

Aug. 25, 1942.

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2,293,748

MAGNETIC BRAKE

Filed Oct. 29, 1941

2 Sheets-Sheet 1

FIG. 1

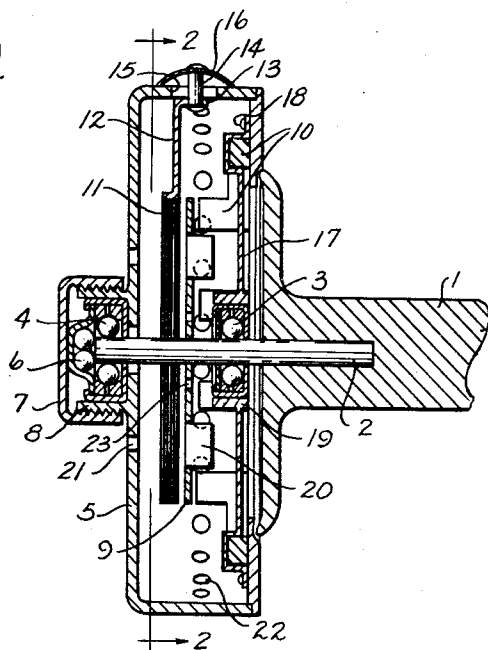
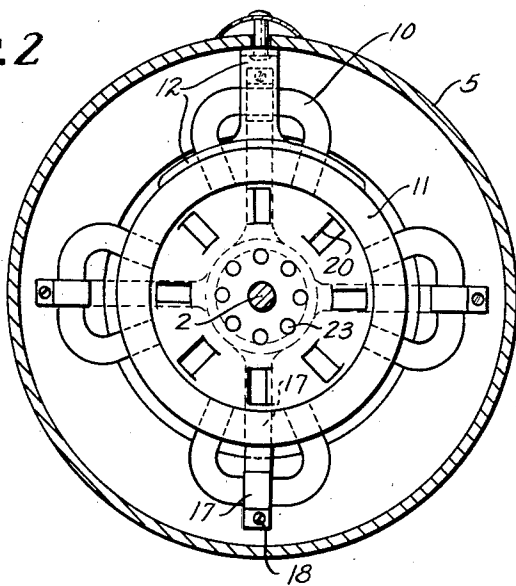


FIG. 2



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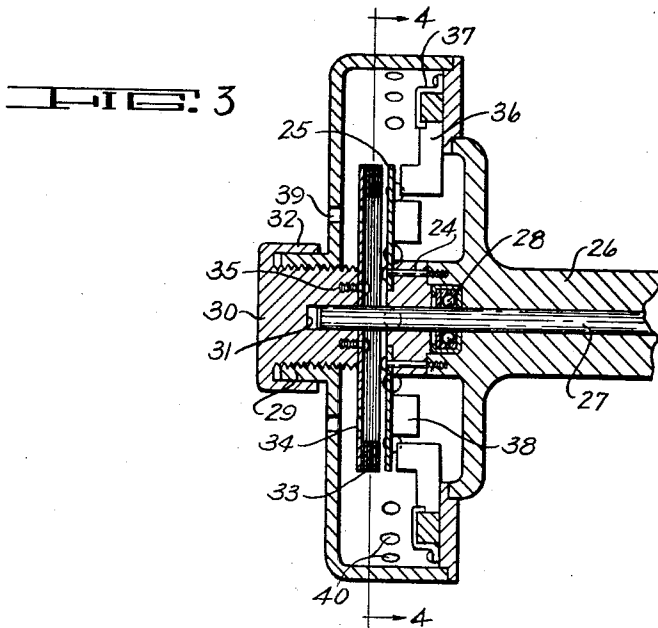
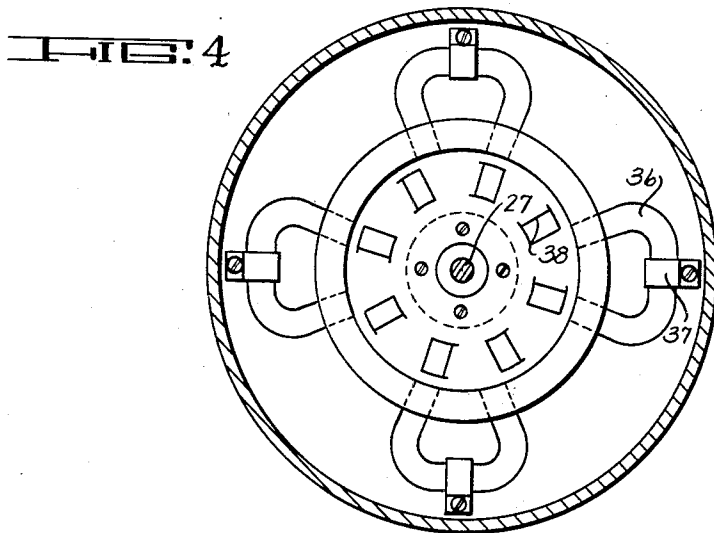
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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MAGNETIC BRAKE

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Application October 29, 1941, Serial No. 417,015

1 Claim. (Cl. 188—104)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to improvements in magnetic brakes and more particularly to magnetic drag devices suitable for use on various types of reels such as tow target reels, wire reels, fishing reels, etc.

