

April 14, 1959

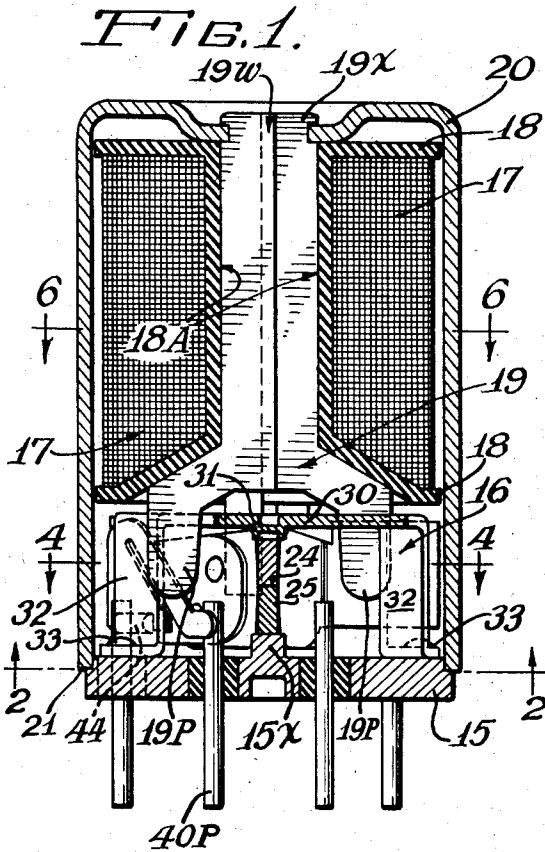
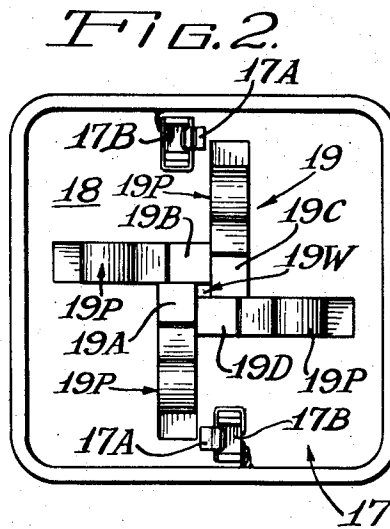
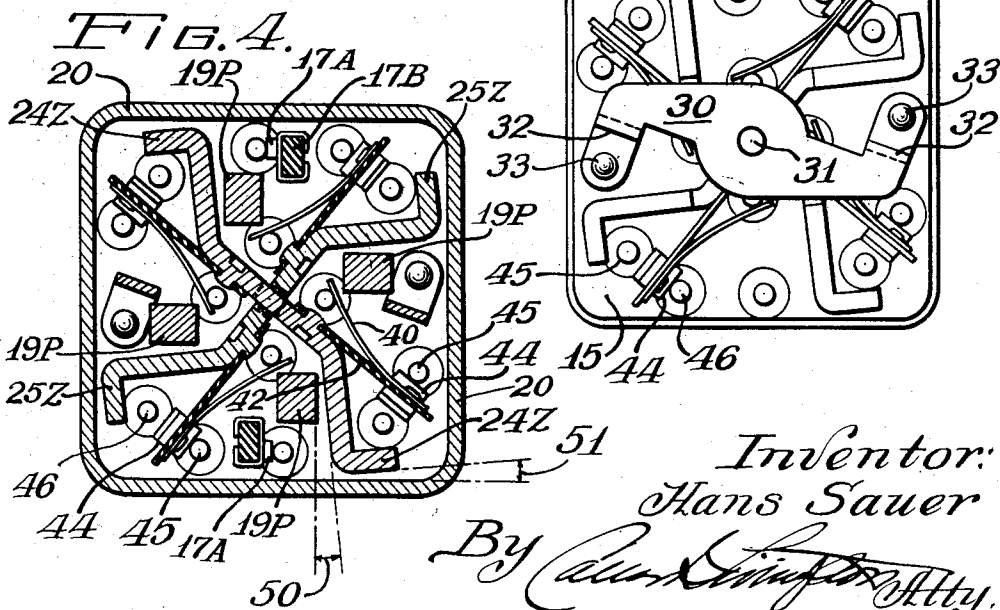
H. SAUER

