July 27, 1937. M. A. LISSMAN 2,088,526

MULTIPLE CIRCUIT FOR ENERGIZING TREATER UNITS

Filed Feb. 5, 1935

Fig. 1.

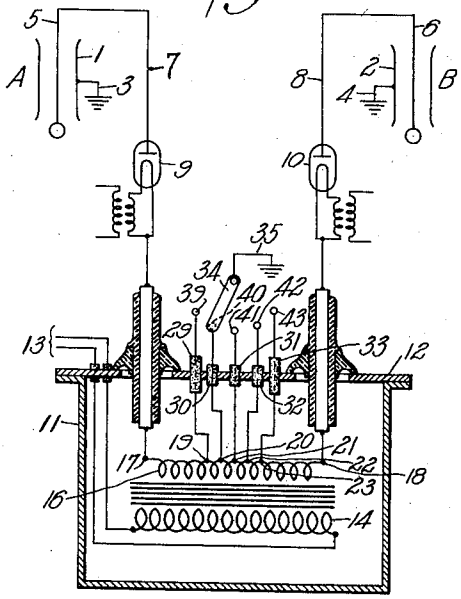


Fig. 2.

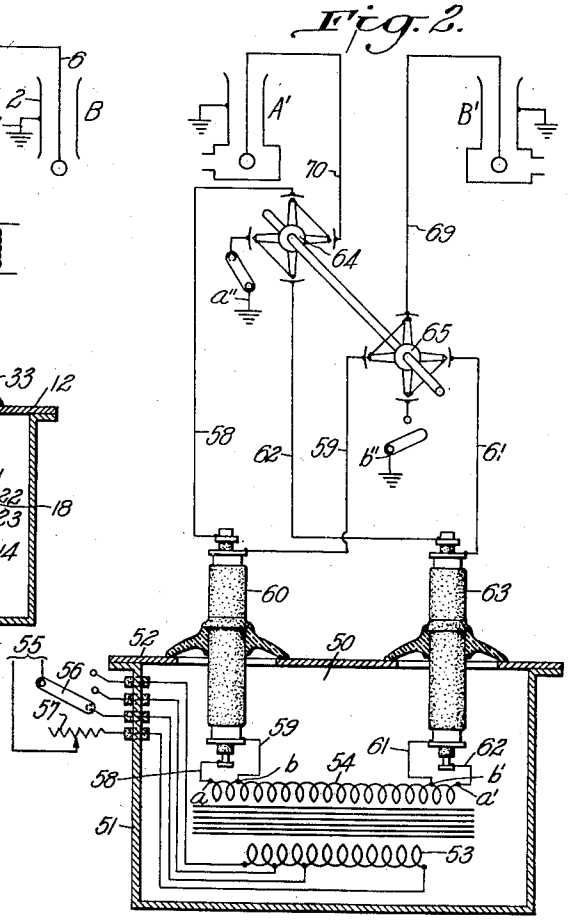
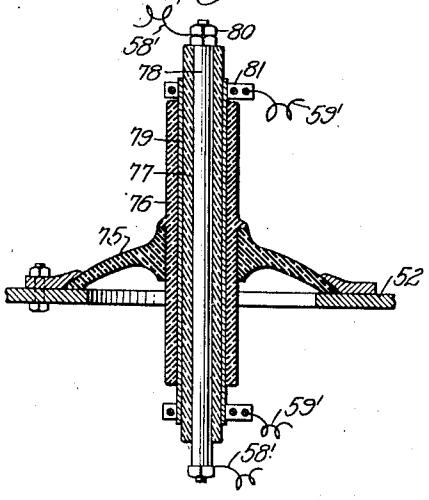


Fig. 5.



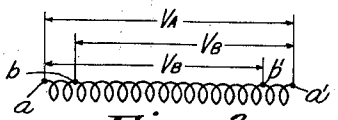


Fig. 3.

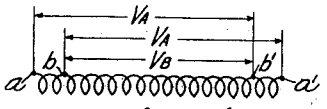


Fig. 4.

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MULTIPLE CIRCUIT FOR ENERGIZING TREATER UNITS

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16 Claims. (Cl. 183—7)

My invention relates to electric circuits and combinations of circuits for supplying electric energy to a plurality of devices at different potentials.

