April 5, 1966 W. T. BIRGE 3,244,944

MAGNET FOR ELECTRIC BRAKES

Filed May 28, 1962

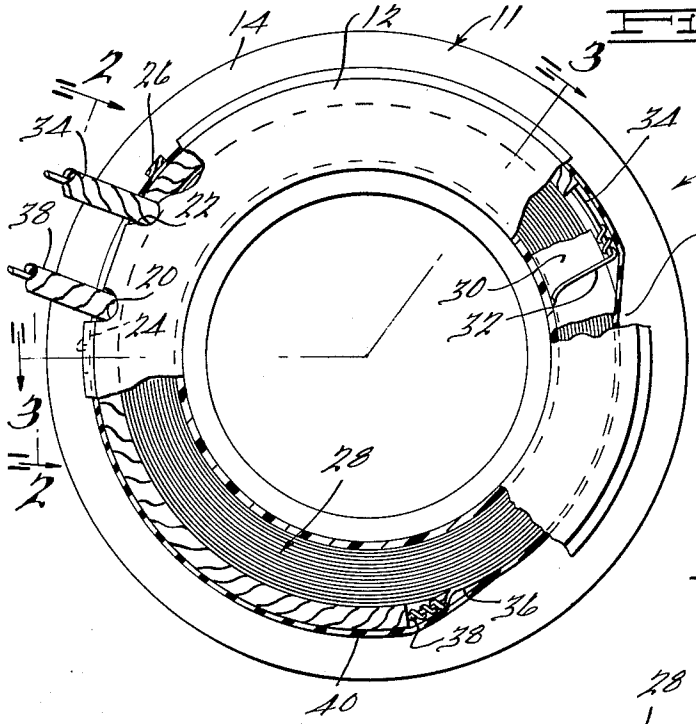


FIG. 1.

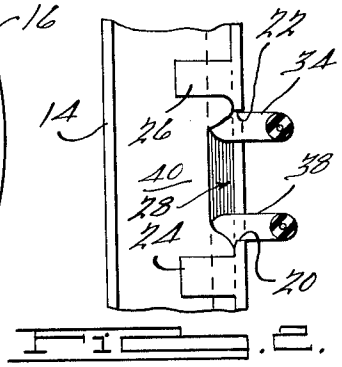


FIG. 2.

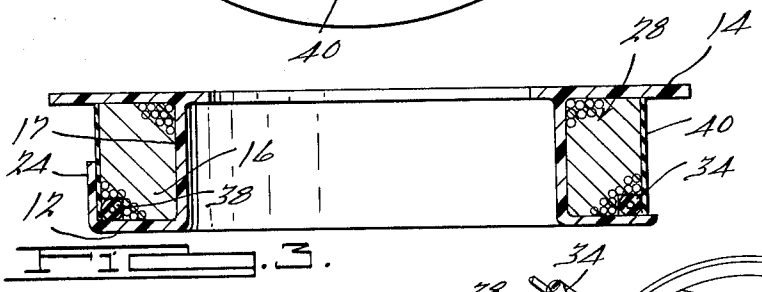


FIG. 3.

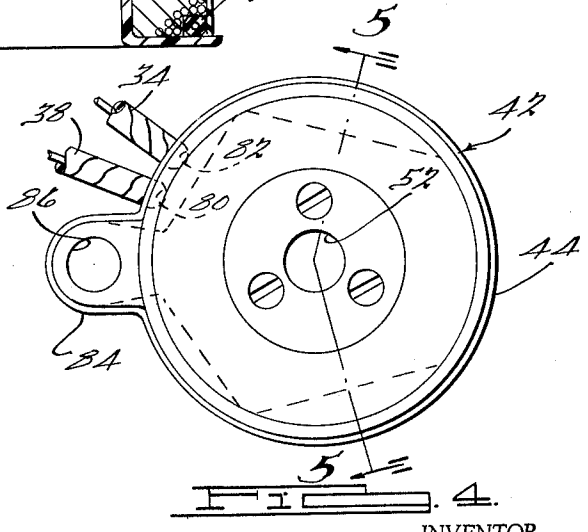


FIG. 4.

