Dec. 13, 1955 W. M. POWELL 2,727,190

CALUTRON

Filed March 22, 1946

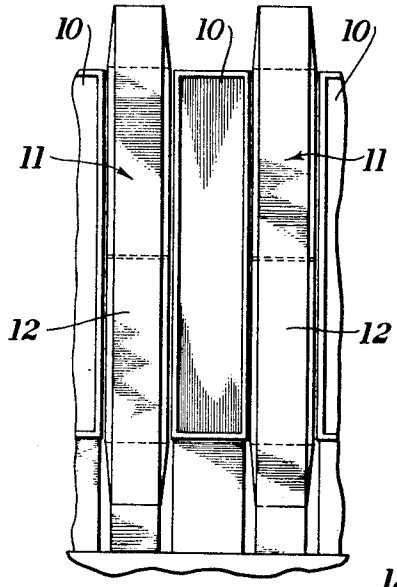


FIG. 1

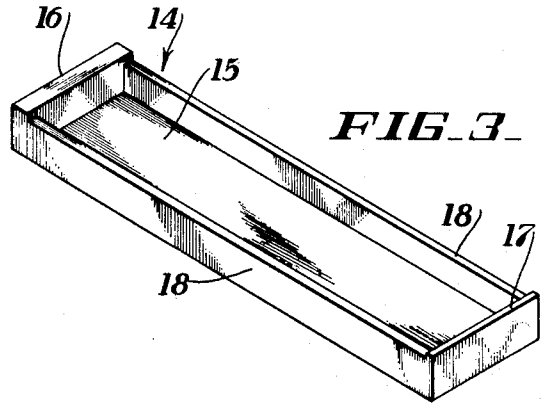


FIG. 3

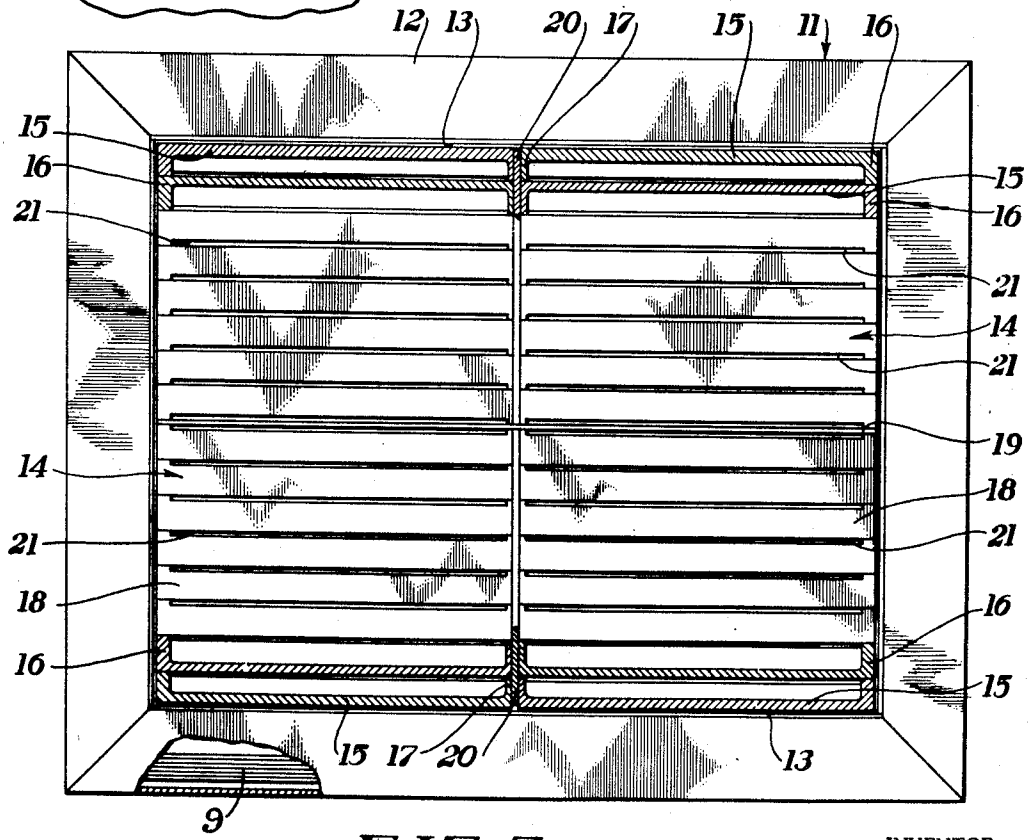


FIG. 2

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CALUTRON

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7 Claims. (Cl. 317—158)

The present invention relates to calutrons, a term applied to electromagnetic apparatus for separating ions of polyisotopic elements, and more particularly to magnets employed in setting up the magnetic field required in such calutrons.

