

March 15, 1949.

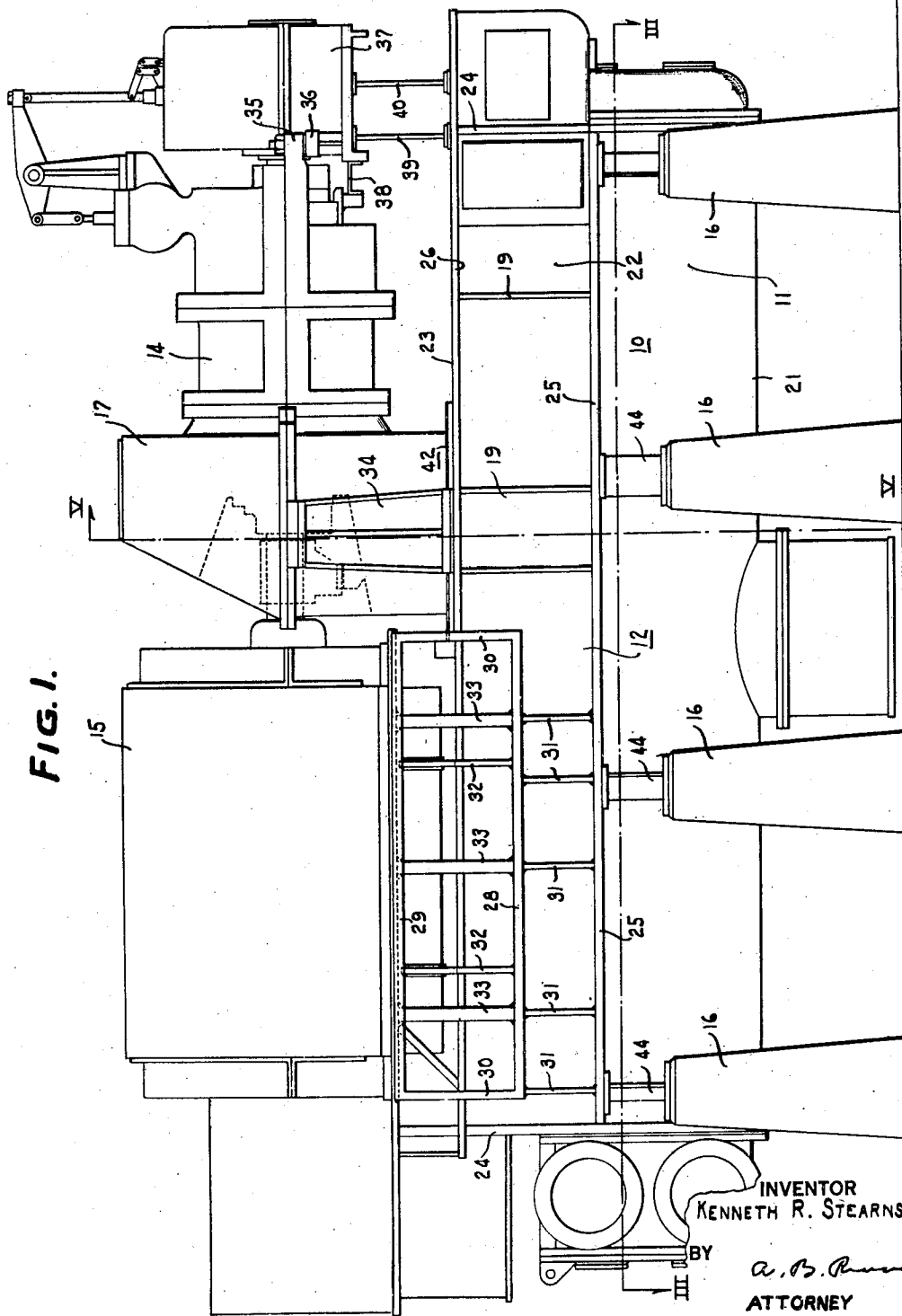
K. R. STEARNS

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HEAT EXCHANGER OR CONDENSER SUPPORT

