Jan. 31, 1956 F. OPPENHEIMER 2,733,346

ION PRODUCING MECHANISM

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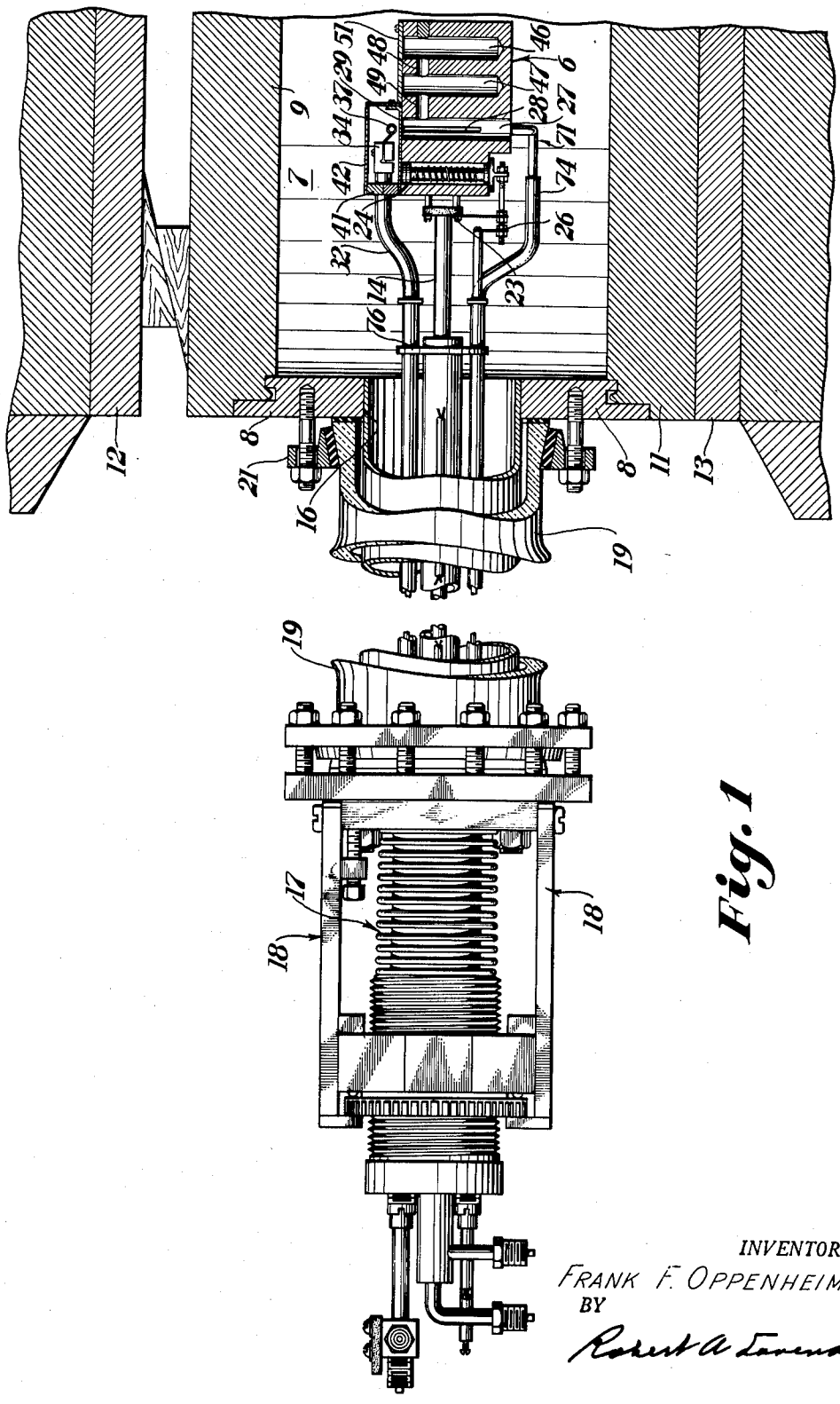