For a complete description of the basic elements and theory of calutrons, and a description of a calutron system in which my invention finds its greatest field of utility, reference is made to application Serial No. 571,420, filed January 5, 1945, by Ernest O. Lawrence and now Patent No. 2,709,222, issued May 24, 1955. It is sufficient for present purposes to note that a calutron comprises essentially an evacuated tank or vessel, located in a strong, substantially uniform magnetic field, and containing an ionizing chamber, wherein the element whose isotopes are to be separated is ionized, accelerating electrodes for projecting a beam of ions transversely of the magnetic field, and a receiver for receiving and collecting one or more isotopes of said element after the magnetic field has caused them to complete substantially 180° of arcuate travel with consequent separation as a result of mass differences.

As disclosed in the application identified above, significant economies and improved ease of operation follow arranging the tanks and magnets in a closed figure, in which the tanks and magnets are alternated. Thus a closed path for the magnetic flux is provided, and the necessity for a return yoke is avoided.

In the copending application of Leslie O. Waite, Serial No. 641,617, filed January 16, 1946, it has been proposed to form the cores of electromagnets used in such calutron systems of a nonsolid structure, with consequent economies of weight and material.

Specifically, the present invention represents an improvement of the Waite application identified above. In the present construction, the magnet coils are arranged to provide generally rectangular core openings, which in the case of large magnets may be subdivided by suitable horizontal and vertical partitions into a plurality of smaller generally rectangular openings. A plurality of identical structural elements are provided which may be stacked in assembled relation to fill these openings, and these elements are shaped so as to be self-sustaining, to provide a plurality of spaced-apart strips extending from edge to edge of the magnet and to provide a substantially continuous flat pole face for the magnet. The structural elements are conveniently formed as castings in the shape of long, shallow trays, the ends of which provide the stacking surfaces, the bottoms of which provide the spaced-apart strips, and the sides of which provide the pole face.

With the foregoing general description in mind, it is an object of the present invention to effect substantial economies in the construction of magnet cores by providing identical structural elements which may be assembled into a nonsolid magnet core, while at the same time providing thereby substantially continuous pole faces interconnected by a plurality of uniformly spaced-apart, flux-conducting strips.

More specifically, it is an object of the present invention to provide structural elements for building up a magnet core in the form of long, shallow tray-shaped elements.

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

Figure 1 is a fragmentary end elevation of a portion of a calutron system embodying the present invention;

Fig. 2 is an enlarged side view of a magnet, with parts in section; and

Fig. 3 is a perspective view of one of the structural elements from which the core is built up.

Referring first to Fig. 1, I have illustrated a portion of a calutron system such as is fully described in the Lawrence application identified above. This system comprises a closed figure of alternated tanks **10** and magnets **11**. In a preferred form, the closed figure comprises two long, parallel, straight sections, joined at the ends by arcuate sections.

Each of the tanks **10** is of substantial size, as for example about 12 feet high and 8 feet wide. In practice a pair of tanks may be conveniently provided in edge abutting relation between each adjacent pair of magnets. The magnets **11** comprise winding cases **12** enclosing windings **9** and having a core opening **13** of generally rectangular cross section of approximately the size of the tank or tanks adjacent thereto. Within the core opening **13** there is provided a nonsolid, built-up structure composed essentially of structural elements **14** formed of magnetic material.

The structural elements **14** are in the form of shallow tray-like elements having bottoms **15**, a relatively thick end wall **16**, a relatively thin end wall **17**, and side walls **18**. End walls **16** and **17** are slightly higher than side walls **18**, and thus form parts by which said elements may be stacked.

