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MAGNETS

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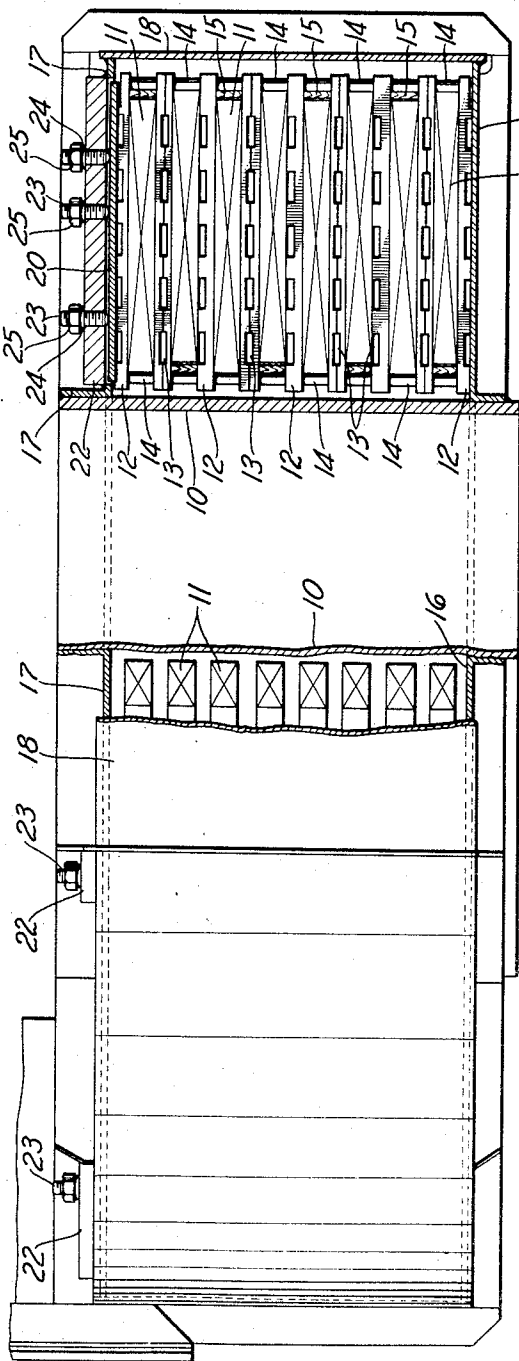


Fig. 1

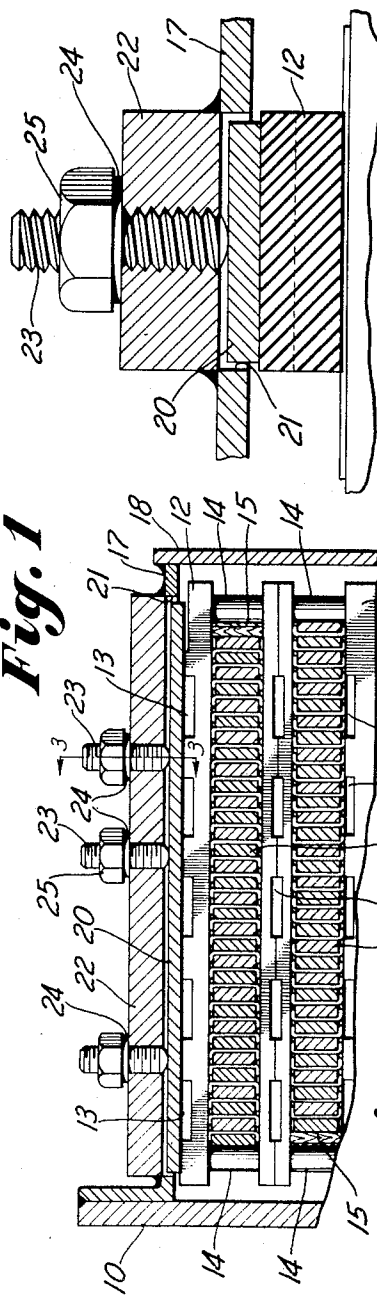


Fig. 2

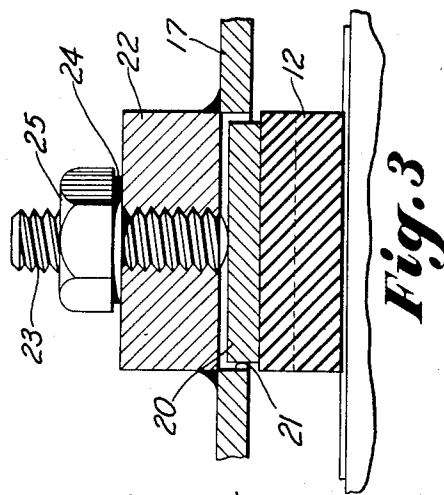


Fig. 3

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MAGNETS

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4 Claims. (Cl. 317—158)

The present invention relates to magnets and more particularly to means for clamping an assembly of magnet coils and coil spacers into tightly assembled relation in a fluid-tight vessel.