2,882,460

ELECTROMAGNETIC RELAY

Filed June 29, 1956

3 Sheets-Sheet 1



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April 14, 1959

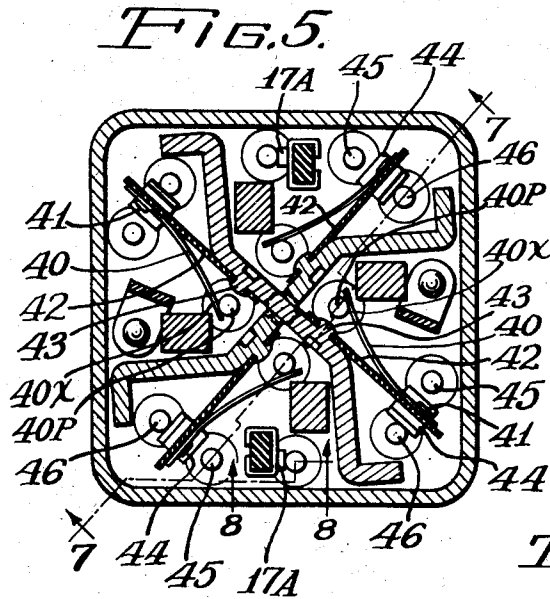
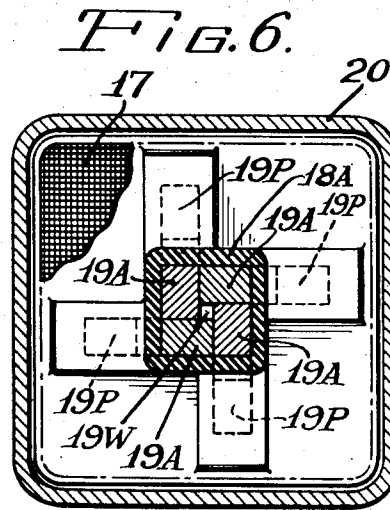
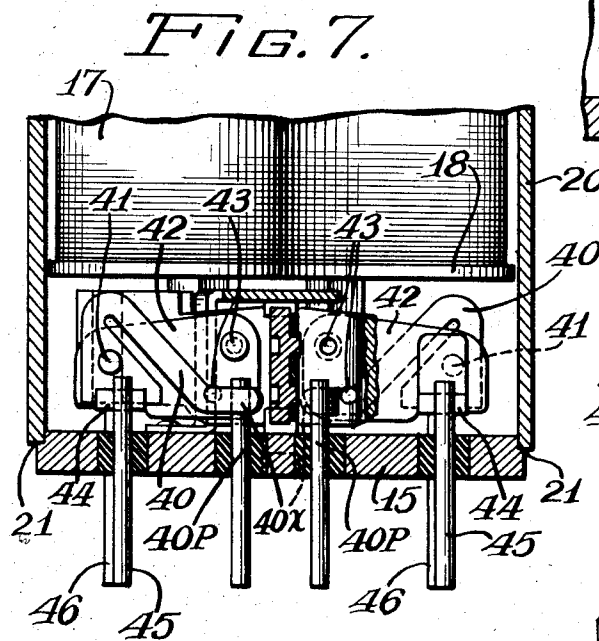
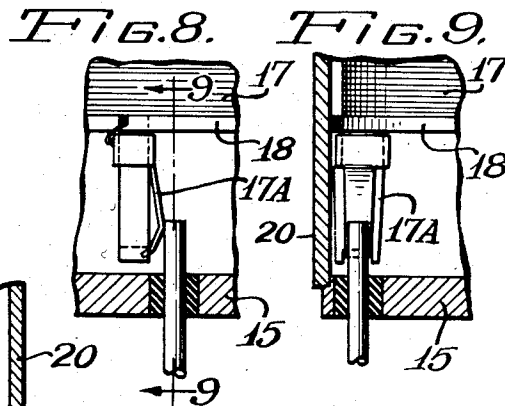
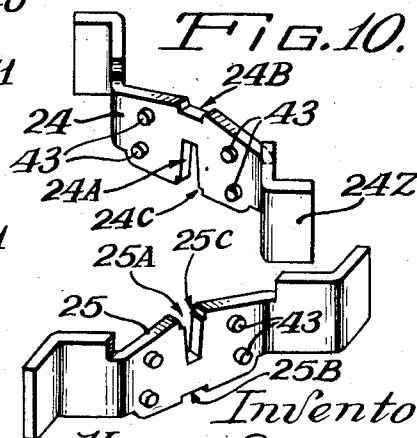
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2,882,460

