

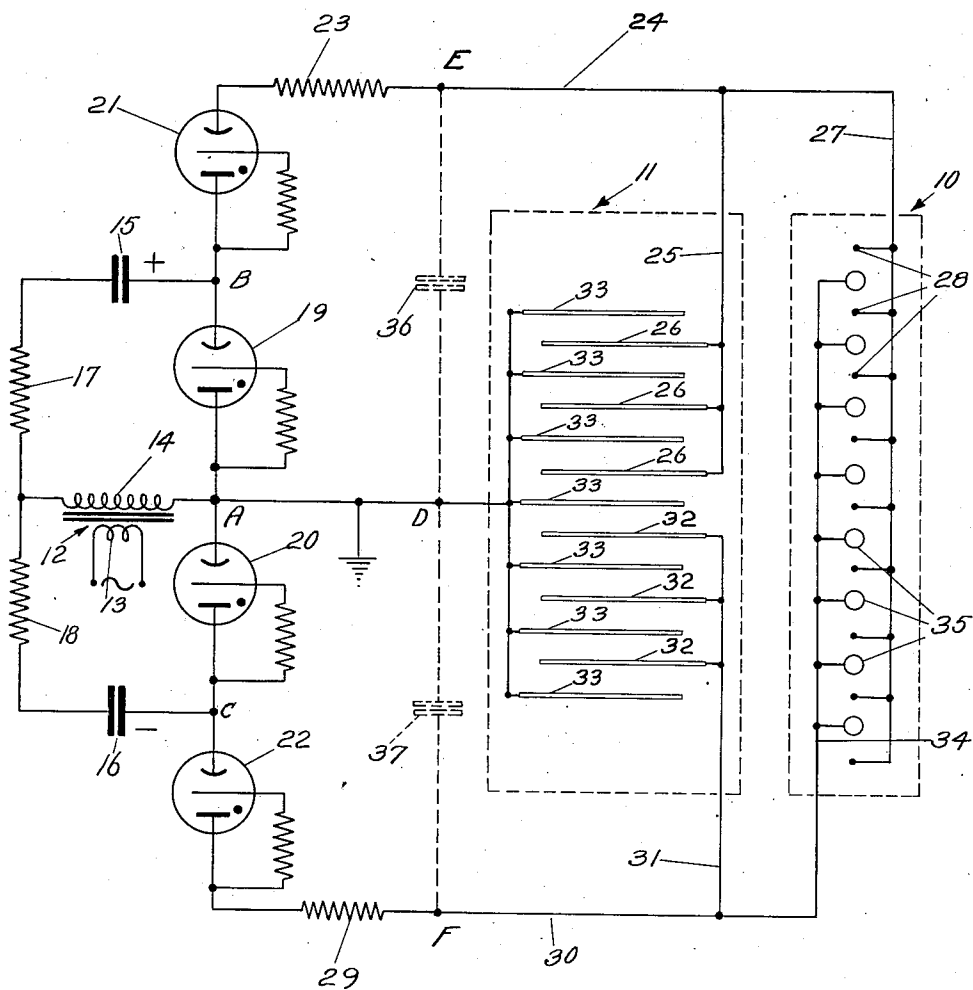
May 3, 1949.

H. KLEMPERER

2,469,231

ELECTRICAL PRECIPITATOR

Filed June 20, 1946



INVENTOR
HANS KLEMPERER

BY *Elmer J. Jones*
ATTY.

UNITED STATES PATENT OFFICE

2,469,231

ELECTRICAL PRECIPITATOR

Hans Klemperer, Belmont, Mass., assignor to
Raytheon Manufacturing Company, Newton,
Mass, a corporation of Delaware

Application June 20, 1946, Serial No. 678,153

12 Claims. (Cl. 183—7)

1

This invention relates to electrical precipitators for electrically separating dust and smoke from air, flue gases and the like, and more particularly to a power supply circuit for supplying suitable potentials to the ionizing device and the control plates forming the precipitating means.

