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ELECTRIC RECTIFYING SYSTEM

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Fig. 1

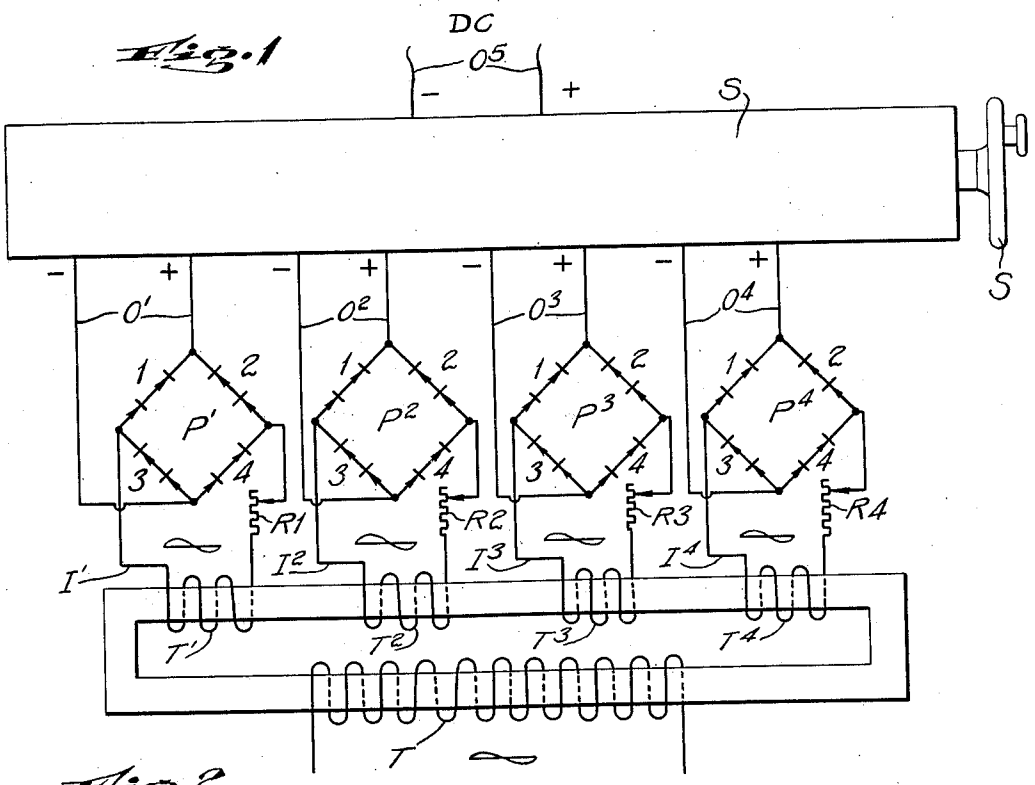
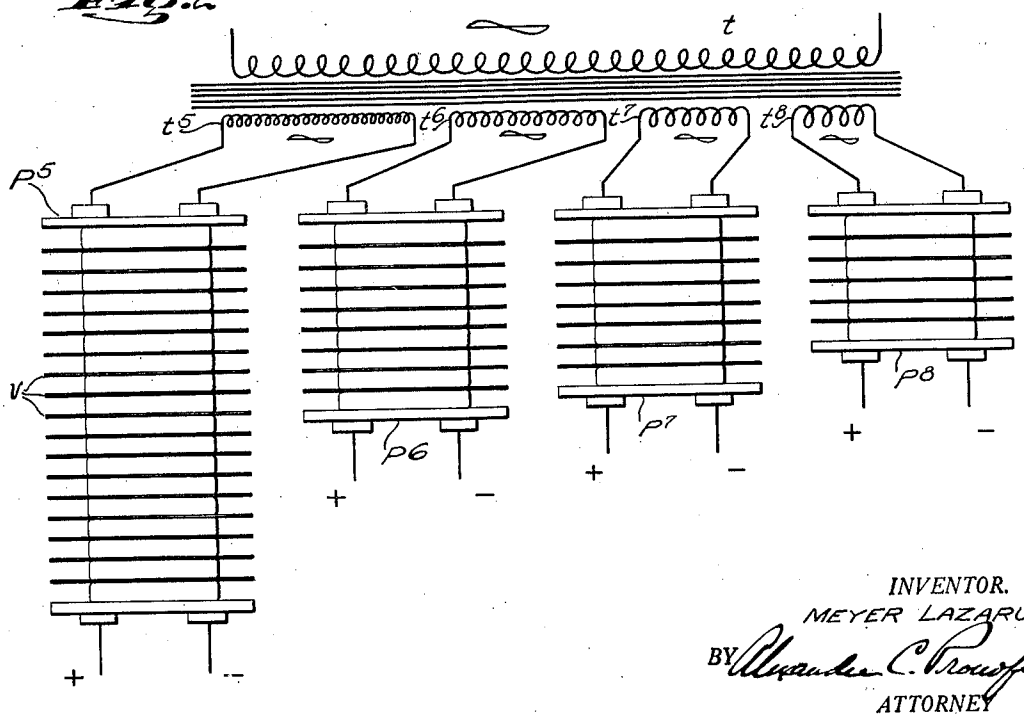