ELECTROMAGNETIC RELAY

Filed June 29, 1956

3 Sheets-Sheet 2



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2,882,460

ELECTROMAGNETIC RELAY

Filed June 29, 1956

3 Sheets-Sheet 3

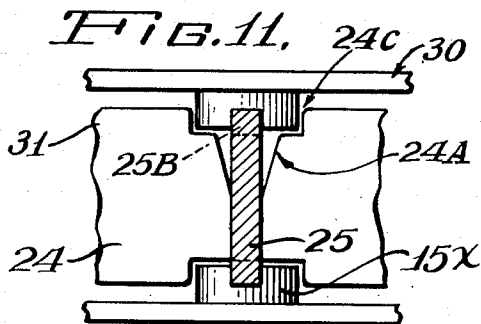
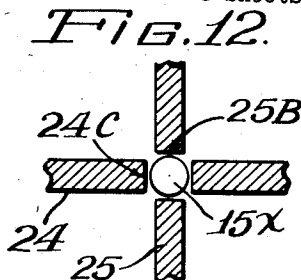
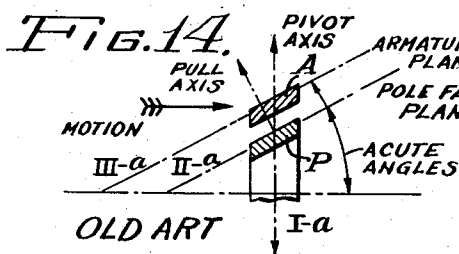
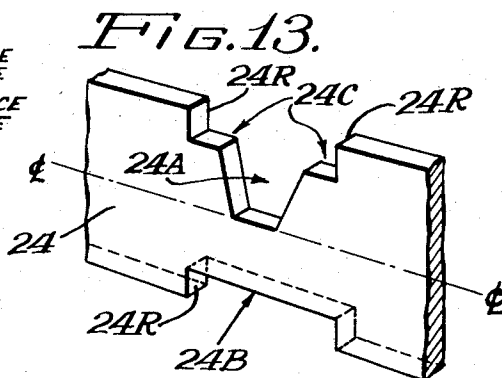


FIG. 15.

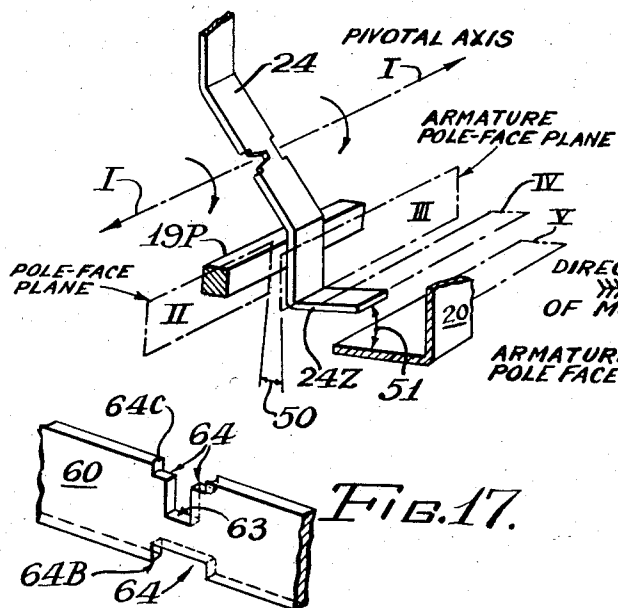
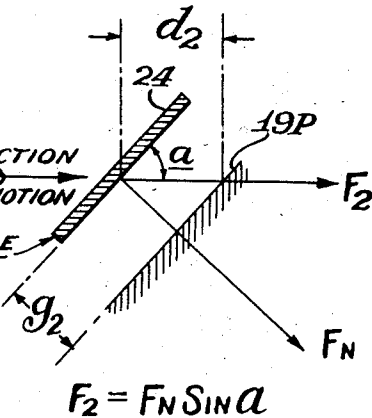
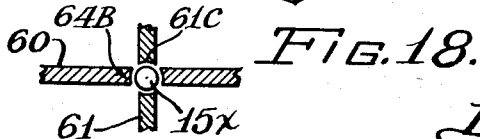


FIG. 16.



