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E. ERTL ET AL

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ELECTROMAGNETIC SWITCH RELAYS

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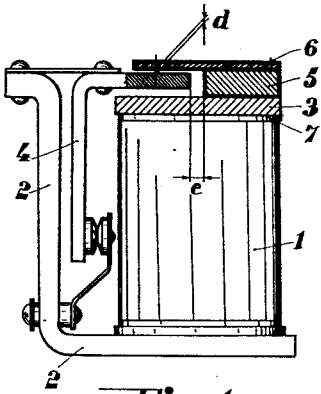


Fig. 1

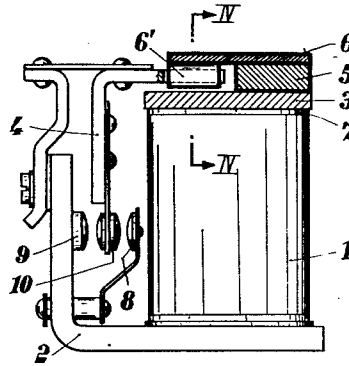


Fig. 2

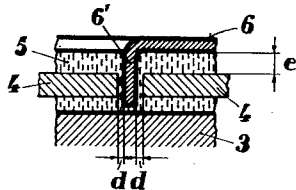


Fig. 4

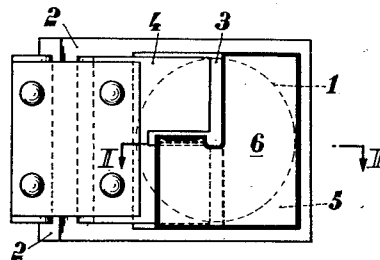


Fig. 3

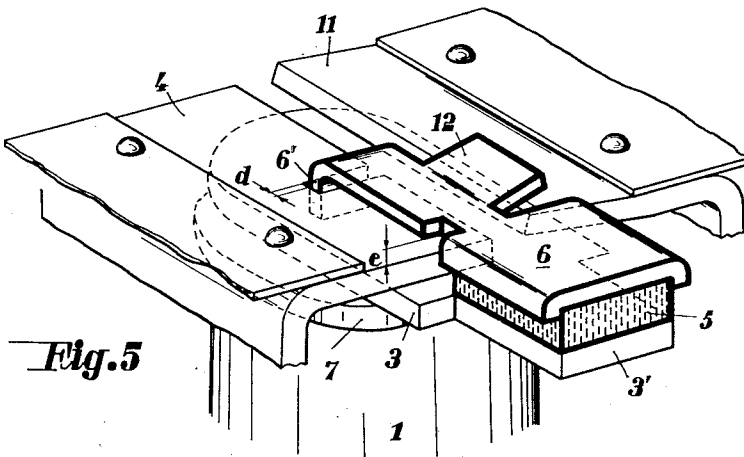


Fig. 5

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ELECTROMAGNETIC SWITCH RELAYS

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13 Claims. (Cl. 200—32)

This invention relates to an electromagnetic switch relay, more especially a voltage regulator or charging switch or a constructional combination of the two for lighting installations of powered vehicles, and the object thereof is to provide a switch relay equipped with a particularly effective device for modifying the temperature-dependent changes of the magnetic flux.

The regulation range of this device will be sufficiently large not only to keep constant-independently of those temperature-dependent changes of the magnetic flux which are produced by heating of the coil windings due to the Joule effect—the values controlled by the relay, such as for instance voltage or charging current of a lighting dynamo, but also to render possible adaptation of the voltage and the charging current of the dynamo to the current consumption requirements of the vehicle in operation, which requirements vary with the external temperature prevailing at any given moment.

In modern power-driven vehicles, more especially in vehicles driven by diesel engines, the charging of the lighting and starter batteries must take place under conditions which vary very greatly with differences in external temperature, depending on the season or the geographical position. Thus more especially when the external temperature is low the engine is difficult to start and takes from the battery many times more current than when the external temperature is high; also, the lighting consumption of the vehicle is greater in winter than in summer. Furthermore, for correct charging of the battery, allowance must be made for the fact that the maximum voltage of a fully charged battery depends on the temperature and varies for instance between 2.7 volts and 2.4 volts per cell if the temperature varies between 0 and 50° C. In order to prevent overcharging or undercharging of the battery, the regulated voltage of the lighting dynamo should automatically adapt itself to the operating conditions of the battery.