Fig. 2



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ELECTRIC RECTIFYING SYSTEM

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2 Claims. (Cl. 175—363)

This invention relates to electric rectifying systems of the dry oxide type for rectifying alternating current into unidirectional current, and relates more particularly to such systems comprising a large number of asymmetric electric valves or one-way discharge devices each of which is adapted to permit flow of current in one direction, but to obstruct flow of current in the opposite direction, and my present application is in part a continuation of my application, Ser. No. 303,583, filed September 1, 1928.

An important object of the present invention is to provide such a rectifier system with a plurality of units each embodying a number of one-way electric discharge devices of the dry oxide type, and of much greater capacity than existing systems so constituted which are characterized by the connection of all the component units to a single secondary coil of a transformer which serves as the source of the alternating current.

Existing rectifier systems of the dry oxide type are necessarily limited in capacity for effective output by several characteristics, first of which is the fact that the size of each of the individual valve devices is practically limited to an area of about eight square inches, of a copper disk or plate, for example, which has been oxidized on its outer surface. Any increase in the total area above eight square inches is accompanied by some decrease of resistance in the useful direction, but not at all proportionate to the increase in size, while the leakage in the reverse direction is increased somewhat out of proportion to the increase in area, so that the rectifying ratio clearly diminishes rapidly upon increasing the area.

A concrete example is to take a plate with an area of eight square inches which will be found to have a resistance of two ohms in the useful or low resistance direction, and a resistance of five hundred ohms in the reverse or obstructive direction, yielding a rectifying ratio of 250 to 1; whereas, upon increasing the size of such a plate to a total area of sixteen square inches, I have found that the resistance in the useful direction is 1.3 ohms, with a resistance of 220 ohms in the reverse direction, so that the rectifying ratio was reduced very undesirably, not remaining constant with the increase in area.

Starting then with this inherent limitation in the area of the individual valves, the capacity of a unit embodying a plurality of such valves is further limited when seriesing the valves to a large extent. The resistance increases in direct proportion to each valve added and therefore a large voltage drop will be encountered, which will require a voltage high enough to be applied to render ineffective the high resistance factor of the valves, in the useful direction, and this results in working the unit at a low efficiency and in time destroying the rectifying properties of the individual valves by overheating.

Accordingly, the size of the units thus containing valves in series is practically limited to very few valves for each unit, so that the capacity of each unit is small.

When a considerable number of such small units of the dry oxide type are connected in parallel to a single alternating current source, for the purpose of increasing the current output, objectionable over-heating effects are still encountered, when an attempt is made to work the system to full capacity, for the reason that there is a lack of balance between the units, due to a difference in the internal resistance of the respective units.

Some of the units become overheated to a destructive degree, probably due to circulating currents between units of which the input circuits are connected to a single alternating current source, and the output terminals of which are connected together; and probably due also to some units having plates with a higher resistance in the direction in which the useful current has to pass.

This is especially true of dry oxide type valves of the kind in which the outer surface of the oxide layer has been partly reduced to metal, a step which is difficult to accomplish uniformly, and which for that reason creates the above mentioned lack of balance.

It has therefore not been found practicable to connect in series the output terminals of such an assembly of units when the inputs are connected in parallel to a single current source.