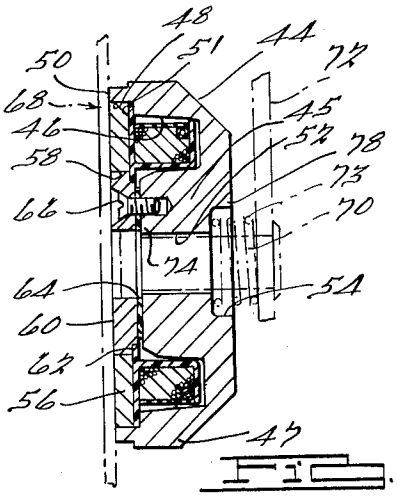


FIG. 5.

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MAGNET FOR ELECTRIC BRAKES

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This invention relates to a system for electrically actuating brakes, and more particularly to the construction of an electromagnet for use in such a system.

In conventional, hydraulically actuated brakes, a pair of brake shoes are pivotally secured to a stationary brake back-up plate and are caused to move into contact with a brake drum by the actuation of pistons in a hydraulic brake cylinder responsively to fluid pressure applied to the brake cylinder. In an electrically actuated system, the brake shoes are moved by means responsive to an electrical current; such a system is exemplified by the United States Patent to William F. Penrose, No. 2,273,-065. In these electrically operative systems a lever arm is pivotally secured to the brake back-up plate such that rotation of the lever arm causes movement of the brake shoes into contact with the brake drum. At the end of the lever arm is secured an electromagnet which is usually maintained in sliding contact with an armature plate which is secured to and moves with the brake drum. Upon energization of the electromagnet, a magnetic flux path is provided from the electromagnet through the armature plate resulting in a magnetic attraction between the electromagnet and the armature plate thereby causing the electromagnet to be moved with the armature plate as it rotates. Movement of the electromagnet causes a corresponding pivotal movement of the lever arm which in turn causes movement of the brake shoes into contact with the brake drum resulting in braking action.

This invention is directed to a novel construction of an electromagnet assembly for use in such an electrically actuated system. It is an object of this invention to provide an electromagnet of improved construction for use in systems for electrically actuating brakes.

It has been the current practice to provide a construction in which the coil for the magnet is disposed in the body and held in that body by means of a potting compound. Oftentimes, under conditions of hard brake usage, i.e., high temperatures, severe vibration, etc., the potting compound breaks down, allowing the coil to rub against the sides of the members containing it, resulting in a short circuit or other type of failure. It is an object of this invention to provide an improved construction of an electromagnet whereby a potting compound is not required to hold the coil and whereby damage to the coil due to frictional movement is eliminated.

Occasionally during assembly of electromagnets of the old type construction, the coil wires were subjected to damage. It is an object of this invention to provide an improved construction for an electromagnet whereby damage to the coil wires during assembly is substantially eliminated.

Other objects, features, and advantages of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a side elevational view, with some parts shown in section and some parts shown broken away, depicting a coil form, with a coil wound therein, as utilized in the novel electromagnet assembly of this invention;

FIGURE 2 is a fragmentary view of a portion of the coil form and coil as shown in FIGURE 1 and taken substantially along the line 2—2 in FIGURE 1;

FIGURE 3 is a sectional view of the coil form and coil of FIGURE 1 taken substantially along the line 3—3 of FIGURE 1;

FIGURE 4 is a side elevational view depicting a complete electromagnet assembly embodying the features of this invention, and

FIGURE 5 is a sectional view of the complete electromagnet assembly shown in FIGURE 4 and taken substantially along the line 5—5 in FIGURE 4 and shown in relation to a lever arm and an armature plate (both in phantom) of a system for electrically actuating brakes.