The invention is especially useful where fluids are to be treated in treaters comprising several units, and the fluid or fluids in the different units have different electric characteristics and require treatment under different electrical conditions. Where the units are very large, a separate electric circuit including a transformer can be provided for each unit and operated economically with it. But where the units are small or the amount of energy consumed by each unit is small in amount, great savings can be realized by using a circuit arranged in accordance with the present invention in which a single transformer is used to provide the proper voltages for the several units.

The invention typically comprises a transformer with primary and secondary winding and enclosure for the same, terminals and intermediate taps on the secondary winding, connections on the terminals and taps, insulating bushings through the wall of the enclosure through which the connections pass, and switches and translating devices connected to the several connections to distribute the energy to a plurality of treating units.

A principal object of the invention is to provide in a multiple electric circuit comprising a single transformer, means for energizing a plurality of treater units at different potentials.

Another object of the invention is to provide in combination with a plurality of treater units which are to be energized at different voltages, a transformer with the secondary winding divided into sections and conductors connecting the sections through translating devices to the respective treater units.

Another object of the invention is to provide in connection with the energization of a plurality of treating units, a transformer with a secondary divided into sections and with conductors connected to the terminals of the various sections and brought out through the casing of the transformer in such relationship that the voltage drop between conductors permits an economical arrangement of outlet bushings.

Another object of the invention is to parallel an existing circuit for energizing a fluid treater, the existing circuit comprising rectifying means and the secondary winding of a transformer, with an additional circuit comprising at least a substantial part of the secondary winding of the same transformer but separate rectifying means and having a different working voltage from the existing circuit.

Another object of the invention is to use a single transformer to impress rectified full wave current at different potentials upon a plurality of treater units.

The manner in which the above mentioned objects and other objects, to be later disclosed, are realized with the present invention will be made apparent in the following description illustrated with the appended drawing, in which:

Fig. 1 shows, diagrammatically, one embodiment of my invention;

Fig. 2 shows, more or less diagrammatically, another embodiment of my invention;

Figs. 3 and 4 represent alternate voltage relationships that are obtained with the circuit illustrated in Fig. 2; and

Fig. 5 shows, in detail, in vertical section, the transformer bushing indicated in Fig. 2.

The embodiment of the invention illustrated in Fig. 1 comprises two parallel circuits each of which energizes a separate treater unit with alternate half wave impulses from a common transformer. Each of the two circuits, which may be considered branches of a multiple circuit, comprises a separate portion of the secondary winding of the common transformer. The circuits have a grounded return in common and the extent of the respective portions of the secondary winding included in the respective circuits is determined by the location of the intermediate point on the winding at which the ground return is attached.

In Fig. 1, A designates a treater unit, for example, a unit of a Cottrell precipitator for electrically removing suspended particles from gases, with an electrode 1 and an opposing or complementary electrode 5. Electrode 1 is grounded at 3 and electrode 5 is connected by conductor 7 through hot cathode rectifier 9 to terminal 17 of secondary winding 16 of transformer 11. A second unit B comprises electrode 2 grounded at 4 and complementary electrode 6 connected by conductor 8 and rectifier 10 to the opposite terminal 18 of transformer winding 16. Intermediate the terminals 17 and 18 are taps marked 19, 20, 21, 22, and 23 which are brought out by insulated conductors through bushings 29, 30, 31, 32 and 33, respectively, to switch points 39, 40, 41, 42 and 43, respectively. A switch arm 34 can be rotated to contact any one of the above switch points and so connect to ground at 35 that tap on the secondary winding connected to the

particular switch point contacted. Tap 21 is shown at the midpoint of the winding and when the winding at this point is grounded, equal voltages are impressed upon each of the treater units A and B.

A common voltage impressed across the opposing electrodes of a Cottrell precipitating unit is 50,000 volts, so, by way of example, it can be assumed that the winding between tap 21 and terminal 17 is such that when it is energized by passing alternating current from supply circuit 13 through primary winding 14 at the prescribed voltage, the voltage between tap 21 and terminal 17 is 50,000 volts and this voltage is impressed across the electrodes of treater A. A like voltage is impressed across the electrodes of treater B because the winding between tap 21 and terminal 18 is similar to the winding between tap 21 and terminal 17. But it is often advisable to have a voltage drop across one unit somewhat less than that across another unit. Referring to Fig. 1 it can be seen that this is readily accomplished by rotating contacting arm 34 to contact 40 as shown, which causes tap 20 to be grounded and causes treater A to be energized with a circuit comprising that portion of secondary winding 16 between terminals 20 and 17 which has less turns and sets up a lower voltage difference than that portion between terminals 20 and 18 which energizes treater unit B.

