

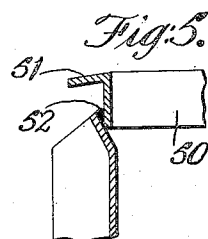
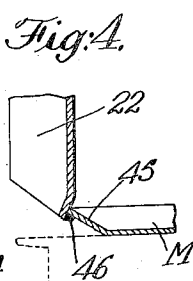
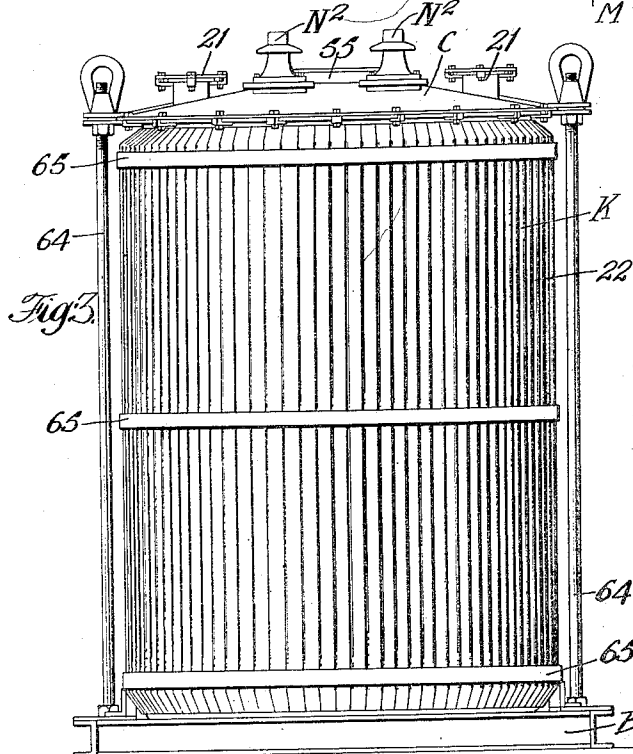
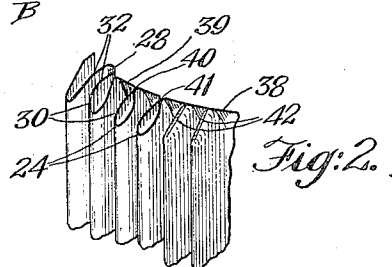
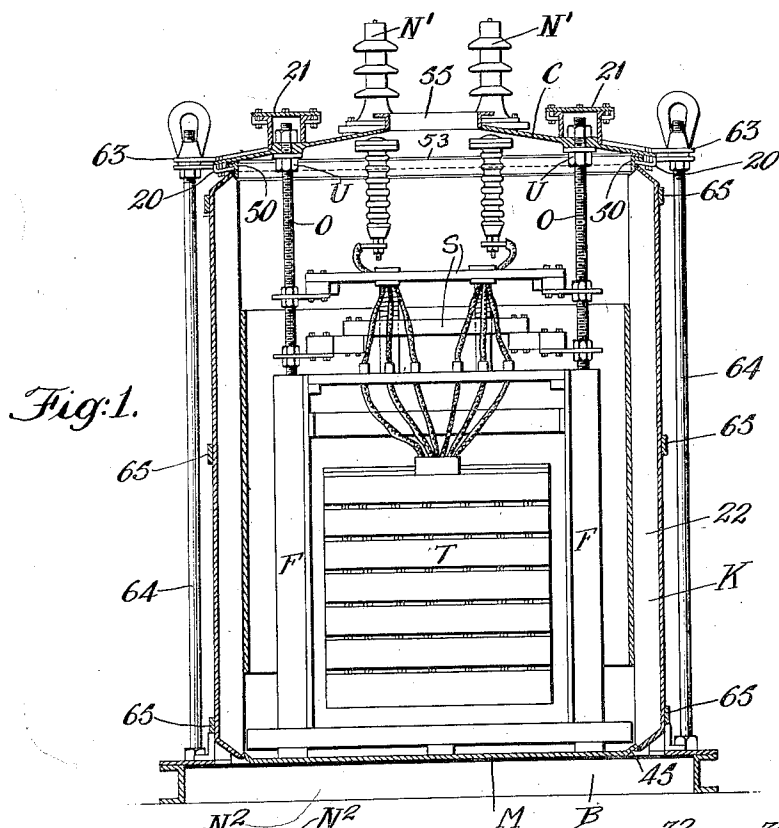
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R. V. BINGAY

OIL COOLED TRANSFORMER

Original Filed June 2, 1920



INVENTOR

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BY

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UNITED STATES PATENT OFFICE.

