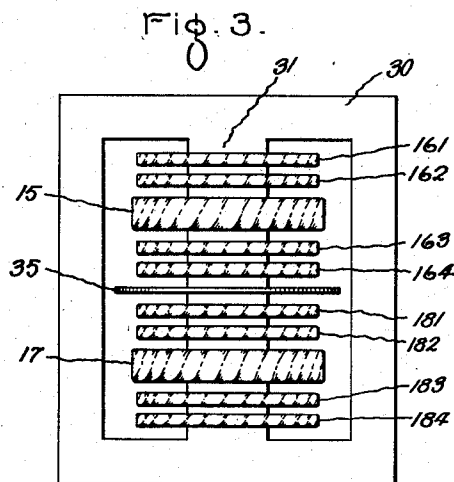
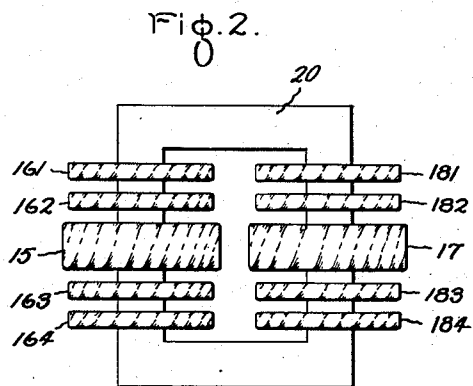
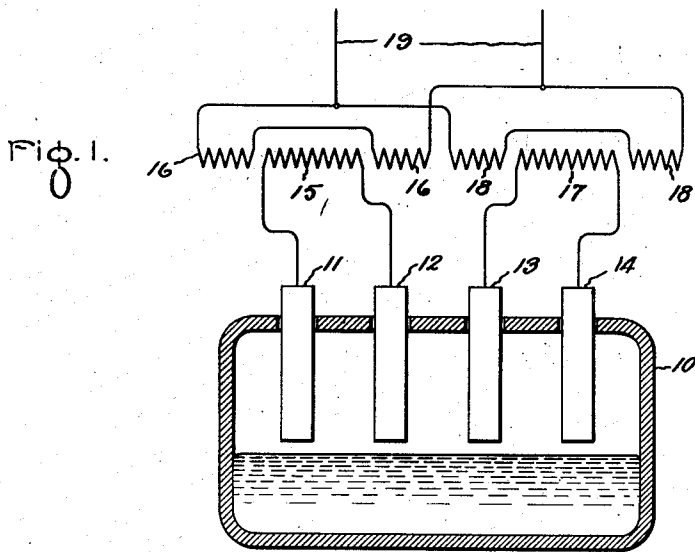


Feb. 20, 1923.

1,445,978.

H. O. STEPHENS.
STATIONARY INDUCTION APPARATUS.
FILED APR. 30, 1921.



Inventor:
Howard O. Stephens,
by *Albert G. Davis*
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UNITED STATES PATENT OFFICE.

HOWARD O. STEPHENS, OF PITTSFIELD, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

STATIONARY INDUCTION APPARATUS.

Application filed April 30, 1921. Serial No. 465,896.

To all whom it may concern:

Be it known that I, HOWARD O. STEPHENS, a citizen of the United States, residing at Pittsfield, in the county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Stationary Induction Apparatus, of which the following is a specification.

My invention relates to stationary induction apparatus and has for its object an improved, economical, and readily manufactured arrangement of parts.

More particularly my invention relates to transformers adapted for supplying large currents through circuits connected in multiple. Such connections are frequently required in the industrial consumption of power; as for instance, in the multiple electrode type of electric furnaces.

In multiple connected transformers, a short circuit on one secondary circuit generally has undesirable reactions (through line regulation) on the current flowing in the secondary circuit in parallel with it; in furnace work for instance, a short circuit across two electrodes at different potential would reduce the voltage across a pair in parallel with it to a point where the arc may go out or else cause their electrode adjusting mechanism to operate in a manner which would result in such electrodes taking an undue portion of the load.

If the secondary circuits in multiple are on the same magnetic core; the undesirable reactions become more exaggerated than when supplied from separate transformers, as the large leaking flux produced by the short circuit current tends to buck out the inducting or magnetizing flux from the other circuit.

By my invention, however, a construction is employed whereby the multiple circuits are supplied substantially without undesirable mutual reactions. In my arrangement all the windings belonging to the two circuits are mounted on the same magnetic core thereby obtaining all the economies incident to the construction of a single electrical machine. My arrangement involves the separate excitation of each multiple secondary circuit, and the loose coupling of the same with their respective primaries. This may be accomplished by placing each secondary and its associated primary on a separate leg, or each on a separate portion of the same leg.

