March 29, 1966 L. R. BRONLUND 3,242,879

RAILROAD TRANSPORTATION OF LARGE TRANSFORMERS

Filed Nov. 7, 1963 3 Sheets-Sheet 1

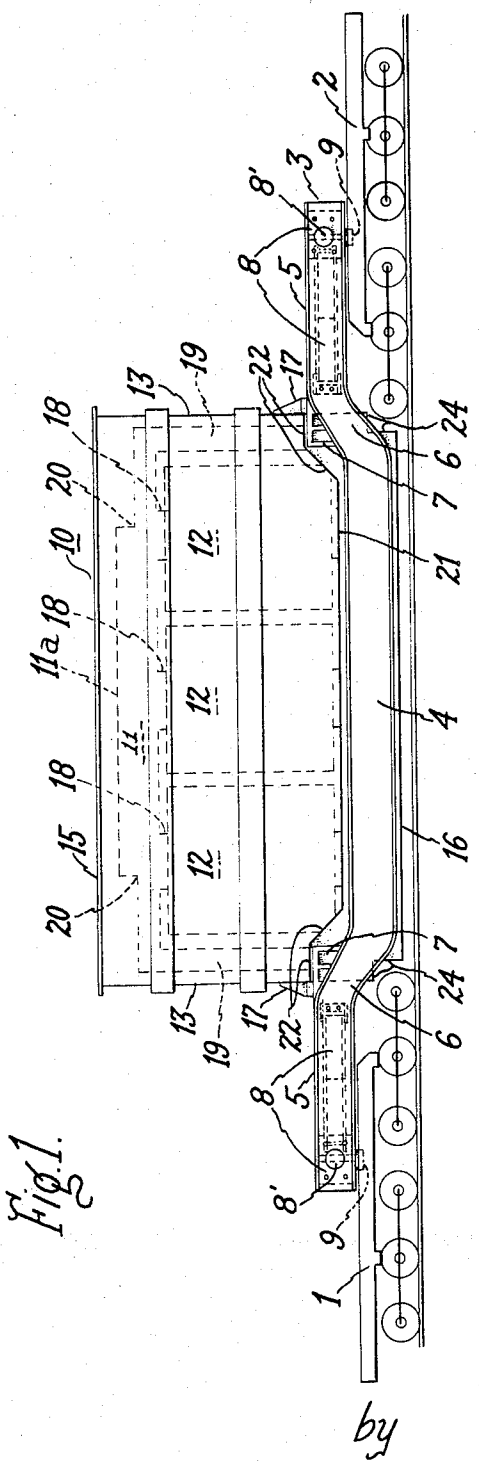


Fig. 1.

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Fig. 2.