My device is based on the well-known principle that an electrically conductive disk rotating in a magnetic field will have electrical currents set up within it which will react with the magnetic field in such a manner as to oppose the continuing rotation of the disk. Accordingly, in my retarding device for reels, I have provided a disk made of copper or other conductive material which is fastened to the reel so as to rotate therewith. On one side of the disk is arranged a series of magnets, either permanent magnets or electromagnets, and on the other side of the disk is placed a soft iron armature in close proximity thereto for the purpose of strengthening the magnetic field passing through the disk. Hence, as the disk and reel rotate, currents will be set up within the disk which oppose its rotation and a resulting smooth, steady drag will tend to retard the rotation of the reel. The armature is adjustably mounted with relation to the disk in order that the amount of drag imposed upon the disk may be varied by moving the armature toward or away from the latter. I have also provided means for cooling said disk which means at the same time imposes an additional drag on the rotating system.

Accordingly, one of the objects of my invention is to provide a magnetic brake for a rotating member, such as a tow target reel, in which the retarding effect of the brake may be varied by the adjustment of a soft iron armature either toward or away from the disk.

A further object of my invention is to provide cooling vanes on the rotating disk which serve to circulate the air thereabout and thus prevent the disk from overheating as a result of the electrical currents set up therein due to its rotation in the magnetic field.

Still a further object of my invention is to provide a cooling system for the above described type of magnetic brake in which the circulation of the cooling medium is effected by means of the rotating disk itself and thus an additional retarding force is imposed upon the rotating reel.

Several preferred embodiments of the present invention will be hereinafter described with refer-

ence to the accompanying drawings, given merely by way of example, in which:

Figure 1 is a sectional elevation of the magnetic braking device as applied to one end of a rotating reel. In this embodiment the revolving disk is fixed to a shaft which extends from the end of the reel, the shaft being rotatably mounted in ball bearings carried by the housing which incloses the braking device.

Figure 2 is a cross-sectional view of the magnetic brake taken on the line 2—2 of Figure 1 showing the manner in which the permanent horseshoe magnets are arranged around the periphery of the revolving disk.

Figure 3 illustrates another embodiment of my braking device in which the revolving disk is rigidly attached to the end of the reel, the disk and the reel being mounted for rotation on a shaft which is supported by the end housings of the reel.

Figure 4 is a cross-sectional view of the brake taken on the line 4—4 of Figure 3.

In Figure 1, I have shown my device as applied to one end of a reel 1 on which is wound the cable, wire, string, etc. which is being used. While only one end of the reel is shown, it is to be understood that a similar device may be provided on the other end of the reel if desired, or the other end may consist of merely a bearing support for rotatably supporting this end of the reel. A short shaft 2 is rigidly mounted in the end of the reel, which shaft is supported for rotation in the ball bearings 3 and 4 supported in the housing 5 disposed at the end of the reel. The housing 5 and the reel 1 should be formed of non-magnetic material so as not to interfere with the magnetic field of the braking magnets which are described hereinafter. A thrust bearing 6 is provided at the end of shaft 2 for the purpose of taking up any end thrust imposed on the reel and an end cap 7 is screwed on over a threaded sleeve 8 projecting from the housing for the purpose of protecting the bearings 4 and 6 from dust and dirt. A disk 9 is rigidly secured to the shaft 2, this disk being constructed of an electrically conductive material such as copper, brass, etc. Permanent horseshoe magnets 10 are supported on the inner wall of the housing 5 and have their pole pieces bent off at right angles so that the latter will be directed toward the face of the disk 9. These pole pieces are located in close proximity to the disk and are equally spaced around the circumference thereof so as to effect a steady and balanced retarding force on the disk. On the side of the disk opposite the pole pieces

is arranged a laminated soft iron armature 11, this armature being preferably made in the form of an annular ring in order to permit free circulation of a cooling medium about the disk. Securely fastened to the outer periphery of the armature is a bracket 12 formed with a flange 13. Secured to this flange is a pin 14 passing through a slot 15 in the upper portion of the housing 5. A spring button 16 is riveted to the upper end of this pin and serves to frictionally retain the armature in any position to which it may be moved. By sliding the button 16, and thereby the armature 12, back and forth in the housing, the gap between the armature and the disk 9 may be varied so as to either strengthen or weaken the magnetic flux passing through the disk. In this way the retarding force on the disk, and hence on the reel 1, may be varied as desired. The magnets 10 are retained in position on the wall of the housing 5 by means of a spider 17 which is secured to the housing by means of screws 18. This spider is formed with an annular flange 19 in the center thereof for the purpose of supporting the inner ball bearing 3. Hence, it will be seen that while the reel and the disk are free to rotate on the ball bearings 3, 4 and 6, a retarding effect will be produced as a result of the rotation of the disk 9 in the field of the magnets 10.