Looking now to FIGURE 1, a bobbin or coil assembly is generally indicated by the numeral **10** and comprises a plastic bobbin member or coil form **11** which has a radially extending outer flat face portion **14** and a radially extending inner flat face portion **12** which flat face portions are axially spaced from each other by an axially extending intermediate portion **17**. The face portions **12, 14** and the intermediate portion **17** define a radially outwardly facing annular cavity **16**. The flat face portions **12, 14** are circularly ring shaped with outer face portion **14** having a larger outer diameter than that of the inner face portion **12** for a purpose to be readily seen. A pair of generally semicircularly shaped notches **20** and **22** are formed in the radially outer periphery of the inner face portion **12** and are disposed circumferentially proximate to each other. A pair of tabs **24** and **26** are disposed on opposite circumferential sides of the notches **20** and **22**, respectively, and extend axially partially toward the outer face portion **14** for a purpose to be described.

In the preferred embodiment, the bobbin or coil form **12** is made of a substantially nonmagnetic and electrically nonconductive material and is moulded in one piece from nylon with tabs **24** and **26** initially extending radially outwardly instead of axially, thereby leaving the annular cavity **16** completely accessible. A coil **28** is wound into the cavity **16** in the same manner as thread is wound upon a bobbin with the wire being coated with enamel or other type of electrical insulation. The wire size, number of turns, etc., of the coil **28** are determined by the particular application. One terminating end **32** of coil **28** is soldered or otherwise electrically connected to the end of a lead wire **34**. A piece of electrical insulating tape **30** is disposed proximate the end **32** of the coil **28** and prevents the end **32** and its point of connection to lead wire **34** from rubbing or abrading the remaining wires of the coil **28**. Likewise, the opposite terminating end **36** of the coil **28** is connected by soldering or other means to a lead wire **38** and a piece of insulating tape is provided therebetween to also prevent abrasion between this connection and the remaining wires in the coil **28**. Finally a piece of electrically insulating tape **40** is wound completely circumferentially around the top of the coil **28** to both protect the coil **28** and also to restrain the lead wires **34** and **38**.

The lead wires **34** and **38** extend oppositely circumferentially from their connections with ends **32** and **36**, repectively, and are disposed within the slots **22** and **20**, respectively, on the inner face portion **12**. After the coil **28** has been wound and the lead wires **34, 38** so disposed, tabs **24** and **26** are then pressed down from their initial radially extending position into the axially extending position shown in FIGURE 2 to thereby further restrain the lead wires **34** and **38** and also to restrain the coil **28** from rotation within the cavity **16**.

The coil assembly **10** is a part of a complete electromagnet assembly **42** (see FIG. 4), which includes an iron housing or magnet body **44** (see FIG. 5) which has an annular groove **46** extending axially inwardly from a counterbore **48** in a frontal surface **50** thereof. The annular groove **46** defines a radially inner core portion **45** and a radially outer annular portion **47**. The housing

44 is made of iron or some other magnetic (i.e., low reluctance) material and has a centrally located throughbore 52 which terminates at its rearward extremity in a counterbore 54. The coil assembly 10 is located with the cavity 16, the coil 28 and the inner face portion 12 disposed substantially entirely within the annular groove or recess 46. The diameter of the outer face portion 14 of the coil form or bobbin 11 is substantially the same as the diameter of the counterbore 48; thus, upon insertion of the cavity 16, coil 28, and face portion in the groove 46, the outer face portion 14 abuts against a front face 51 of counterbore 48 on the body member 44. A flat ring or washer 56 of asbestos or other type frictional and nonmagnetic (i.e., high reluctance) material is disposed within the counterbore 48 and seats axially against the outer face portion 14 of the coil form or bobbin 11. Located concentrically within the bore 58 of the frictional washer 56 is a surface contact washer or flat ring member 60 made of ingot iron or some other magnetic (i.e., low reluctance) material. A relief groove 62 formed in the back face of the washer 60 matably receives the radially innermost extending surface of the outer face portion 14 of the bobbin or molded one-piece coil form 11. A thin magnetically insulating washer 64 of brass or some other nonmagnetic (i.e., high reluctance) material is disposed between the metallic washer 60 and the frontal face 51 of the housing 44. A plurality of bolts 66 extends through aligned bores in both the metallic washer 60 and the insulating washer 64 and are threadably engaged in aligned bores within the body 44 to thereby secure the metallic washer 60 and the nonmagnetic washer 64 to the body 44. The frictional washer 56 has its O.D. and I.D. of a size to provide a slight interference fit with the counterbore 48 and the outside diameter of the metallic washer 60, respectively, and is thereby retained to the electromagnet assembly 42. As assembled, the metallic washer 60, the frictional washer 56, and the frontal face 50 of the body 44 provide a relatively planar surface.

