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APPARATUS FOR PRODUCING EXTREMELY FAST CORPUSCULAR RAYS

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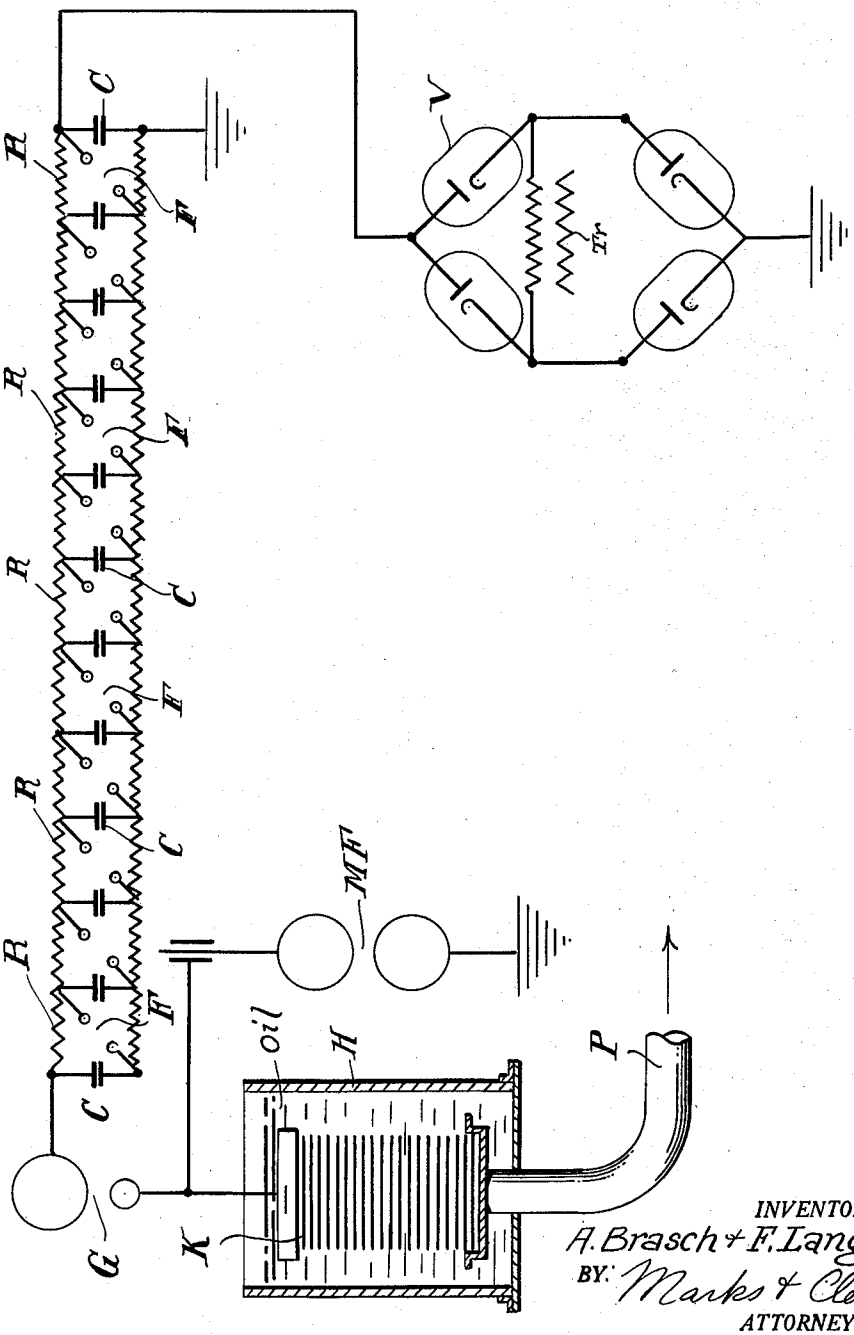

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APPARATUS FOR PRODUCING EXTREMELY FAST CORPUSCULAR RAYS

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2 Claims. (Cl. 250—34)

This invention relates to a method of producing extremely hard X-rays, and to electrical discharge vessels employed for this purpose. This application forms a continuation-in-part of our copending application Ser. No. 469,654, filed on July 21, 1930.

More particularly, the invention resides in a novel method of operating these discharge vessels for the purpose of accomplishing the result in question.

For the purpose of the invention it is necessary to make use of extremely high potentials, and in association with electrical discharge tubes high potentials are frequently accompanied by undesirable auxiliary or leakage discharges. In the present instance the potentials concerned are assumed to be of considerably more than 200,000 volts, and in particular to amount to one or several million volts. Heretofore a reliable and safe method of suppressing the discharges referred to has not been found.