Original Filed Nov. 9, 1946

4 Sheets-Sheet 1



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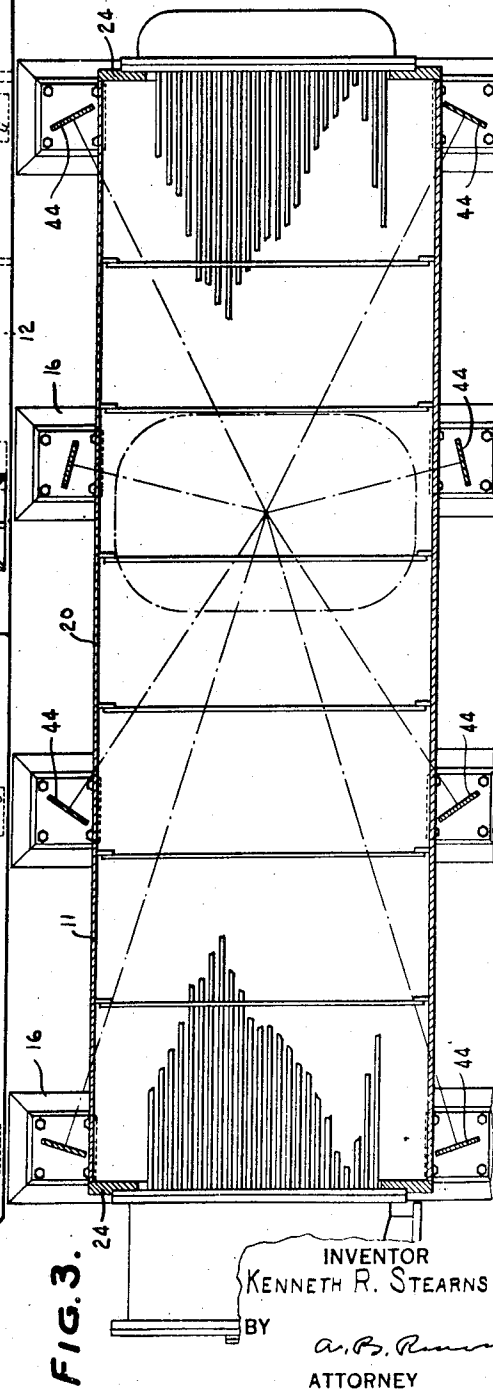