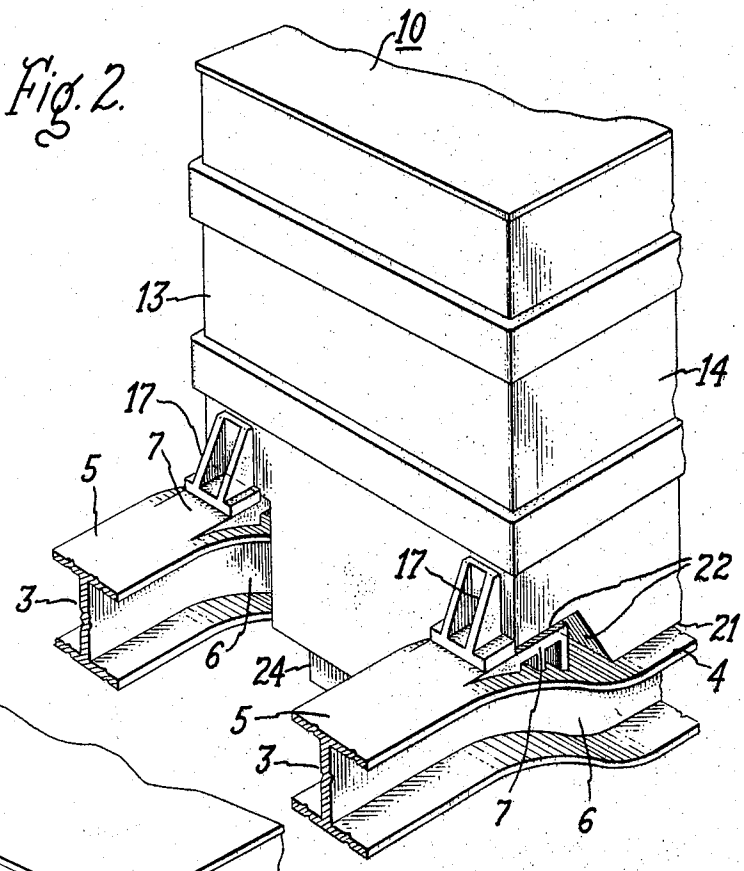
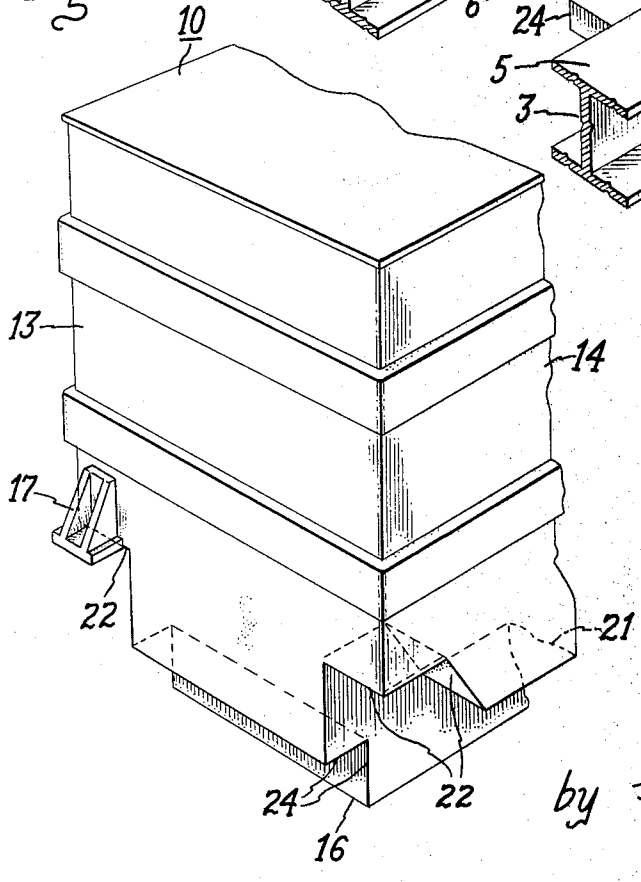


Fig. 3.



