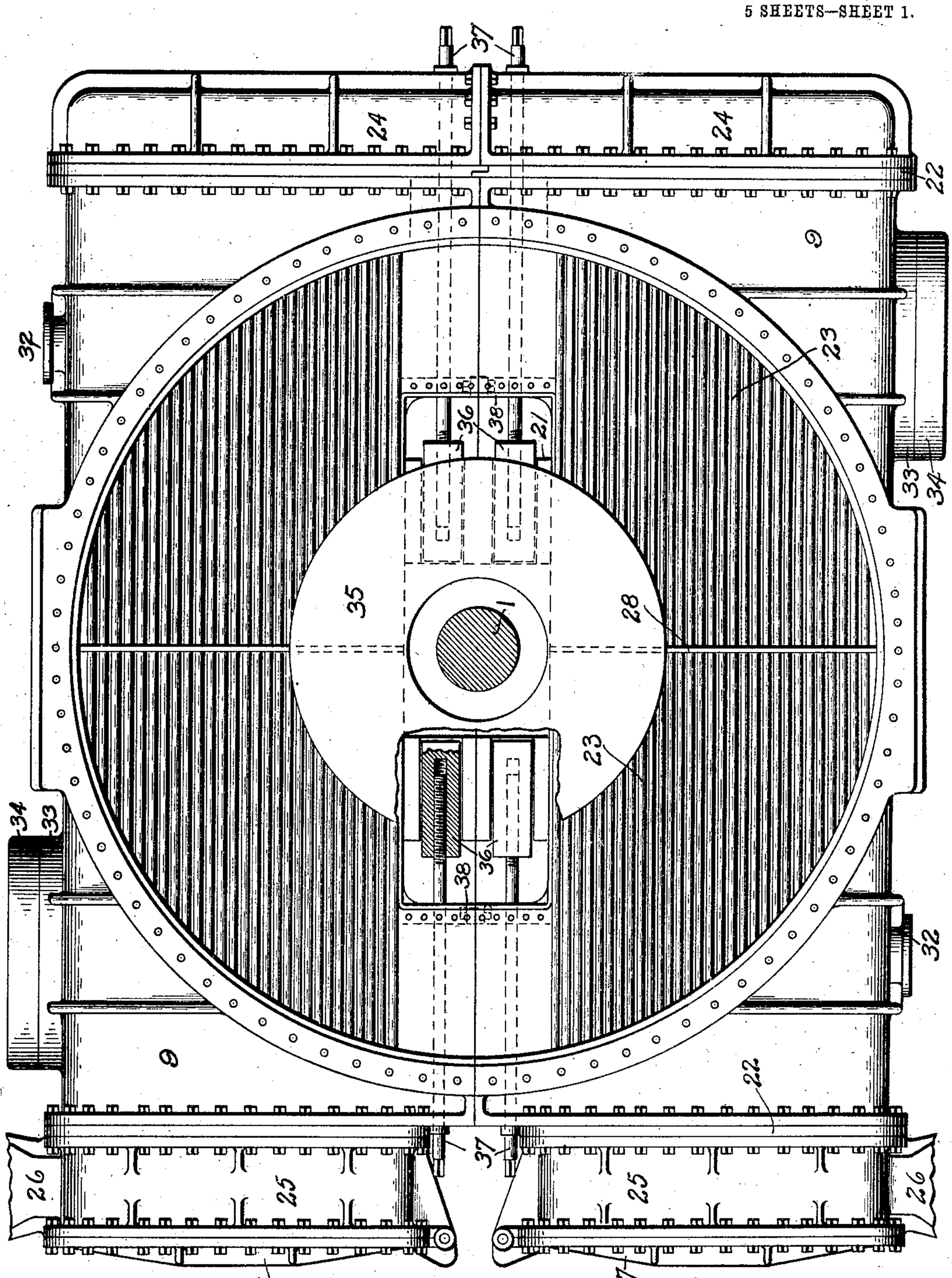
No. 845,294. PATENTED FEB. 26, 1907.

W. L. R. EMMET.

SURFACE CONDENSER FOR TURBINES.

APPLICATION FILED SEPT. 14, 1903.

5 SHEETS—SHEET 1.



Witnesses:

C. F. Whittemore

A. F. Macdonald.

Inventor:
William L. R. Emmet,
by Albert G. Davis
Att'y.

No. 845,294. PATENTED FEB. 26, 1907.