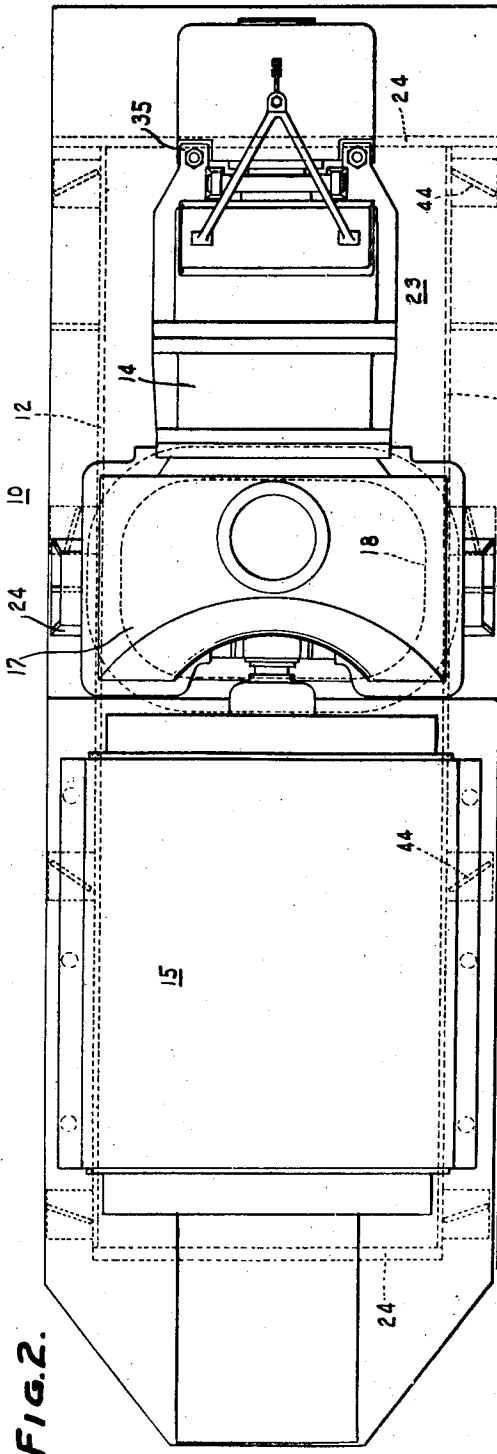
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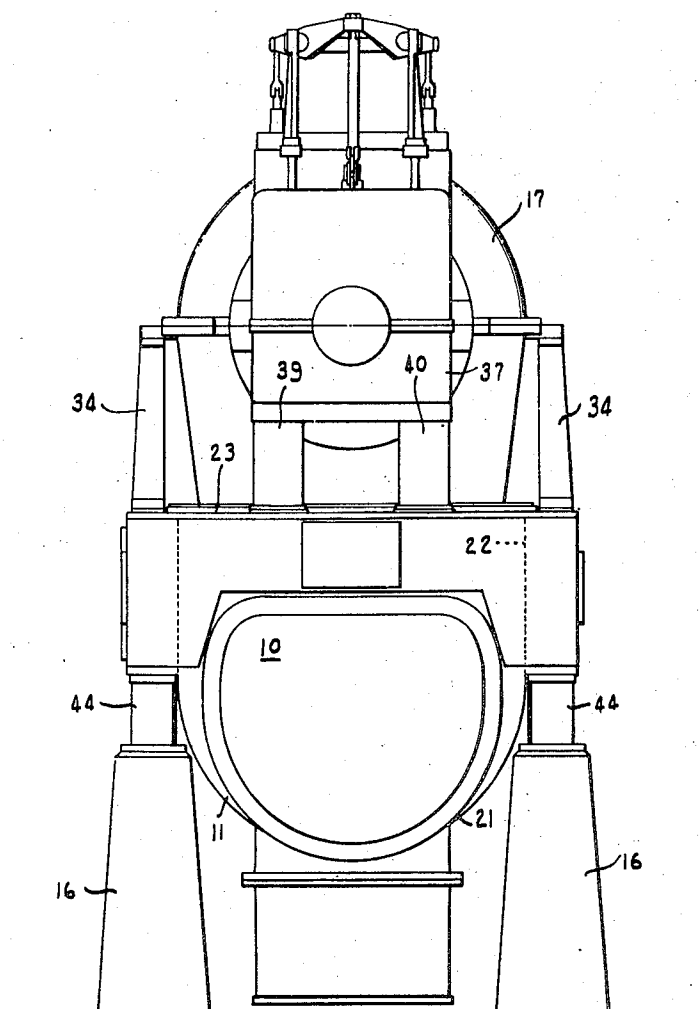


