(No Model.) 2 Sheets—Sheet 1.

C. KURDA.

POLYPHASE CURRENT TRANSFORMER.

No. 600,228. Patented Mar. 8, 1898.

Fig. 1.

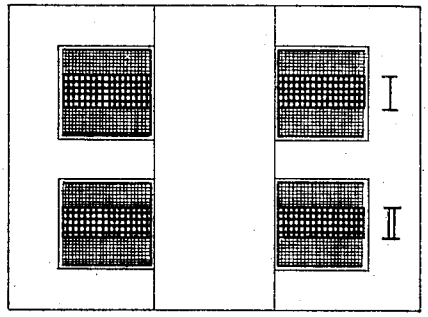


Fig. 2.

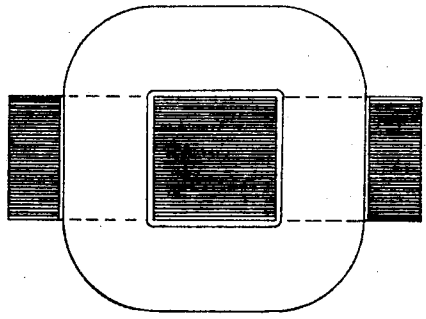


Fig. 3.

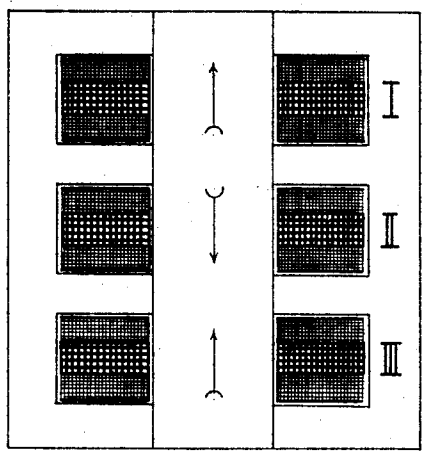


Fig. 4.

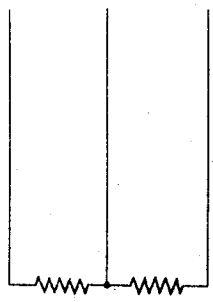
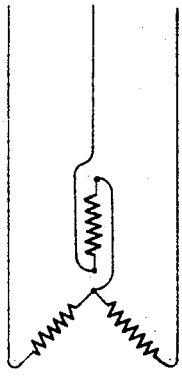


Fig. 5.



Witnesses:-
Edward L. Rowland.
M. M. Robinson.

Inventor:
Carl Kurda
By Charles J. Kintner
attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

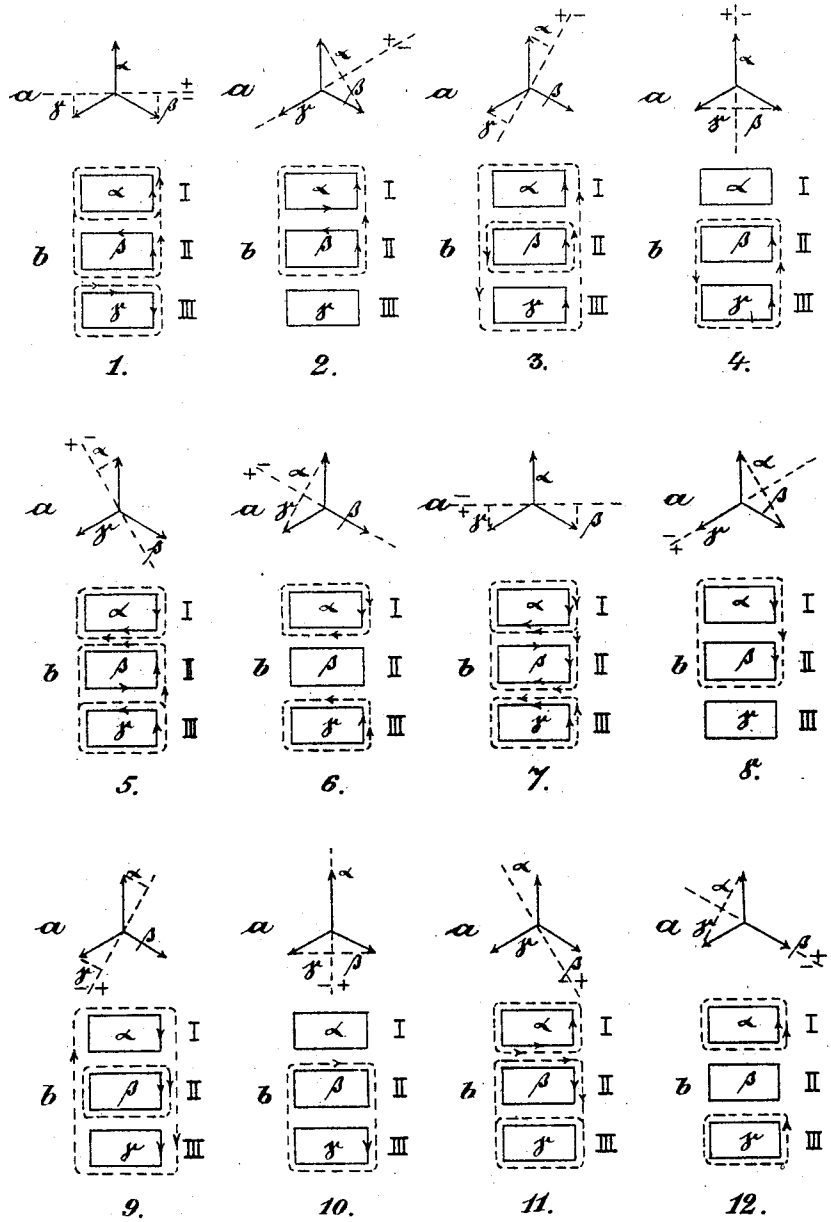
(No Model.) 2 Sheets—Sheet 2.