The above limitation of output is obviated by the novel provision, briefly disclosed, and generically claimed, in my co-pending application, Serial No. 303,583, by which a plurality of transformer coils, each coil being connected to one of the rectifying units and each rectifying unit consisting of one or more valves. The number of valves in each unit may be as large as is consistent with the desirable limitation of ohmic resistance in the useful direction to avoid the need for impressing a voltage which would impair the efficiency and cause destructive heating.

As each unit has its own transformer coil, and operates independently of the others, there

is no unbalanced effect as between the units, and as none of the units is over-taxed, the tendency to operate at a low efficiency and to become overheated is obviated.

Furthermore, the output terminals from the units can be connected in series or in parallel, or in any other arrangement known in the art, and so any desired voltage or potential, or volume of current can be secured in the direct current output, so that the latter will be of maximum efficiency for any given voltage which it is desirable to impress upon the load carrying circuit or circuits.

In practice, I have found that a rectifier thus constituted will outlive several rectifiers of the earlier type above described, and in fact shows no signs of deterioration after periods of use greatly prolonged beyond that of several such conventional rectifiers, which have successively succumbed to the conditions of constant use demanded by particular installations.

Rectifier systems of greatly increased capacity can be readily provided, in accordance with the invention, by simply providing the requisite number of units with a corresponding equipment of transformer secondary coils, one for each unit.

If desired for special purposes requiring very precise work, the valves embodied in any given unit may be tested and matched or selected to insure the presence of valves of approximately the same resistance characteristics in that unit, but that is not an essential prerequisite to the successful operation of the invention. It is also possible to provide each unit with additional resistance external to the units, if for any reason it is wished to equalize, balance or modify the resistances of the various branches of the system, or to provide a safety factor in the event of an overload upon the whole or any part of the system, but this again is optional.

It is also possible, if desired, to provide a transformer with a suitable amount of leakage reactance, whereby an automatic regulation and stabilizing effect will occur throughout the rectifying units and current will be fed to each rectifying unit in proportion to its internal resistance.

Such provision will also serve as a safety factor, in case of an overload or short circuit on the rectifying system, in which event the voltage will be retarded and any overheating or destructive effect will be prevented.

The above and other features of the invention are illustrated and described in the accompanying drawing and specification and are pointed out in the claims.

The accompanying drawing illustrates, in somewhat diagrammatic form, a now-prefererd embodiment of the invention.

Fig. 1 is a diagrammatic view of a rectifying system; and

Fig. 2 is a diagrammatic view of a modified form of system.

In the embodiment of the invention selected for illustration and description, the parts designated by the reference characters P^1, P^2, P^3, P^4, are rectifier units adapted for rectifying an alternating current into unidirectional current, each of the units comprising a plurality of one-way electric discharge valves or devices of the dry-oxide type, such, for example, as the valves illustrated in United States Letters Patent No. 1,741,319, altho any suitable valves or one-way discharge devices of the dry-oxide type may be utilized.

In each of the branches 1, 2, 3, 4, each unit is connected up in the typical Wheatstone bridge circuit commonly used for rectifying full-wave alternating currents, so that detailed description of the circuit connections is not necessary, the indications in the drawing being ample to permit understanding thereof by those skilled in the art. However, other types of rectifying circuits may be used.

So also, it is not essential to derive the operating current from a single phase alternating current source, as a polyphase source of alternating current can be used to advantage.

In pursuance of the invention, each unit has its input terminals I^1, I^2, I^3, I^4, respectively, connected with an individual secondary coil or winding T^1, T^2, T^3, T^4 of an alternating current transformer, which may be of any usual or suitable type, the primary coil of the transformer being designated by the reference character T.

The positive and negative output terminals from each unit, designated by the reference characters O^1, O^2, O^3, O^4, respectively, may be connected up in series, or in parallel, or in any other way known to the art, and to facilitate the making of the various changes connecting these leads, for the purpose of delivering a direct current output of desired voltage or current to the load-carrying circuit, designated by the reference character O^5, the output terminals from the respective units may be led to a suitable switching device S, provided with a control or operating handle *s*.

Such switching devices are in common use, and it is therefore not necessary to illustrate the interior structure of the device indicated, which may be considered to be of the character of any well-known form of so-called drum-type controller.