ROBERT V. BINGAY, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO PITTSBURGH TRANSFORMER COMPANY, A CORPORATION OF PENNSYLVANIA.

OIL-COOLED TRANSFORMER.

Original application filed June 2, 1920, Serial No. 386,115. Divided and this application filed October 11, 1921. Serial No. 507,121.

To all whom it may concern:

Be it known that I, ROBERT V. BINGAY, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Oil-Cooled Transformers, of which the following is a specification.

This invention relates to electrical transformers and particularly to transformers cooled by the circulation of oil in a tank, and this application is a division of prior application, Serial No. 386,115, filed June 2, 1920.

The chief object of the invention is to provide a transformer and tank construction that is inexpensive and strong and adapted to provide for the efficient circulation of the cooling oil.

The transformer tank is preferably formed of sheet steel and further objects of the invention particularly in the method of relatively supporting the transformer and tank will appear from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a vertical sectional elevation of a transformer illustrating a specific embodiment of the invention,

Fig. 2 is a perspective view of a portion of the tank body illustrating its formation,

Fig. 3 is a vertical elevation of the tank in place on its base, and

Figs. 4 and 5 are detail sectional views on enlarged scale.

In the specific embodiment of the invention shown in Fig. 1 a transformer T, for instance of the double magnetic circuit type, is supported in frame work F resting on the bottom M of tank K. The tank K stands on the base B and has a cover C fastened to its top by clamps 20. Bolts O extending upward from the frame F pass through the cover C and have their ends enclosed by air tight caps 21. The cover C also carries the primary and secondary terminal insulators N' and N² and the frame F carries a super structure S for supporting the leads L to the transformer coils and the terminals.

The tank K is preferably of sheet metal and preferably circular, oval or rounded in section and the sides 22 are corrugated to a depth dependent upon the size of the tank and the relative cooling surface required. Hitherto the depth of these side corruga-

tions has been limited by considerations of strength and the difficulty and expense of producing deep corrugations. The shallower corrugations give a correspondingly restricted cooling surface and often it has been necessary to resort to extra cooling pipes or circulating means where the available air cooling of the tank itself will be sufficient if properly provided for. In the tank of this invention corrugations of the tank body may be of any desired depth and strength required by practice and at the same time these corrugations are formed from sheet metal plates in a simple and inexpensive manner and the resultant structure is strong and self-sustaining and when assembled with the top and bottom portions provides a rigid, durable container.

In building up the tank sides or body rectangular sheets of desired length are notched at the ends and corrugated and assembled and welded in cylindrical or other desired form giving a corrugated body as shown in the drawings. The closing of the ends of the corrugations is illustrated in Fig. 2 and comprises a flattening or turning over of the ends of the inner corrugations 28 as indicated at 39. The end edges of these corrugations are thus flattened out into substantially straight lines as indicated at 38 and the ends of the corrugations are spread so as to be brought toward and finally into contact with each other as indicated at 40 and 41. The edges of the intermediate portion 30 and the outer bends 29 are also hammered over and brought into contact along line 42 and welded securely together along this line. The hammering outward of the ends of the corrugations 28 forms the inclined flattened surfaces 39 and brings the extreme ends of these surfaces substantially into the line of the corners 32 of the notches 24, forming a continuous annular ridge around the end of the tank from which the corrugations incline in opposite directions.

This gives a strong arched construction terminating in a solid continuous apex or peak; the end of each corrugation is arched with a central heavily welded seam, and all these arches of the corrugations converge to the top ring so that these corrugations are not only strong in themselves but reinforce and mutually sustain each other through their common connection. All vertical sec-

tions through this structure show a characteristic arched form and all horizontal sections also show continuous corrugations with arched connecting bends, and with a tank
5 constructed according to the method of this invention it is possible to use a very light gage of sheet steel.

The two ends of the tank body are substantially identical and comprise a corrugated cylinder with the corrugations inclined and arched at each end and rigidly
10 welded to a continuous annular end portion at each end. This tank body is very strong, irrespective of its connection with the bottom and cover pieces. At each end it provides an annular beveled surface formed by the ring of inclined flattened surfaces 39 and this beveled surface serves for the attachment of the bottom and top pieces in a simple and very rigid manner. When the bottom and top pieces are in place, as hereinafter described, this strong tubular portion reinforces the end portions in such manner that each part is trussed against the other
15 to receive the strains put upon the tank.