FIG. 4.

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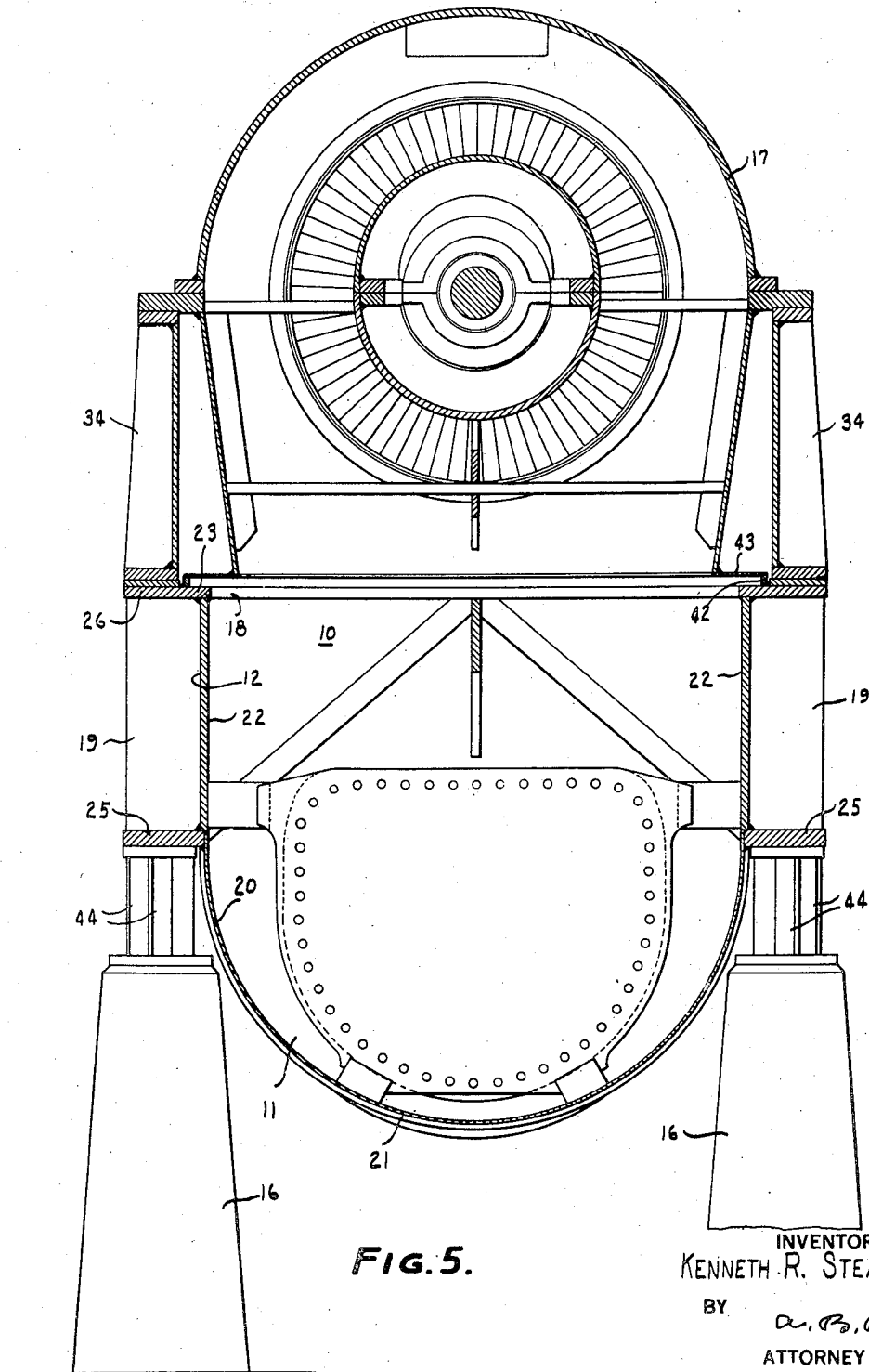
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HEAT EXCHANGER OR CONDENSER SUPPORT

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UNITED STATES PATENT OFFICE

2,464,356

HEAT EXCHANGER OR CONDENSER
SUPPORTKenneth R. Stearns, Springfield, Pa., assignor to
Westinghouse Electric Corporation, East Pitts-
burgh, Pa., a corporation of PennsylvaniaOriginal application November 9, 1946, Serial No.
708,880. Divided and this application January
9, 1948, Serial No. 1,410

5 Claims. (Cl. 257—43)

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The present application is a division of my co-
pending application, Serial No. 708,880, filed No-
vember 9, 1946.

The invention relates to condenser or heat ex-
change apparatus and it has for its object to pro-
vide the shell of such apparatus supported from
the foundation by web plates arranged to flex to
accommodate for expansion and contraction of
the shell to avoid any substantial loading of the
foundation on account thereof.

