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C. T. BUFF ET AL

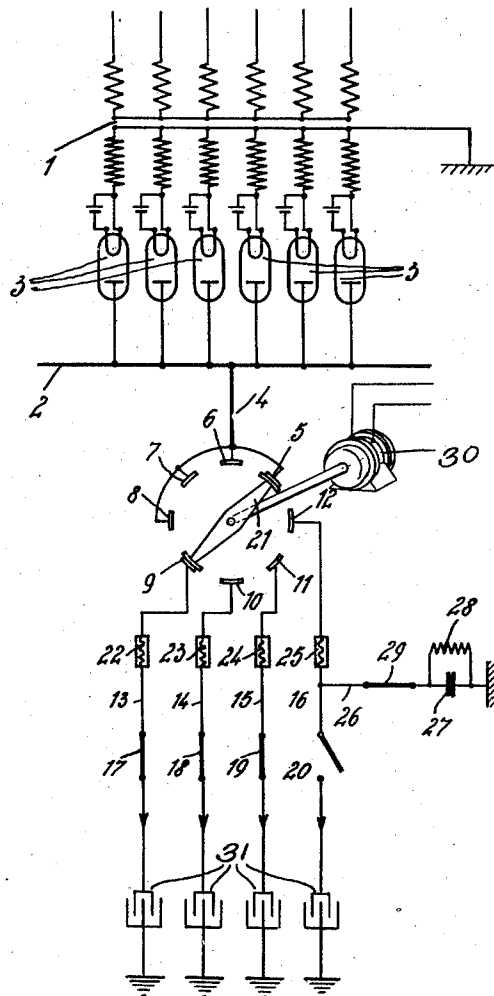
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ELECTRICAL PRECIPITATION APPARATUS

Filed April 9, 1931

2 Sheets-Sheet 1

Fig. 1.



Inventors

Carl Theodor Buff, +

Richard Heinrich

by *Knight B.* Attorney

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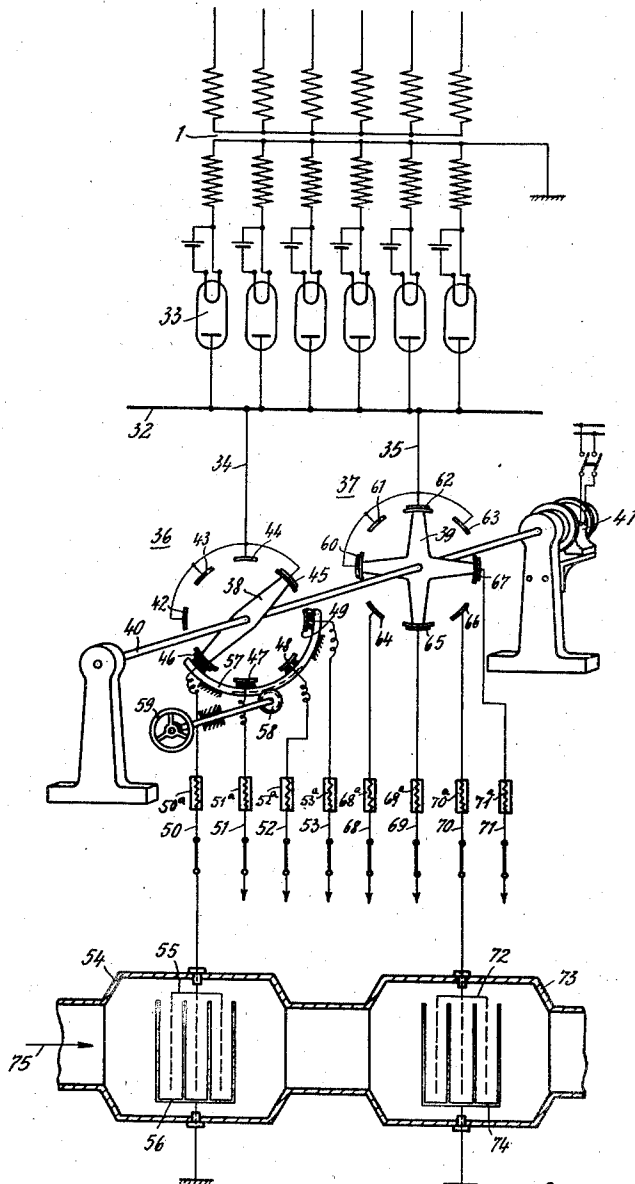
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Fig. 2



