Aug. 12, 1958 E. O. LAWRENCE 2,847,576

CALUTRON SYSTEM

Filed Jan. 16, 1946 2 Sheets-Sheet 1

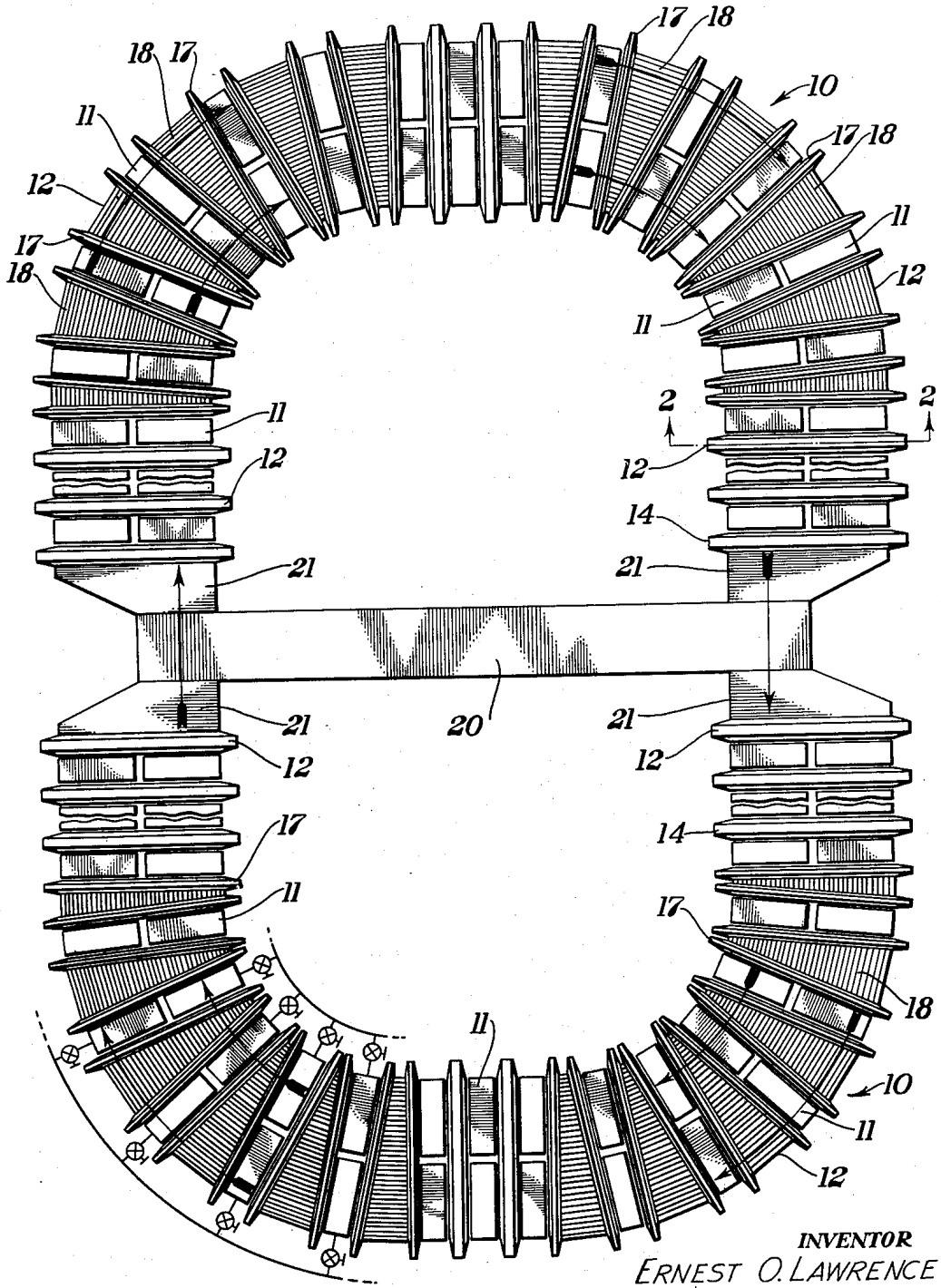

Fig. 1

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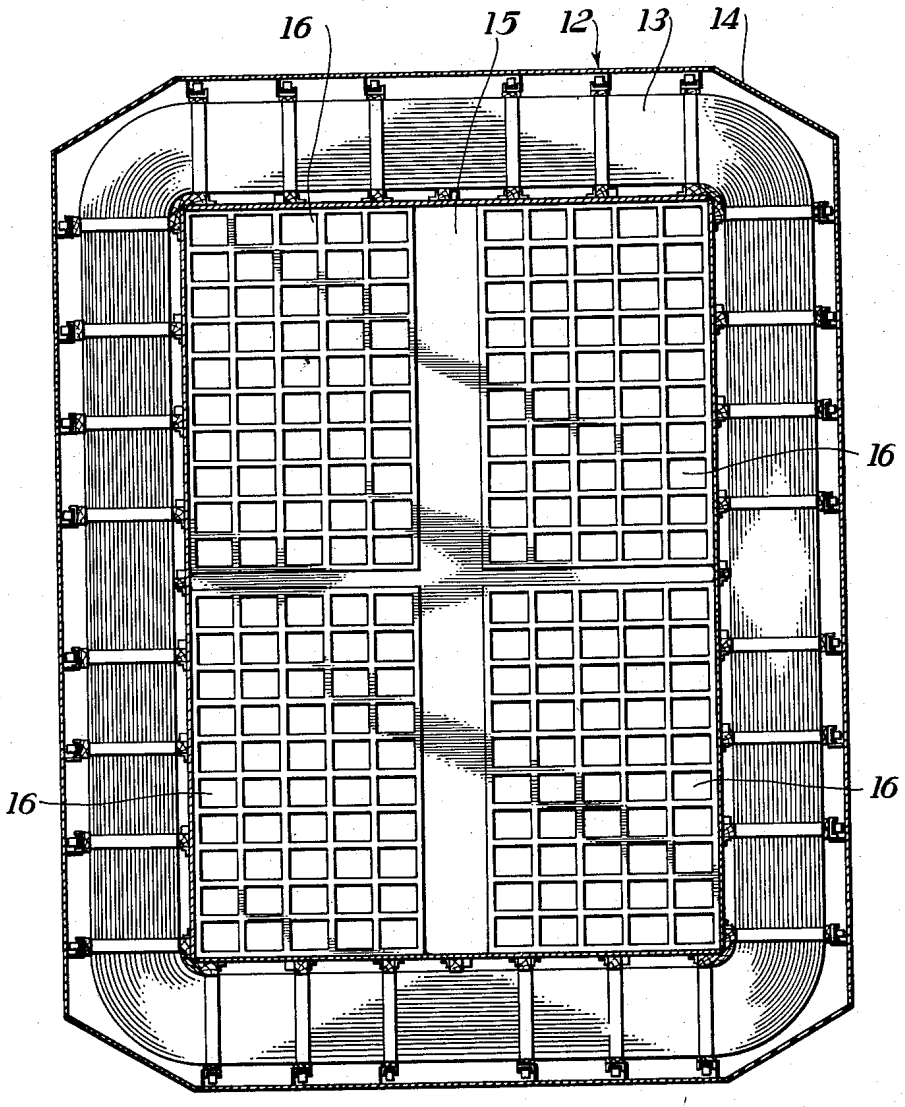

Fig. 2

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CALUTRON SYSTEM

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5 Claims. (Cl. 250—41.9)

The present invention relates to apparatus for effecting separation of isotopes of a polyisotopic element by electromagnetic means and more particularly to a system comprising a plurality of individual devices arranged so that a portion of the devices may be rendered inactive without interrupting the operation of the remainder.

An apparatus of this type is termed a calutron, and for a complete description of the same, reference is made to my U. S. Patent No. 2,721,272 which issued on October 18, 1955.

For the purpose of the present disclosure, it is sufficient to note that a calutron comprises essentially an evacuated vessel or tank located in a strong, substantially uniform magnetic field. Within the tank are provided an ion beam transmitter and receiver. The ion beam transmitter comprises essentially an ionization chamber wherein a charge material as, for example, uranium is ionized, and accelerating electrodes defining an exit slit therebetween carried at a high negative potential with respect to the ionization chamber, whereby positive ions are withdrawn from the chamber and transmitted in a narrow beam through the slit into the tank in a direction normal to the magnetic field. These ions, under the influence of the magnetic fiield, follow circular arcs, and different isotopes of the material, due to their different mass, follow arcs of different radii. The ion receivers are positioned to receive and effect selective collections of one or more of the different isotopes.