Fig. 1

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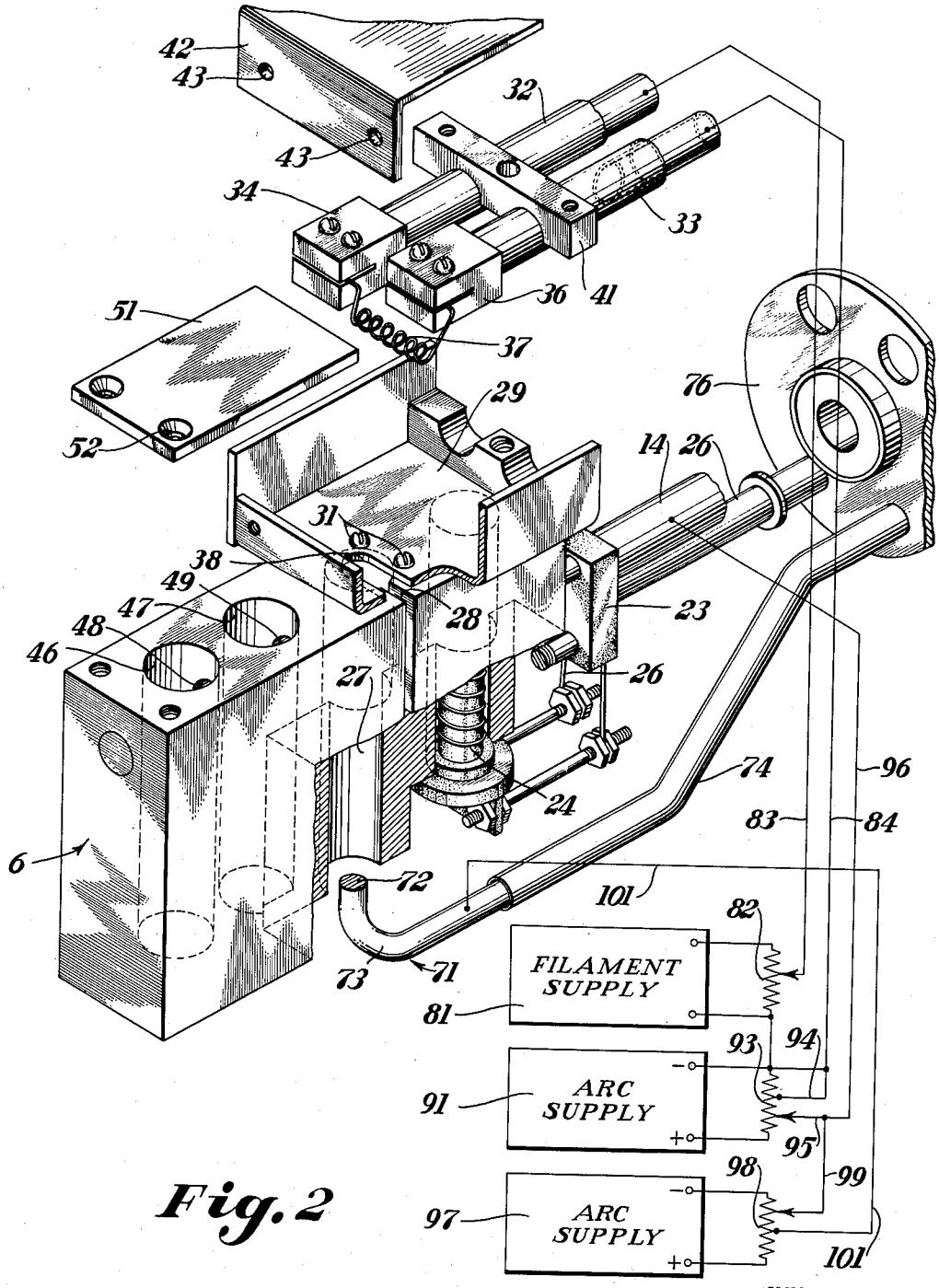


Fig. 2

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ION PRODUCING MECHANISM

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2 Claims. (Cl. 250—41.9)

The invention relates to ion producing mechanisms and especially to ion producing mechanisms of the type utilized in connection with a calutron, especially one of the type disclosed in the copending application of Ernest O. Lawrence, filed October 9, 1944, Serial No. 557,784, now Patent No. 2,709,222. The particular embodiment of calutron with which the present invention is most readily understood is disclosed in Figures 3 to 5 of the mentioned Lawrence application, to which reference is made for a detailed description of the structure and its mode of operation.