In practice it has been found advantageous to have the portions of the winding between taps, e. g., between 21 and 22, of sufficient number of turns to set up a voltage difference of approximately 2500 volts. So when contacting arm 34 is moved from contact 41 to contact 40 thereby grounding point 20 instead of point 21, the voltage difference at treater A becomes approximately 2500 volts less and the voltage difference at treater B becomes approximately 2500 volts more, or a difference of 5000 volts in the potential applied to treater units A and B. By moving arm 34 to 39, the voltage difference across unit A becomes 10,000 volts less than across unit B, a very appreciable difference and usually sufficient to provide for any variation in electrical characteristics of the fluids treated in units A and B. With the construction shown in Fig. 1, that is with the means for changing the voltage relationship applied at the grounded portion of the secondary winding, the matter of insulating the various alternate connections is simple and economical. While arm 34 is grounding point 19, for instance, there is no voltage drop across insulating bushing 29 to transformer cover 12 when the latter is grounded, as it ordinarily is. The conductor passing through insulating bushing 33, when point 19 is grounded, has a potential of four times 2500 volts or 10,000 volts above that of grounded case 12 and bushing 33 must insulate against this voltage difference. But an insulator for 10,000 volts is relatively simple and cheap. The other bushings, i. e. 30, 31 and 32, need provide for even less voltage differences.

Fig. 2 illustrates how the invention can be used to separately energize two treater units at different potentials with full wave current, that is, both half waves of an alternating current are impressed upon each unit. Each unit is energized with a separate branch of a multiple circuit and each branch circuit preferably comprises rectifying means because of the advantages that usually result from operating fluid treaters with unidirectional rather than with alternating current. A common transformer is used and both branch circuits utilize the same secondary winding and terminal bushings, as will be described hereafter.

In Fig. 2, treater units A′ and B′ are connected through rectifiers 64 and 65, respectively, to transformer 50. Transformer 50 has a casing 51, a cover 52, primary winding 53 and secondary winding 54. The primary winding is energized from a supply circuit 55 of alternating current and the voltage impressed upon the primary winding is controlled by variable impedance 57 and by a choice of taps on the primary winding provided by selective switch 56. The secondary winding is connected to external conductors at four points. Conductors 58 and 62 are connected, respectively, to the end terminals *a* and *a′* and conductors 59 and 61 are connected, respectively, to intermediate terminals or taps *b* and *b′*. Conductors 58 and 62 are included in one circuit to energize treater A′ and conductors 59 and 61 are included in a parallel circuit to energize treater B′.

The difference in potential of conductors 58 and 59 depends upon the turns of the secondary winding between terminals *a* and *b* and similarly the turns between *b′* and *a′* determine the potential difference between conductors 62 and 61. For the purposes of the invention, the potential difference between 58 and 59 and between 62 and 61 need not exceed 10,000 volts which makes it possible to take each of these pairs of conductors through transformer cover 52 in a single insulating bushing. The former pair of conductors pass through bushing 60 and the latter pair of conductors pass through bushing 63. The manner of insulating the conductors from each other and from the transformer cover is shown in detail in Fig. 5.

The rectifying means for translating the half wave current impulses set up by the transformer so that they will always reach the treater units at the same polarity are shown conventionally at 64 and 65 to be of the common mechanical switch type. The rotors of both rectifiers are mounted on a common shaft and turn in synchronism with the alternations of the supply current in circuit 55. It is convenient to show the return circuits from the treater units as grounded although they need not be grounded. Rectifier 64 is shown grounded at *a″* and a ground connection is provided at *b″* for rectifier 65. But rectifier 65 and rectifier 64 are not grounded simultaneously because a short circuit of portions *a*—*b* and *b′*—*a′* of transformer winding 54 would result. Portion *b′*—*a′* would be short circuited with the rectifiers in the position shown and when the rectifiers had revolved a quarter turn the winding between *a* and *b* would be short circuited.