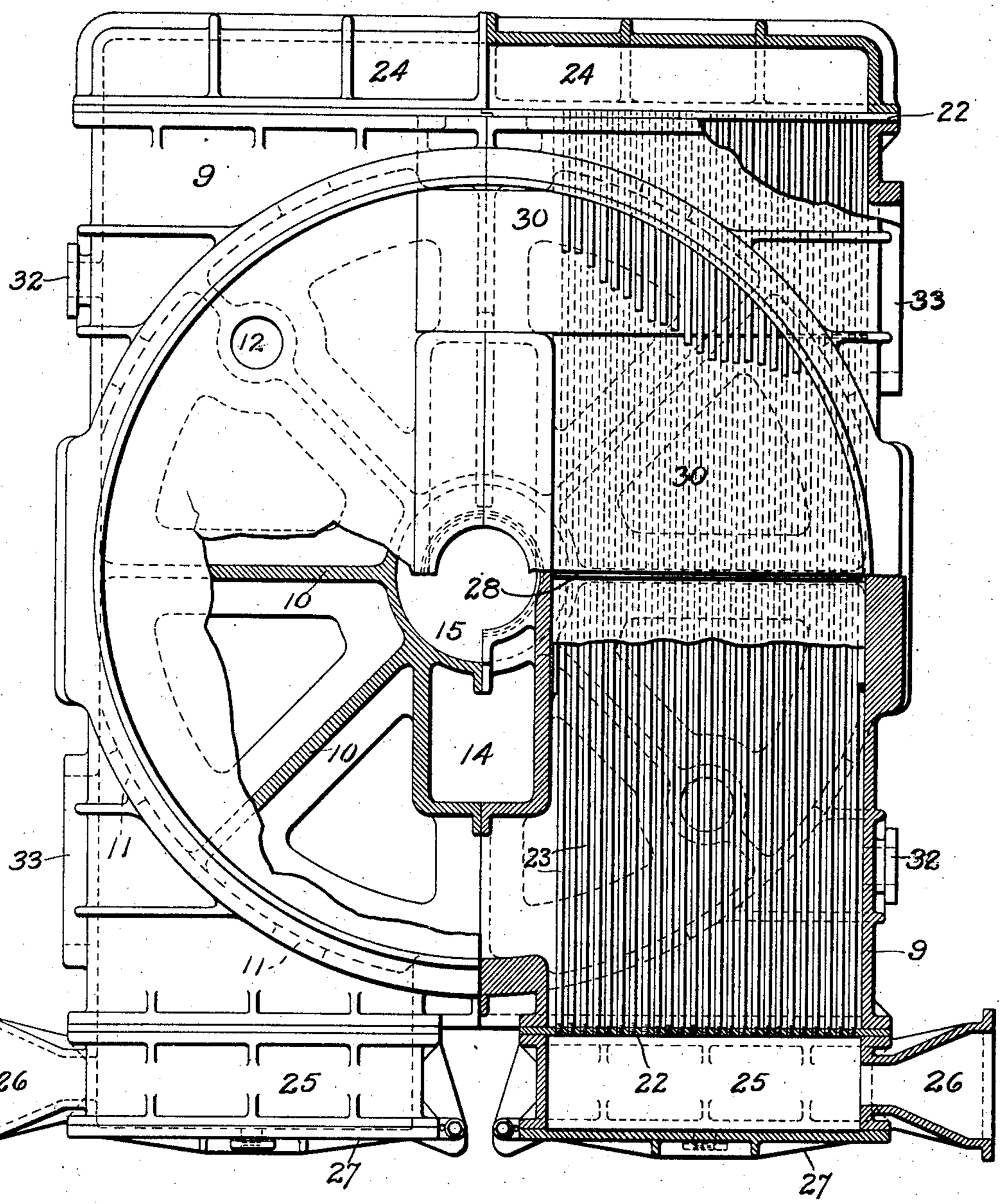
W. L. R. EMMET.

SURFACE CONDENSER FOR TURBINES.

APPLICATION FILED SEPT. 14, 1903.

5 SHEETS—SHEET 2.

Fig. 2.



Witnesses:

A. F. Macdonald.

Inventor:

William L. R. Emmet,

by Allen A. Lewis

Atty.

No. 845,294. PATENTED FEB. 26, 1907.

W. L. R. EMMET.

SURFACE CONDENSER FOR TURBINES.

APPLICATION FILED SEPT. 14, 1903.