The structure incorporates means for ionizing a charge material to be processed, the means being in the nature of an electric arc operated within a magnetic field. A stream of gas or vapor is passed through and in the vicinity of the electric arc, and some of the gaseous particles are thereby ionized. An important consideration is to maintain the arc as uniform in its operation over a period of time as possible, and also to maintain the arc as uniform as possible throughout its length. The general aim is to produce as many ions as feasible with the structure employed, and any considerations that will add to the total ionization are highly desirable. All of the factors that govern or control the operation of an electric arc in a magnetic field are not fully understood nor explained in the literature, and it has therefore been necessary to develop changes and alterations in previous practices to augment the desired functioning of the structure. Some of these changes, while in some respects improving the operation of the arc, have not been feasible from the structural or electrical standpoint; and some of them, while perhaps satisfactory in connection with the arc, have produced secondary effects in the resulting ion stream which have overbalanced, because of their disadvantageous nature, the otherwise advantageous arc results.

It is, therefore, an object of the invention to provide means for improving an ionizing arc without simultaneously introducing secondary difficulties.

Another object of the invention is to improve the uniformity of the electric arc, both in time and throughout its length.

A further object of the invention is to provide means for readily controlling the conditions under which a calutron arc is operated.

A further object of the invention is, in general, to improve an electric arc operating in a magnetic field.

A still further object of the invention is, in general, to improve the operation of a calutron.

Other objects, together with the foregoing, are attained in the embodiment of the invention described in the following description and illustrated in the accompanying drawings, in which:

Figure 1 is a fragmentary view of a calutron, particularly disclosing in cross section on a vertical, axial plane an ion generating mechanism or "source," especially of the type shown in Fig. 4 of the mentioned Lawrence application; and

Fig. 2 is, for the most part, an exploded view, in isometric perspective, of the source block and associated mechanism shown in Fig. 1, with portions being broken away to expose the interior construction, and portions being shown diagrammatically to illustrate the electrical connections and circuits.

While a complete description of a calutron is contained in the mentioned application of Lawrence, the structure most pertinent to the present disclosure can be briefly characterized as follows. A calutron is inclusive of an ion source unit, generally designated **6**, disposed in the evacuated interior **7** of a tank defined by a side wall **8**, a top wall **9**, and a bottom wall **11**. The tank is situated in a magnetic field established between an upper pole piece **12** and a lower pole piece **13** of an electromagnet.

The source block **6** is electrically insulated from the tank wall **8** and is supported at the end of a mounting stem **14**, extending through an aperture **16** in the wall **8** of the tank and carried by a mounting and adjusting mechanism **17**. This latter mechanism forms no part of the present invention, and is therefore not described herein in detail. The mechanism **17** is in turn supported on a framework **18** fastened to an electrical insulator **19**, itself secured to the tank wall **8** by an appropriate fastening mechanism **21**.

As more particularly disclosed in Fig. 2, the inner end of the stem **14** is connected to the source block **6** by a thermal insulator **23**, as the block **6** itself is preferably fabricated of a thermally conducting material such as a metal, for example copper. Within the block **6** is disposed an electrical heating coil **24**, supplied with energy by a lead **26** passing through the insulator **19** to an exterior source of energy. Adjacent the heater **24**, in thermally conducting relationship therewith, is a gas distribution chamber **27**, constituted by a cavity within the block **6** and having an outlet passage **28** to the interior of the tank **7**.

Closing the upper end of the heater cavity **24** and the upper end of the gas distribution cavity **27** is a cover plate **29**, secured by fastenings **31** and forming a support for a pair of filament leads **32** and **33** extending through the insulator **19** to a source of energy and terminating in grips **34** and **36** holding a filament **37** over an aperture **38** in the plate **29** and in registry with the passage **28**. A securing block **41** holds the filament leads **32** and **33** in position, while the enclosure of the filament is completed by a cap plate **42**, removably positioned by fasteners operating through cap plate apertures **43**.

For supplying the gas distribution chamber **27** with a vapor or gas to be subsequently ionized, the block **6** is provided with a pair of cavities **46** and **47**, each of cylindrical form and extending almost but not quite entirely through the metal of the block, so that heat from the source **24** is conducted to the walls of each of the cavities **46** and **47**. The cavities communicate with the chamber **27** through outlet apertures **48** and **49**, respectively, so that gas flow from both chambers **46** and **47** to chamber **27** is readily effected. The two chambers **46** and **47** are simultaneously closed by a cover plate **51**, preferably held removably in position on the block **6** by fastenings operating through apertures, such as **52**, in the top plate **51** and in the block **6**.

