

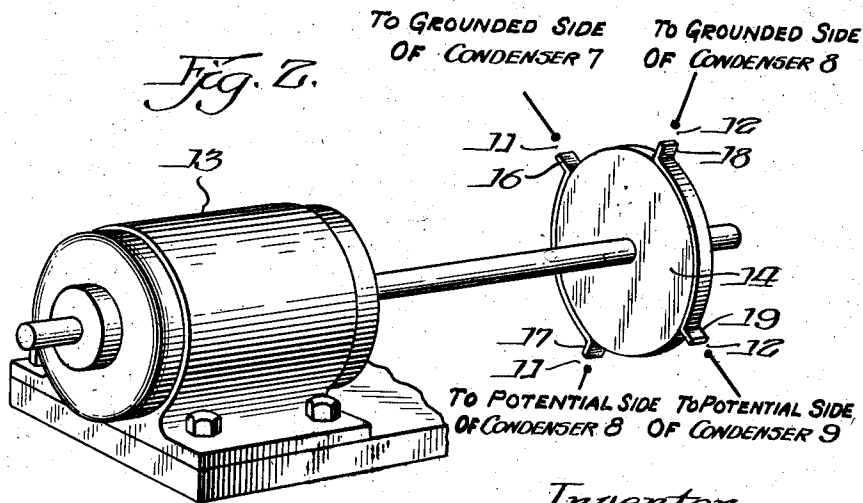
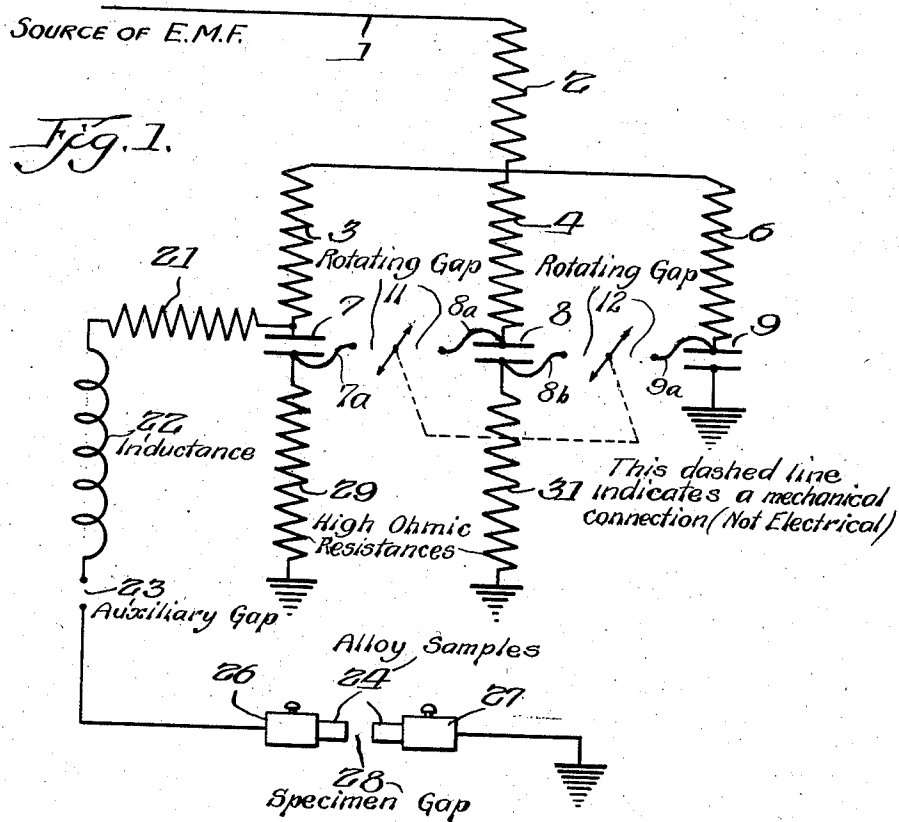
June 2, 1942.

S. ANDERSON

2,285,322

ELECTRICAL DISCHARGE APPARATUS FOR SPECTROGRAPHIC ANALYSIS AND THE LIKE

Filed July 2, 1941



Inventor:
Stanley Anderson
By Joseph O. Lange
Atty.

UNITED STATES PATENT OFFICE

2,285,322

ELECTRICAL DISCHARGE APPARATUS FOR SPECTROGRAPHIC ANALYSIS AND THE LIKE

Stanley Anderson, Chicago, Ill., assignor to Crane Co., Chicago, Ill., a corporation of Illinois

Application July 2, 1941, Serial No. 400,808

5 Claims. (Cl. 176-12)

This invention relates to a new and improved electrical discharge apparatus for spectrographic analysis and the like and has for one of its principal objects the provision of a device capable of producing electrical discharges of predetermined intensities and qualities for purposes hereinafter described at length.

