Jan. 30, 1968 W. SCHMIDT 3,366,904

HIGH-POWER MULTI-STAGE KLYSTRON WITH ADJUSTABLE PERIODIC MAGNETIC FOCUSSING

Filed Dec. 14, 1965 3 Sheets-Sheet 1

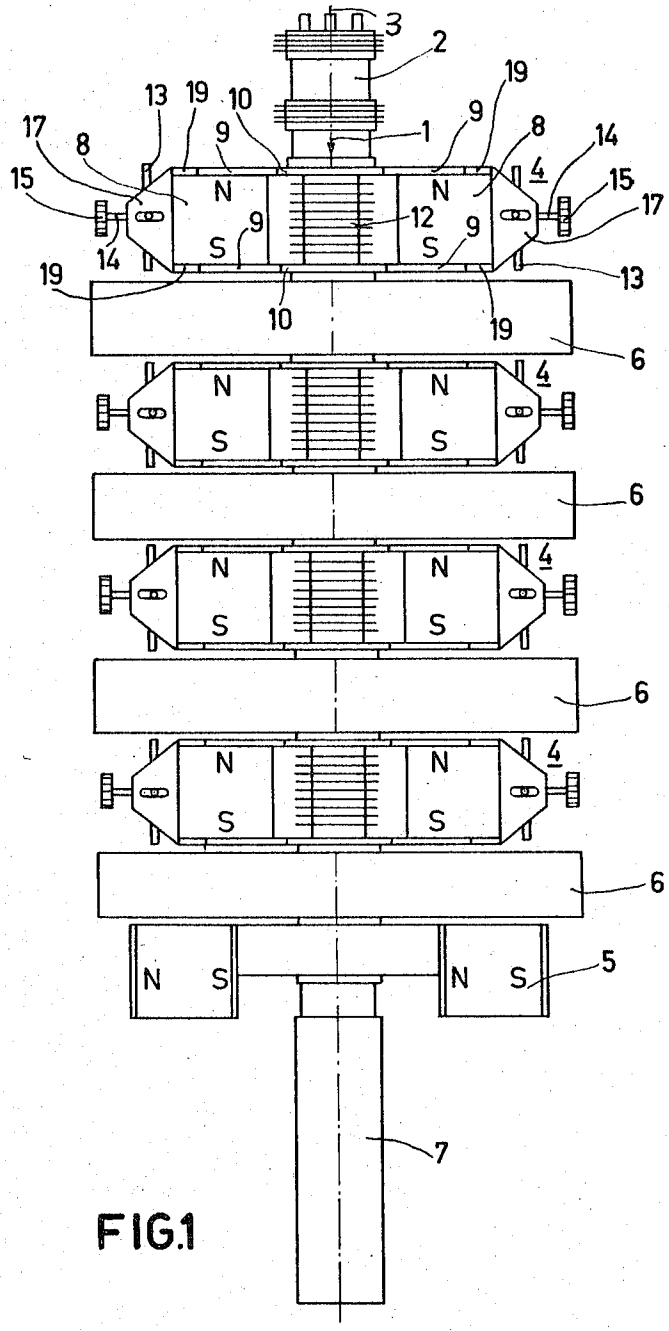


FIG.1

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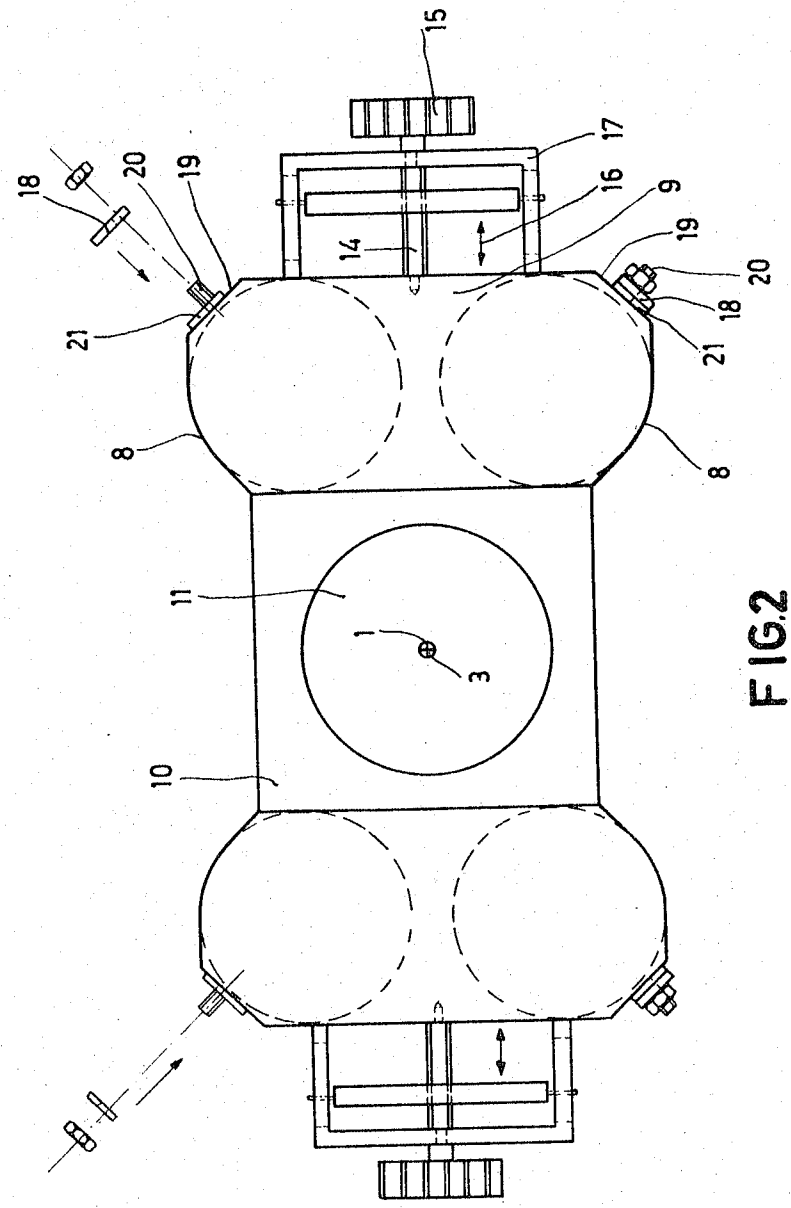


FIG.2

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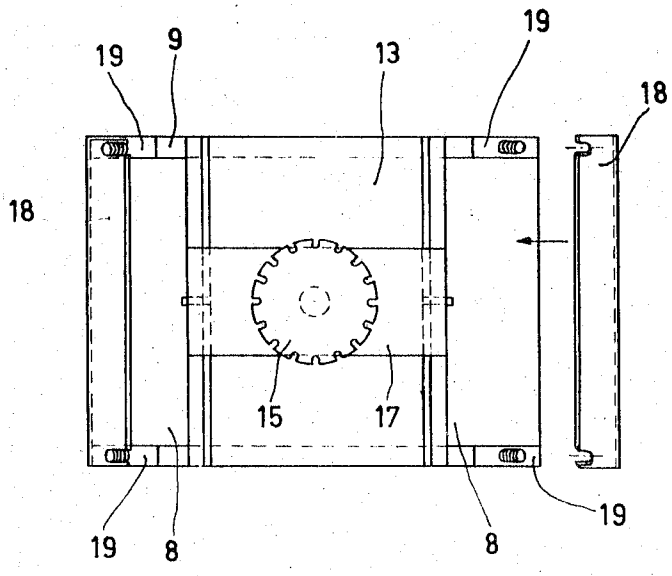


FIG.3

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HIGH-POWER MULTI-STAGE KLYSTRON WITH ADJUSTABLE PERIODIC MAGNETIC FOCUSSING

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3 Claims. (Cl. 335—211)

ABSTRACT OF THE DISCLOSURE

A klystron employing periodic magnetic focussing of the electron beam in which the magnet systems for focussing the electron beam include adjustable magnetic shunts for most efficient operation at a given potential of the beam.