Magnets of the type illustrated herein are useful in combination with ion separating means of the type referred to as the calutron which are illustrated and described in detail in the application for Letters Patent of the United States, filed by Ernest O. Lawrence Serial No. 571,420, filed January 5, 1945, and granted as U. S. Patent No. 2,721,272 on October 18, 1955. In this type of construction a series of calutron tanks are alternated with a series of electromagnets, preferably in a closed geometric pattern, whereby the magnetic flux set up by the electromagnets passes in series relation through the calutron tanks. The electromagnets referred to comprise essentially a core having substantially flat pole faces which are in substantially abutting relation to the side walls of adjacent tanks, and are surrounded by a winding. The winding is in the form of a plurality of separate but electrically connected coils each of which forms a structure known in the art as a "pie."

In a commercial calutron the magnets are of very considerable size, the core having a cross section on the order of 12 feet by 2 feet. It is necessary in these magnets to provide cooling means, which is accomplished by interposing spacers of insulating material between adjacent pies in a manner to provide a path for coolant, such as oil, therethrough. The windings are closed in a fluid-tight vessel or tank and coolant fluid is pumped therethrough continuously so as to remove heat therefrom.

In the past it has been customary to construct magnets of this type by assembling the coils and insulating spacers in an open-topped tank, and thereafter providing a cover for the tank which is applied in a manner to tightly enclose the assembly, coils and spacers. However, it has been found in practice that after a substantial period of use there is a tendency for the assembly of coils and spacers to become loose so that when the current is turned on the assembly can move in the tank with the result that hammering develops.

According to the present invention, means are provided for taking up any looseness which develops in the assembly of coils and spacers, and this means may be operable from the exterior of the fluid-tight vessel which contains the windings.

With the foregoing general description in mind, it is the object of this present invention to provide a magnet comprising windings made up of an assembly of alternated coils and spacers in a fluid-tight vessel, in combination with means for clamping the assembly which is operable from the exterior of said vessel.

A feature of the present invention is the provision, in a fluid-tight coil tank, of a clamping strip associated with clamping mechanism extended through a supporting bar mounted on a wall of the fluid-tight vessel.

Reference is now made to the drawings in which Fig. 1

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is a side elevation of a magnet embodying the present invention with parts broken away;

Fig. 2 is a fragmentary section through the coil housing; and

Fig. 3 is an enlarged section on the line 3—3 of Fig. 2.

Referring now to Fig. 1, the magnet comprises a core of suitable design received within a box 10. Surrounding the box 10 is the magnet winding comprising individual coil pies 11 separated by spacers 12. The spacers 12 are of suitable insulating material such, for example, as Bakelite and are formed so as to provide passages 13 therethrough for the circulation of cooling fluid. Pins 14 are provided for securing the spacers 12 in aligned relationship and each coil pie is wedged in position by means of wedges 15 which as shown may be alternated from inside and outside of the adjacent pies.

The assembly of coils 11 and spacers 12 is received within an annular fluid-tight vessel, of which the box 10 forms the inner wall. Secured to the box 10 are side walls 16 and 17 the outer edges of which are connected by outer wall 18. Thus the windings are received within a fluid-tight vessel in which a cooling fluid such as oil may be circulated by suitable means in a conventional manner.

Prior to my invention, the customary method of assembly of magnets of this type was to provide the inner wall 10, the side wall 16 and the outer wall 18 in preliminarily assembled relation with welded fluid-tight joints therebetween. Thereafter, the winding comprising assembly of coil pies 11 and spacers 12 was built up, spacers were connected by the pins 14, and wedges 15 were inserted and secured in place. Thereafter, as a final step, the closure 17 was brought into position and was welded to the walls 10 and 18 while pressure was maintained thereby on the assembly of coils and spacers. This resulted in a tight assembly which operated satisfactorily. However, it was found that as time went on a looseness developed whereby movement of the assembly of coils and spacers was permitted, with the result that this assembly would slam against a side closure of the fluid-tight vessel when the magnet was turned on, and also hammering or vibration was permitted.

