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MAGNETRON

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Fig. 1

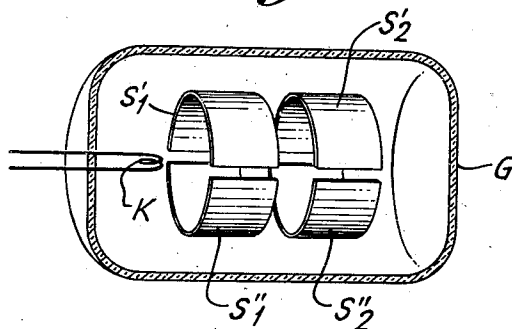
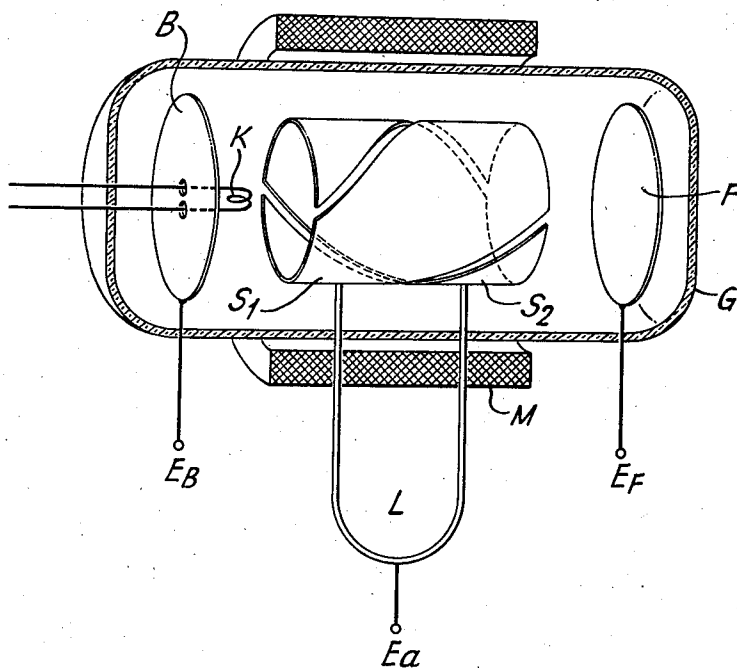


Fig. 2



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MAGNETRON

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3 Claims. (Cl. 250—27.5)

My invention relates to electron discharge de-
vices of the so-called magnetron type in which
the electrode system of the device is subjected
to a magnetic field during the operation of the
device.

Various magnetron tubes have of late been
evolved and disclosed in which one or two
cathodes are disposed outside the anode cylinder
in order to protect the cathodes from the extra
heating caused by electrons returning thereto.
In one form of such tubes, the conventional form
of magnetron has been preserved so far as the
construction and arrangement of the anode is
concerned; that is to say, the anode cylinder
may be closed upon itself or else be split into
two, three or more segments which, individually
or combined into groups, are associated with a
suitable oscillatory circuit, for example, a Lecher-
wire system. Another form of tube having ex-
ternal cathodes has a cylindrical anode (or anode
cylinder) subdivided not into segments parallel
to the axis, but by sections at right angles to
the axis to result in two or more rings also united
into groups. Inasmuch as in these two types of
tube, the electrons travel along spiral paths from
the cathode into the interior of the anode cyl-
inder, it is possible in one case by slit-fields par-
allel to the axis as well as in the other case by
means of concentric fields to obtain delivery of
energy at the rhythm or rate of the rotation fre-
quency or multiples thereof.

Fundamentally speaking, it would be self-sug-
gesting to combine these two actions in a tube
schematically illustrated in Figure 1 by subdivid-
ing the anode cylinder both into segments as well
as into rings so that there results a magnetron
tube comprising a great number of segments as
indicated at S_1' , S_1'' , ..., S_2' , S_2'' , etc. How-
ever, it will be readily understood that the at-
tempt to excite all of these different segments in
phase or in phase opposition and to connect them
together in a suitable way so as to result in two
groups excited in phase must encounter serious
difficulties, for the reason that the exciting fre-
quencies to be considered for both modes of sub-
division can be made equal only with great diffi-
culties, and also on the ground that the compli-
cated connection of such a great number of ele-
mentary segments, where ultra-high frequencies
are concerned, could never be free from disturb-
ing secondary actions, primarily because of the
inductances of criss-crossing connecting wires.