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2,882,460

ELECTROMAGNETIC RELAY

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Application June 29, 1956, Serial No. 594,876

18 Claims. (Cl. 317-197)

This invention pertains to electromagnetic relays of the rocking armature type, and especially, but not by limitation, to the smaller varieties thereof classified as miniature and subminiature relays.

The disclosure affords a relay of the class described characterized by the provision of a composite armature consisting of diametrically crossed armature pieces with peculiarly offset limbs affording a plurality of offset pole faces symmetrically arranged about a central pivot axis and each cooperating with a corresponding stationary pole face for movement relative to the latter in a diagonal relationship in which the planes containing the working faces of the armature pole and the stationary pole are parallel to the pivotal axis, in contradistinction to prior types of diagonal-moving armatures in which the planes containing the pole faces are variously situated at acute angles to the armature axis thereby providing in the new diagonal construction substantial advantages more fully pointed out hereinafter.

The novel composite armature structure is further characterized by the provision of interfitting bearing notch formations thereon whereby the several crossed armature members are individually borne on a common bearing means with one, two, or three degrees of freedom.

Still another feature is the provision of a novel core structure consisting of several individual pole members nested together in the bore of the coil bobbin so as to afford an air exhaust path, spaced working poles, and an economically assembled magnetic coil structure.

Additional objects relate to the provision of an armature subassembly consisting of the above-mentioned composite armature means working according to the prescribed diagonal principles at higher efficiencies, and so contrived that the armature can be worked as a single armature or as two armatures depending upon the appertaining air gap and spring tension parameters, so that different operating currents in a single coil will actuate the system accordingly; together with the provision of the improved coil means as another subassembly adapted to be conjoined with the first subassembly economically to provide a hermetically sealed relay, for example of the subminiature type, which can be worked as a single four-pole double-throw relay, or differentially as two two-pole double-throw relays from a single coil.

Further aspects of novelty and utility relate to details of the construction and operation of the device described hereinafter in view of the annexed drawings, in which:

Fig. 1 is a vertical section of the complete relay drawn to substantially enlarged scale;

Fig. 2 is a view of the coil subassembly looking up along lines 2-2 of Fig. 1, and showing the bottom face of the coil bobbin and parts of the field pole assembly in plan;

Fig. 3 is a top plan view of the armature subassembly and contact means;

Fig. 4 is a cross section through the armature subassembly and contact means taken along lines 4-4 of Fig. 1;

Fig. 5 is an operating detail, similar to Fig. 4, and show-

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ing the armature and contacts in fully operated condition;

Fig. 6 is a horizontal section through the coil bobbin looking along lines 6-6 of Fig. 1;

Fig. 7 is an enlarged vertical sectional fragment with parts shown in elevation, looking along lines 7-7 of Fig. 5;

Figs. 8 and 9 are magnified fragmentary sectional details at the bobbin contact means looking, respectively, in the direction of lines 8-8 of Fig. 5, and 9-9 of Fig. 8;

Fig. 10 is an enlarged perspective detail of the armature members disassembled;

Fig. 11 is a magnified fragmentary sectional detail of the tapered armature-bearing interfit;

Fig. 12 is a magnified fragmentary diagram detailing an axial end view of the bearing structure;

Fig. 13 is a magnified fragmentary perspective detail of one of the tapered bearing slots;

Fig. 14 is a diagram illustrative of the acute-angle diagonal-armature principle;

Fig. 15 is a schematic representation of the new parallel-plane relationship of armature axis, and working pole faces;

Fig. 16 is a force-diagram.

Fig. 17 is a magnified fragmentary detail of the modified or straight-walled bearing slot;

Fig. 18 is a magnified fragmentary diagram of the axial end view of the modified bearing means.

In the sectional view of Fig. 1, the relay comprises a metal base 15 in which the required number of contact pins 45, 46, etc. are embedded in insulation seals.

Secured on said base is a compact armature and contact subassembly generally indicated at 16 and shown in top plan view in Fig. 3.

Situated above the armature subassembly is another subassembly including coil 17 on bobbin 18 having a square bore 18A (Fig. 6) in which is inserted a composite pole assembly consisting of four identical members 19 (Figs. 1, 2, and 6) each having a long leg portion 19A terminating at its lower end in a peculiarly offset salient pole piece 19P. The legs of the four identical pole components are assembled in such manner that in cross section they define a square array, as in Fig. 6, with a central exhaust passage 19W (Fig. 1 also) traversing the entire longitudinal extent thereof and issuing at the upper exposed end region 19X thereof. In the final stages of manufacture the relay canister may be substantially exhausted of air and the open end 19WX suitably sealed off.