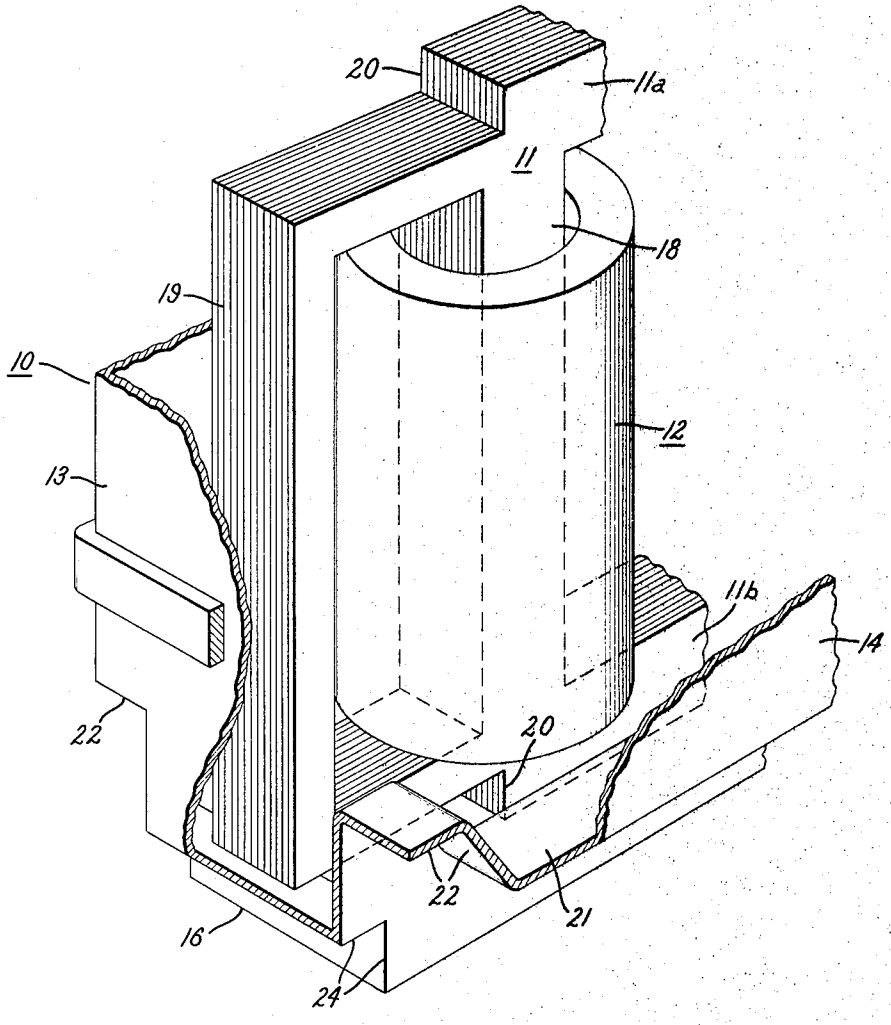
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RAILROAD TRANSPORTATION OF LARGE TRANSFORMERS

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Fig. 4.



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RAILROAD TRANSPORTATION OF LARGE TRANSFORMERS

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3 Claims. (Cl. 105—367)

This invention relates to railroad transportation of large transformers and more particularly to cooperative improvements in cars and transformers for decreasing the ratio of car length to transformer size.

Generally speaking, the larger the kva. rating or electrical size of a transformer, the greater are its three physical dimensions of height, width and length as well as its weight. All three dimensions of the largest present day transformers are near the limit which can be shipped by rail, but the trend to larger sizes shows no sign of abating.

This invention is concerned primarily with the length dimension problem and it provides a reduction in the ratio of car length to transformer length without increasing the height. This means that a longer transformer can be shipped on a car of given length, or a shorter car can be used to ship a transformer of given length. This is important because the maximum permissable length of a car is determined by the radius of curvature of the track which is already fixed. In other words, the length problem is created by curves in the track where the center of the car swings inward in proportion to the length of the car so that the width limitation is encountered.

Heretofore, because of the height problem, the largest transformers have been shipped on depressed center side girder flat cars. An example of this is shown in expired United States Patent 2,341,903. A feature of that patent was to obtain a further reduction in height by constructing the transformer so that at the bottom it extended downwardly between the depressed center portion of the side girders of the car.

A well-known way of reducing the height of a transformer for a given size or rating is to provide the core with end legs, beyond the main winding legs, which carry some of the winding leg flux and thus permit reducing the height of the core yoke and hence the height of the transformer. However, the presence of end legs increases the length of the transformer.

In accordance with this invention, there is provided a novel construction whereby the transformer is supported at its ends above and beyond the depressed flat center portion of the side girders of the car without increasing the height. This not only decreases the ratio of the length of the car to the length of the transformer, but it also reduces the length of the bending moment arm on the side girders because it brings their loading points closer to their ends. Thus, heavier transformers can be supported by girders of the same cross section.

Although in no sense limited thereto, the invention is particularly suitable for power transformers having a core in accordance with United States Patent 2,779,926 in the name of Wallace M. Johnson et al. and assigned to the same assignee.