At the outset, it should be understood that in spectrographic analyses work the electrical discharge constitutes an essential element of the entire operation. If the discharge can be well regulated it is possible to obtain a quantitative analysis fully as accurate as a chemical analysis and in only a small fraction of the time required for the making of the chemical analysis. In industrial plants the spectrograph plays an important role in the immediate analysis of production metals. For example, in the casting of metals or other materials it is necessary to have a definite percentage of each constituent or element in the ultimate product, but after metals, for example, are placed into induction furnaces or the like and melted, the only way of ascertaining the percentage of each element in the alloy mixture is by an analysis of some kind. It is the general current practice that sample melts are drawn of the molten alloy and then by promptly making analyses of them before any further pouring is done operations may be halted if the percentage of elements is not correct. While of course a chemical analysis by wet methods may be made, the foundry is thus required to maintain a batch of molten metal in the operating induction furnace, but it is not practical because a chemical analysis necessitates a relatively large amount of time, and to delay foundry pouring of the melt for such time as required to make the chemical analysis would be prohibitive insofar as cost is concerned, realizing that such delays are expensive under production foundry methods. In contradistinction thereto, however, in the determination of low concentration alloying elements in steel, for example, a spectrographic analysis may be made within the space of only a few minutes, and as this inspection can be performed as accurately as a chemical analysis, providing absolute control of the electrical discharge is maintained, it is truly a valuable contribution to industry. It has been found that this method is capable of analyzing steel and iron reliably for the elements manganese, silicon, molybdenum, chromium, nickel, copper and aluminum and many other elements. The precision attained is equivalent to that of routine chemical analysis by wet methods.

Other advantages include (a) improved control of melts due to increase in speed and to extension of analyses to elements impractical to determine by wet methods; (b) improvements in reliability of routine analyses; and (c) savings in operating costs.

An important object of this invention is to provide an apparatus for spectrographic analyses in which the desirable high voltage is generated for an extremely short time interval and is distributed across a series of insulators with the consequent advantage that proper insulation is more readily obtained than with other prior devices.

Other important objects will become apparent from the disclosure in connection with the following specification, in which the invention in a preferred form is described merely for illustrative purposes.

In the drawing:

Fig. 1 is a diagrammatic illustration of the preferred electrical circuit employed.

Fig. 2 is a perspective view of the apparatus using the rotating spark gaps.

Referring to the diagram of Fig. 1, the reference numeral 1 indicates generally a source of electromotive force preferably direct current, but alternating current is also usable as it is easily adapted to the apparatus. Resistances 2, 3, 4, 6, 29 and 31 are connected at suitable locations in the circuit with the condensers 7, 8 and 9 which may have similar capacities. The condensers have discharge terminal leads 7a, 8a, 8b, and 9a. Other means may be substituted for the resistances; for example inductances could be used in place of or in combination with some or all of these resistances. The E. M. F. is applied to the three condensers in parallel and taken from them in series which in effect provides that their voltages are added to each other. The circuit diagrammatically indicates only one gap at each of points 11 and 12; however, in practice it is convenient to actually use double gaps as shown in Fig. 2 for each of the diagrammatically shown gaps 11 and 12 in order that the rotating member need not be connected with the circuit by a brush or similar device.

Referring to Fig. 2, the disc 14 has gap points 16 and 17 operating as one unit in position 11 acting between the condensers 7 and 8. The other set of gap points 18 and 19 operate as a unit between condensers 8 and 9 in position 12. It will be apparent that a plurality of discs with any number of gap points could be used and operated on a single shaft.

In operation, E. M. F. is supplied to the condensers 7, 8 and 9 through resistances 2, 3, 4, 6, 29 and 31 and the motor 13 is rotated. When the condensers 7, 8 and 9 are practically fully charged the gaps 11 and 12 break down and the condensers are discharged in series and the total E. M. F. is projected through the resistance 21, the inductance 22, the auxiliary gap 23 and specimen gap 28. The auxiliary gap could be an integral part of the rotating gap instead of a separate element as shown, and in some installations such a construction might be more desirable. Two small samples 24 of the material to be analyzed are affixed in jigs 26 and 27 and placed in the circuit following the auxiliary gap 23. The specimen spark gap 28 between the two samples 24 does not offer sufficient insulation in itself to prevent the input voltage from breaking down through it. Therefore the auxiliary gap 23 is provided which in series with the gap 28 will not discharge at the input voltage or less, thus permitting the condensers to become fully charged. The effective E. M. F. causing the specimen discharge is directly controlled by the input at 1. Irrespective of whether the voltage input is increased or decreased the specimen spark voltage will always be roughly three times the input voltage or, in other words, the input voltage is multiplied by the number of condensers used. Any desired number of condensers may be employed.