While four units are shown in the rectifier system selected for illustration by way of example, it is to be understood that a system of any desired capacity may be provided with the individual transformer windings for each unit, and thus power circuits may be supplied with a rectified current of any desired current, volume or potential, which cannot be efficiently secured with any existing dry plate rectifiers.

If desired, the individual valves may be tested before assembly, to insure the presence in each unit of valves having approximately the same resistance, but it is not essential to do so, and in any event, there may be considerable difference between the resistances of the different units.

So, also, it is optional to provide external resistances R^1, R^2, R^3, R^4, to balance or equalize the resistance characteristics of the component units of a rectifying system embodying the invention, and, in general, many modifications may be made in the arrangement of valves in units, and of units in a system, such as may occur to those skilled in the art, when making particular applications of the invention.

In Fig. 2 of the drawing is illustrated a rectifier system embodying the invention, in which each of the units P^5, P^6, P^7, P^8 receives a supply of alternating current from individual secondary coils t^5, t^6, t^7, t^8 of a transformer, and as the said units comprise different numbers of component valves *v*, they are respectively adapted to deliver, independently of each other, unidirectional current of different predetermined voltages.

The system of the present invention has the advantage over existing conversion apparatus, such as motor-generator sets and rotary con-

verters, in being free from rotating parts, which are noisy, bulky and expensive to install and to maintain, on account of the attention required for operation and the costly replacements. It also has the advantage over bulb-type rectifiers of being less fragile and less subject to deterioration, so that fewer replacements, if any, are necessary; and it is more reliable in operation and requires less care than electrolytic cell rectifiers. It is silent, clean, compact and efficient.

These advantages are characteristic to a certain extent of the dry type of rectifier to which the disclosed invention relates, but heretofore it has not been possible to make rectifiers of the dry type of sufficient capacity to serve the larger installations in which the other above mentioned types of conversion apparatus are usually employed, for the reasons already explained.

For example, currents of different polarity are required to operate a plurality of relays in telegraphy and in signal systems, etc., and in charging batteries in large numbers a different voltage is often required for charging separate batteries having a different number of cells; while in various other applications a different voltage is required, as in hotels, where one voltage is used for operating the call bells and annunciator service, and another for the telephone system, etc.

So, also, in radio installations, to operate devices for sound reproduction in connection with moving picture apparatus, the filament voltage required in the amplifying tubes is relatively low, and the plate voltage is very high.

For all the above-mentioned classes of service, it is desirable to employ a single, compact rectifying apparatus from which separate circuits of different voltages lead to the various branches of the service, as, for example, to the filaments of the amplifying tubes above referred to, and to the plates of the said tubes, in connection with suitable filter devices.

The electric rectifier system herein disclosed is capable of serving the requirements of each of the above mentioned applications, and in general can be used for any such applications as may require individual circuits carrying direct currents of different voltages; and also those which must be operated independently and without interference with each other, some to actuate devices requiring changes of polarity and some to actuate other devices where changes of polarity do not occur.

I claim:

1. A rectifier system comprising a plurality of rectifier units and current transforming means adapted to receive alternating current from a suitable source, said current transforming means having a plurality of secondary wire coil windings each adapted to deliver alternating current of desired voltage to a selected rectifier unit of said system, said component rectifier units embodying collectively a multiplicity of rectifying elements of the dry type having individual resistance characteristics differing among the several elements, the elements composing any given unit having approximately the same resistance characteristics and individual secondary transformer windings being connected respectively only to rectifier units having relatively uniform resistance characteristics and differing to a substantial degree from the resistance characteristics of units to which other transformer windings are connected.

2. A rectifier system comprising a plurality of rectifier units and current transforming means adapted to receive alternating current from a suitable source, said current transforming means having a plurality of secondary windings each adapted to deliver alternating current of desired voltage to a selected rectifier unit of said system, said component rectifier units embodying collectively a multiplicity of rectifying elements of the dry type having individual resistance characteristics differing among the several elements, the elements composing any given unit having approximately the same resistance characteristics and individual secondary transformer windings being connected respectively only to rectifier units having relatively uniform resistance characteristics and differing to a substantial degree from the resistance characteristics of units to which other transformer windings are connected, said units having output terminals connected with each other in series or parallel according to the work to be performed by said rectifier system.

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