As previously mentioned, the forward face of the electromagnet assembly 42, including the metal washer 60, frictional washer 56, etc., are held in light frictional contact with an armature plate 68 (shown in phantom) which is movable in rotation as previously discussed. A pin 70 (shown in phantom) is piloted within the bore 52 and is secured at one end to a lever arm 72 (shown in phantom), which lever arm actuates a pair of brake shoes (not shown) as it is pivoted about an axis (not shown). A coil spring 73 (shown in phantom) has one end seated within the rearwardly disposed counterbore 54 and has its other end in engagement with the lever arm 72. The spring 73 is precompressed to bias the electromagnet assembly 42 axially away from the arm 72 and into contact with the movable armature plate 68.

As the coil 28 is electrically energized, a forward portion 74 of the radially inner core portion 45 is caused to have one magnetic polarity while an axially rearward portion 78 of the radially inner core portion 45 is caused to have an opposite magnetic polarity. Since the rearward portion 78 is magnetically connected to the outer annular portion 47 of the body 44, the outer annular portion 47 is also placed at this opposite polarity. With the forward face of the electromagnet assembly 42 contacting the armature plate 68, a flux path is completed from the rear portion 78 of the radially inner core 45 through the outer annular portion 47 through the armature plate 68, through the metallic contact washer 60, through the insulating washer 64 and to the axially forward portion 74 of the radially inner core portion 45. This results in a magnetic attraction between the electromagnet assembly 42 and the armature palte 68 causing the electromagnet 42 to move with the rotating armature plate 68 and hence causing the lever arm 72 to move the brake shoes (not shown) associated therewith into engagement with the brake drum (not shown).

The insulating washer 64 is provided of a nonmagnetic material such as brass or other type nonmagnetic material and provides a means for varying the force of magnetic attraction between the electromagnet 42 and the armature plate 68. Thus, by making the washer 64 thicker, the reluctance of the magnetic path is increased and hence the effective magnetic force is reduced. By making the washer 64 thinner, the converse occurs. Thus, in production, essentially identical electromagnet assemblies 42 can be provided and can be set for different applications requiring different attractive forces simply by using a different washer 64. The washer 64 also tends to minimize the amount of residual magnetism remaining on the electromagnet 42 after it is de-energized.

The frictional washer 56 is provided to decrease the amount of wear between the armature plate 68 and the metallic parts of the electromagnet 42 contacting the armature plate 68, thus giving the electromagnet assembly 42 a longer life.

Looking now to FIGURE 4, a pair of apertures 80 and 82 are provided in the housing 44 whereby the lead wires 34 and 38 can be extended therethrough for connection to a brake-actuating circuit (not shown). A lug 84 with an aperture 86 therethrough is formed integrally with the body portion 44. A pin member (not shown) secured to the lever arm 72 is seated within the bore 86 and thus prevents rotation of the electromagnet assembly 42 about the pin 70.

With the electromagnet assembly 42 as described, it can be seen that by mounting the coil 28 in the plastic bobbin 11, the coil 28 is held from movement and hence failure of the coil 28 due to abrasion is prevented. Also, by the use of the molded nylon coil form 11, damage to the coil 28 during assembly is also prevented. The result is an improved, durable and economical electromagnet assembly.