The lower offset end portions or salient pole pieces 19P lie in a somewhat squared array (Figs. 2 and 6) in the sense that each pole falls substantially at the corner of a square configuration and in plan view (Fig. 3) gives somewhat the appearance of a swastika.

Connection to the coil 17 is established through the medium of a pair of pendant contact presser springs 17A (Figs. 2, 8, and 9), which are crimped upon pendant insulating lugs 17B projecting integrally from the lower face of the bobbin 18, the terminal wires (not seen) from the coil 17 being soldered to said springs, and the latter being firmly slidably engaged by corresponding contact pins carried on base 15, as depicted in Figs. 8 and 9, when the two subassemblies are brought together.

Of great importance to the success of the instrument is the composite armature structure which consists essentially of two elongated members 24 and 25 of highly permeable metal, each having the peculiar reversely offset end portions 24Z, 25Z of L-shape (seen in Figs. 5 and 10), the angular characteristics of which, in respects to be pointed out hereinafter, are of considerable importance to the efficient operation of the device.

Referring to Fig. 10, it will be observed that the two

offset armature members are alike in symmetry, and that both have tapered bearing slots 24A, 25A (Fig. 11 also), the former of which is on the lower edge, while the latter is on the upper edge, in consequence of which these two long notch portions can be interfitted to join the two members in the diametric array shown, for example, in Fig. 4, the slots being dimensioned so that in such assembled condition (per Figs. 3 and 11) the two members 24 and 25 can move independently relative to each other, and jointly as a single armature, the independent movements being pivotal and also lateral relative to the common pivotal axis. These members also have a further limited freedom to shift axially up and down along said axis; and while these relative motions are all of slight degree, being in the order of a few thousandths of an inch, depending upon the size of relay and operating characteristics required, they are nevertheless deliberately contrived as important functional parameters of the new structure, as will more fully appear hereafter.

Bearing means to support the armature include an upward stud embossment 15X on the upper face of the base member (Fig. 1) and a downward embossment 31 on a bronze bearing strap 30 (Figs. 1 and 3), which has offset legs 32 seating upon and pinned to the base, as at 33, the two uppermost edges of both armature members being relieved or cut away, as shown, to clear this strap in the aforesaid several possible movements of which the armature pieces are capable.

On the edge of each armature member opposite its tapered bearing slot there is provided a smaller bearing notch 24B or 25B (Fig. 13); and at the mouth of each of said tapered slots 24A or 25A there is provided a similarly dimensioned small complementary bearing notch 24C or 25C of such character that when the armature pieces are interfitted (Figs. 11 and 12) the upper complementary bearing notch 24C of one will be juxtaposed with the lower bearing notch 25B of the other, and so on, whereby to define upper and lower bearing seats for the aforesaid bearing embossments or studs 15X and 31 in the assembled condition depicted in Fig. 1, each said seat thus affording four discontinuous sides or points of bearing contact with the corresponding bearing stud, as depicted in Fig. 12.

Thus, the assembled armature members 24, 25 may pivot jointly about the pivotal axis through the bearing studs 15X and 31; they may also pivot independently about this axis owing to the long-tapered-notch interfit and the four-point bearing seats; and finally, either armature member may rock somewhat laterally of said axis in a form of automatic self-adjustment in which said members seek to locate themselves according to the existing torque forces exerted by the magnetic moment on the one hand and the effort of the normal springs acting thereon, as will presently appear.

The contact system includes partially-disjoined wiping contact springs 40 (Figs. 5 and 7) riveted, as at 41, to thin insulating wafers 42 which in turn are riveted to embossed rivet studs 43 (Fig. 10 also) punched from each of the armature pieces 24 and 25, said springs being fabricated of very thin spring stock of optimum conductivity and each having an elongated diagonal slit to form a free end portion 40X constituting a presser finger (Figs. 5 and 7) projecting to bear in wiping action against a combination stop post and connector pin 40P projecting up through the base member 15, by means of which electrical connection is established between each of said contact springs and a corresponding contact pin.