Inventors:
Carl Theodor Buff and
Richard Heinrich
by *Heigold*
attorneys

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ELECTRICAL PRECIPITATION APPARATUS

Carl Theodor Buff, Berlin-Spandau, and Richard Heinrich, Berlin-Sudende, Germany, assignors, by mesne assignments, to International Precipitation Company, Los Angeles, Calif., a corporation of California

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4 Claims. (Cl. 183—7)

Our invention relates to electrical precipitation apparatus, and particularly to means for feeding the electrical high-voltage discharge fields of such apparatus with high-tension pulsating unidirectional current.

The erection of electrical precipitating plants of considerable dimensions, for electrical precipitation of suspended particles from gases, often encounters difficulties, since it is not possible, owing to the restricted space, to accommodate an individual high-voltage generator set for each precipitator unit. The present invention refers to an arrangement by which the above-mentioned difficulties are eliminated.

According to the invention a high-voltage unidirectional current generating system is utilized for feeding several electrical high-voltage discharge fields with high-tension pulsating unidirectional current, said generating system being connected to a common high tension conductor from which the unidirectional current is supplied to the different discharge fields by means of a rotary transfer switch, in such a manner that these fields are intermittently charged. For instance, as in the specific example herein shown, a six-phase transformer in connection with a bank of thermionic rectifier valves may be utilized as a high-tension unidirectional current generator. Only a small space is required for the erection of such a high-tension generating system, even for supplying an installation of considerable size with various kinds of electrical high-voltage discharge fields, such for instance as are employed in precipitators.

The transfer switch is advantageously designed in such a manner that it possesses switch arms and associated contact members disposed in only one plane. In some cases it may also be convenient to design the transfer switch in such a way as to have the switch arms and contact members in different planes. Besides it is convenient to provide a device for controlling the speed of the rotary transfer switch. It is thereby possible to regulate at will the duration of the impulses for feeding the different precipitators. If necessary the contacts connected to the common high tension conductor or to the respective discharge fields may also be designed so as to be adjustable in order that the regulation of duration of impulses may

be effected by the displacement of the contact segments.

A further advantage of the device resides in the possibility of switching in a grounded phantom load in place of a discharge field. It is thus possible to maintain the existing conditions of the system if an operating field is switched off.

Finally it is convenient to provide special regulating resistors for controlling the voltage, said resistors being inserted in the high-voltage lines leading to the discharge fields.

The accompanying drawings show schematically two embodiments of the invention.

In these embodiments:

Fig. 1 shows diagrammatically the use of a single rotary switch, and

Fig. 2 shows diagrammatically the use of several rotary switches for supplying simultaneously different impulse frequencies to different groups of discharge electrodes.

Referring to Fig. 1, 1 denotes a six-phase transformer, to the secondary coils of which are connected thermionic rectifier valves 3, the output electrodes of which are connected to the common high tension conductor 2. The high tension conductor is connected by the conductor 4 to four contacts 5, 6, 7, and 8, located on the periphery of the transfer switch 21, driven by any suitable means, for instance by a motor 30. Correspondingly opposite to these contacts are arranged the contacts 9, 10, 11, and 12, which are connected respectively by means of conductors 13, 14, 15, 16 through the switches 17, 18, 19, and 20 with the respective precipitators diagrammatically indicated at 31. As is customary in such apparatus, the high tension conductors are shown as connected to the discharge electrode means of the respective precipitators, while the collecting electrode means are grounded, the circuit being completed by grounding the low tension side of the secondary coils of the transformer, as shown. During the rotation of the switch 21 about its axis each of the contacts 5, 6, 7 and 8 is connected successively to its diametrically opposite contact 9, 10, 11 and 12 respectively, so that the several precipitators 31 are intermittently charged by means of unidirectional high potential impulses delivered thereto at regular intervals from the common high tension generator.

Such a generating plant may be of very small dimensions and yet feed the precipitator plant sufficiently with impulses so that effective precipitation is attained.