On the other hand a method of generating high potentials of the order above stated has been known for a long time in the art under the name of the "Marx connection". It has, however, not seemed possible heretofore to make use of these high potentials for the operation of electrical discharge tubes.

Accordingly, it is the primary object of this invention to provide a method which will enable electrical discharge vessels to be operated with very high potentials.

A further object is to permit of the operation of electrical discharge vessels with the high potential system according to Marx.

Other objects and advantages of the invention will become apparent as the description proceeds.

Now we have found that the disturbing auxiliary or leakage discharges do not take place immediately after application of the potential, and that these require a certain length of time to form. This may amount to perhaps 10^{-3} seconds. The auxiliary or leakage discharges apparently emanate from the unavoidable residual traces of gas contained in the vessel, the walls and the electrodes.

As a normal way of overcoming this difficulty and preventing the discharges in question, it might appear feasible to conduct the outgassing operation up to a greater extent than has heretofore been usual.

We have found, however, that much more satisfactory results may be obtained at considerably less expense if the discharge period is made to be so short that the disturbing auxiliary discharges are unable to occur. A sufficient interval requires to be included between the single discharges, and the discharge vessel is accordingly operated by means of single potential impulses of brief duration.

For producing these single impulses there is preferably employed an impulse potential system, which is known generally as the "Marx connection system", this being selected for the purpose of illustrating a possible method of putting the invention into effect. Obviously, however, the invention is not limited to this system alone, and the same consists broadly in operating an electrical discharge vessel by means of single impulses which are of such brief duration that auxiliary discharges do not have sufficient time to develop. The rise in potential may take place over a period of, say, 10^{-8} seconds, and the full potential applied to the tube for, say, 10^{-7} to 10^{-3} seconds, followed by an interval.

In order to illustrate the tube circuit which will perform the method as claimed, there is attached hereto a diagrammatic drawing. The following description of the drawing is made: The condensers C are charged in parallel over the resistances R. Direct current is used for the charge. The high potential from the transformer Tr is rectified in the hot cathode valves V (hot cathode valve rectifier). When the first condenser C is sufficiently charged, a spark will jump over the first spark gap at F, and since the condensers C are connected in series, the spark at each succeeding gap F will increase in strength and the total voltage will thus increase in accordance with the number of condensers in the series.

During the short time required the high potential does not pass over the resistances R, which act like a choke for the impulse potential. G is the main spark gap, which prevents the direct current with which the condensers are charged, from flowing to the discharge tube K during the entire charging period. It is only during the high potential impulse that the spark will jump the gap G and discharge the entire condenser load into the tube K. The vacuum tube K, which is laminated or made up of a series of alternately disposed insulating and metallic discs, is placed in an oil vessel H to prevent a discharge over the outer walls of the tube K. MF are balls for measuring the potential of the tube. The laminated discharge tube K may be evacuated through the medium of the pipe P.

The form of operation as described may also be made use of in those cases, in which the rapid electrons or ions occurring in the discharge

tube are employed in direct fashion. The X-rays produced in accordance with the invention are particularly adapted for lighting through very thick layers of metal, and the rapid electrons are extremely suitable as a means for treating cancer.

The new method according to the invention provides numerous advantages. In particular, the Marx connection permits of the use of currents of such intensity that generally speaking one single impulse is sufficient for lighting purposes or for producing the desired biological effect.

Moreover, the discharge vessel, if operated in accordance with the invention, does not require to be highly evacuated, and a vacuum will be found sufficient such as may be obtained, for example, with the assistance of rotary oil pumps.

What we claim as new and desire to secure by Letters Patent is:

1. In a system for producing extremely fast corpuscular rays, a discharge tube, several spark gaps, condensers and resistances, the spark gaps and condensers being alternately connected in series and each condenser and adjacent spark gap being bridged by a resistance, means for charging said condensers connected to one end of the series and means for discharging said condensers connected to the other end of the series and to the tube, said latter means including a spark gap so dimensioned as to break down at voltage much higher than the charging voltage for the single condensers.

2. In a system for producing extremely hard X-rays, an X-ray tube, several spark gaps, condensers and resistances, the spark gaps and condensers being alternately connected in series and each condenser and adjacent spark gap being bridged by a resistance, means for charging said condensers connected to one end of the series and means for discharging said condensers connected to the other end of the series and to the tube, said latter means including a spark gap so dimensioned as to break down at voltage much higher than the charging voltage for the single condensers.

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