If the voltage of the lighting dynamo is regulated by means of an electromagnetic vibratory regulator without a device for temperature compensation, a voltage variation results which is exactly the opposite of what is required as stated above. That is to say, at high temperatures the electrical resistance of the copper winding increases and the magnetic attractive force acting on the armature becomes correspondingly smaller; at higher temperatures this causes the lighting dynamo to be regulated to a higher voltage and the battery to be given a higher charge than at lower temperatures.

For these reasons, various indirectly or directly acting devices have been proposed which however render possible only compensation of the temperature-dependent changes of the magnetic flux and in which either a bimetallic strip or a part made from a special alloy of temperature-dependent permeability, for instance an iron-nickel alloy, is used as a regulating member.

In the first case, in the constructions known heretofore the bimetallic spring is disposed outside the magnetic cir-

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cuit, for instance as a suspension spring for the movable armature or as an additional counterspring.

For the second case, forms of construction are known in which there is a magnetic shunt in parallel with the main circuit of the magnetic flux, and in this shunt a part which is made of the above-mentioned special alloy, and of which the magnetic conductivity is greater at low temperatures than at high temperatures, so that at low temperatures a greater part of the magnetic flux is deflected into the shunt than at higher temperatures. Therefore, compensation of the above-mentioned effect takes place, in such a manner that the flux, i. e. the magnetic attractive force of the coil, is reduced when the external temperature increases and that the regulated voltage will remain approximately constant throughout the entire temperature range.

One example of an embodiment of a regulating device of this kind is described in British patent specification No. 211,119, in which the magnetic shunt consists of a part made of an iron-nickel alloy, an air gap which is adjustable by means of an adjusting screw, and lastly the yoke made of soft iron. However, only a relatively very small proportion of the flux can be deflected into this shunt, because of the known fact that the magnetic resistance of such alloys having a temperature-dependent permeability is approximately ten times as great as that of ordinary soft iron. The operating range of this compensation device is therefore very limited.

It has been found that in all the above-mentioned known devices for compensation of the temperature-dependent changes in the magnetic flux the regulating range is very small and only allows compensation of those changes in the magnetic flux which depend on the heating of the copper windings through the Joule effect. This so-called "copper error" amounts to about 3.8% for every 10° C. Admittedly, by means of these known compensation devices the adjusted electrical values of the voltage and the charging current can be kept constant if the external temperature remains constant, but they cannot be adapted to the above-defined requirements which depend on the season.

These requirements however are fully complied with by means of the invention, by reason of the fact that in an electromagnetic switch relay, more especially a voltage regulator and/or charging switch for lighting installations of power-driven vehicles, the required modification of the temperature-dependent changes of the magnetic flux is effected by means of a magnetic counter-pole of soft iron which overlaps the armature plate—or both armature plates in the case of combined voltage regulators and charging switches—on the side remote from the coil and is connected with the pole plate of the coil through a part made of a ferro-magnetic special alloy of temperature-dependent permeability.

In one particularly preferred form of construction of a voltage regulator, according to a further feature of the invention the armature plate is provided with a slot-shaped cavity, and the magnetic counter-pole is angularly formed, its free arm engaging in this cavity without touching the sides thereof, the air gap between the cavity and the engaging part of the counter-pole being substantially smaller than the air gap between the main surfaces of the armature and of the counter-pole.

It is in many cases a normal practice to combine the voltage regulator and the charging switch to form a single relay, in which the two armatures are arranged symmetrically over a common coil. For relays of this kind, a particularly advantageous embodiment of the invention results if the pole plate of the relay coil is provided with a lateral extension, disposed symmetrically with respect to the two armature plates, and if the connection member carrying the counter-pole and made of the above-men-

tioned special alloy is attached to this extension so that the counter-pole overlaps both armature plates substantially symmetrically. That part of the counter-pole which is directed towards the regulator armature is in this case also provided with an angularly formed end which engages in a slot-shaped cavity in this armature, whereas that part of the counter-pole which is directed towards the armature of the charging switch forms an abutment to which this latter armature clings until the attractive force of the coil prevails and the armature is pulled away abruptly.

Iron-nickel alloys, or combinations thereof with so-called Monel metal have been found to be particularly suitable as special alloys for temperature-dependent regulation of the magnetic flux of the counter-pole.