5 SHEETS—SHEET 3.

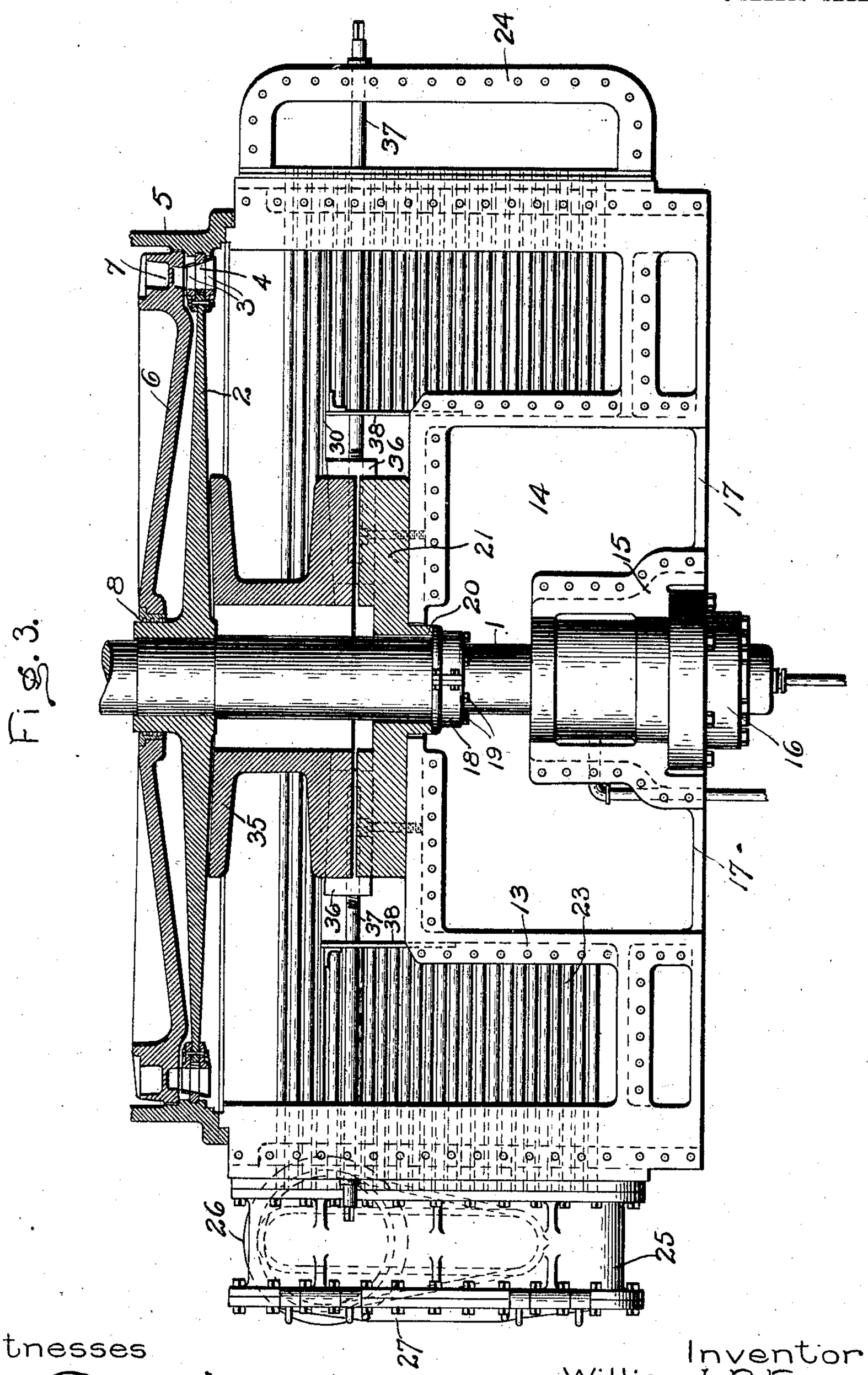


Fig. 3.

Witnesses

J. F. Whittemore

A. F. Macdonald.

Inventor

William L. R. Emmet,

by Allen & Davis

Atty.

No. 845,294. PATENTED FEB. 26, 1907.