The foregoing and other objects are effected by
the invention as will be apparent from the follow-
ing description and claims taken in connection
with the accompanying drawings, forming a part
of this application, in which:

Fig. 1 is a side elevation of the unitary power
plant;

Fig. 2 is a top plan view of the apparatus shown
in Fig. 1;

Fig. 3 is a section along the line III—III of
Fig. 1;

Fig. 4 is an end elevation of the plant as viewed
from the turbine end; and

Fig. 5 is a section taken on the line V—V of
Fig. 1.

In the drawing, there is shown a unitary power
plant comprising a horizontal condenser aggre-
gate, at 10, including a condenser 11 and flange
girder structures 12 unitary with the latter at the
sides thereof. The aggregate carries the axially-
aligned turbine 14 and generator 15 thereabove
and its side girder structures are supported by
foundation piers 16. The turbine has an exhaust
nozzle 17 from which exhaust steam flows through
the inlet opening 18 into the condenser.

The condenser shell 20 includes a concave bot-
tom wall 21, vertical side walls 22, a horizontal
top wall 23, and end walls 24. The top wall 23
is provided with said inlet opening 18.

The flange or girder structures 12 include lower
flanges 25 and web portions, comprised by the
adjacent side walls 22. For the length of the
turbine, the girder structures are of braced chan-
nel form, the top plate overhanging and being
joined to the side wall webs 19 to provide upper
flanges 26; and, for the length of the generator,
the girder structures are of angle form, defined by
the webs 22 and the lower flanges 25 and are re-
inforced by structures forming the generator air
cooling passages, such structures comprising
lower, upper, and end plates 28, 29 and 30, respec-
tively, strut plates 31 supporting the lower plates
28 on the lower flanges 25, the duct-dividing
plates 32 stiffening the lower plates 28 to function
as stiffened elements of the side condenser gird-

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ers, and the end plates joining the upper and
lower plates.

The generator is supported above the condenser
on the top plates 29 and the load of the latter
is transmitted through columns 33 whose upper
ends are connected to the upper plates and whose
lower ends are connected to the stiffened lower
plates forming components of the condenser in-
tegral side girders. As the columns are free to
flex laterally and as the rectangular structures
formed by the plates 28, 29 and 30 are not stiff-
ened diagonally, such structures are capable of
deformation to the extent required to accommo-
date for relative expansion and contraction of the
generator, turbine and condenser, the upper
plates 29 remaining fixed relative to the gener-
ator and moving relative to the lower plates 28 to
the extent required for such accommodation and
the columns 33 carrying the weight of the genera-
tor directly on the condenser side girder plates
28.

The exhaust end of the turbine casing is carried
by columns 34 whose lower ends bear on and are
connected to the girder structures and whose up-
per ends carry and are connected to the turbine
casing. The inlet end of the turbine casing has
feet 35 which bear on abutments 36 carried by
the bearing pedestal 37. The turbine casing is
connected to the bearing pedestal by the verti-
cally flexible tie plate 38 and the pedestal is sup-
ported from the condenser by plates 39 and 40
extending in planes normal to the turbine axis
and are therefore arranged to provide axial flexi-
bility.

The exhaust end of the turbine is held by the
columns 34 and by the expansion joint, at 42, con-
necting the turbine exhaust nozzle 17 to the con-
denser, the expansion joint including a diaphragm
43 extending in a horizontal plane parallel to the
turbine axis, the diaphragm providing flexibility
in the direction of length of the nozzle and stiff-
ness against lateral movement of the latter.
While the columns carry the weight of the tur-
bine, flex to accommodate radial expansion, and
take the turbine reaction torque, the horizontal
stiffness of the diaphragm opposes axial and lat-
eral movements of the exhaust end of the turbine.
At the inlet end, the plates 39 and 40 confine the
turbine axis against transverse movement so that
it is held vertically and horizontally while flexi-
bility thereof provides for expansion and contrac-
tion axially.