Further features and details of the invention are described with reference to the accompanying drawings, in which

Figure 1 shows a simple voltage regulator with single contact regulation and a simple counter-pole, partly in section,

Figure 2 shows a voltage regulator with two-contact regulation, provided with the angularly formed counter-pole, partly in section on line II—II of Figure 3,

Figure 3 shows the ground plan thereof,

Figure 4 shows a detail of the upper part of the regulating device, on line IV—IV of Figure 2, on a larger scale, and

Figure 5 shows the upper part of a switch relay, with two armatures, comprising an advantageous constructional form of the common counter-pole.

In Figure 1, 1 is the coil, 2 is the yoke, 3 is the pole plate and 4 the angularly formed armature resiliently attached to the yoke and extending over about one half of the pole plate 3. To the other half of the pole plate is attached the part 5 which effects temperature compensation, being made of a ferromagnetic alloy of temperature-dependent permeability, preferably an iron-nickel alloy, while to this part 5 is attached the counter-pole 6, made of ordinary soft iron and formed as a simple plate, which overlaps the armature 4 from above.

The counter-pole 6 is disposed parallel to the armature and at a short distance d therefrom, in such a manner as not to be touched by the armature in its highest position, i. e. when the contact is closed.

The magnetically induced counter-pole 6 is of the same polarity as the pole plate 3 and acts on the armature against the attractive force of the coil 1, i. e. the main attractive force is reduced by the action of the counter-pole.

The magnetisation line of the alloys used for making the part 5 must be such that their magnetic saturation decreases with increasing temperature from about -20°C . and that their Curie point is substantially higher than the highest operating temperature of the regulator.

Thus, as the temperature arises the reduction in the attractive power of the coil is countered by a corresponding and substantially greater decrease in the attractive power of the counter-pole due to the increase of the magnetic resistance in the part 5, so that the resultant effect on the armature is the same as that of an increase in the attractive power of the coil, whereby the effect envisaged according to the invention is produced. With falling temperature, the effect is correspondingly reversed.

With a regulating device constructed according to the invention, if the dimensions of the active iron-nickel part 5 and the counter-pole 6 are made very small, the range of regulation of the magnetic attractive force over a temperature range of approximately 0 to 70°C . is at least twice as great as is necessary for compensation of the error arising from heat in the coil winding due to the Joule effect. Therefore, not only is it possible to compensate the flux variation arising from the heating of the coil by the current, but in addition it is also possible to effect regulation of the magnetic flux in such a manner that the

attractive force exerted by the coil on the armature 4 is greater at higher than at lower temperatures and that the voltage will as required be lower at high temperatures than at low temperatures.

Admittedly, the air gap d between the armature 4 and the counter-pole 6 varies during the operation of the vibratory regulator, but in the case of the single-contact regulator illustrated this variation amounts only to a few hundredths of a millimetre.

Lastly, it may be mentioned that the upper flange 7 of the coil 1 may consist of highly heat-conductive material, for instance of aluminium, so that the active part 5 will acquire the temperature of the coil as nearly as possible.

Figures 2 and 3 illustrate a voltage regulator with two contact regulation, contact 8 being used for regulation in the lower speed range and contact 9 for regulation in the upper speed range. The range of movement of the armature therefore depends on the path traversed by the contact 10, which is attached to this armature, between the two contact positions at 8 and 9. The size of the upper air gap e varies, during operation, by the amount corresponding to this armature movement. This variation would therefore be several times that in the example illustrated in Figure 1, and would very greatly affect the action of the counter-pole.

In order to remove this disadvantage and to provide uniform conditions for the action of the counter-pole, the armature is provided, in its centre, with a slot-shaped cavity, and the counter-pole 6 is angularly formed in such a manner that its free arm 6' projects into this cavity.

Since the air gap d between the edge of the said cavity and the arm 6' of the counter-pole 6 remains unaltered in all positions of the armature 4, this air gap can be made very narrow without thereby interfering with the actuation of the armature. This invariable lateral air gap d is therefore so much smaller than the air gap e that the force exerted by the counter-pole is transmitted mainly through this lateral air gap d and is therefore not affected by the movement of the armature. The arm 6' must obviously be sufficiently long to penetrate completely into the armature 4 even when this armature is in its lowest position.

The dimensional relationships described above are clearly shown in Figure 4.