It is inherent in a calutron that only relatively small amounts of material can be handled in a single tank, and to effect separation of commercial quantities of isotopes it has been the practice to employ a large number of calutrons in a single system. I have disclosed in my prior related patent identified above an efficient system in which a large number of tanks are disposed in a closed series providing a closed magnetic path for a magnetic field set up by electromagnets interposed between adjacent tanks. Preferably the series of alternated tanks and magnets is arranged in a regular manner as, for example, a racetrack formation in which two long straight parallel series are joined at their ends by arcuate series of tanks and magnets.

In a racetrack of this type there may be as many as several hundred individual calutron tanks, all traversed by a strong magnetic field. As will be apparent, it may often be desirable to operate only a portion of the calutron units, and the present invention contemplates means which provide a closed magnetic path through only a portion of the tanks in a series. This means takes the form of a mid-yoke which in the case of a racetrack arrangement may conveniently extend across the racetrack substantially midway between its ends. When all of the magnets in the racetrack are energized, the magnetic path extends around the racetrack and no appreciable amount of flux extends through the mid-yoke. When, however, only the electromagnets in a portion of the racetrack lying at one side of the mid-yoke are energized, a complete magnetic circuit is provided for this portion of the racetrack through the mid-yoke, and no substantial amount of flux extends through the balance of the racetrack.