The present invention more especially contemplates the provision, as a member entirely separate and physically distinct from the source block **6**, of an anode **71**, simply formed by the inturned end **72** of an electrical conducting rod **73**. The end **72** is in substantial alignment in the magnetic field with the filament **37**, and has an area that, while not precisely equal to, is still directly comparable to the effective emitting area of the filament **37**. Thus, an arc struck from the filament **37** to the end **72** of the anode passes directly through the ionizing chamber **27** from one end thereof to the other.

The anode rod 73 extends through an insulating jacket 74, through a mounting plate 76 and through the supporting structure 17 to the exterior of the evacuated chamber 7, so that it can appropriately be included in an electrical circuit also incorporating the filament leads 32 and 33 and the stem 14 of the arc block 6.

The circuit and connections, as diagrammatically illustrated in Fig. 2, include a filament supply 81 of any sort capable of affording a source of electric current at a suitable voltage to supply the filament 37 for heating the filament to electron emitting temperatures. Preferably, the circuit includes a potentiometer 82, connected to leads 83 and 84 respectively joined to the filament leads 32 and 33, so that by adjusting the position of the potentiometer 82 the power supplied to the filament is carefully regulated.

In addition, the electrical supply includes also an arc power supply 91 of any suitable type, for furnishing current at a suitable voltage to maintain an arc between the filament and the anode. There is included a potentiometer 93, having a connection 94 to the lead 84 and having a variable connection 95 to a lead 96 extending to the support stem 14 of the source block 6. By suitable regulation of the potentiometer 93, the potential of the block 6 with respect to the filament can be controlled.

For supplying the anode, the arc supply 91 also includes a source 97 of power, provided with a potentiometer 98 connected by a variably positioned lead 99 to the lead 96 and also by a lead 101 to the anode rod 73, so that the potential of the anode with respect to the arc block 6 and with respect to the filament can be established at any value desired.

With this electrical arrangement, it is possible, outside of the vacuum chamber 7 and by suitably adjusting the potentiometers 82, 93, and 98, to establish any desired potential differences between the filament, the arc block, and the anode, respectively. This includes, as well, the desired potential difference between the filament and the anode. Stated differently, it is possible to establish the desired potential difference between the filament and the anode and to establish the arc block at a potential either the same as that of the filament or the anode, or at a different potential than that of the filament or the anode. By appropriately adjusting the potentiometers, conditions for the production of an optimum arc can readily be established without producing any deleterious secondary effects, and without unduly complicating the structure.

It has been found in practice that under different conditions of operation, depending somewhat upon the pressures existing within the vacuum chamber 7, depending somewhat upon the temperatures at which the source block is operated, and perhaps on other factors, that it is sometimes beneficial to operate the anode 73 at a potential somewhat different from that of the arc block; whereas at other times, usually during the major part of the continuance of a run, it is preferable to operate the anode and the arc block at substantially the same, or precisely the same, potential. With the disclosed structure, such adjustments and operating characteristics can readily be established, so that the general operation of the calutron structure is, in accordance with the invention, considerably improved.

What is claimed is:

1. An ion generator for a calutron comprising an arc block having an ionizing chamber therein open at both ends and a slot in one wall thereof extending from one end substantially to the other end, an electron emitting surface disposed adjacent said block to overlie one end of said chamber and said slot, an anode disposed at the other end of said chamber, means connected to said surface for rendering the same electron emissive, means connected between said surface and said block for maintaining an arc therebetween along the length of said slot, and means connected between said surface and said anode for maintaining an arc through said chamber.

2. An ion generator for a calutron comprising an arc block having an ionizing chamber therein open at both ends and a slot in one wall thereof extending from one end substantially to the other end, a filament disposed adjacent said block to overlie one end of said chamber and said slot, a plate having an elongated aperture disposed between said filament and block for defining the communicating area therebetween, an anode disposed at the other end of said chamber, a first adjustable power supply connected across said filament for rendering the same electron emissive, a second adjustable power supply connected between said filament and said block for maintaining an arc therebetween along the length of said slot, and a third adjustable power supply connected between said filament and said anode for maintaining an arc therebetween through said chamber.

References Cited in the file of this patent

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