July 14, 1931. J. JONAS 1,814,557

ELECTRIC TRANSFORMER

Filed Feb. 2, 1929

Fig. 1

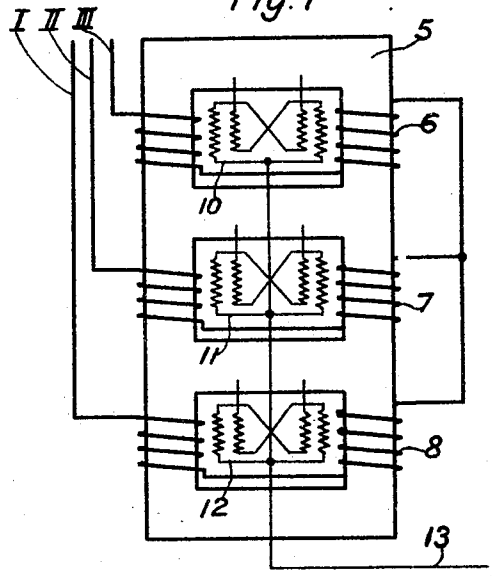
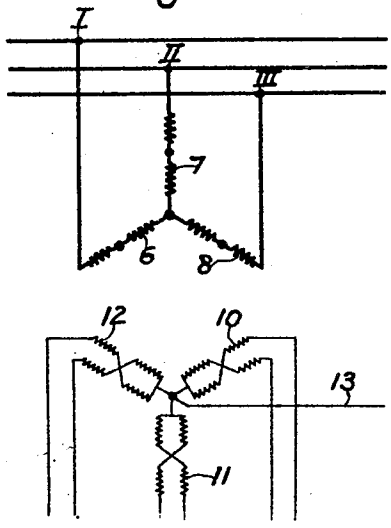


Fig. 2.



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Patented July 14, 1931 1,814,557

UNITED STATES PATENT OFFICE

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ELECTRIC TRANSFORMER

Application filed February 2, 1929, Serial No. 337,068, and in Germany February 13, 1928.

This invention relates to improvements in electric transformers, and more particularly, to such transformers for supplying a 3 N phase metallic vapor electric current rectifier of any well known type.

It will be understood that, although the present invention is of particular value for use with rectifiers as above mentioned, the invention is not limited thereto but is valuable for other purposes as will be readily apparent.

Rectifiers of electric current usually comprise a structure including a plurality of anodes and a cathode of some relatively easily vaporized metal such as mercury. In such rectifiers, each anode carries current for a period of $\frac{1}{3}N$ of the total current period so that each anode carries the full current load for only a short time. Among the disadvantages resulting from this arrangement are the increased danger of reverse currents or so-called "back-firing" due to the high anode current density and the increased voltage drop of the arc within the rectifier.

Various means have been proposed to avoid these disadvantages by giving the current per anode an approximately sinusoidal form. Such current form would provide an increase in the flow of current per period and a reduction in the maximum current strength per anode. The direct current from the anodes, which are simultaneously supplied with current, combines to produce an overlapping of the current of the several anodes. Such overlapping of the current was, heretofore, produced by use of a coil connected between two similarly formed portions of the supplying transformer secondary winding. Such structure created a third harmonic of the voltage which added to the transformer secondary voltage produced an opposite third harmonic to that of the anodes thereby produced a pure sinusoidal current.

But the above described structure is not advantageous for the reason that a three phase transformer usually has only three legs in which the ampere turns create a third harmonic direct field, closed over the air gap, thereby requiring a special coil to produce the third harmonic overfield.

The present invention avoids the above disadvantage by using three single phase transformers to produce the third harmonic of the anode current thereby permitting the formation of a field within each of the primary phases. This third harmonic opposes the third harmonic of the anode current so that the desired pure sinusoidal form is obtained without the use of auxiliary means.

The three single phase transformers may be so mechanically combined that the cores form a single magnetic circuit.

It is, therefore, among the objects of the present invention to provide a transformer structure, particularly for electric current rectifiers of the metallic vapor type, which will produce a current approximating a sinusoidal form.

Another object of the invention is to provide a transformer structure having a plurality of single phase transformers on a single magnetic core.

A further object of the invention is to provide a transformer including three single phase transformers which will produce a current of the third harmonic.

Objects and advantages, other than those above set forth, will be apparent from the following description taken in connection with the drawings in which;

Figure 1 is a schematic view of one embodiment of the present invention showing the mechanical arrangement thereof, and

Figure 2 is an entirely diagrammatic view of the connections of the embodiment of the invention.

Referring more particularly to the drawings by characters of reference, the reference numeral 5 indicates a single magnetic circuit formed by the combined or connected cores of the several portions.

A plurality of windings 6, 7 and 8, forming the primary windings of three single phase transformers, are arranged on the core 5 and are connected in the well known star connection, as may readily be seen in Fig. 2. The several primary windings are

arranged to be connected to the phases I, II and III of a three phase supply system, not shown. Each of the primary windings is composed of two portions connected in series and wound on opposite sides of the core 5.

A plurality of windings 10, 11, and 12, each comprising two pairs of series connected coils arranged in parallel, form the secondary windings for the accompanying primary windings 6, 7 and 8, respectively, of the several single phase transformers. The secondary windings are star connected with the usual conductor 13 leading therefrom to form a portion of the direct current circuit. The ends of the several secondary windings are arranged to be connected with the anodes of a rectifier (not shown), in the usual manner.

It will be seen that the central portion of the magnetic circuit forms a cross-path for the adjacently disposed single phase transformers. The central portion need therefore have only

$$\sqrt{3}$$

the strength of the outer portions so that the weight of the entire structure is materially reduced. It will be apparent that three single phase bushing type transformers may also be used if the cores thereof form a single magnetic circuit.

Although but one embodiment of this invention has been illustrated and described, it will be understood that various other embodiments are possible, and that various changes may be made without departing from the spirit of the invention or the scope of the claims.

The invention claimed is:

1. In an electric transformer supplying a voltage on which is impressed a harmonic component, a plurality of windings, each constituting the primary of a single phase transformer, said single phase transformers having their cores juxtaposed to form a single core element, and a plurality of secondaries for said transformers in operative relation respectively with said primaries, said secondaries comprising windings inducing a harmonic voltage opposing said harmonic component.

2. In an electric transformer supplied from a 3-phase network and supplying $3n$ phase voltage, n being an integer >1, said voltage having a harmonic component impressed thereon, three windings, each constituting the primary of a single phase transformer, said transformers having their cores juxtaposed to form a single core element, and $3n$ secondaries in operative relation respectively with said primaries, said secondaries each comprising a winding inducing a harmonic voltage opposing said harmonic component.

In testimony whereof I have hereunto subscribed my name this 22nd day of January A. D. 1929.

JULIUS JONAS.