Figure 5 shows an advantageous embodiment of the invention for a combined voltage regulator and charging switch, of which the two armatures 4 and 11 symmetrically overlap the common relay coil 1. The pole plate 3 is provided, laterally of the two armatures, with an extension 3' to which is attached the active part 5 made of the above-mentioned special alloy and carrying the counter-pole 6. This counter-pole overlaps both armature plates substantially symmetrically, and its angularly formed end 6' engages in a cavity in the armature plate 4 of the voltage regulator, in the manner described above with reference to Figures 2 to 4. On the side directed towards the armature 11 of the charging switch the counter-pole 6 is provided with an abutment 12 against which the upwardly stressed armature 11 strikes. This achieves the result that when current flows through the magnet coil, at lower temperatures the delaying effect of the holding force of the magnetised abutment 12 will cause the armature 11 to be pulled away later, whereas as the temperature rises this holding force will lessen and finally vanish, so that the said armature will be pulled down without delay. The armature 11 of the charging switch therefore closes at the same voltage throughout the temperature range covered by the regulating device.

The compensation effect essentially depends upon dimensioning (cross-section and length of the path of the magnetic flux) of the ferromagnetic alloy. According to the invention this fact is taken into account by directing the magnetic flux in temperature-dependent shunt, thereby utilizing as much as possible the iron path.

The magnetic flux diverted to the shunt joins again the main magnetic flux through the pole shoe 6 directly through the movable anchor 4 of the relay, thus influencing the main magnetic flux directly in the manner of an electromagnetic counter-pole. Thereby not only a very efficient compensation and regulation effect is warranted, but it is also possible, by arranging the construction elements of the shunt independently from the current of the magnetic flux of all known iron-nickel, nickel-copper alloys, and so on, to influence the form and the quantity of the functional curve of the compensation and regulation effect.

The device according to the invention allows the highest possible linear temperature-dependent regulation of the magnetic flux by substituting for instance the part 5 by a combination of several plate shaped elements with different, especially inverse temperature coefficients. For this purpose a combination of elements corresponding to the U. S. patent specification No. 1,608,872 consisting of plate shaped elements made from an iron-nickel alloy and of plate shaped elements made from Monel metal is particularly suitable.

Reference is made to our copending application Ser. No. 177,158, filed August 2, 1950, now abandoned, of which the present application is a continuation-in-part.

What is claimed is:

1. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member arranged adjacent the main pole member, said temperature-compensating member having a temperature dependent permeability; a counter-pole member arranged adjacent said temperature-compensating member and spaced from said main pole member to form an air space therebetween, said main pole member, said temperature-compensating member and said counter-pole member being arranged in a continuous magnetic flux circuit; and an armature movably mounted on said yoke member and spaced from both said pole members to divide said air space into a first and a second air gap, said first air gap being between said armature and said counter-pole member and said second air gap being between said armature and said main pole member, said armature being capable of assuming any one of a plurality of positions between said main pole and said counter-pole members, whereby when energy is supplied to the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature compensating member and the position of said armature between said main pole and counter-pole members being dependent upon the relative flux distribution therebetween.

2. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member arranged adjacent the main pole member, said temperature-compensating member having a negative temperature coefficient of magnetic permeability; a counter-pole member arranged adjacent said temperature-compensating member and spaced from said main pole member to form an air space therebetween, said main pole member, said temperature-compensating member and said counter-pole member being arranged in a continuous magnetic flux circuit; and an armature movably mounted on said yoke member and spaced from both said pole members to divide said air space into a first and a second air gap, said first air gap being between said armature and said counter-pole member and said second air gap being between said armature and said main pole member, said armature being capable of assuming any one of a plurality of positions between said main pole and said counter-pole members, whereby when energy is supplied to

the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature-compensating member and the position of said armature between said main pole and counter-pole members being dependent upon the relative flux distribution therebetween.

3. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member mounted on the main pole member, said temperature-compensating member having a temperature dependent permeability; a counter-pole member mounted on said temperature-compensating member and spaced from said main pole member to form an air space therebetween; and an armature pivotally mounted on said yoke member and spaced from both said pole members to divide said air space into a first and a second air gap, said first air gap being between said armature and said counter-pole member and said second air gap being between said armature and said main pole member, said armature being capable of assuming any one of a plurality of positions between said main pole and said counter-pole members, whereby when energy is supplied to the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature-compensating member and the position of said armature between said main pole and counter-pole members being dependent upon the relative flux distribution therebetween.

4. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member mounted on the main pole member, said temperature-compensating member having a negative temperature coefficient of magnetic permeability; a counter-pole member mounted on said temperature-compensating member and spaced from said main pole member to form an air space therebetween; and an armature pivotally mounted on said yoke member and spaced from both said pole members to divide said air space into a first and a second air gap, said first air gap being between said armature and said counter-pole member and said second air gap being between said armature and said main pole member, said armature being capable of assuming any one of a plurality of positions between said main pole and said counter-pole members, whereby when energy is supplied to the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature-compensating member and the position of said armature between said main pole and counter-pole members being dependent upon the relative flux distribution therebetween.

5. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member arranged adjacent the main pole member, said temperature-compensating member having a temperature dependent permeability; a counter-pole member arranged adjacent said temperature-compensating member and spaced from said main pole member to form an air space therebetween, said counter-pole member having a flange portion, said main pole member, said temperature-compensating member and said counter-pole member being arranged in a continuous magnetic flux circuit; and an armature movably mounted on said yoke member in the direction of said flange portion and spaced from both said pole members to divide said air space into a first and a second air gap, said armature having an opening into which the

flange portion of said counter-pole projects, said first air gap being between said armature and the flange portion of said counter-pole member and said second air gap being between said armature and said main pole member, whereby when energy is supplied to the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature-compensating member.

6. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member arranged adjacent the main pole member, said temperature-compensating member having a negative temperature coefficient of magnetic permeability; a counter-pole member arranged adjacent said temperature-compensating member and spaced from said main pole member to form an air space therebetween, said counter-pole member having a flange portion, said main pole member, said temperature-compensating member and said counter-pole member being arranged in a continuous magnetic flux circuit; and an armature movably mounted on said yoke member in the direction of said flange portion and spaced from both said pole members to divide said air space into a first and a second air gap, said armature having an opening into which the flange portion of said counter-pole projects, said first air gap being between said armature and the flange portion of said counter-pole member and said second air gap being between said armature and said main pole member, whereby when energy is supplied to the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature-compensating member.

7. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member mounted on the main pole member, said temperature-compensating member having a negative temperature coefficient of magnetic permeability; a counter-pole member mounted on said temperature-compensating member and spaced from said main pole member to form an air space therebetween, said counter-pole member having a flange portion; and an armature pivotally mounted on said yoke member in the direction of said flange portion and spaced from both said pole members to divide said air space into a first and a second air gap, said armature having an opening into which the flange portion of said counter-pole projects, said first air gap being between said armature and the flange portion of said counter-pole member and said second air gap being between said armature and said main pole member, whereby when energy is supplied to the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature-compensating member.

8. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member arranged adjacent the main pole member, said temperature-compensating member having a temperature dependent permeability; a counter-pole member arranged adjacent said temperature-compensating member and spaced from said main pole member to form an air space therebetween, said main pole member, said temperature-compensating member and said counter-pole member being arranged in a continuous magnetic flux circuit; an armature movably mounted on said yoke member and spaced from both said pole members to divide said air space into a

first and a second air gap, said first air gap being between said armature and said counter-pole member and said second air gap being between said armature and said main pole member, said armature being capable of assuming any one of a plurality of positions between said main pole and said counter-pole members; and means for resiliently urging said armature towards the said counter-pole so that said first air gap is substantially smaller than said second air gap whereby when energy is supplied to the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature-compensating member and the initial position of said resilient urging means and the position of said armature between said main pole and counter-pole members being dependent upon the relative flux distribution therebetween.

9. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member mounted on the main pole member, said temperature-compensating member having a negative temperature coefficient of magnetic permeability; a counter-pole member mounted on said temperature-compensating member and spaced from said main pole member to form an air space therebetween; an armature pivotally mounted on said yoke member and spaced from both said pole members to divide said air space into a first and a second air gap, said first air gap being between said armature and said counter-pole member and said second air gap being between said armature and said pole member, said armature being capable of assuming any one of a plurality of positions between said main pole and said counter-pole members; and means for resiliently urging said armature towards the said counter-pole so that said first air gap is substantially smaller than said second air gap whereby when energy is supplied to the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature-compensating member and the initial position of said resilient urging means and the position of said armature between said main pole and counter-pole members being dependent upon the relative flux distribution therebetween.