An object of the invention is to provide a new and improved construction for railroad shipment of large transformers.

Another object of the invention is to provide a new and improved structural combination of railroad car and transformer.

A further object of the invention is to provide a new and improved transformer adapted for shipment on a new and improved railroad car.

An additional object is to provide a new and improved railroad car adapted to transport a new and improved transformer construction.

The invention will be better understood from the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

In the drawings,

FIG. 1 is a side elevation view partly in phantom of a preferred embodiment of the invention,

FIG. 2 is a partly sectionalized perspective view showing the relation between one end of the transformer and the side girders of the car,

FIG. 3 is a view similar to FIG. 2 of the transformer alone, and

FIG. 4 is a fragmentary prospective view of one end of the transformer with the enclosing tank broken away to show the internal core and coil structure and its positional relation with respect to a bottom corner of the tank.

Referring now to the drawings and more particularly to FIG. 1, there is shown therein a railroad car consisting essentially of multi-axle end trucks **1** and **2** joined by a pair of parallel girders **3** shown in cross section in FIG. 2. These girders have a depressed flat center portion **4** and flat raised end portions **5** joined by intermediate curved portions **6**. Attached to the girders **3** beyond the center portion **4**, such as over the curved portions **6** near their upper ends, are flat mounting pads or load bearing brackets **7**. The girders **3** are attached to rigid end frames **8** by bolts to give transverse rigidity to the car and by horizontal load bearing pins **8'** for transferring the load from the girders to the end frames. The end frames **8** are attached to the trucks **2** by vertical pins **9**, or the like, which permit a limited amount of pivotal movement in all directions to accommodate curves, grades and other irregularities in the track.

Mounted on the car between the girders **3** and resting on the mounting brackets **7** is a large transformer **10** comprising essentially a multi-legged magnetic core **11** having a plurality of electrical coils **12** enclosed in a tank comprising end walls **13**, side walls **14**, a top **15**, and a bottom portion **16**. The end walls **13** of the tank are provided with supporting brackets **17** whose lower surfaces rest on the mounting pads or brackets **7** on the car.

For reduced yoke height, the core **11** is shown as of the five-legged construction having three inner winding legs **18** respectively carrying the three coil units **12** and having end legs **19**. In a three-phase transformer, the end legs will carry about one-third the winding leg flux so that they have about one-third the cross sectional dimension of the winding legs. The upper yoke portion **11***a* of the core which joins the legs is shown notched at **20** over the two outer winding legs in order to save magnetic material. The lower yoke **11***b*, omitted at FIG. 1 to avoid complication of the drawing, is shown in the fragmentary prospective view of FIG. 4 to be of substantially the same configuration as the upper yoke.

As shown most clearly in FIGS. 2 and 3 and 4, the sides **14** of the tank are stepped inwardly near the bottom at **21** along their center portion which is coextensive with the depressed flat center portion **4** of the side girders. This, of course, is made possible because the core and its usual clamps (not shown) are not as thick as the diameter of coils **12** so that the lower part of the tank can be narrowed to conform generally to the width of the lower core yoke and clamps below the coils **12** (FIG. 4), and in this manner the lower part of the tank containing the lower yoke is between the side girders **3**. At the ends of the inwardly stepped portions **21** of the midportion of the tank sides near their bottom, the step is raised as shown most clearly FIGS. 3 and 4 at **22** so as to overlie the intermediate curved portions **6** and the pads **7** of the side girders **3**. However, as shown in FIGS. 1 and 2 there is a slight vertical clearance between the central recessed por-

tions 21 and the center portions 4 of the side girders and also between the raised recessed portions 22 and the curved portions 6 and pads 7 of the girders. The flat bottom surface of the brackets 17 extend below the flat bottom portions of the ends of the raised steps 22 so that the entire weight of the transformer is transmitted by the brackets 17 to the pads 7 on the girders 3. In FIG. 3 one of the brackets 17 has not been shown so as not to obscure the showing of the recess 22.