Inasmuch as the input voltage is only one-third as much as the resultant specimen spark voltage, the potential does not have to be unduly high at 1 and insulation is therefore not a great problem. In prior devices of this type wherein the specimen spark voltage was the same as the input voltage insulation of these unduly high potentials constituted an expensive and elaborate undertaking. Now it is possible to obtain a specimen spark voltage within the desired range of 30,000 to 100,000 volts by only putting in a fraction of that amount. The condensers receive this fractional voltage in parallel and it is discharged in series under full control. Furthermore, transformers and rectifying equipment used in the source of supply need not be as expensive as with the type of circuit where no multiplication of voltage occurs.

As previously stated, either direct or alternating current may be used for charging the apparatus. With direct current no precise timing of the speed of the rotating gaps is required, although the maximum speed of rotation is limited by the values used for resistances 2, 3, 4, 6, 29 and 31 and for capacities of condensers 7, 8 and 9. With alternating current, as may be obtained directly from a transformer connected to the commercial supply, the motor 13 must be a synchronous motor in order to properly position the rotating gaps correctly with respect to the wave-form of the impressed voltage.

The electrical discharge of the gap 28 between the two samples 24 has proven under actual operation to be very desirable for spectrographic analyses work. The apparatus is not unduly expensive and is economically operated in conjunction with research or actual industrial performance.

I am aware that many details of construction may be varied throughout a wide range without departing from the principles herein described and I, therefore, do not propose limiting the claims otherwise than as necessitated by the prior art.

I claim:

1. An apparatus for causing electrical discharges between samples of a material comprising a circuit having a gap, a supply of electromotive force, a plurality of resistances arranged in a plurality of groups, the said groups of resistances being individually wired in series and jointly in parallel, a condenser in series with each of said groups of resistances and so arranged that resistances are on each side of the condensers in at least all but one of the groups, the said condensers having discharge terminals, a rotor intermittently in series with the condenser discharge terminals, a motor to rotate the said rotor, the said rotor and condenser discharge terminals having gaps therebetween, a resistance and an inductance in the circuit with the first said gap, the said circuit having an auxiliary gap whereby discharge of condenser charges is prevented until full capacity of the condenser charges is attained.

2. An apparatus causing electrical discharges between samples of an alloy comprising a circuit having a gap, a supply of alternating electromotive force, a plurality of inductances arranged in a plurality of groups, the said groups of inductances being individually wired in series and jointly in parallel with the said supply of E. M. F. condensers wired in series with the said groups of inductances whereby the said condensers are charge in parallel by the supply of E. M. F., the said condensers having discharge terminals, a rotor having electrodes thereon, a motor to rotate the said rotor, the said rotor electrodes and condenser discharge terminals having rotary gaps therebetween, whereby the said condensers are substantially fully charged they discharge in series through the said rotary gaps and through the first said gap, means for preventing said discharge until the condensers are substantially fully charged.

3. An apparatus causing electrical discharges between samples of an alloy comprising a circuit, a supply of alternating electromotive force, the said circuit having a spark gap, a plurality of condensers having discharge terminals intermittently connected in series with the said spark gap, a resistance connected to each side of all but one of said condensers, the said one remaining condenser having a resistance connected to one side, said resistances in turn connected in parallel with the said source of E. M. F., a rotor having electrodes synchronized with the input E. M. F., a motor for rotating said rotor centrally of the condenser discharge terminals, the said electrodes and terminals having gaps therebetween, whereby intermittent discharge in series of the charged condensers occurs at the said spark gap, an inductance and a resistance in the circuit with the spark gap, the said circuit having means for preventing the discharge until full condenser charges are attained.

4. An apparatus causing electrical discharges between samples of an alloy comprising a circuit, a supply of alternating electromotive force, the said circuit having a spark gap, a plurality of condensers intermittently connected in series with the said spark gap, an inductance connected to each side of all but one of said condensers, the said one remaining condenser having an inductance connected to one side, said inductances in turn connected in parallel with the source of E. M. F., a rotor having electrodes synchronized with the input E. M. F., a motor for rotating said rotor centrally of the said con-

denser discharge terminals, the said electrodes and terminals having gaps therebetween, whereby intermittent discharge in series of the charged condensers occurs across said spark plug, another inductance, a resistance and the circuit including an auxiliary gap in the circuit with the spark gap.

5. An apparatus for causing electrical discharges between samples of a material to be spectrographically analyzed, comprising a circuit having a gap, a supply of electromotive force, a plurality of resistances arranged in a plurality of groups, the said groups of resistances being individually wired in series and jointly in parallel,

a condenser in series with each of said groups of resistances and so arranged that resistances are on each side of the condensers, the said condensers having discharge terminals, a rotor intermittently in series with the condenser discharge terminal, a motor to operate the said rotor, the said rotor and condenser discharge terminals having rotary gaps therebetween, whereby the said first named gap and the rotary gaps are intermittently bridged when the condensers are substantially fully charged, means for preventing a discharge of the said condensers until such time as they are substantially fully charged.

STANLEY ANDERSON.