In the high-voltage conductors leading from the transfer switch contacts 9, 10, 11, and 12 to switches 17-20 are inserted the regulating resistors 22, 23, 24, and 25, respectively, by which it is possible to regulate in the desired manner the voltage of each individual precipitator. From the high-voltage supply line 16 a conductor 26 leads to ground, a capacitor 27 and in parallel relation thereto a reactor 28 being inserted in this conductor together with a switch 29 which is generally open. Should the precipitator 31 fed by the high-voltage line 16 be disconnected by means of the switch 20 for any reason, a phantom load can be substituted for this removed precipitator immediately, in the form of capacity 27 and reactance 28, by closing switch 29. It is thereby possible to maintain the existing operating condition in the high-voltage circuit unaltered, even in the case of a failure of the precipitator.

Similar devices may also be advantageously utilized for the other precipitators 31 fed through the conductors 13, 14, and 15.

Such an impulse supply arrangement lends itself with very great efficiency to multiple-stage electrical cleaning of gases (extraction of dust), in which it is sometimes desirable to provide different frequencies of electric impulses in the respective stages. Fig. 2 shows an arrangement which may be advantageously used for supplying unidirectional impulses at different frequencies to the successive stages of such an apparatus, from a common source of electrical energy. In this figure, 1 represents, as in Fig. 1, a six-phase transformer, the secondary of which is connected by way of rectifier valves 33 of well-known character to the common high tension conductor 32. This common conductor is connected by the conductors 34 and 35 respectively to the two rotary switches 36 and 37, the arms 38 and 39 of which are mounted on a common shaft 40 driven by an electric motor 41, the speed of which may be controlled in any accepted well-known manner. Rotary switch 36 has four fixed supply contacts 42, 43, 44 and 45 which are connected by the conductor 34 with the common conductor 32. Opposite to these contacts are placed the normally fixed contacts 46, 47, 48 and 49, which latter are connected by way of lines 50, 51, 52 and 53 each with an electrical precipitator provided with a suitable number of electrodes. In order to simplify the illustration only one electrical precipitator 54 is shown, provided with discharge electrode means 55 and collecting electrode means 56; said discharge means being connected to the rotary switch line 50. The collecting electrodes 56 are grounded as usual, the secondary of transformer 1 being also grounded, so that in this manner the circuit is completed. It will be understood that other electrical precipitators may be similarly connected to the lines 51, 52 and 53. As in Fig. 1, into each of these connections between the electrical precipitators and the pertaining switch contacts is connected a resistance as shown at 50a, 51a, 52a and 53a, for the purpose stated hereinbefore with reference to Fig. 1. The four contacts 46 to 49 while normally fixed, are rotatably adjustable as a group in the manner shown conventionally. The particular manner is entirely immaterial so far as the subject matter of the present invention is concerned.

By rotatably adjusting this contact group the duration of the contact between these contacts and arm 38 can be adjusted, and thus it is possible to adjust the duration of each impulse transmitted to the electrodes between a maximum and a minimum.

Rotary switch 37 whose arms rotate in a plane parallel to that in which arms 38 rotate is provided with a four-armed rotor 39 as distinguished from the two arms of the other rotor 38. The contacts 60, 61, 62 and 63 of this switch are connected to common conductor 32 by the conductor 35. These contacts cooperate through the arms of said rotor with contacts 64, 65, 66 and 67 which are respectively connected by lines 68, 69, 70 and 71 with the individual electrical precipitators of another group. Also in this case for simplicity's sake only one precipitator of this other group is shown, namely 73, whose discharge electrodes 72 are connected by way of conductor 70 to contacts 66 and whose collecting electrodes 74 are grounded but it will be understood that additional electrical precipitators may be similarly connected to the lines 68, 69 and 71. The gas stream to be purified passes in the direction of the arrow 75 in series through the two precipitators 54 and 73. In the first precipitator 54 these gases may be subjected to a pulsating unidirectional current of twenty-five pulses per second. Thence they pass into the second precipitator 73 whose electrodes are supplied with a pulsating unidirectional current of double the above number of impulses per second. In this manner the suspended material contained in the gases is subjected successively to unidirectional impulses of different frequencies in accordance with the requirement for most effective precipitation. It will be understood that the other precipitators of the respective groups may likewise be connected for passage of gas therethrough in series, so that the gas passes in each case first through a precipitator of one group and then through a precipitator of the other group.