The bottom M of the tank is formed by a circular plate, preferably of rolled steel, with its edge flanged upwardly at an angle (Figs. 1 and 4) and this edge flange 45 of the bottom M is nearly at right angles to the beveled surfaces 39 and is just fitted to an intermediate portion of these surfaces. With the bottom piece M assembled and clamped in place a heavy weld 46 is made in the corner between the surfaces 39 and the flange 45 so that the bottom surface of the tank is below the surface of this weld which will therefore be held spaced from the base B of the transformer in finally assembled
20 position. This flanging of the bottom plate M gives this plate an arched construction and protects it against warping due to the heat of the welding operation and due to any strains on it in service, and this arching at the bottom also holds the welded seam away from contact with the base or other surfaces so that this seam does not collect moisture and become rusty or weaken or wear in use. This construction permits the bottom plate and the top ring, or either, to be made either thicker or thinner than the metal in the tank body, or of the same thickness as may be most advantageous.

The top of the tank body has welded to it the steel or iron angle ring 50, formed by rolling an angle into circular form with its flange 51 inclined at substantially the angle of the tank cover C and the ends of the circle welded together. This ring 50 is sized
25 to fit into the top of the tank and engage an intermediate portion of the beveled surfaces 39 at the top and is fastened in place by heavy welding 52 all around in the annular corner between the surfaces 39 and ring 50. This ring forms additional rein-

forcement of the tank body and provides a strong and simple connection for the tank cover C.

The cover C which may be of about the same thickness of sheet steel as the bottom M is crowned as shown and fastened to the ring 50 by clamps 20 with gasket 53 between the cover and the ring. This cover is provided with the central flanged opening 55 and with terminal insulators N' and N² for the leads. The bolts O of the frame F pass through this cover and are adapted to have eyes screwed on their upper ends for lifting the frame F and transformer T out of the tank the cover being lifted with the transformer and the clamps 20 having been released. Underneath the cover C the bolts O carry nuts U bearing against the under surface of the cover and adjusted on the bolts to press upward on the cover and causing screw rods O to thrust downward on the frame F standing on the bottom M of the tank when the clamps 20 are fastened in place. The weight of the transformer parts therefore is not carried by the tank sides but is transmitted directly to the bottom M resting on base B. Projections 63 are welded to the edges of the tank cover and through these holding bolts 64 pass to the base B. For further strengthening, if desired, especially in the case of large tanks one or more reinforcing bands 65 may surround the tank and be welded to the outside bends of the corrugations. In this combination the tank sides or body 22 instead of being under compressive stresses, except by the side bolts 64 at the edges of the cover, has an upward pull transmitted to its upper end by cover C, clamps 20 and angle ring 50. The tank body is merely a light housing supported on the transformer and serves therefore simply as a casing for containing and cooling the oil with which it is filled.

In accordance with this invention I provide guide vanes for separating the rising and descending currents of oil comprising guiding surfaces adjacent the inner bending of the corrugations, and for this purpose I have shown an inner baffle cylinder 60 just within the bends 29. The columns of cooled oil in the corrugations are relatively heavy and pass down rapidly through the corrugations, drawing in at the top the heated currents of oil rising through the transformer coils and discharging the cooled oil at the bottom.

By the method of this invention the relative area of the outer cooling flutes and the inner passages through and around the coils and core may be made in most effective proportion and this circulatory system provides definite areas of heating and cooling, avoids interference between the rising and descending currents, and in effect gives a forced circulation which by the outer rapid passing

of the oil down through the corrugations distributes the heated oil over a larger area of the transformer sides instead of accumulating as heretofore within a relatively small area at the top with slow and sluggish progress down the sides is rapidly circulated downward through the pipes formed by the corrugations. The temperature gradient at the sides therefore is much less abrupt and the cooling taking place over a much larger area is much more efficient.

I claim:—

1. In a transformer construction, the combination with a tank having a sheet metal body from the bottom to the top of the tank, of a transformer having its frame supported on the sheet metal bottom of said tank, a sheet metal cover for said tank, adjustable holding means between said cover and said frame, and means to clamp said cover upon said tank with said holding means pressing upward on said cover and downward on said frame to hold said frame against the bottom of said tank and to assist in supporting the body of the tank.

2. In a transformer construction, the combination with a transformer, of a base, a housing surrounding said transformer and comprising a bottom member, sides and a removable cover, all formed of sheet metal, means to support said housing in assembled relation upon said transformer, said means comprising a frame for said transformer, and adjustable bolts between said frame and cover affording support to said cover independently of said housing sides, and means comprising exterior tie rods to secure said cover removably to said base.