The object of my invention is to provide an
electron discharge device of the magnetron type

of novel construction and having improved char-
acteristics.

According to the invention, simultaneous sub-
division or splitting in directions parallel to the
axis and at right angles thereto is effected by
dividing the anode cylinder into two or more
helical segments by a helical split, the ensuing
divisions or segments in the usual manner being
connected with one another and with an oscil-
latory circuit. By such a step the electrons along
their spiral paths will repeatedly encounter split
fields in the presence of a substantially perpen-
dicular field and of the same rhythm, provided
that the pitch of the helical splits is adapted to
the operating conditions, in other words, to the
magnetic and the electrical field intensity.

A practical exemplified embodiment of a tube
as here disclosed is illustrated in Figure 2 in
schematic form, the tube being provided with
two helical anode segments S_1 and S_2 . The
cathode K is mounted at the left-hand end of
the anode cylinder. This cathode is rearwardly
shielded by means of a flat disc shield B. The
open opposite end of the anode cylinder is closed
by the disc electrode F, which, if desired, may be
impressed with a constant, positive auxiliary po-
tential, and which is adapted to adjust the axial
component of the motion of the electrons, that
is, in the presence of a given magnetic field in-
tensity, the pitch of the helical movement. The
anode cylinder, in a way as hereinbefore ex-
plained, is divided by means of two helical splits
extending in a sense contrary to the rotational
motion of the electrons, into two segments S_1
and S_2 both of which are connected with a suit-
able resonance circuit, say, an inductance clip
or loop L. An electromagnetic coil M produces
a magnetic field within the space surrounded by
said anode segments and parallel to the longi-
tudinal axis of said segments. Inasmuch as the
time of rotation or circulation of electrons in-
side a homogeneous magnetic field, as well known,
is always the same, it follows that the helical
split field will always be traversed by electrons
at the same rhythm; in other words, the seg-
ments at all points are excited at the same fre-
quency. It will, of course, be understood that
the helical splitting could be effected by three,
four, or more segments rather than in two; and
just as in the conventional magnetron tube, the
connection thereof may be in pairs or in groups
with segments placed parallel to the axis. In
order that natural oscillations of the compara-
tively long helical segments may be prevented, it
is preferable to connect the same at a number

of points by bridging clips. On the contrary, however, the segments could be used to act also as an oscillatable resonance system though in such case care must be taken so that standing waves will be set up along the segments. However, all of these steps are well known with the conventional magnetron tube, and they may similarly be adopted in connection with the tube here disclosed without the necessity of more detailed explanation.

It goes without saying that, as to the rest, all such ways and means as are conducive to improved conditions of excitation in connection with other types of tubes could be applied also to the tube here disclosed having helical splits. More particularly, the performance and efficiency of the tube is increasable by providing two cathodes, one mounted at each end of the anode cylinder, without the basic idea of the invention, namely, to provide a helical split of the anode cylinder, experiencing any basic alteration. Moreover, as disclosed in connection with standard external cathode tubes, it is possible to mount in the axis of the discharge system a non-emissive cathode, say, in the form of a rod connected with the cathode proper, to the end of thereby insuring more symmetric voltage conditions.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the

purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

What I claim as new is:

1. An electron discharge device having an envelope containing a cathode and an anode comprising a pair of segments provided with helical gaps between said segments, said anode segments being displaced longitudinally of said cathode, and means for producing a magnetic field within the space surrounded by said anode segments and parallel to the longitudinal axis of said anode.

2. An electron discharge device having an envelope containing a pair of anode segments having helical gaps therebetween, a cathode positioned at one end of said anode segments, an electrode positioned at the other end of said anode segments and adapted to have a positive potential applied thereto and means for producing a magnetic field within the space surrounded by said anode segments and parallel to the longitudinal axis of said segments.

3. An electron discharge device having an envelope containing a pair of anode segments having helical gaps therebetween, a cathode positioned at one end of said anode segments, an electrode positioned at the other end of said anode segments and adapted to have a positive potential applied thereto and means for producing a magnetic field within the space surrounded by said anode segments and parallel to the longitudinal axis of said segments, and a shielding device positioned on the other side of said cathode from said anode segments.

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