The selection of the proper frequency of impulses depends upon the nature of the gases to be cleaned. If for instance dry gases are involved, the suspended particles of which possess an insufficient electrical conductivity, one proceeds advantageously by feeding the first cleaning stage with unidirectional current of lower pulsation frequency than the following stages. It is thereby possible, by reducing the frequency of pulsation of the unidirectional current, to present almost completely the occurring of flash-overs, which unfavourably act upon the degree of extraction of dust, in the first stage. By means of ionization of the gas its conductivity is increased. The gas consequently will cause flash-overs to occur to a smaller extent in the following cleaning-stages. It is therefore possible to now feed the following stages with a unidirectional current of a higher rate of pulsation than those of the first stage. For instance it has proven advantageous to supply to the first cleaning stage a unidirectional current of about 25-50 pulsations per second and to the next cleaning stage a unidirectional current of more than 50 impulses per second.

A condition of too strong an ionization may thereby occur, so that the next cleaning stages consume too much energy. In this case it is preferable to again feed the last fields of the cleaning system with unidirectional current of a lower number of impulses.

Should the cleaning of gases be involved, the

dust particles of which possess from the beginning a good electrical conductivity, it is convenient to feed the first field with pulsating unidirectional current of a higher number of pulsations and the next field with unidirectional current of a lower number of pulsations in order to prevent in this way the current consumption in the second and in the following fields from becoming too great as a result of the high ionization. Owing to the fact that the number of impulses of the unidirectional current corresponding to the condition of the gas is chosen for each cleaning stage it is possible to obtain in every case the most favourable current consumption and separation effect.

We claim as our invention:

1. In electrical precipitation apparatus including a plurality of units each comprising complementary discharge and collecting electrodes, a common source of high tension unidirectional current, parallel circuits connecting said source of current across the electrodes of said units, said circuits including means for independently connecting periodic high voltage impulses of a predetermined frequency and duration to separate groups of said units.

2. In electrical precipitation apparatus including a plurality of units each comprising complementary discharge and collecting electrodes, said units being connected for the flow of gases there-through in series, a common source of high tension unidirectional current, parallel circuits connecting said source of current across the electrodes of said units, said circuits including means for independently connecting periodic high voltage impulses of a predetermined frequency and duration to separate groups of said units.

3. In electrical precipitation apparatus, a plurality of electrical precipitators each provided with discharge electrode means and collecting electrode means, a high voltage unidirectional current generator, a common high tension conductor connected to the high tension side of said generator, a plurality of rotary transfer switches connected to said common high tension conduc-

tor, each switch having a plurality of fixed contacts, and each switch having a rotary contact element cooperating with the pertaining fixed switch contacts, and having a number of contacts different from the number of contact members possessed by the remaining rotary switch elements, connections between the fixed contacts of each switch and the discharge electrode means of a desired number of said electrical precipitators, to permit the intermittent supply of unidirectional current impulses of a different frequency to the discharge electrode means connected to the several switches, to produce intermittent electrical discharges between the electrodes of said precipitators, each at a frequency adequate to the condition of the suspended material passing through the particular precipitator.

4. In electrical precipitation apparatus, a plurality of electrical precipitators each provided with discharge electrode means and collecting electrode means, a high voltage unidirectional current generator, a common high tension conductor connected to the high tension side of said generator, a plurality of separate conductors connected to the discharge electrode means of the respective precipitators, a rotary switching device operable to successively and separately connect said common conductor to the respective separate conductors so as to intermittently supply high voltage impulses to the discharge electrode means of the respective precipitators at a frequency commensurate with the characteristics of the gas and suspended material to be passed therethrough, a plurality of shunt paths connected to the respective separate conductors and each provided with electrical resistance means and capacity means, and switch means for opening and closing the respective shunt paths, so as to permit substitution of a phantom load for any precipitator which is not in operation.

CARL THEODOR BUFF.
RICHARD HEINRICH.

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