3. The combination with a tank formed at its upper edge with a cover seat, a transformer in said tank, a yielding arched sheet metal cover on said tank having its outer edge extending beyond said seat, means between said transformer and cover adapted to press upwardly on said cover at points inwardly spaced from said seat and clamping means engaging said cover and causing the said cover to conform to said seat to form a tight joint therewith.

4. In a transformer structure the combination with a transformer tank having a sheet metal body, an angle bar bent to ring form and fastened to the upper end of said body and providing an outwardly extending flange, a gasket on said ring, and a cover clamped at its outer edge on said gasket and formed of sheet metal in arched shape toward the center so as to yield to the clamping pressure at the edges to resiliently accommodate itself to the ring and gasket and form therewith a tight seal under the clamping pressure between the cover and ring while transmitting a downward pressure from said ring to a structure within the tank.

5. In a transformer construction the com-

bination with a transformer tank having a sheet metal body formed with longitudinal corrugations with arched ends meeting in a ridge around the end of the body, an angle bar bent to ring form and fastened to the upper end of said body and providing an outwardly extending flange, a gasket on said ring, and a cover clamped at its outer edge on said gasket and formed of sheet metal in arched shape so as to yield to the clamping pressure to resiliently accommodate itself to the ring and gasket and form therewith a tight seal under the clamping pressure between the cover and ring while transmitting a downward pressure from said ring to a structure within the tank.

6. A transformer tank comprising a body portion of corrugated sheet metal with the upper ends of the inner corrugations flattened to form an inclined surface, and a top ring formed by an angle rolled into circular form and welded at its meeting ends, the vertical side of the angle being welded to the inclined surface of the body portion and the horizontal side of the angle forming a cover supporting flange, a transformer core on the base plate, a sheet metal cover resting on said cover supporting flanges, means for clamping the cover to the flange, and supporting bolts extending from the transformer core to exert upward pressure on the under side of the cover.

7. A transformer tank comprising a body portion of corrugated sheet metal with the upper ends of the inner corrugations flattened to form an inclined surface, and a top ring formed by an angle rolled into circular form and welded at its meeting ends, the vertical side of the angle being welded to the inclined surface of the body portion and the horizontal side of the angle forming a cover supporting flange, a transformer core on the base plate, a sheet metal cover resting on said cover supporting flanges, means for clamping the cover to the flange, supporting bolts extending from the transformer core to exert upward pressure on the under side of the cover, a base on which the tank rests, and clamping rods outside the cover exerting pressure from the upper outer circumference of the cover to the base outside the tank.

8. A tank having a side wall and a bottom of sheet metal, a cover adapted to be secured to the tank, a transformer on said bottom, a base and means to clamp said bottom between the base and the transformer, said means comprising an adjustable member extending between said transformer and cover and an adjustable member extending between said cover and base.

9. A tank comprising a bottom and wall both of sheet metal, a base, a cover for said tank secured to said base, a transformer in said tank spaced from said wall and ad-

justable holding means pressing upward on said cover and downward on said transformer.

10. The combination with a sheet metal tank and a transformer therein, means for clamping said transformer in position in said tank comprising means pressing downwardly on said transformer and adjustable means external to said tank, said adjustable means operating independently of the sides of said tank to press upwardly on said transformer.

11. An electrical apparatus consisting of a transformer and tank therefor having bottom and sides of sheet metal and a holding and supporting structure adapted to absorb strains incident to movement or use of said apparatus, said structure comprising a base, a cover for said tank, and connecting means between said base and cover and between said transformer and cover supporting the sides of said tank from said transformer and holding said transformer downward towards said base.

12. An electrical apparatus consisting of a transformer and tank therefor having bottom and side walls of sheet metal and a hold-

ing and supporting structure adapted to absorb the strains incident to movement or use of said apparatus, said structure comprising a base, members extending from said base above said tank, and connecting means between said members and said tank and said transformer adapted to exert a downward pressure on said transformer and an upward pull on the side walls of said tank.

13. An electrical apparatus consisting of a tank therefor having bottom and sides of sheet metal, a transformer on said bottom positioned substantially centrally thereof, and a holding and supporting structure adapted to absorb strains incident to movement or use of said apparatus, said structure comprising a base, a cover for the tank, adjustable means connecting said base and cover adapted to press downwardly on said cover and adjustable means adapted to press upwardly on said cover and downwardly on said transformer whereby the bottom of the tank is clamped, at its central portion only, between said transformer and base.

ROBERT V. BINGAY.