As clearly shown at FIG. 4 the above described construction is made possible by the use of a core having end legs which do not carry windings. If the core were a three legged three phase core or a two legged single phase core, the coils on the legs would be so near the ends of the tank that it would not be possible to have the raised recessed portions 22 in the tank. The present construction has at least two distinct advantages. In the first place, it reduces the ratio of the car length to the transformer length, thus making it possible either to transport a longer transformer on a car of given length or a transformer of given length on a car of shorter length. In the second place, it moves the loading points on the car closer to the ends of the girders 3 thus shortening the bending moment arm of the load. For example, if the entire length of the transformer was within the length of the central depressed flat portions 4 of the girders as in previous practice, then the effective load bearing points on the girders would be within the extent of this depressed center portion instead of being substantially at the ends of the raised flat upper portions as in the present invention.

The weight of the transformer which is mostly in its core and coil assembly is transmitted to the brackets 17 through the lower portions of the flat vertical end walls 13 of the tank and the recessed flat vertical side walls 14 of the tank below the portions 21 and 22 thereof. As these flat vertical members are made of steel plate, they are very strong and can easily transmit this heavy weight when applied parallel to their planes as in the present construction.

By reason of the particular core construction employed, including the bottom yoke notches 20, it is possible to notch the lower ends of the transformer tank at 24 (FIGS. 1 and 4) so as to provide ample clearance for the inner wheels of the trucks. This, of course, contributes to overall object of reducing the ratio of car length to transformer length.

The girders 3 are removably attached to the end frames 8 so that if a consignee of the transformer does not have a crane strong enough to lift the transformer out of the car, the transformer can be jacked up a short distance, one of the girders 3 removed, and the transformer moved out sidewise from the car on rollers or skids.

While there have been shown and described particular embodiments of the invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention, and therefore it is intended by the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A large electric power transformer adapted to be transported upon an open-center railroad car of the parallel side-girder depressed-center type having stepped-up girder end portions comprising, a rectangular core including a horizontal bottom yoke and at least three vertical legs and having a width less than the lateral spacing between said side-girders, said legs including a pair of end legs at the extremities of said yoke and at least one intermediate leg, a current-carrying coil positioned upon said intermediate vertical leg and having an outer diameter greater than said lateral spacing, and an enclosing casing for said transformer having inwardly stepped lower side portions inset immediately below said coil, said bottom yoke being substantially wholly positioned between said inwardly stepped side portions thereby to permit positioning of said transformer upon said car with said bottom yoke substantially wholly between said side-girders, said casing being additionally inwardly stepped at its corners above the level of said inwardly stepped side portions thereby to form raised corner steps adapted to overhang said stepped-up girder end portions, said corner steps being laterally adjacent said core end legs and longitudinally adjacent said coil.

2. A power transformer as in claim 1, in which said core has corner notches where the end legs join the bottom yoke and said casing is correspondingly notched transversely at its opposite lower ends to provide clearance for the inner wheels of said car.

3. In combination, an open center railroad car of the parallel side-girder depressed-center type, said side-girders having curved step portions over the inner wheels of said car integrally joined by depressed flat center portions and being laterally spaced apart, load-bearing pads mounted upon said girders at the top of said curved step portions, a large electric power transformer positioned between said side-girders and mounted upon said bearing pads, said transformer comprising a rectangular core of a width less than the lateral spacing between said side-girders and including a horizontal bottom yoke and at least three vertical legs, said legs comprising a pair of end legs at the extremities of said yoke and at least one intermediate leg, a current-carrying coil positioned upon said intermediate vertical leg and having an outer diameter greater than said lateral spacing, and an enclosing casing for said transformer having inwardly stepped lower side portions immediately below said coil and positioned substantially wholly between the depressed center portions of said girders, said casing being additionally inwardly stepped at its corners above the level of said inwardly stepped portions thereby to form raised corner steps extending over said curved step portions of said girders and seated upon said bearing pads, said corner steps being laterally adjacent said core end legs and longitudinally adjacent said coil.

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