Electrical precipitators of the type to which the invention relates require the application of relatively high potentials of the order of 12,000 volts or more between the electrodes of the ionizing device and of the order of 6,000 volts between adjacent plates of the precipitating means. To supply such potentials from a commercial power supply line requires expensive equipment. The transformer is necessarily expensive in that, if the full 12,000 volts potential is applied thereacross, heavy insulation must be provided.

It is among the objects of the present invention to provide a ladder circuit in which voltage from the transformer may be doubled or quadrupled to the end that smaller and less expensive equipment may be utilized.

A further object of the invention is to provide a circuit of the type described in which the control plates of the precipitating means constitute a portion of the capacitance required in the ladder circuit.

The above and other objects and features of the invention will be made fully apparent to those skilled in the art from a consideration of the following detailed description taken in conjunction with the accompanying drawing which shows schematically an electrical precipitator together with a power supply circuit constructed in accordance with the present invention.

Referring to the drawing, reference numeral 10 indicates generally the ionizing element of an electrical precipitator, and 11 indicates generally the precipitating unit comprising a plurality of collector plates. To supply the ionizing device 10 and the precipitating means 11 with suitable potentials, a transformer 12 is provided having a primary winding 13 supplied from a suitable source of alternating current and a secondary winding 14. The transformer 12 is adapted to step up the voltage of the source, in this instance to a value of the order of 3,000 volts. One terminal of the secondary winding 14 is jointly connected to the condensers 15 and 16 through suitable resistors 17 and 18, which resistors may be of the order of 10,000 ohms. The opposite terminal of the secondary winding 14 is grounded and is also connected through tubes 19 and 20 to the opposite sides of the condensers 15 and 16, respectively. The tube 19 has its anode connect-

2

ed to the grounded side of the secondary winding 14, and its cathode connected to the condenser 15. The tube 20 has its cathode connected to the grounded side of the secondary winding 14, and its anode connected to the condenser 16. The tubes 19 and 20 may be any suitable rectifiers, such as well-known diodes. In order to avoid the necessity of providing heating circuits for the cathodes of such rectifiers, I prefer to utilize a glow rectifying tube such as a 1B48, as disclosed in the copending application of Paul W. Stutsman for Gaseous discharge device, Serial No. 647,463, filed February 14, 1946.

The portion of the circuit just described constitutes a voltage doubler. Taking the A. C. voltage on the high voltage side of the transformer as E_0 against ground, the condensers 15 and 16 are charged to $E_0 \sqrt{2}$ each at a different sign. The voltage across the points A—B is therefore $E_0 \sqrt{2}$ positive and the voltage from between points A and C is $E_0 \sqrt{2}$ negative. The potential across the points B and C is therefore $2 E_0 \sqrt{2}$. The potential at terminals B and C may again be doubled in a simple manner and to this end rectifier tubes 21 and 22 are provided between the points B and C, respectively, and portions of the collecting plates of the precipitator. To this end the tube 21 has its anode connected to the point B, and its cathode connected through a resistor 23, and a conductor 24 to a conductor 25 connected to each of a plurality of alternate plates 26 of the precipitating means 11. The plates 26 constitute one-half of the charged plates of the precipitator. The tube 22 has its cathode connected to point C, and its anode connected through a resistor 29, and a conductor 30 to a conductor 31 connected to the remainder of the charged plates 32 of precipitator 11. The ground plates 33, one of which intervenes between any two successive charged plates 26 and 32, are jointly connected to ground. The conductor 24 is also connected through a conductor 27 to each of a plurality of fine wire electrodes 28 of the ionizing device 10. The conductor 30 is connected by conductor 34 to each of a plurality of tubular electrodes 35 of the ionizing device.