While it will be apparent that the preferred embodiments of the invention disclosed are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. An electromagnet comprising a plastic coil form having an annular, radially outwardly facing cavity axially defined by axially spaced, radially extending, annular inner and outer face portions, a coil annularly wound within said cavity, a magnet body having an annular, axially facing recess in a frontal face thereof, said coil form with said coil located in said recess, and means including an axially outwardly facing friction member secured at said frontal face on said magnet body axially retaining said coil form.

2. An electromagnet comprising a plastic coil form having an annular, radially outwardly facing cavity axially defined by axially spaced, radially extending, annular inner and outer flat face portions, said inner and outer face portions being circularly ring shaped with said outer face portion having a greater outer diameter than that of said inner face portion, a coil annularly wound within said cavity, a magnet body having an annular axially facing recess extending axially rearwardly from a counterbore having a diameter substantially equal to the diameter of said outer face portion in a frontal face thereof, said coil form having said cavity with said coil therein and said inner face portion located substantially within said recess in said magnet body and having said outer face portion matably disposed within said counterbore, and means in engagement with said outer face portion and secured at said frontal face on said magnet body for axially retaining said coil form.

3. An electromagnet comprising a plastic coil form having an annular, radially outwardly facing cavity axially defined by axially spaced, radially extending, annular inner and outer flat face portions, said inner and outer face

portions being circularly ring shaped with said outer face portion having a greater outer diameter than that of said inner face portion, a coil annularly wound within said cavity, a magnet body having an annular axially facing recess extending axially rearwardly from a counterbore having a diameter substantially equal to the outer diameter of said outer face portion in a frontal face thereof, said recess defining a radially inner core portion and a radially outer annular portion, said coil form having said cavity with said coil therein and said inner face portion located substantially within said recess in said magnet body and having said outer face portion matably disposed within said counterbore, a flat washer member of nonmagnetic material matably disposed within said counterbore and in axial contact with said outer face portion, and a flat contact ring member disposed concentrically with and matably within said washer member and in substantial axial alignment with said radially inner core portion; said frontal face, said washer member, and said ring member substantially defining a planar, outer surface.

4. The electromagnet of claim **3** further including a flat reluctance washer member of a substantially nonmagnetic material disposed between said contact ring member and said radially inner core portion.

5. The electromagnet of claim **4** in which said flat washer member is made of a frictional material and in which said ring member is made of a magnetic material.

6. An electromagnet comprising a plastic coil form having an annular, radially outwardly facing cavity axially defined by axially spaced, radially extending, annular inner and outer face portions, one of said face portions having a pair of generally radially extending, axially through slots formed in the radial periphery thereof, a coil annularly wound within said cavity, a pair of lead wires each electrically connected to a terminating end of said coil and the end of each disposed within one of said slots, a magnet body having an annular, axially facing recess in a frontal face thereof, said coil form with said coil located in said recess, and means secured at said frontal face on sad magnet body for axially retaining said coil form.

7. An electromagnet comprising a plastic coil form having an annular, radially outwardly facing cavity axially defined by axially spaced, radially extending, annular inner and outer face portions, said inner and outer face portions being circularly shaped with said outer face portion having a greater diameter than said inner face portion and with said inner face portion having a pair of generally radially extending slots formed at the periphery thereof, a pair of bendable tabs formed integrally with said inner face portion and disposed proximate to and at opposite ends of each of said slots therein, a coil annularly wound within said cavity, a pair of lead wires each electrically connected to a terminating end of said coil and each disposed within one of said slots, said tabs bent to extend axially towards said outer face portion and in overlying relationship with said lead wires, a magnet body having an annular axially facing recess in a frontal face thereof, said coil form with said coil located in said recess, and means secured at said frontal face on said magnet body for axially retaining said coil form.

8. The electromagnet of claim **7** further including tape means disposed between each said terminating end of said coil and said coil for preventing abrasion between each said terminating end and said coil.