While mention has been made of the desirability of thus sectionalizing a racetrack so as to permit one portion thereof to be operated independently of the rest, another advantage follows if the mid-yoke is positioned such that the racetrack is divided thereby into two unequal portions. For example, the track may be divided into two portions including respectively one-third and two-thirds of the total number of tanks. This permits operation of the system at one-third, two-thirds, or full capacity simply by energizing the appropriate electromagnets.

With the foregoing general description of my improved calutron system in mind, it is an object of the present invention to improve the efficiency of operation of a calutron system by permitting operation of a predetermined portion thereof while the remainder of the system may be shut down.

More specifically, it is an object of the present invention to provide a calutron system comprising a closed series of alternated tanks and electromagnets having a mid-yoke connecting intermediate positions of said series dividing said series into two portions and adapted to provide a closed magnetic path through either of said portions.

Other objects will become apparent as the description proceeds especially when taken in conjunction with the appended drawings, in which:

Figure 1 is a schematic plan view of a calutron system embodying the present invention, and

Fig. 2 is a section on the line **2—2**, Fig. 1.

Referring first to Fig. 1, I have illustrated at **10** a racetrack shape closed series of alternated tanks **11** and electromagnets **12**. Electromagnets **12**, as better illustrated in Fig. 2, each comprises windings **13** enclosed within a winding case **14**, and surrounding a core **15** which is illustrated as made up of honeycombs or grids **16** in order to conserve material and avoid unnecessary weight in the installation. The electromagnets located in the curved portions of the track each comprises a pair of windings, each in a separate winding case **17**, arranged angularly with respect to each other and having a portion of its wedge-shaped core **18** exposed between the winding cases **17**.

The mid-yoke **20**, as illustrated in Fig. 1, comprises a beam or similar structure of iron of sufficient cross section to carry the required magnetic flux without approaching saturation. In order to prevent distortion of the magnetic field in the tanks **11** adjacent to the mid-yoke, electromagnets **12** are provided next adjacent to the ends of the mid-yoke **20**. As illustrated, the mid-yoke **20** includes end portions **21** shaped to provide a convenient path for the flux passing through either portion of the series of tanks and magnets, and for this purpose constitutes in effect an extension of the cores of the magnets adjacent its ends.

It will be appreciated that when all magnets are energized, there is no substantial electromotive force tending to pass flux through the mid-yoke **20**. However, when the magnets of either portion of the track between ends of the mid-yoke **20** are energized, and the magnets in the other portion are not energized, the mid-yoke will serve to complete the magnetic circuit through the portion of the track containing the energized magnets.

It will be understood, of course, that the circuits for the magnet coils are arranged so as to permit selective energization of the groups of magnets in either portion of the track between opposite ends of mid-yoke **20**, or to permit energization of the magnets in both groups simultaneously. It will further be understood that the windings of all magnets are arranged so as to set up a

continuous flux extending around the track, as for example in the direction of the arrows in Fig. 1.

While I have illustrated and described a preferred form of my improved calutron system in considerable detail, it will be understood that the purpose of the specific disclosure is merely to enable those skilled in the art to practice my invention, the scope of which is indicated by the appended claims.

What is claimed is:

1. A calutron system comprising a closed series of alternated tanks and electromagnets, said tanks enclosing electromagnetic isotope separating means, and a yoke section spanning said closed series so as to provide a complete magnetic circuit through only a portion of said tanks, while the magnets alternated with the remaining tanks may be de-energized.

2. A calutron system comprising a series of alternated tanks and electromagnets arranged in a closed geometric figure, said tanks containing electromagnetic ion separating mechanism, and a mid-yoke spanning said figure and connected at each end into the series between adjacent

electromagnets, said mid-yoke dividing said series into two independently operable sub-series.

3. A calutron system comprising a series of alternated tanks and electromagnets arranged in a closed geometric figure, said tanks containing electromagnetic ion separating mechanism, and a magnetic member extended diametrically of said figure, said member having enlarged end portions disposed between adjacent electromagnets.

4. A calutron system comprising a first and a second series of alternated tanks and electromagnets, each of said series beginning and ending with an electromagnet, a first magnetic element disposed between one end of each of said series, a second magnetic element disposed between the other end of each of said series to form a closed figure, and a magnetic yoke disposed between said elements to complete a magnetic circuit therebetween.

5. The combination of claim 1 wherein the electromagnets comprise a magnetic core having a grid structure and a winding disposed around the perimeter of said core.

No references cited.