In service, the condenser may be subject to
unusual temperature conditions, as would be the
case when starting before the vacuum is built up

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or when running noncondensing in the event of loss of vacuum. Under these unusual conditions, the condenser temperature may be of the order of 212° F. or more and the increase from normal temperature would cause the condenser and girder structures to expand. Therefore, the girder structures are supported by means accommodating for expansion while avoiding transverse and lengthwise displacements of the structure as well as loading of the foundation on account thereof to any substantial extent. This result is secured, for example, by plates 44 connected at their upper ends to the girder structures 12, at their lower ends to the foundation piers 16, and having their webs arranged normal to radii from a suitable vertical axis of the condenser and girder structure and which are, therefore, flexible in the direction of such radii. While the vertical axis may be at any suitable place within the projection of the condenser bounded by the supporting plates, it is shown in the vertical plane of the condenser center line and of the turbine axis and, more particularly, at the center of the exhaust inlet.

From the foregoing, it will be apparent that I have devised a unitary power plant comprising a condenser aggregate carrying a turbine and an aligned generator driven thereby and comprising a condenser and unitary side girders and wherein the latter are supported from the foundation in such manner and the turbine and generator are carried by the condenser aggregate so that expansion and contraction of the aggregate may take place without any effort being exerted on either the turbine or the generator, with the result that expansion, incident to going from condensing to noncondensing operation or when starting up, and contraction, incident to going from non-condensing to condensing operation, may take place without disturbing either the turbine or the generator. As the vertical plates supporting the side girders from the foundation are arranged normally with respect to radii from a common center, such plates restrict movement of the condenser aggregate to directions which are radial to the common center, in consequence of which the aggregate may expand and contract longitudinally and transversely without movement thereof bodily, whereby, with the vertical columns carrying the generator and the turbine capable of lateral flexibility and the plates 39 and 40 capable of axial flexibility, transverse and longitudinal expansion and contraction of the aggregate may take place without disturbing either the turbine or the generator. The elastic plates 44 protect both the condenser and the foundation from the very large horizontal loads radial to the center of support which would result from an attempt to oppose the thermal expansion of the condenser by rigid supports. Therefore, these plates operate to avoid the manufacturing cost, operating uncertainty and maintenance, of lubricated slides, which would otherwise have to be used.

While I have shown the invention in but one

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form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What is claimed is:

1. Heat exchange apparatus comprising a horizontal shell subject to wide temperature changes producing expansion and contraction thereof; said shell including flange constructions at opposite sides thereof; and vertical plates having their upper ends supporting the flange constructions and connected to the latter, their lower ends arranged for attachment to the foundation and their webs arranged normally with respect to radii to a common vertical axis falling within the vertical projection of the shell between the flange constructions.

2. A horizontal surface condenser comprising a shell provided with supporting flange constructions at opposite sides thereof; and vertical web plates having their upper ends supporting the flange constructions and connected to the latter, their lower ends arranged for attachment to the foundation and their webs normal to radii to a vertical axis in the vertical plane of the centerline of the condenser.

3. A horizontal surface condenser comprising a shell provided with flange constructions at opposite sides thereof; said shell having an exhaust inlet opening at its top; and vertical plates having their upper ends supporting the flange constructions and arranged for attachment to the latter, their lower ends connected to the foundation and their webs normal to radii to the vertical axis of the center of said inlet opening.

4. A horizontal surface condenser including a shell provided with girder structures unitary therewith at opposite sides thereof; said shell including a curved bottom wall, vertical side walls, and a horizontal top wall; said girder structures each including upper and lower flanges joined by a side wall with the lower flange joined to the adjacent edges of the bottom and side walls and the upper flange being formed by an overhanging portion of the top wall; and vertical plates having their upper ends supporting the girder structures and connected to the latter, their lower ends arranged for attachment to the foundation and having their webs extending in planes normal to radii from a vertical axis in the vertical plane of the centerline of the condenser.

5. Apparatus as claimed in claim 4 wherein the top wall has an exhaust inlet opening whose vertical axis is in the vertical plane of the centerline of the condenser and is the axis of radii normal to the plate webs.

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REFERENCES CITED

The following references are of record in the file of this patent:

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