9. The electromagnet of claim **7** with said magnet body having said recess extending axially rearwardly from a counterbore in said frontal face having a diameter substantially equal to the diameter of said outer face portion, said recess defining a radially inner core portion and a radially outer annular portion, said coil form having said cavity with said coil therein and said inner face portion located substantially within said recess in said magnet body and having said outer face portion matably disposed within said counterbore, a flat washer member of nonmagnetic, frictional material matably disposed within said counterbore and in axial contact with said outer face portion, a flat contact ring member of magnetic material disposed concentrically with and matably within said washer member and in substantial axial alignment with said radially inner core portion, and a flat reluctance washer member of a substantially nonmagnetic material disposed between said contact ring member and said radially inner core portion; said frontal face, said frictional washer member, and said ring member substantially defining a planar outer surface.

10. In a system for electrically actuating brakes comprising a lever arm pivotally secured to a fixed brake backup plate and adapted to move brake means into contact with a rotatable brake drum responsively to pivotal movement, an armature plate secured to the brake drum, an electromagnet secured to the lever arm at a position proximate to the armature plate, and spring means biasing the electromagnet into contact with the armature plate, the improvement comprising an electromagnet for use in said system and including a plastic coil form having an annular, radially outwardly facing cavity axially defined by axially spaced, radially extending, annular inner and outer face portions, said inner and outer face portions being circularly shaped with said outer face portion having a greater diameter than said inner face portion, a coil annularly wound within said cavity, a magnet body having an annular axially facing recess extending axially rearwardly from a counterbore having a diameter substantially equal to the diameter of said outer face portion in a frontal face thereof, said coil form having said cavity with said coil therein and said inner face portion located substantially within said recess in said magnet body and having said outer face portion matably disposed within said counterbore, and means in engagement with said outer face portion and secured at said frontal face on said magnet body for axially retaining said coil form.

11. In a system for electrically actuating brakes comprising a lever arm pivotally secured to a fixed brake backup plate and adapted to move brake means into contact with a rotatable brake drum responsively to pivotal movement, an armature plate secured to the brake drum, an electromagnet secured to the lever arm at a position proximate to the armature plate, and spring means biasing the electromagnet into contact with the armature plate, the improvement comprising an electromagnet for use in said system and including a plastic coil form having an annular, radially outwardly facing cavity axially defined by axially spaced, radially extending, annular inner and outer face portions, said inner and outer face portions being circularly shaped with said outer face portion having a greater diameter than said inner face portion and with said inner face portion having a pair of generally radially extending slots formed at the periphery thereof, a pair of bendable tabs formed integrally with said inner face portion and disposed proximate to and at opposite ends of each of said slots therein, a coil annularly wound within said cavity, a pair of lead wires each electrically connected to a terminating end of said coil and each disposed within one of said slots, said tabs bent to extend axially towards said outer face portion and in overlying relationship with said lead wires, a magnet body having an annular axially facing recess in a frontal face thereof, said coil form with said coil located in said recess, and means in engagement with said outer face portion and secured at said frontal face on said magnet body for axially retaining said coil form.

12. The electromagnet of claim **11** with said magnet body having said recess extending axially rearwardly from a counterbore in said frontal face having a diameter substantially equal to the diameter of said outer face portion, said recess defining a radially inner core portion and a radially outer annular portion, said coil form having said cavity with said coil therein and said inner face portion located substantially within said recess in said magnet body and having said outer face portion matably

disposed within said counterbore, a flat washer member of nonmagnetic, frictional material matably disposed within said counterbore and in axial contact with said outer face portion, a flat contact ring member of magnetic material disposed concentrically with and matably within said washer member and in substantial axial alignment with said radially inner core portion, and a flat reluctance washer member of a substantially nonmagnetic material disposed between said contact ring member and said radially inner core portion; said frontal face, said frictional washer member, and said ring member substantially defining a planar outer surface.

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