It will be seen that the plates 26 acting in conjunction with a portion of the plates 33 constitute a capacitance, the electrical equivalent of which is shown in dotted lines at 36 extending between a point D at ground potential and a point E on the conductor 24. The plates 32 constitute with the remainder of the ground plates 33 a capacitance, the equivalent of which is indicated in

3

dotted lines at 37. It will be seen that the potential between points D and E will be $2 E_0 \sqrt{2}$ positive, and the potential across the condenser 37 will be $2 E_0 \sqrt{2}$ negative. Since potentials across D and E and D and F represent the potentials across the collecting plates of the precipitator, it will be seen that the potential between any two adjacent plates will be $2 E_0 \sqrt{2}$. The potentials across points E and F being the sum of potentials across the points E and D and D and F will be $4 E_0 \sqrt{2}$ and this potential is applied between the fine wire electrodes 28 and the tubular electrodes 35 of the ionizing device.

Inasmuch as each of the tubes 19 and 20 must stand twice the peak transformer voltage in an inverse direction, it will be desirable in some instances to use a plurality of such tubes in series for each of the tubes 19, 20, 21 and 22 in order that the tubes will hold up under the high inverse voltage.

The resistors 17, 18, 23 and 29 are used in series with every capacity of the circuit to limit starting currents and prevent relaxation oscillations between the capacity and rectifying gas discharges.

While there have been herein described certain preferred embodiments of the invention, other embodiments within the scope of the appended claims will be obvious to those skilled in the art in consideration of the forms shown and the teachings hereof.

What is claimed is:

1. An electrical precipitator for purifying gas comprising an ionizing device including a plurality of electrodes between which an ionizing discharge is adapted to occur, a precipitating means including a plurality of spaced, parallel collector plates upon which impurities in said gas are collected, means for charging a portion of said plates to a predetermined potential relative to ground, means for charging another portion of said plates to a potential in the opposite polarity relative to ground, means for deriving a potential substantially equal to the combined potential across said two portions of said collector plates, and means for applying said derived potential across said ionizing electrodes.

2. An electrical precipitator for purifying gas comprising a plurality of ionizing electrodes between which an ionizing discharge is adapted to occur, a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, means for applying a potential which is positive relative to said ground plates to a portion of said charge plates, means for charging another portion of said charge plates to a negative potential relative to said ground plates, means for deriving a potential equal to the combined potential across said two portions of said collector plates, and means for applying said derived potential across said ionizing electrodes.

3. An electrical precipitator for purifying gas comprising a plurality of ionizing electrodes between which an ionizing discharge is adapted to occur, a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, circuit means including a rectifier for applying a potential which is positive relative to said ground plates to a portion of said charge plates, circuit means including a rectifier for charging another portion of said charge plates to a negative potential relative to said ground

4

plates, means for deriving a potential equal to the combined potential across said two portions of said collector plates, means for applying said derived potential across said ionizing electrodes, and resistors in each of said circuit means for preventing relaxation oscillations between the capacitance provided by each of said portions of said charge plates and said rectifiers.

4. An electrical precipitator for purifying gas comprising a plurality of ionizing electrodes between which an ionizing discharge is adapted to occur, a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, means for applying a potential which is positive relative to said ground plates to a portion of said charge plates, means for charging another portion of said charge plates to a negative potential relative to said ground plates, said two portions of said charge plates constituting with said ground plates the capacitance of a voltage doubler circuit for applying a potential across said ionizing electrodes which is substantially twice that applied between said charge plates and said ground plates.

5. An electrical precipitator for purifying gas comprising an ionizing device including a plurality of electrodes between which an ionizing discharge is adapted to occur, a precipitating means including a plurality of spaced, parallel collector plates upon which impurities in said gas are collected, a voltage doubler circuit for charging a portion of said plates to a predetermined potential relative to ground, a second doubler for charging another portion of said plates to a substantially numerically equal potential in the opposite polarity relative to ground, means for deriving a potential equal to the combined potential across said two portions of said collector plates, and means for applying said derived potential across said ionizing electrodes.