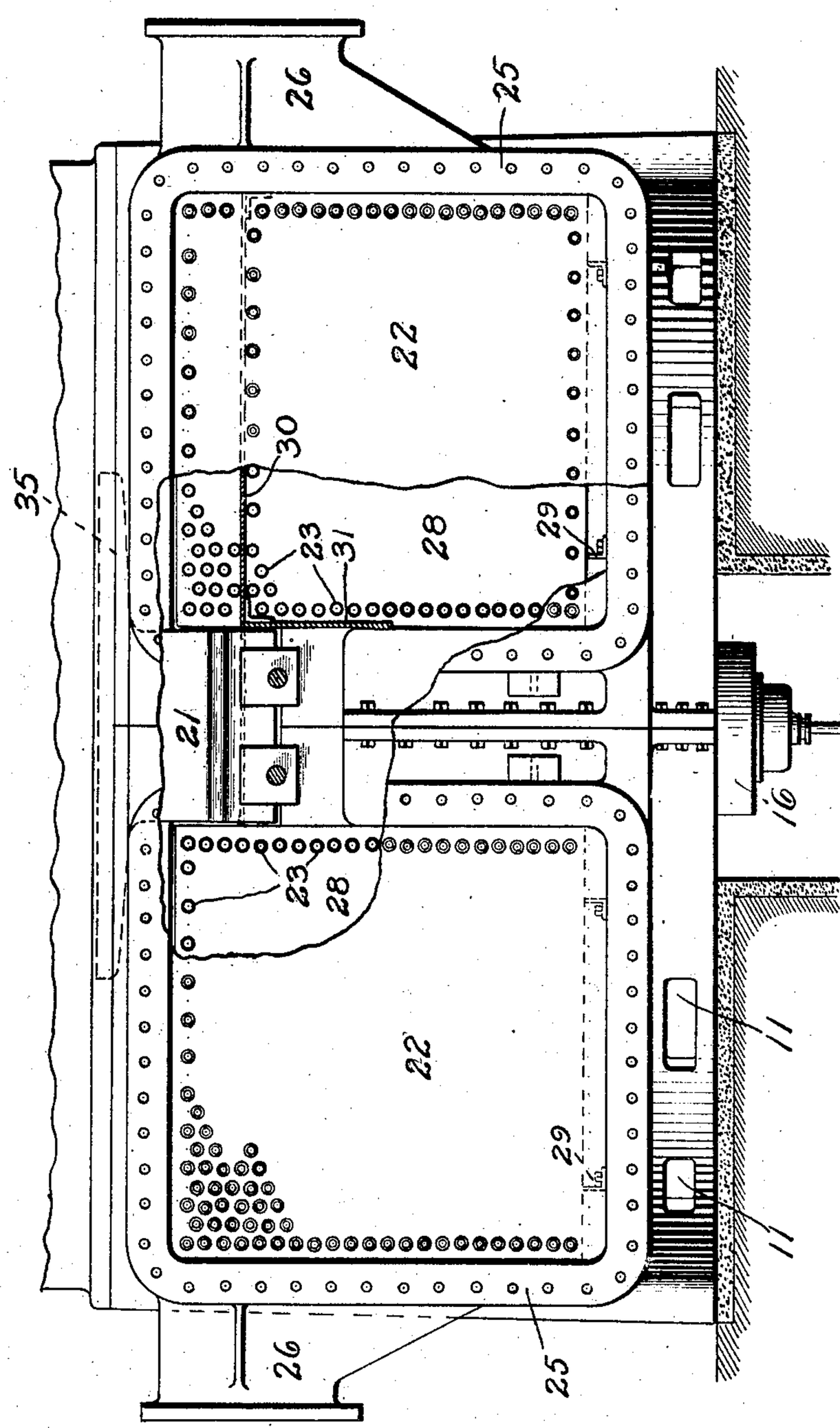
W. L. R. EMMET.

SURFACE CONDENSER FOR TURBINES.

APPLICATION FILED SEPT. 14, 1903.

5 SHEETS—SHEET 4.

Fig. 4.



Witnesses:

Geo. C. Whittemore

A. F. Macdonald.

Inventor

William L.R. Emmet,

by Albert G. Davis

Att'y.

No. 845,294. PATENTED FEB. 26, 1907.

W. L. R. EMMET.

SURFACE CONDENSER FOR TURBINES.

APPLICATION FILED SEPT. 14, 1903.