C. KURDA.

POLYPHASE CURRENT TRANSFORMER.

No. 600,228. Patented Mar. 8, 1898.

Fig. 6.



Witnesses:
Edward C. Rowland.
M. M. Robinson.

Inventor:
Carl Kurda
By Charles J. Kintner
attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CARL KURDA, OF NUREMBERG, GERMANY, ASSIGNOR TO THE ELEKTRIZITATS AKTIENGESELLSCHAFT, VORMALS SCHUCKERT & CO., OF SAME PLACE.

POLYPHASE-CURRENT TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 600,228, dated March 8, 1898.

Application filed November 5, 1896. Serial No. 611,177. (No model.)

To all whom it may concern:

Be it known that I, CARL KURDA, electrician, a subject of the German Emperor, residing at Seuffertstrasse 23, Nuremberg, in the Kingdom of Bavaria, German Empire, have invented a new and useful Polyphase-Current Transformer, of which the following is a specification.

Up to the present transformers for polyphase currents with common magnetic circuits have been built in which several electromagnets are arranged side by side between the base-plate and an iron cover. It is obvious that this arrangement can only be used with transformers of the core type. It is, however, well known that up to a certain size for single-phase currents transformers of the ironclad type are to be preferred. For polyphase currents the latter type has not yet been used.

The object of the present invention is to produce ironclad transformers for polyphase systems.

In the accompanying drawings, Figure 1 is a plan of a transformer of the new type destined for two-phase currents. Fig. 2 is an elevation of the same. Fig. 3 shows a similar apparatus for three phases. Figs. 4 and 5 illustrate the connections, and Fig. 6 illustrates the magnetic conditions of the different circuits for a special case.

The invention consists in arranging the electromagnets one above the other instead of placing them side by side, as heretofore, thus giving the electromagnets a common vertical axis. The iron is laminated, as usual. The single sheets may consist of two E-shaped flat iron pieces and a third piece interposed which by preference is of rectangular form, as shown in Fig. 1. The arrangement of the iron pieces and of the windings will easily be understood from the figures.

The connections for a three-phase system may be according to the well-known Δ or γ principle, as required by the special conditions of the case. Any other connection, however, may be used instead—as, for instance, the Steinmetz connection, (shown in Fig. 4,) which requires only two bobbins for three currents of different phase.

A special advantage is obtained with the three-phase system of the Δ or γ principle by joining the second bobbins in the opposite sense. (See Fig. 5.) The magnetic conditions for this special arrangement are shown in Fig. 6. The direction of the windings is opposite in the second one, as above mentioned—that is to say, the effect will be the same as if the three bobbins were connected in the same manner and traversed by alternating currents differing in phase by sixty degrees. This will be easily understood from well-known theories.

Referring to the diagram Fig. 6, it will be noted that their upper part is only the representation of a three-phase sinus system—viz., the lines denoted by $x\ y\ z$ correspond to three sinus differing in phase by one hundred and twenty degrees. Each clock diagram shows the condition of the sinus system at a time which differs from that of the system illustrated by the preceding or subsequent diagram by one-twelfth of a complete revolution or period. In the parts marked b the rectangles $\alpha\ \beta\ \gamma$ represent the bobbins. The arrows marked on the rectangles show the direction of the lines of force for each bobbin, and the arrows in the dotted circuits indicate the direction of flow of the resultant fluxes. In Fig. 6, for instance, the direction of current would correspond to the upper part a. Hence α is positive and β and γ negative, but as β corresponds to a coil joined in the opposite direction, as explained above in the part b, β acts in the opposite direction—viz., the currents α and β run in the same direction—*i. e.*, in a direction opposite to that of the hands of a clock. With regard to generally-known theories it is not necessary to explain the phases 1 to 12 in detail. If the two fluxes are equal and opposite, of course the resultant is zero. Now if the winding of the middle bobbin were not joined in the opposite sense there would be a different effect. Assuming the maximum flow in a bobbin as unity, the magnetic flow in 1 would be 1.5 and in 2—viz., a twelfth of a period later—1. sin. 60.2= 1.73, the latter expression being the maximum resultant flow. In the condition, however, which the new arrangement embodies the maximum will be less. It will be observed from the diagrams—for instance, at 1—that

the maximum is obtained when two components, as β and γ, are equal and act in the same sense—that is, 2 sin. 30=1. In other words, whereas the maximum of the resultant in the first case has been 1.73, in the present case the maximum will never exceed 1. From this fact results a saving in the section of the iron. Consequently the transformers can be built smaller in size and less in weight for the same capacity of induction. Besides this the losses in the iron are proportionately reduced.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. A transformer for polyphase alternating currents consisting of two or more sets of inducing-coils of different phase placed one upon another, in combination with laminated sheet-inductive material surrounding said sets of inducing-coils and separating them from each other, substantially as described.

2. A transformer for three-phase alternating currents consisting of three sets of inducing-coils of different phase placed one upon another, in combination with laminated sheet-iron surrounding said inducing-coils and separating them the one from the other, the electrical connection for the inner set being made in an opposite sense to that of the outer sets, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CARL KURDA.

Witnesses:
JACOB BIERLEIN,
FRANZ ZINKING.