At the bottom edge of each contact spring 40, at an end remote from the appertaining presser finger portion, is a small, U-shaped contact shoe 44 crimped onto said edge (Figs. 5 and 7) with contacting portions exposed at both faces of the spring for engagement with one or the other of a corresponding pair of contact posts 45, 46 projecting upwardly and downwardly through the base 15. Joint action of the several contact springs 40 urges

the armature assembly into the normal position shown in Fig. 4, in which the contact shoes 44 engage corresponding posts 45; and when the relay coil is energized the armature pivots slightly clockwise to engage the shoes 44 with their off-normal contacts 46, as in Fig. 5.

Thus, in the embodiment shown, there is provided in a very minuscule assemblage, a 4-pole, double-throw contact system affording highly satisfactory contact pressures and loading effects on the armature and having good electrical characteristics. Moreover, the symmetrically balanced system obviates adjustment of the normal springs and provides an exceptionally compact subassembly construction especially suited to subminiature adaptations.

One of the very useful features of the composite armature structure arising from the independent mobility of the component members 24, 25, is the fact that the relay shown may be selectively operated as a 4-pole, double-throw switching means in the case where all of the normal springs 40 are rated alike.

However, if the pair of springs 40 belonging to either armature member 24 or 25 is made weaker or stronger than the pair belonging to the remaining said member, then a differential operating response is achieved such that by passing a first current through coil 17 of magnitude calculated to actuate the armature member having the lower spring rating will cause that member to function as a 2-pole double-throw switch; and a higher coil current will likewise cause the remaining armature member to act in the same capacity.

When the device operates as a 4-pole relay, whether or not the two armature members 24, 25 are to work jointly or severally, the tapered bearing slot is employed so that three degrees of freedom are available, and it is to be noted that in such case, the base or root portion of each tapered slot is a bearing point relative to the root portion of the other, and this is true whether the relay is operated on the aforesaid differential or as a 4-pole unit at only one value of operating current.

However, it is frequently desirable to employ the composite armature structure for 2-pole operation (not illustrated) and to omit the contact shoes and appertaining set of normal springs from one of the two members 24 or 25 to reduce both mass and loading, yet retain the benefit of the symmetrical construction and magnetic efficiency.

Accordingly, the tapered bearing slot structure of Fig. 13 is replaced by a straight slot 63 such as shown in Fig. 17 in the armature member 60. In this case the notch portions 64 have their side walls 64B, 64C formed on a radius to fit closely with the bearing studs 15X, 31 in the manner depicted diagrammatically in Fig. 18, wherein portions of the two diametrically crossed armature members 60, 61 (analogously to the showing of Fig. 12) are seen in relation to the bearing stud 15X with their respective radially relieved bearing faces 60B, 61C embracing said stud, from which it will be understood that in this construction the lateral or rocking freedom of the interfitted armature members 60, 61 is eliminated, the same being unnecessary in this type of two-contact or 2-pole operation, because there is no independent movement of the several armature pieces required.

Since the highly efficient magnetic circuit includes the magnetically-permeable canister or casing 20, it may be pointed out here that when the two (coil and armature) subassemblies are brought together and fitted into the canister the latter will be sealed onto the base in the region 21 (Fig. 1) and the upper extension 19X of the salient pole legs will be peened over into tight fit upon the top of the canister, the orifice 19W being sealed whether the relay is exhausted, charged, or simply hermetically sealed.

Responsive to energization of the coil 17, the magnetic circuit will be seen to extend (describing only one of the four possible circuits with reference to Fig. 4) between the working face of any salient pole 19P across the angular primary air gap 50 to the confronting working surface (pole face) of the juxtaposed limb of one of the apper-

taining armature members 24 or 25, thence from the offset end pole 24Z or 25Z of the latter across the angular secondary air gap 51 to the confronting surface portion of the canister wall, to return through the latter to the end of the circuit at the conjoined ends 19X of the field or salient pole members 19.

It will be understood, therefore, that two working air gaps (e.g. 50, 51) are thus provided for each limb of the composite armature structure, and it will be demonstrated hereinafter that certain important technical advantages derive from this arrangement.

In general, the primary working poles (involving the primary air gaps 50) in each set consists of the salient poles 19P and the confronting working faces on the appertaining armature limbs, while the corresponding secondary working poles (involving the secondary gaps 51) in each instance consist of the corresponding offset end pole portions 24Z or 25Z and their respectively confronting wall portions of the permeable canister 20.