The effect of grounding the circuits at the rectifiers can be explained more definitely with the diagrams in Figs. 3 and 4. Assuming that the voltage induced in the transformer secondary winding is approximately proportional to the turns of the winding, then the voltage between any two taps or terminals is proportional to the turns between those two taps. Fig. 3 shows the relationship between the voltage impressed across the electrodes of units A and B when rectifier 64 is grounded at *a″* and rectifier 65 is not grounded. Terminals *a* and *a′* are now alternately grounded through conductors 58 and 62 and alternately connected to the high potential electrode of unit A. The full voltage induced along the complete winding is impressed at each

half wave impulse across the electrodes of unit A. This voltage is represented in Fig. 3 as V_A. When terminal a' is grounded, tap b' is connected with conductor **61** to an open circuit at b'' and tap b is connected through conductor **59** to the high potential electrode of unit B. The voltage across B is represented by the top dimension V_B. The lower dimension V_B in Fig. 3 represents the voltage across unit B when the rectifiers have rotated 90 degrees and the electrical phase relationship has changed 180 degrees. V_B can be the same for each impulse but will not be if a—b is different from b'—a'. It will be seen that unit A always gets full potential and B always gets a lesser potential because deprived of the voltage induced in first one end section and then the other end section of the secondary winding.

When rectifier **65** is grounded at b'' and the grounding switch on rectifier **64** is opened at a'', the voltages across the two treater units are as represented in Fig. 4. The transformer winding included in the circuit energizing unit A is now from terminal a to tap b' and from tap b to terminal a', alternatively. The voltage differences resulting from these conditions are represented by V_A, V_A in Fig. 4. The transformer winding now included in the circuit energizing unit B is always from b to b' and the voltage difference is represented by V_B in Fig. 4.

The arrangement just described adds appreciably to the flexibility of multiple circuits for energizing a plurality of treater units. If two units are operating at 55,000 volts and 50,000 volts, respectively, with rectifier **64** grounded at a'' and these voltages prove too high, the ground at a'' can be opened and rectifier **65** can be grounded at b'' which will cause the treater units to be energized at 50,000 volts and 45,000 volts, respectively. Further regulation can be obtained where conditions warrant the expense, by adding further taps to the secondary winding between terminals a and b and between terminals b' and a'. Connections to these extra taps are brought out through sections of a multi-conductor high voltage cable within insulating bushings **60** and **63** and connections external to the transformer are made to the different conductors to give the voltages required. The extra taps mentioned are not shown in the figures but they comprise more or less obvious embodiments of the present invention. Impedances, such as ohmic resistances and induction coils, can be inserted in the feeder connections to the treaters to give further voltage control but, as the results to be obtained with such devices vary with the amount of current passing and the frequency of the current impulses, emphasis is placed on regulation by varying the transformer windings which are independent of the factors mentioned.

The terminal bushing shown in Fig. 5 is made up of an insulating flange **75**, an insulating tube **76** and another insulating tube **77**. Between tubes **76** and **77** is a conducting tube **79** that comprises a part of conductor **59'** corresponding to conductor **59** in Fig. 2. Inside of insulating tube **77** is a conductor **78** comprising a part of conductor **58'** corresponding to conductor **58** in Fig. 2. Members **80** and **81** indicate clamping means on conductors **78** and **79** respectively. This bushing can take various forms as those versed in the art know. For instance, as mentioned above, a cable comprising a plurality of conductors, insulated from one another, can be used in place of conductor **78** and conductor **79** can be dispensed with. Only two separate branch circuits are shown in Fig. 2 but with three or more conductors passing through bushings **60** and **63**, three or more parallel circuits can be connected to the secondary winding of the transformer and can be used to separately energize units at voltages to be arranged.

The foregoing description has pointed out how the invention makes it possible for a single transformer to energize a plurality of different treater units at different potentials and how, when the potentials are relatively high, the desired results can be obtained without adding high voltage outlet bushings to the transformer and, furthermore, how regulation can be obtained with simple readily accessible switching devices.

I claim:

1. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, a conductor attached to each of the terminals of said secondary winding, at least one conductor excentrically attached to said secondary winding intermediate the terminals thereof, and means for connecting each of said treater units with a different pair of said conductors at each alternation of the current whereby energy is supplied to each of said treater units at a different potential and at the same polarity.

2. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, a conductor attached to each of the terminals of said secondary winding, at least one conductor excentrically attached to said secondary winding intermediate the terminals thereof, and means for connecting each of said treater units with a different pair of said conductors including current directing devices for conducting every half cycle of the current to each unit at constant polarity, whereby energy is supplied to each of said treater units at a different potential.

3. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, a conductor attached to each of the terminals of said secondary winding, at least one conductor excentrically attached to said secondary winding intermediate the terminals thereof, and means for connecting each of said treater units with a different pair of said conductors including mechanical rectifiers for conducting every half cycle of the current to each unit at constant polarity, whereby energy is supplied to each of said treater units at a different potential.

4. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, a conductor attached to each of the terminals of said secondary winding, at least one conductor excentrically attached to said secondary winding intermediate the terminals thereof, and means for connecting each of said treater units with a different pair of said conductors including thermionic rectifiers for maintaining the polarity of the current supplied to said units constant, whereby energy is supplied to each of said treater units at a different potential.

5. Apparatus for electrically energizing a plu-

rality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, a conductor attached to each of the terminals of said secondary winding, a plurality of conductors attached to said secondary winding intermediate the terminals thereof, and means for selectively connecting each of said treater units with a different pair of said conductors.

6. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, a conductor attached to each of the terminals of said secondary winding, a plurality of conductors attached to said secondary winding intermediate the terminals thereof, and means including current rectifying devices for selectively connecting each of said treater units with a different pair of said conductors.

7. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, means connecting each of said treater units to a separate point on the secondary winding, means connecting all of said treater units to a common grounded point on said secondary winding, and means for changing the position of said common point at each alternation of the current.

8. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, means connecting each of said treater units to a separate point on the secondary winding, means connecting all of said treater units to a selected common point on said secondary winding, and means for changing the position of said common point at each alternation of the current.

9. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, means including current rectifying means connecting each of said treater units to a separate point on the secondary winding, means connecting all of said treater units to a selected common point on said secondary winding, and means for changing the position of said common point at each alternation of the current.

10. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, means including mechanical current rectifying means connecting each of said treater units to a separate terminal of the secondary winding, means connecting all of said treater units to a selected common point on said secondary winding, and means for changing the position of said common point at each alternation of the current.

11. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, means connecting each of said treater units to a separate point on the secondary winding, means connecting all of said treater units to a selected common point on said secondary winding, and means for changing the position of said common point at each alternation of the current.

12. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, means connecting each of said treater units to a separate point on the secondary winding, means connecting all of said treater units to a selected common point on said secondary winding, and means for changing the position of said common point, said last-named connecting means including current rectifying means.

13. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, means connecting each of said treater units to a separate point on the secondary winding, means connecting all of said treater units to a selected common intermediate point on said secondary winding, and means for changing the position of said common point.

14. Apparatus for electrically energizing a plurality of treater units comprising a transformer including a primary winding connected to a source of alternating current and a secondary winding, means connecting each of said treater units to a separate point on the secondary winding, means connecting all of said treater units to a selected common point on said secondary winding, and means for changing the position of said common point, said last named means including mechanical current rectifying means.

15. An electrical system comprising a supply winding energized at alternating polarity, a pair of conductors connected at spaced points adjacent each end of said winding, two treater units each adapted to be energized through a pair of said conductors, and mechanical rectifiers adapted to connect said conductors in pairs to said units in alternation with the alternation in polarity to energize the units separately at approximately the full voltage across the winding at constant polarity.

16. An electrical system comprising a supply winding energized at alternating polarity, a pair of conductors connected at spaced points adjacent each end of said winding, two treater units each adapted to be energized through a pair of said conductors, and mechanical rectifiers adapted to connect said conductors in pairs to said units in alternation with the alternation in polarity to energize the units separately at differing voltages approximating the full voltage across the winding at constant polarity.

MARCEL A. LISSMAN.

CERTIFICATE OF CORRECTION.

Patent No. 2,088,526. July 27, 1937.

MARCEL A. LISSMAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, line 60, claim 10, for "terminal of" read point on; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of September, A. D. 1937.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.

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