According to the present invention, a plurality of substantially laterally extending clamping strips 20 which may conveniently be formed of metal, are provided in abutting relation against the outermost of coil spacers 12. The number of such clamping strips provided is of course dependent upon the size of the magnet and may be varied as desired, the only important consideration being that sufficient are provided to maintain the assembly at all times in tight-clamped relationship.

The side wall of the fluid-tight vessel which contains the windings is cut away to provide a slot 21 overlying the strip 20 and a relatively heavy bar 22 is welded or otherwise secured in sealing relation over the slot 21. The purpose of the bar 22 is to provide a rigid support for the means which applies the clamping pressure to the clamping strips 20.

Referring to Fig. 2 it will be observed that the outermost spacer 12 is provided with a plurality of openings 13 for the circulation of coolant through the vessel and it will be appreciated that the spacers 12 extend radially of the coils and are spaced apart as desired. The clamping strips 20 are positioned to overlie the spacers 12 so as to apply pressure thereto.

The means for applying clamping pressure to the clamping strips 20 may conveniently take the form of a plurality of bolts 23 which extend through tapped openings in the bars 22 so as to extend to the interior of the fluid-tight vessel and to apply clamping pressure to clamping strips 20. Preferably, the bolts 23 are spaced

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along the bar 22 so as to overlie portions of the spacers 12 which are not cut out to provide the openings 13 for the circulation of coolant. This permits very substantial pressure being applied to the clamping strip 22 in a manner to retain the assembly coils and spacers in tight relationship.

While the bolts 23 may be provided with hexagonal heads if desired, the form in Figs. 2 and 3 are preferably provided with hex recesses for the reception of a suitable key for tightening. In order to prevent leakage along the threads of the bolts 23 sealing gaskets 24 are provided, in combination with clamping nuts 25 which in addition to retaining the gaskets 24 in fluid-tight relationship on the top of the bars 22, also serve to lock bolts 23 in any position of adjustment.

The foregoing apparatus permits taking up any looseness which may develop in the assembly of coils and spacers during extended operation of the magnet and efficiently prevents the development of hammering or vibration therein.

While I have illustrated and described a specific embodiment of my invention it will be appreciated that this has been done merely to enable those skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What is claimed is:

1. A fluid cooled magnet comprising windings made up of an assembly of alternated pan-cake type coils and spacers, an annular fluid-tight vessel closely containing said windings, a plurality of clamping strips lying along angularly spaced radii extending normally from the axis of said vessel and engaging an end surface of said assembly, and a plurality of radially spaced bolts extending through the adjacent wall of said vessel and engaging said clamping strips, said bolts having adjustment means situated externally of said vessel.

2. A fluid cooled magnet comprising windings made up of an assembly of alternated pan-cake type coils and spacers, an annular fluid-tight vessel closely containing said windings, a plurality of clamping strips lying along angularly spaced radii extending normally from the axis

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of said vessel and engaging an end surface of said assembly, a plurality of radially spaced bolts extending through the adjacent wall of said vessel and engaging said clamping strips, said bolts having adjustment means situated externally of said vessel, and sealing means closely surrounding said bolts to prevent escape of fluid from said vessel.

3. A fluid cooled magnet comprising windings made up of an assembly of alternated coils and spacers, an annular fluid-tight vessel closely containing said windings, a plurality of clamping strips lying along angularly spaced radii extending normally from the axis of said vessel and engaging an end surface of said assembly, slots in the adjacent wall of said vessel in registry with said strips, bars extending over said slots in sealing relation thereto, and radially spaced bolts extending through said bars and engaging said clamping strips, said bolts having adjustment means situated externally of said vessel.

4. A fluid-cooled magnet comprising windings made up of an assembly of alternated pan-cake type coils and spacers, the latter having radially spaced passages for the circulation of a cooling fluid, an annular fluid-tight vessel closely containing said windings, a plurality of clamping strips lying along angularly spaced radii extending normally from the axis of said vessel and engaging an end surface of said assembly, and a plurality of bolts aligned with the portions of said spacers between said passages and extending through the adjacent wall of said vessel in pressure-transmitting relation to said strips, said bolts having adjustment means situated externally of said vessel.

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