5 SHEETS—SHEET 5.

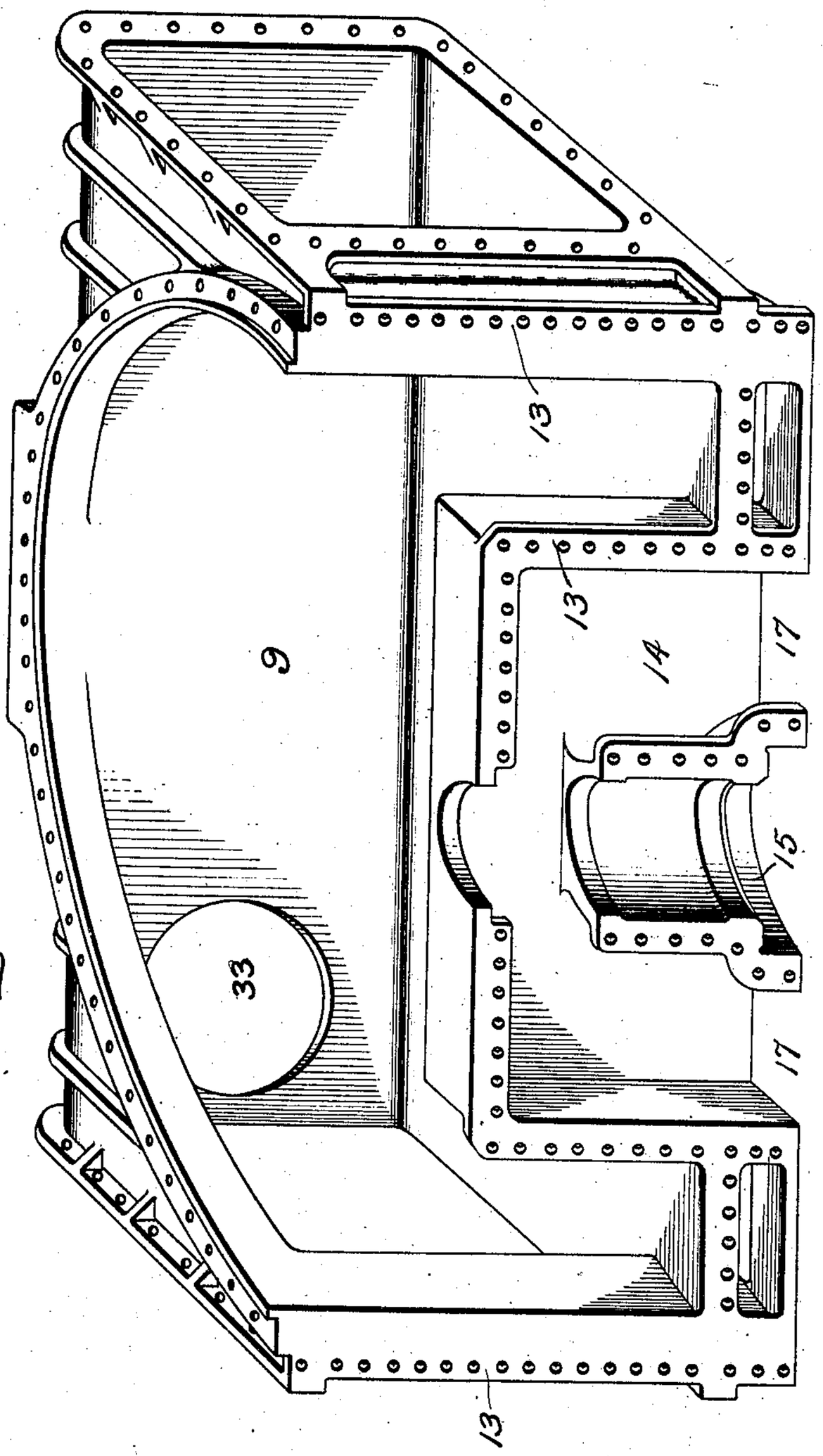


Fig. 5.

Witnesses:

J. F. Schmeisser

A. F. Macdonald.

Inventor:

William L. R. Emmet,

by Albert G. Davis

Atty.

UNITED STATES PATENT OFFICE.

WILLIAM L. R. EMMET, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SURFACE CONDENSER FOR TURBINES.

No. 845,294. Specification of Letters Patent. Patented Feb. 26, 1907.

Application filed September 14, 1903. Serial No. 173,027.

To all whom it may concern:

Be it known that I, WILLIAM L. R. EMMET, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Surface Condensers for Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to surface condensers for elastic-fluid engines, and especially to turbine-engines having upright shafts.