The disk 9 is provided with a number of axially disposed vanes 20 stamped out on one side thereof, these vanes serving to circulate the air about the disk to prevent its overheating. Holes 21 are provided in the side wall of the housing 5 so as to permit the entrance of cooling air into the housing and additional holes 22 are provided around the periphery of the housing for the purpose of permitting the egress of the cooling air therefrom. The vanes on the disk serve as a pump for circulating the air through the housing, the cool air from the outside being drawn into the housing through the holes 21 after which it passes through the apertures in the disk formed by the stamping out of the vanes and also through the holes 23 provided near the center of the disk for this purpose. The vanes then catch the air and throw it toward the periphery of the housing after which it passes out of the housing through the holes 22.

It will be observed that the vanes 20 have their outer edges located in close proximity to the inner edges of the pole pieces of the magnets 10 thus resulting in a shearing action of the cooling medium as the vanes revolve past the pole pieces. Thus, in addition to the work done by the vanes in pumping the cooling medium through the housing, a further amount of work is expended in imposing a shearing action on the cooling medium thereby assisting in the retardation of motion of the reel.

Figure 3 shows a further modification of my device in which an electrically conductive disk 25 is rigidly attached to the end of the reel 26 by means of the screws 24. In this instance the disk and reel rotate on a fixed shaft 27 the right-hand end of which (not shown) is suitably supported in the right-hand end housing of the reel (not shown). The left-hand end of the shaft is received in a hole 31 provided in a threaded bushing 30 which screws into an internally threaded flange 29 provided on the right-hand end housing of the reel. A combined radial and thrust bearing 28 serves to permit the free rotation of the reel and disk on the shaft and to take up any end-thrust imposed on the reel. The

bushing 30 is provided with a reverse flange 32 so as to afford a broad finger grip on the bushing 30 and also to serve as a protective shield over the screw threads cut thereon. A laminated soft iron armature 33, similar to the armature 11 shown in Figure 1 is fastened to a mounting disk 34 which is rigidly secured to the bushing 30 by means of screws 35. Horseshoe magnets 36 similar to those described in connection with Figures 1 and 2 are mounted upon the side wall of the brake housing by means of brackets 37. The disk 25 is provided with vanes 38 similar to the vanes 20 of Figure 1 and the housing is provided with holes 39 and 40 located in the side and periphery thereof respectively. The action of the magnetic brake shown in Figures 3 and 4 is in all respects similar to that of Figures 1 and 2 except for the fact that the armature 33 is adjusted toward or away from the disk 25 by screwing the bushing 30, which carries this armature rigidly attached thereto, back and forth along the threads on flange 29.

Since the magnetic drag on the disk varies approximately as the square of the speed it lends itself very favorably to situations where a heavy pull at high speeds is encountered as in the case of tow target reels. It is also useful to prevent a dangerous backlash which might occur in case the speed of the target away from the plane should suddenly diminish due to changing air currents. The mechanical friction brakes now used with these reels are very unsatisfactory due to the excessive heat developed at the braking surface when the brake is applied for more than a few seconds at a time. Hence the present practice is to let the target run free for about a thousand feet and then apply the brake to stop the reel. This procedure is repeated as often as is necessary in order to let the target out to the desired distance. Such a method is not only slow but also dangerous, because of the backlashes which may occur if the target is let run too long a time before the brake is applied. With my device, the speed of the reel is held within reasonable limits and no backlash can occur due to the constant drag on the spool. This type of brake is likewise useful for preventing excessive speed or backlash on wire spools and is also well suited for preventing backlash on fishing reels and for providing a variable drag on such a reel.

When the brake is to be used on a wire reel or a fishing reel, where the pull on the reel is comparatively light, it will be found best to back the armature part way off from the disk. It should be noticed that a light drag will always be present on the reel even though the armature be backed all the way off. This is due to the fan and shearing action of the vanes carried by the conductive disk. When the reel is to be used for heavy service such as in paying out the cable connected to an aerial tow target, the armature may be moved very close to the disk so as to obtain the maximum braking effect on the reel.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

A magnetic brake for retarding the motion of a rotating member comprising an electrically conductive disk fastened to said member for rotation therewith, a housing completely enclosing said disk and having one set of ports located adjacent the center of said disk and another set of ports located adjacent the periphery thereof, a plurality of magnets mounted in said housing with their pole pieces facing one side of said disk,

a soft-iron armature mounted in said housing on the other side of said disk, and a plurality of radially disposed vanes extending from said disk toward the poles of said magnets, said pole pieces and said vanes being so arranged that the outer edges of said vanes will pass in close proximity to the inner edges of said pole pieces as the disk revolves whereby a suitable cooling medium may be drawn into said housing through said one set of ports, sheared by the vanes as they pass by the pole pieces of the magnets, and expelled from said housing through said other set of ports thereby cooling the disk and at the same time imposing an additional retarding force on said rotating member.

WILLIAM J. JOHNSON.