In Fig. 2 the core space **13** is shown as divided into smaller spaces by a horizontal partition **19** and a vertical partition **20**. It will be appreciated that if the core space **13** is of a size such that it need not be divided by partitions **19** and **20** into smaller spaces, the structural elements **14** will be provided with relatively thick end walls such as end wall **16** at both ends. In the embodiment illustrated in Fig. 2, however, end walls **17** need not be of the same thickness as walls **16**, since they are in abutting relation with partitions **20**.

The assembled structural elements **14** and partitions **19** and **20** may be secured together to form an integrated structure by spot welding, or the like.

As seen in Fig. 2, the tray-like structural elements in the lower portion of the core, or those beneath the partition **19**, are positioned with their open side up, while those above partition **19** are inverted. This arrangement is not critical, and if desired the elements **14** may be inverted below partitions **19** and positioned with their open sides up above the partition.

It will be understood that in selecting the dimensions of the individual structural elements **14**, the first consideration is to provide adequate flux conducting material in such distribution that the field extending through the tanks between the pair of magnets adjacent thereto will be substantially uniform. Since the side walls of the tanks are heavy iron plates, they will serve as flux distributing poles, so that the fact that narrow openings **21** are left in the pole faces of the cores is not disadvantageous from the standpoint of flux distribution, and these openings, which result from the slight difference in height in end walls **16** and **17**, and side walls **18**, permit a cooling circulation of air to pass through the magnet cores.

While I have illustrated and described a single embodiment of my improved magnet core, it will be appreciated that this has been done merely to enable those

killed in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim is:

1. In a magnet structure comprising windings, a core of magnetic material disposed in said windings, said core being formed of a plurality of long, flat, tray-shaped members assembled to form a nonsolid structure having a plurality of spaced-apart strips extending across the core formed by the bottoms of said members, and having substantially complete pole-forming faces formed by the edge walls of said members, and means enclosing said windings and core and supporting said core within said windings.

2. In a magnet having windings, a casing enclosing said windings and defining a substantially rectangular core space, a nonsolid core having crossing horizontal and vertical partitions secured to said casing and dividing the core space into a plurality of smaller spaces, a plurality of tray-shaped elements filling each of said smaller spaces, said tray-shaped elements having end walls by means of which they are assembled in stacked relation, bottom walls extending in parallel spaced relation across said spaces, and side walls adapted to form substantially continuous flat pole faces.

3. In a magnet having windings, a casing enclosing said windings and defining a substantially rectangular core space, a nonsolid core having crossing horizontal and vertical partitions secured to said casing and dividing the core space into a plurality of smaller spaces, a plurality of tray-shaped elements filling each of said smaller spaces, said tray-shaped elements having end walls by means of which they are assembled in stacked relation, bottom walls extending in parallel spaced relation across said spaces, and side walls adapted to form substantially continuous flat pole faces, the said side walls of said tray-shaped elements being of slightly less height than said end walls, whereby said pole faces are interrupted by narrow, parallel gaps.

4. In a magnet having windings enclosed by a casing and defining a generally rectangular core space, a nonsolid core within said core space comprising a plurality of identical elements having flat strips and laterally projecting end portions by means of which said elements are stacked in assembled relation with said flat strips in spaced parallel relation and extending transversely of said core space.

5. Structural elements for assembly in a generally rectangular magnet core space to form a nonsolid core structure, each of said elements comprising a flat strip of magnetic material having projecting end portions by means of which said elements may be stacked with said strips in uniformly spaced relation.

6. Structural elements for assembly in a generally rectangular casing defining a magnet core space to form a nonsolid core structure, each of said elements comprising a flat strip of magnetic material having projecting end portions by means of which said elements may be stacked with said strips in uniformly spaced relation, said elements having a length substantially equal to the transverse width of the core space, and having a width substantially equal to the axial dimension of the core space.

7. Structural elements for assembly in a generally rectangular casing defining a magnet core space to form a nonsolid core structure, each of said elements comprising a flat strip of magnetic material having projecting end portions by means of which said elements may be stacked with said strips in uniformly spaced relation, and having projecting edge portions of a height somewhat less than the height of said end portions, forming substantially continuous pole portions.

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