The object of the invention is to embody the condenser in one structure with the turbine in order to save space and material and obtain economical results. Upright turbines are usually mounted on a hollow base into which the steam or other motive fluid exhausts and from which it is led away by suitable piping to a separate condenser. I utilize this base as a condenser, housing therein a plurality of tubes through which a cooling medium, such as water, can be forced, and making suitable connections for the water-supply, air-pumps, and the like. In large machines the base may be divided into halves in the plane of the axis of the shaft. In each half is arranged a bank of tubes, suitably supported in tube-sheets, each of which forms one wall of a chamber adjacent thereto. The chambers at one end of the machine are connected, while those at the other end form the inlet and the outlet for the condensing water. As the tubes are horizontal and the exhaust from the buckets of the turbine comes down vertically; the steam has excellent distribution among the tubes. In order to equalize the work, a baffle-plate is introduced above a portion of the tubes which carry the incoming colder water, so that the greater portion of the steam will be at first thrown over among the tubes through which the warmer water is outflowing and will then return under the baffle-plate to the colder tubes.

Other details of construction will be hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, Figures 1 and 2 are top plan views, partly broken away and partly in section, of a condenser embodying my invention. Fig. 3 is a cross-section on the plane of division between the halves of the condenser. Fig. 4 is an end view, partly broken away, and with doors or covers removed; and Fig. 5 is a perspective view of one of the castings forming half the base.

The type of steam-turbine engine to which the invention is applied is immaterial. In the drawings a turbine of the Curtis type is shown, having a vertical shaft 1, Fig. 3, on which is secured the horizontal bucket-wheel 2, whose peripheral buckets 3 coöperate with stationary intermediate buckets 4, supported on the inside of a section 5 of the casing. Just above the wheel is a stationary diaphragm 6, containing nozzles 7 for delivering the steam or other elastic fluid to the buckets. The joint between the diaphragm and the shaft or hub of the wheel is provided with a packing 8 to make it steam-tight.

The section 5 of the wheel-casing rests on the lower section of the casing, which forms the condenser. This may be cast in one piece; but for large machines it comprises two duplicate castings meeting on a plane coincident with the axis of the shaft 1. Each casting, one of which is shown in Fig. 5, has a substantially rectangular box-like body 9, having a large semicircular opening in its top to register with one-half of the bottom of the wheel-casing of section 5. The bottom of each casting is strengthened by flanged ribs 10, Fig. 2, radiating from the axis of the shaft. Holes 11, Fig. 4, are formed in the outer circular wall between said ribs, so that when the castings are set on a suitable circular foundation grouting can be run in through said holes, filling the spaces between the ribs and securely anchoring the machine to its foundation. An escape-pipe 12 is cored through an enlargement of one of the ribs to convey the water of condensation to the hot-well.

The meeting faces of the two bodies 9 are open, so that said bodies combine to form a single steam-chamber. The edges of the two bodies register and have flanges 13 to receive fastening-bolts. It will be seen that the vertical flanges 13 also act as standards or supports to sustain the weight of the wheel-casing and parts at the points midway between the side walls of the base. Without these flanges or their equivalent there would be a tendency for the upper part of the base to sag when the casing was mounted in place. In the middle and lower part of each meeting face is cast a reëntrant roomy recess 14, in the lower part of which is a support 15, in-

tegral with the body and receiving the step-bearing 16 for the shaft 1. The step-bearing is bolted to said support from below, so that when necessary it can be dropped down and removed. Openings 17 at each end of the recess give access thereto, the space being large enough for a workman to enter. At the point where the shaft passes up through the top of the recess it is surrounded by packing-rings held in place by an annular support 18, secured by bolts 19 to some surrounding stationary portion of the machine, such as a depending flange 20 on a heavy plate 21, which surrounds the shaft and rests on the top of the recess, said tops and the under surface of the plate being faced off to make a tight joint.

The ends of the bodies 9 are closed by tube-sheets 22, in which are held the ends of a plurality of parallel tubes 23, running lengthwise of said bodies. Fastened to each end of each body is a cap or cover, the caps 24 at one end communicating, preferably by having open registering sides, so as to form a continuous passage connecting the ends of the tubes in one body with the adjacent ends of the tubes in the other body. At the opposite ends the caps 25 are separate, each having on one side a flanged neck 26, one serving as the inlet and the other as the outlet for the condensing water. These caps are preferably provided with hinged lids or doors 27, giving access to all the tubes for purposes of inspection, cleaning, and repair. In order to prevent the tubes from sagging, an intermediate tube-sheet 28, Fig. 1, is provided, resting on suitable supports 29, Fig. 4, which give free circulation of the water of condensation collecting on the bottom of the condenser.