6. An electrical precipitator for purifying gas comprising an ionizing device including at least two ionizing electrodes of opposite polarity between which an ionizing discharge is adapted to occur, a precipitating means including a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, means for applying to one of said electrodes a predetermined potential relative to ground, means for applying to the other of said electrodes a predetermined potential of the opposite polarity relative to ground, and means for directly electrically connecting at least a portion of said charge plates to one of said electrodes.

7. An electrical precipitator for purifying gas comprising an ionizing device including at least two ionizing electrodes of opposite polarity between which an ionizing discharge is adapted to occur, one of said two electrodes being a fine wire and the other of said two electrodes being a tubular metallic member, a precipitating means including a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, means for applying to one of said electrodes a predetermined potential relative to ground, means for applying to the other of said electrodes a predetermined potential of the opposite polarity relative to ground, and means for directly electrically connecting at least a portion of said charge plates to said tubular member.

8. An electrical precipitator for purifying gas comprising an ionizing device including at least

5

two ionizing electrodes of opposite polarity between which an ionizing discharge is adapted to occur, one of said two electrodes being a fine wire and the other of said two electrodes being a tubular metallic member, a precipitating means including a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, means for applying to said tubular member a predetermined negative potential relative to ground, means for applying to said fine wire electrode a predetermined positive potential relative to ground, and means for directly electrically connecting at least a portion of said charge plates to said tubular member.

9. An electrical precipitator for purifying gas comprising an ionizing device including at least two ionizing electrodes of opposite polarity between which an ionizing discharge is adapted to occur, a precipitating means including a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, circuit means including a rectifier for applying to one of said electrodes a predetermined potential relative to ground, circuit means including a rectifier for applying to the other of said electrodes a predetermined potential of the opposite polarity relative to ground, and means for directly electrically connecting at least a portion of said charge plates to one of said electrodes.

10. An electrical precipitator for purifying gas comprising an ionizing device including at least two ionizing electrodes of opposite polarity between which an ionizing discharge is adapted to occur, one of said two electrodes being a fine wire and the other of said two electrodes being a tubular metallic member, a precipitating means including a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, circuit means including a rectifier for applying to one of said electrodes a predetermined potential relative to ground, circuit means including a rectifier for applying to the other of said electrodes a predetermined potential of the opposite polarity relative to ground, and means for directly electrically connecting at least a portion of said charge plates to said tubular member.

11. An electrical precipitator for purifying gas

6

comprising an ionizing device including at least two ionizing electrodes of opposite polarity between which an ionizing discharge is adapted to occur, a precipitating means including a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, means for applying to one of said electrodes a predetermined potential relative to ground, means for applying to the other of said electrodes a predetermined potential of the opposite polarity relative to ground, and means for directly electrically connecting at least a portion of said charge plates to one of said electrodes, said portion of said charge plates constituting with said ground plates a portion of the capacitance of a voltage doubler circuit for applying a potential across said electrodes which is substantially twice that applied between said charge plates and said ground plates.

12. An electrical precipitator for purifying gas comprising an ionizing device including at least two ionizing electrodes of opposite polarity between which an ionizing discharge is adapted to occur, a precipitating means including a plurality of spaced, parallel collector plates comprising alternate charge and ground plates upon which impurities in said gas are collected, means for applying to one of said electrodes a predetermined negative potential relative to ground, means for applying to the other of said electrodes a predetermined positive potential relative to ground, and means for directly electrically connecting at least a portion of said charge plates to said one electrode, said portion of said charge plates constituting with said ground plates a portion of the capacitance of a voltage doubler circuit for applying a potential across said electrodes which is substantially twice that applied between said charge plates and said ground plates.

HANS KLEMPERER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,280,330	White	Apr. 21, 1942
2,318,093	Penny	May 4, 1943