearly shown in Figs. 6 and 7 of the drawings, the columns 30 are free from connection with the condenser shell or casing 1 and provide rigid tieing connection between the exhaust inlet member 10 and the hot well 20 so as to balance atmospheric thrust. The downward atmospheric thrust upon the exhaust casing of the turbine (not shown) is balanced by the upward atmospheric thrust on the hot well 20 and top member 21.

It is often desirable and necessary, to compensate for operating conditions in a power plant of the type utilizing a condenser of the present invention, to provide a definite down-pull on the exhaust neck of the turbine (not shown), and, to provide such down-pull, the present invention embodies springs 36 which abut supporting beams 37, which are in turn carried by the turbine supporting structure B.

A spring 36 in each unit is confined between the auxiliary beam 37 and a tension regulator 38, which is adjustably supported from the bracket 39 by a bolt 40. The bracket 39 is formed upon the exhaust steam inlet member 10, as clearly shown in Figs. 4 and 5 of the drawings. The tension regulator 38 has a guiding pin 41 thereon which is moveable through a suitable opening 42 in the auxiliary beam 37. One of the units embodying the spring 36 and companion members is preferably provided at each corner of the exhaust steam inlet member 10 and by regulation of the tension of the springs 36 through adjustment of the bolts 40, the down-pull on the turbine support B may be varied to provide the desired poundage.

By tightening of the jack screws or bolts 40, the tension of the springs 36 may be regulated to vary the down pull of the exhaust steam inlet member and turbine exhaust neck and therefore either press the turbine base more firmly upon the foundation B or relieve the pressure as desired. The increasing of the down pull and the increasing of the pressure of the turbine base upon the foundation by the tightening of the bolts or jack screws 40 will counteract atmospheric uplift pressure.

All of the weight of the exhaust inlet member 10 and the hot well 20 is sustained by spring supports 44, which are associated with bracket feet 45 carried by the top member 21 of the hot well or condensate reservoir 20, the weight of the exhaust steam inlet member 10 being distributed to the supporting springs 44 through the columns 30. If it is so desired, adjustable tension members 46 may be provided for adjusting the tension of the springs 44.

While in the drawings and in the foregoing description both the top and bottom expansion joints are shown and described as the same size, shape and area, it is not desired to limit the invention to this specific relationship of the expansion joints, as in many instances they will be of the same area, though not necessarily of the same size or dimensions.

Further: a slight difference of area between the upper and lower expansion joints, or inlet cross sectional areas of the exhaust inlet member 10 and the top member 21 of the condensate reservoir 20 may be preferred in instances where usual and preferred arrangement and adjustment of the springs 36 cannot be obtained or where it may be necessary to omit either these springs 36 or the springs 44.

A steady bearing 48 is provided, which prevents undue lateral vibration or movement of the hot well structure 20 but permits the necessary vertical movement. The steady bearing 48 may be of any approved construction; however, in the drawings it is illustrated as comprising a piston member 49 rigidly carried by the hot well 20 and moveable vertically in a pot or cylinder 50, which is carried by the foundation A. While a particular type of steady bearing of the dash pot type is illustrated in the drawings, and has just been described, it is to be understood that such is for the purpose of illustration of an operative structure only, and any other suitable approved means for steadying the condensate reservoir or hot well 20 and its companion parts may be provided without departing from the spirit of the invention.

From the foregoing description taken in connection with the accompanying drawings, it will be apparent that a condenser structure has been provided wherein the weight of the condenser proper, the weight of the circulating water and of the steam and condensate in the condenser body, is supported upon a structure independent of the turbine support B, and one in which the weight suspended from the turbine exhaust neck, in normal service is relatively light, since the main support for the steam inlet member 10 and hot well is through the spring supports 44 and columns 30, and that the turbine columns, footings, and pilings are, by the employment of the condenser as disclosed in the present application, embodying the two expansion joints and other features, relieved of the relatively great weight of the condenser, circulating water contained therein, etc.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown but that these may be modified widely within the invention as defined by the claims.

What is claimed is:

1. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir, and expansion joints between said inlet member and shell and between said condensate reservoir and shell.

2. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, and rigid columns connecting said inlet member and said condensate reservoir.

3. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, and rigid columns connecting said inlet member and said condensate reservoir, said columns extending through and being free from connection with said condenser shell.

4. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, rigid columns connecting said inlet member and said condensate reservoir, said columns extending through and being free from connection with said condenser shell, and spring supports for said condensate reservoir.

5. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir expansion joints between said inlet member and shell and between said condensate reservoir and shell, and springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support.

6. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support, and supporting springs for supporting the weight of said condensate reservoir.

7. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, and spring supports for said condensate reservoir.

8. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, and atmospheric pressure distributing means rigidly connecting said inlet member and condensate reservoir.

9. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, atmospheric pressure distributing means rigidly connecting said inlet member and condensate reservoir, and springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support.

10. In a condenser, the combination with a

support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, atmospheric pressure distributing means rigidly connecting said inlet member and condensate reservoir, springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support, and spring supports for said condensate reservoir.

11. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, rigid columns connecting said inlet member and condensate reservoir, said columns extending through and being free from connection with said condenser shell, springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support, and spring supports for said condensate reservoir.

12. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, columns connecting said inlet member and condensate reservoir, springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support, and spring supports for said condensate reservoir, a part of said condensate reservoir being of equal cross sectional area with said inlet member for balancing atmospheric thrust.

13. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, an expansion joint between said inlet member and shell, and springs associated with said support and inlet member for increasing the down-pull of said inlet member upon said support.

14. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, an expansion joint between said inlet member and shell, springs associated with said support and inlet member for increasing the down-pull of said inlet member upon said support, and adjustable means for regulating the tension of said springs.

15. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support, and adjustable means for regulating the tension of said springs.

16. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir including a top member of equal cross sectional area with said inlet member, and expansion joints between said inlet member and said shell and between said condensate reservoir and shell.

17. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir including a top member of equal cross sectional area with said inlet member, expansion joints between said inlet member and said shell and between said condensate reservoir and shell, and spring supports for said condensate reservoir.

18. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir including a top member of equal cross sectional area with said inlet member, expansion joints between said inlet member and said shell and between said condensate reservoir and shell, and rigid columns connecting said inlet member and condensate reservoir.

19. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir including a top member of equal cross sectional area with said inlet member, expansion joints between said inlet member and said shell and between said condensate reservoir and shell, rigid columns connecting said inlet member and condensate reservoir, and means associated with said condensate reservoir to permit vertical movement and prevent lateral movement thereof.

20. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, rigid columns connecting said inlet member and condensate reservoir, said columns extending through and being free from connection with said condenser shell, springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support, spring supports for said condensate reservoir, a part of said condensate reservoir being of equal cross sectional area with said inlet member for balancing atmospheric thrust, and means associated with said condensate reservoir to permit vertical movement and prevent lateral movement thereof.

21. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir, means connecting said condenser shell and reservoir and condenser shell and inlet member to permit relative movement of the shell, reservoir, and inlet member, and means within the shell for establishing rigid tying connection between the inlet member and reservoir.

22. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate

reservoir, means connecting said condenser, shell and reservoir and condenser shell and inlet member to permit relative movement of the shell, reservoir, and inlet member, and atmospheric pressure distributing means within the shell rigidly connecting said inlet member and condensate reservoir.

23. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir, said shell, inlet member and reservoir connected for relative movement, and atmospheric pressure distributing columns extending through and being free from connection with said shell and connecting said inlet member and reservoir.

24. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, said shell, inlet member and reservoir connected for relative movement, atmospheric pressure distributing means rigidly connecting said inlet member and reservoir, and springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support.

25. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, said shell, inlet member and reservoir connected for relative movement, atmospheric pressure distributing means rigidly connecting said inlet member and reservoir, and springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support, and means associated with said reservoir to permit vertical movement thereof and prevent its lateral movement.

26. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, said shell, inlet member and reservoir connected for relative movement, atmospheric pressure distributing means rigidly connecting said inlet member and reservoir, springs associated with said support and said inlet member for increasing the down-pull of said inlet member upon said support, and spring supports for said condensate reservoir.

27. In a condenser, a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and said shell and between said condensate reservoir and shell, and adjustable means for yieldably supporting said condensate reservoir.

28. In a condenser, a condensate shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, spring supports for said condensate reservoir and means for adjusting the tension of said springs.

29. In a condenser, the combination with a support, of a condenser shell, an exhaust steam inlet member, a condensate reservoir, expansion joints between said inlet member and shell and between said condensate reservoir and shell, and means connected to said steam inlet member and support and adjustable to vary the down pull of said support.

30. In a condenser, the combination of an exhaust steam inlet member, a condensate reservoir, expansion joints between said condenser and exhaust steam inlet member and between the condenser and reservoir, and means independent of the condenser shell establishing rigid tying connection between said exhaust steam inlet member and said condensate reservoir, the cross sectional areas of said inlet member and reservoir being substantially equal.

31. In a condenser, the combination, of an exhaust steam inlet member, a condensate reservoir, expansion joints between said condenser and inlet member and between the condenser and reservoir, means independent of the condenser shell establishing rigid tying connection between said inlet member and reservoir and means associated with said reservoir to permit vertical movement thereof and prevent lateral movement.

32. In a condenser, the combination, of an exhaust steam inlet member, a condensate reservoir, an expansion joint between the condenser and reservoir, the cross sectional area of said inlet member and reservoir being substantially equal, means independent of the condenser shell establishing rigid tying connection between said inlet member and said condensate reservoir, and a steady-bearing associated with said reservoir to prevent lateral movement and permit vertical movement of the reservoir.

33. In a condenser, the combination, of an exhaust steam inlet member, a condensate reservoir, an expansion joint between the condenser and reservoir, the cross sectional area of said inlet member and reservoir being substantially equal, means independent of the condenser shell establishing rigid tying connection between said inlet member and said condensate reservoir, and a steady-bearing associated with said reservoir to prevent lateral movement and permit vertical movement of the reservoir, and adjustable yieldable supports for said reservoir.

In testimony whereof I affix my signature.

JOHN F. GRACE.