For a more complete understanding of the nature and object of my invention reference should be had to the following detailed description taken in connection with the accompanying drawing in which:

Fig. 1 is a diagrammatic view of my invention adapted for supplying current through two circuits in multiple to a multiple electrode electric furnace taken as showing a typical load to which my invention is applicable. Fig. 2 shows one arrangement of windings on a magnetic core in accordance with my invention; while Fig. 3 shows a modification.

Referring now to the drawing, 10 denotes an electric furnace of the arc type having four electrodes 11 12, 13 and 14, which is a typical translating device requiring current to be fed thereto in parallel circuits. In this furnace the electrodes 11 and 12 are supplied with current from the winding 15 which is a secondary of a transformer excited from the primary 16. Similarly, the electrodes 13 and 14 are supplied with current from the secondary winding 17 which is excited by the primary 18. The primaries 16 and 18 are connected in multiple, as shown, to the feeding conductors 19.

In accordance with my invention these windings are mounted on a single magnetic core and are arranged so that undesirable mutual reactions are avoided. One such arrangement is shown in Fig. 2 where 20 denotes a core assembled preferably from laminated magnetic material. The secondary windings 15 and 17 are shown as mounted each on a separate leg of the core, the primary winding associated with secondary 15 being composed of sections 161, 162, 163 and 164 disposed in spaced relation to each other and to the secondary, the spacing preferably being for relatively great distances apart so as to secure a comparatively loose magnetic coupling effect.

The same arrangement obtains with respect to the secondary 17, which is shown as far removed from secondary 15 on the magnetic circuit as possible. Here the primary sections 181, 182, 183, and 184 are arranged to achieve a similar loose magnetic coupling effect. Consequently the reactance between secondaries 15 and 17 and their primaries 16 and 18 is relatively high.

In Fig. 3 another arrangement of windings in accordance with my invention is il-

illustrated, whereby the windings are all disposed on a single core leg. The core 30 is of the shell type having a single winding leg 31 on which the secondaries 15 and 17 are mounted at points widely separated. The primary coils 161, 162, 163 and 164 are associated with the secondary 15 on the upper half of the leg 31 while primary coils 181, 182, 183 and 184 are arranged on the lower half and associated with secondary 17. A loose coupling magnetically between the secondaries and their associated primaries is arranged for here again, as it is essential that the relative reactance between secondaries and primaries be relatively high. An insulating barrier 35 is also indicated as separating the upper group of primary and secondary windings from the lower group. In operation, it is seen that should a short circuit occur across the electrodes 11 and 12 the consequent rush of current is checked by the self-limiting effect of the high inductance of winding 15 obtaining by reason of the loose coupling magnetically of winding 15 with its primary 16. The current flowing in the primary 16, as a result is not greatly increased by the short circuit, thereby avoiding any material impedance drop in the voltage across the conductors 19 with a consequent drop in voltage across the electrodes 13 and 14. All tendency for the electrode adjusting mechanism to impose automatically an undue portion of the load on electrodes 13 and 14, or for the arc thereacross to go out is accordingly effectually removed. Having now described embodiments of my invention which are at present the best means known to me for carrying the same into effect, I would have it understood that they are merely illustrative, and that I do

not mean to be limited thereby to the precise details shown nor restricted in the choice of recognized equivalents except as defined in my claims hereunto annexed.

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

1. In stationary induction apparatus, the combination with a magnetic core, of a plurality of secondaries mounted thereon and adapted to supply current in parallel circuits to a common translating device, and primaries separately associated with each secondary, loosely coupled magnetically with each other and with their respective secondaries, the separate primaries being connected together in multiple.

2. In stationary induction apparatus, the combination with a magnetic core, of a plurality of secondaries mounted on separate parts of said core and adapted to supply current in parallel circuits to a common translating device, and primaries on each of the separate parts associated with the secondaries thereon and loosely coupled magnetically with said secondaries, said primaries being connected together in multiple.

3. In stationary induction apparatus, the combination with a magnetic core, of a plurality of secondaries mounted on separate parts of said core and adapted to supply current in parallel circuits to a common translating device, and primary coils associated and grouped with each separate secondary and spaced relatively great distances apart from each other and from said secondaries, the groups of primary coils being connected in multiple.

In witness whereof, I have hereunto set my hand this 25th day of April, 1921.

HOWARD O. STEPHENS.