In order to equalize the operation, a baffle-plate is introduced above a portion of the set of tubes through which the condensing water first flows. This plate 30, Figs. 2 and 4, extends inwardly to and beyond the meeting plane of the two bodies 9 and on a level just below the upper five or six rows of tubes. The steam in this half of the condenser is thus prevented from coming in contact with all of the colder tubes, but is deflected to the other side, where it passes down among the warmer set of tubes and then returns under the baffle-plate to the colder set. In other words, the fluid discharged by the bucket-wheel first passes over a few of the colder tubes, then passes laterally and downwardly over the warmer tubes, and finally over the cooler tubes.

At 31, Fig. 4, is shown an upright baffle-plate extending from the under side of the plate 30 to the top of the recess and preventing the steam from returning without first passing down through the warmer set of tubes.

On each body 9 is cast a flanged pipe connection 32 for the attachment of an air-pump. There is also provided an exhaust-port 33, normally closed by a cap or plug 34, but providing for the escape of steam when the engine is to be run non-condensing.

The clearance between the moving and stationary buckets 3 and 4 is about three one-hundredths of an inch. In order to support the wheel in its proper plane when the step-bearing is removed, I provide an annular table or chock 35, concentric with the shaft and resting on the plate 21, with its upper surface close to the wheel. The chock has means for lifting it, preferably constructed as follows: Corresponding transverse grooves are cut in the plate and chock, and in each groove is a wedge 36, into which is tapped a screw-threaded rod 37, rotatable in bearings in the end of the cap and in an upright plate 38, standing at the end of the recess 14 and secured to the under side of the baffle-plate. The rod has a squared end by means of which it can be rotated by a suitable wrench in order to run the wedge in or out, as desired. By forcing the wedges in the chock will be lifted into close contact with the wheel, so that the latter will be firmly supported, and the step-bearing can then be removed. When it has been replaced, the wedges are backed out, so that the chock drops a small fraction of an inch—say one one-hundredth. Then, if the oil or other lubricant pressure in the step-bearing fails, or if for any other reason the shaft settles, so that the buckets would be endangered if the settling continued, the chock will catch the wheel before the danger-point is reached and by the sound of its grinding will give warning of what is happening, so that the engine can be shut down before any damage is done.

In accordance with 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. In an elastic-fluid turbine, a base comprising a rectangular box-like structure having a step-bearing in its lower part a circular opening in the top, and sets of condenser-tubes located within said structure and below the opening.

2. In an elastic-fluid turbine, a base comprising a rectangular box-like structure having a step-bearing in its lower part a circular opening in the top, a wheel-casing mounted on top of the said structure and discharging into the opening, and condenser-tubes located within the structure and below the opening and arranged in two parallel sets.

3. In an elastic-fluid turbine, a base con-

taining sets of condenser-tubes with a step-bearing between said sets.

4. In an elastic-fluid turbine, a base provided with a step-bearing, and condenser-tubes arranged on opposite sides of said bearing.

5. In an elastic-fluid turbine, a base made up of separate portions each containing condenser-tubes, and a bearing for the shaft which is supported by and within the separate portions of the base.

6. In an elastic-fluid turbine, a base comprising hollow bodies to receive the exhaust-steam, a set of condenser-tubes in each body, and a shaft-bearing located in the base and extending into the hollow bodies between the sets of tubes.

7. In an elastic-fluid turbine having an upright shaft, a base comprising sections between which said shaft can pass, condenser-tubes in each, and a reëntrant recess formed in the base around the shaft.

8. In an elastic-fluid turbine, a base composed of sections meeting on the axial plane of the shaft and having registering openings in their meeting faces, and a reëntrant recess formed partly in one section and partly in another.

9. In an elastic-fluid turbine, a base composed of sections meeting on the axial plane of the shaft and having a reëntrant recess around the shaft.

10. In an elastic-fluid turbine, a base composed of sections having a reëntrant recess around the shaft, and a step-bearing support in said recess.

11. In an elastic-fluid turbine, a base composed of sections having a reëntrant recess around the shaft, and a step-bearing support in said recess integral with said sections.

12. In an elastic-fluid turbine, a section for a base, consisting of a box-like body having a semicircular opening in its top, an open side containing a reëntrant recess, and a step-bearing support in said recess.