10. An electromagnetic relay comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; a temperature-compensating member mounted on the main pole member, said temperature-compensating member having a negative temperature coefficient of magnetic permeability; a counter-pole member mounted on said temperature-compensating member and spaced from said main pole member to form an air space therebetween, said counter-pole member having a flange portion; an armature pivotally mounted on said yoke member in the direction of said flange portion and spaced from both said pole members to divide said air space into a first and a second air gap, said armature having an opening into which the flange portion of said counter-pole projects, said first air gap being between said armature and the flange portion of said counter-pole member and said second air gap being between said armature and said main pole member, said armature being capable of assuming any one of a plurality of positions between said main pole and said counter-pole members; and means for resiliently urging said armature towards the said counter-pole so that said first air gap is substantially smaller than said second air gap whereby when energy is supplied to the magnet winding a portion of the magnetic flux produced in said yoke is shunted through said counter-pole and said first air gap to said armature, the portion of the flux shunted depending upon the temperature of said temperature-compensating member and the initial position of said resilient urging means and the

position of said armature between said main pole and counter-pole members being dependent upon the relative flux distribution therebetween.

11. An electromagnetic relay, comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; an armature movably mounted on said yoke member and having a first and a second end portion, said first end portion being spaced from said main pole member and adapted to be attracted towards said main pole member by the magnetic flux established therethrough; a switch having a pair of normally closed contacts, one of said pair of contacts being fixed and mounted on said yoke member and the other contact of said pair of contacts being mounted on said second end portion of said armature to open said switch when said first end portion of said armature is attracted towards said main pole member; temperature-compensating means mounted on said yoke member; and a counter-pole member mounted on said temperature-compensating means and spaced from said main pole member to form an air space with said main pole member, said temperature compensating means causing a portion of said magnetic flux flowing through said main pole member to pass through said counter-pole member to decrease the attraction of said first end portion towards said main pole member, the amount of magnetic flux passing through said counter-pole being dependent upon the temperature of said temperature-compensating means.

12. An electromagnetic relay, comprising, in combination, a magnetic yoke member having a magnet winding mounted thereon and having one end serving as a main pole member; an armature movably mounted on said yoke member and having a first and a second end portion, said first end portion being spaced from said main pole member and adapted to be attracted towards said main pole member by the magnetic flux established therethrough; a switch having a pair of normally closed contacts, one of said pair of contacts being fixed and mounted on said yoke member and the other contact of said pair of contacts being mounted on said second end portion of said armature to open said switch when said first end portion of said armature is attracted towards said main pole member; temperature-compensating means mounted on said main pole member; and a counter-pole member mounted on said temperature-compensating means and spaced from said main pole member to form an air space with said main pole member, said first end portion of said armature being disposed in said air space to divide said air space into a first and a second air gap, said first air gap being located between said main pole member and said first end portion of said armature, said second air gap being located between said counter-pole member and said first end portion of said armature, said temperature-compensating means causing a portion of said magnetic flux flowing through said main pole member to pass through said counter-pole member to decrease the attraction of said first end portion toward said main pole mem-

ber, said armature being capable of assuming any one of a plurality of positions between said main pole and said counter-pole members, the amount of magnetic flux passing through said counter-pole being dependent upon the temperature of said temperature-compensating means and the position of said armature between said main pole and counter-pole member being dependent upon the relative flux distribution therebetween.

13. An electromagnetic regulating relay adapted for use as a vibrating voltage regulator and charging switch for lighting equipment on power-driven vehicles, comprising, in combination, a magnetic coil enclosing an iron core; a pole plate arranged at one end of said iron core; an armature arranged and suspended in spaced relation above said pole plate; resilient means for mounting said armature on the relay in such manner that the periodic movement of said armature during its vibration is carried out without contact with said pole plate, a magnetic temperature-compensating member mounted on said pole plate of said relay, said temperature-compensating member being at the ambient temperature of said power-driven vehicle and being made from a ferromagnetic material having a Curie point between 100-120° C. when the ambient temperature range of said power-driven vehicle is of the order of 80° C.; a counter-pole mounted on said temperature-compensating member to form an air space with said pole plate wherein said armature is disposed, said air space being partitioned into a first and a second air gap by said armature, the distance between said pole plate and said counter-pole being so small that the magnetic flux established in said magnetic core by said magnet winding is divided into two parts, one part of said magnetic flux flowing from said pole plate to one side of said armature through said first air gap and the other part of said magnetic flux flowing to the other side of said armature through said pole plate, said temperature-compensating member, said counter-pole and said second air gap so that said armature is attracted by the difference between the two divided parts of said magnetic flux whereby, under the influence of said temperature-compensating member, the voltage regulated by the vibrating voltage regulator is higher for lower ambient temperatures than for higher ambient temperatures.

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