This invention relates to high power multistage klystrons comprising a plurality of unidirectional permanent magnetic systems which together produce a spatial periodic magnetic field for focussing the electon beam and which include adjustable magnetic shunts.

In such magnetic systems magnetic fields are produced along the axis of the electron beam within the permanent magnetic systems and oppositely directed fields are produced between the permanent magnetic systems. The strength of the magnetic fields required for the most efficient operation at a given potential of the beam is adjusted by means of magnetic shunts. Since the shunts must be accurately adjustable, they can govern only a small range of the operating voltages of such a klystron.

An object of the invention is to provide a construction in which matching to a large range of voltages may be obtained in a simple manner.

According to the invention, in a high power multistage klystron having a plurality of unidirectional permanent magnetic systems which together produce a spatial periodical magnetic field for focussing the electron beam and which include adjustable magnetic shunts, each shunt comprises a fixed portion and a continuously adjustable portion. The voltage range in which the tube can operate may be determined by the fixed portion and the correct matching is obtained with the adjustable portion of the shunt. The fixed portion of the shunt is realized as a plurality of parts one or more of which may be omitted, or the parts of the shunts are exchangeable for parts of other magnetic reluctance or again the fixed parts are connected to the magnetic system leaving a certain air-gap. It is thus achieved, that the fine adjustment of the magnetic field over the whole range of voltages of the klystron is retained.

The invention will now be described with reference to the accompanying drawing in which:

FIG. 1 shows a klystron comprising magnetic system according to the invention;

FIG. 2 is a view in the axial direction and,

FIG. 3 a side view thereof.

In FIG. 1, an electron beam **1** emerging from a prefocussing system and extending along an axis **3** is indicated by an arrow. The focussing system comprises a plurality of identical axial magnetic systems **4** and a single system **5** comprising magnets magnetized in the radial direction. The magnetic systems **4** and **5** are separated by resonant cavities **6** of the klystron and a collector **7** lies externally of the system **5**. The magnetic systems (see FIGS. 2 and 3) each comprise four axially directed, magnetically parallel columns **8** of ceramic permanent magnetic material. The columns **8** are connected through soft-magnetic yokes **9** to pole pieces **10**. The pole pieces **10** have circular apertures **11** which surround travelling spaces **12** of the klystron. The pole pieces **10** produce between said travelling spaces periodic magnetic fields directed along the axis **3** of the klystron. Soft-magnetic plates **13** are arranged at a short distance from the yokes **9** for the fine adjustment of the magnetic fields, said plates being adjustable in directions indicated by arrows **16** by means of screw spindles **14** provided with knobs **15**. The screw spindles **14** are supported in non-ferromagnetic caps **17**. The control range of the plates **13**, which is only small, is adjusted by means of strips **18** of soft-magnetic material which adjoin faces **19** of the yokes **9** and are secured thereto by threaded bolts **20**. The strips **18** and the faces **19** are separated by plates of non-ferromagnetic material, for example, aluminum, or these plates may be omitted.

A wide choice in the region of adjustment of the magnetic field in which the plates **13** bring about the fine adjustment is possible by suitable choice of the cross-section of the strips **18**, the number thereof and the thickness of intermediate layers **21**.

What is claimed is:

1. A high power multistage klystron comprising a plurality of unidirectional permanent magnetic systems which together proudce a spatial periodic magnetic field for focussing an electron beam and which include adjustable magnetic shunts, each of said shunts comprising a fixed portion and a continuously adjustable portion.

2. A multistage klystron as claimed in claim **1**, characterized in that the fixed portion of a shunt comprises a plurality of changeable parts.

3. A multistage klystron as claimed in claim **1** characterized in that the magnetic systems and the fixed shunts are separated by non-ferromagnetic material.

References Cited

FOREIGN PATENTS

953,268 3/1964 Great Britain.

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