13. In a turbine, the combination of a base having a reëntrant recess formed therein, a wheel-shaft, and a support for the wheel-shaft that is carried by the wall of the recess.

14. In a turbine, the combination of a base having a reëntrant recess, a wheel-shaft, a bearing therefor, and a support for the bearing which is located midway between the ends of and is carried by the wall of said recess.

15. In a turbine, the combination of a base having a divided reëntrant recess formed therein, a vertical shaft, a bearing therefor, and supports for the bearing which are carried by the parts of the recess.

16. In an elastic-fluid turbine, a section for one-half of the base, comprising a box-like body with one side open, having a reëntrant recess in its bottom, one side of said recess being open, and having in its top a semi-circular opening whose diameter coincides with the open side of said body and recess.

17. In an elastic-fluid turbine, a condenser-base comprising sections having tubes running lengthwise thereof, caps on said sections covering the ends of said tubes, and a reëntrant support which with the shaft divides the tubes into sections.

18. In an elastic-fluid turbine, a condenser-base comprising sections having tubes running lengthwise thereof, caps connecting said sections at one side, separate caps at the other end forming the inlet and outlet for the condensing water, and a baffle-plate for directing the passage of the exhaust against the tubes.

19. In an elastic-fluid turbine, a condenser-base comprising sections containing tubes, connected caps at one end of said sections, separate caps at the other end, and hinged lids for said separate caps.

20. In an elastic-fluid turbine, a base composed of duplicate sections, a set of tubes for each section, the sets being arranged in parallel relation, and a bearing-support, one half of which is carried by one section and the other half by the remaining section.

21. In an elastic-fluid turbine, a base comprising similar halves meeting on the axial plane of the shaft, each half having an inset.

22. In an elastic-fluid turbine, a base comprising sections each having flanged ribs on its bottom and openings in its outer wall communicating with the spaces between said ribs.

23. In an elastic-fluid turbine, a base containing condenser-tubes, and a baffle-plate for directing the inflowing exhaust.

24. In an elastic-fluid turbine, a base containing two sets of condenser-tubes, and a baffle-plate for directing the inflowing exhaust motive fluid toward one set.

25. In an elastic-fluid turbine, a base containing two sets of condenser-tubes connected in series, and a baffle-plate causing the inflowing steam to pass first among the warmer tubes.

26. In a turbine, the combination with an upright shaft, of a step-bearing therefor, and means for supporting the shaft in its normal position when the step-bearing is to be removed.

27. In a turbine, the combination with the shaft, of an element rotating therewith, a rigid support adjacent to said element, and means for bringing said support into operative contact with said element.

28. In a turbine, the combination with the bucket-wheel, of a chock beneath said wheel, and means for lifting said chock into supporting relation to said wheel.

29. In a turbine, the combination with the shaft and bucket-wheel, of a chock surrounding said shaft beneath said wheel, and wedges for lifting said chock.

30. In a turbine, the combination with a condenser-base, of a stationary grooved plate therein, a chock resting on said plate and having grooves therein, wedges in said grooves, screw-threaded rods tapped into said wedges and extending out through bearings in the walls of the base, and a bucket-wheel rotatable just above said chock.

31. In an elastic-fluid turbine, a base having a reëntrant recess to receive a step-bearing, and condenser-tubes arranged on opposite sides of said recess.

32. In an elastic-fluid turbine, a base having a reëntrant recess, a step-bearing support in said recess, and condenser-tubes arranged on opposite sides of said recess.

33. In an elastic-fluid turbine, the combination with a base having a reëntrant recess in its bottom, a step-bearing in said recess, a shaft extending through said base into the recess, and a packed joint at the point where the shaft passes from the base into said recess.

34. In a vertical-shaft turbine, the combination of a chambered base having a finished upper surface and tube-receiving openings, supports situated between the openings to sustain the weight of the wheel-casing, and a wheel-casing mounted on the top of the base.

35. In a turbine, the combination of an exhaust-receiving structure which is provided with a circular opening and finished wall, supports to sustain the wall at intermediate points, and a wheel-casing engaging with the wall.

36. In an elastic-fluid turbine, the combination with a base having a reëntrant recess in its bottom, a step-bearing in said recess, and a support which extends across the recess, supports the bearing, and permits access to the parts located between the end of the step-bearing and the under wall of the inset.

In witness whereof I have hereunto set my hand this 12th day of September, 1903.

WILLIAM L. R. EMMET.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.