In addition to the foregoing novel structural features relating to the subassemblies, the composite armature and the bearing means therefor making possible economies and advantages in manufacture of such relays, and additionally providing a multiple-contact system capable of selective actuation by differential operating currents through a single operating winding, the disclosure affords improvements in the magnetic circuit by providing a multiple air-gap system in conjunction with a diagonally-moving armature system in which the working pole faces lie in planes which are parallel to the pivotal axis; by reason of which it becomes possible to have the several air gaps in any particular magnetic circuit work at good efficiency because an optimum value can be found for the lengths of air gaps in such a system in accordance with the teachings to follow.

In a construction of the type described, the length of the air gap between any pair of working faces of the appertaining stationary and moving pole members (that is, those pairs involving respectively primary and secondary gaps 50, 51 as aforesaid) will have certain optimum values, and while the primary gaps 50 are alike as to length with respect to each other, and the secondary gaps 51 are likewise of an equal length with respect to each other, the primary gaps 50 are nevertheless different in length from the secondary gaps 51.

In one embodiment of a subminiature type relay, for instance, the angular displacement of the composite armature assembly is of the order of four to five degrees, from which it will be apparent that the moving pole faces defining the secondary gaps being radially more remote from the pivotal axis and the primary pole faces, will necessarily travel through a relatively greater distance.

The principle of the new parallel-to-axis diagonal system as compared to the old acute-angle diagonal system is illustrated with reference to Figs. 14 and 15, the latter depicting one of the new armature members 24 with its pivotal axis indicated at I, while the working face of one of the stationary or salient poles 19P is shown to lie in the dotted-line plane II and the coacting pole face area of the juxtaposed armature limb lies in the plane III, it being observed that either of the pole-face planes II or III is parallel to the axis I.

Likewise, the plane IV containing pole member 24Z and plane V containing the juxtaposed working face of the canister 20 are also parallel to the axis I.

In contradistinction, the old acute-angle diagonal system illustrated with reference to Fig. 14 shows the pivotal axis I-a cutting the planes II-a and III-a of the stationary pole P and armature A at acute angles.

The optimum value of air gap for an angularly displaced armature member, for instance one moving diagonally in accordance with the parallel-to-axis principles mentioned in view of Fig. 15, is to be found according to the methods now explained with reference to the force diagram in Fig. 16, wherein the armature piece 24 is to

be taken as moving in the direction of the fletched arrow toward the stationary pole face 19P, the actual gap distance for which is represented as the value g_2 , and the effective gap value for which is represented as the value d_2 , as follows:

The actual attractive force of the flux acts normally to the planes of the pole faces in the direction of the force arrow F_N , while the resultant or effective attractive force acts in the direction of the arrow F_2 , from which it is found that the resultant force F_2 is a function of the product of the sine of the angle a , which the moving pole face 24 makes with the direction of actual movement of the armature along the effective force component F_2 , and the value of the actual force F_N , expressed simply as:

$$(1) \quad F_2 = F_N \sin a$$

The value of F_2 is now expressed as:

$$(2) \quad F_2 = C \left(\frac{1-t}{\sum R_A \sin a + \sum R_i} \right)^2 \sin a$$

where:

$\sum R_A$ is the sum of the air gap reluctances;

$\sum R_i$ is the sum of the iron reluctances;

t is the air gap leakage factor and is calculated as:

$$t = \frac{p \cdot g \cdot k}{A}$$

where:

p is the periphery around the pole surface;

g is the air gap distance;

k is a constant usually lying between 2 and 3; and

A is the pole surface area

The optimum value of the working angle a is found from the differential quotient:

$$(3) \quad \frac{dF_2}{da} = 0$$

which yields the result:

$$(4) \quad \sin \frac{a}{\text{opt.}} = \frac{\sum R_i}{\sum R_A} = \sum \frac{L_i A}{a_2 \mu A}$$

in which:

$\sum R_i$ is the sum of the iron reluctances;

$\sum R_A$ is the sum of the air gap reluctances;

L_i is the length of the iron path;

A is the working pole face area;

d_2 is the distance between the armature surface and stationary pole surface in the moving direction;

μ is the relative permeability of the iron path.

It is understood that the optimum value of $\sin a$, aforesaid, is assumed to be greater than zero and equal to or less than 90° for purposes of calculation.

Thus the Expression 4 above becomes the general formula for calculating the optimum value of the sine of the working angle a , from which the value of the angle itself, and hence of the optimum length of the air gap, becomes at once available.

In a multiple air gap system such as described, involving a series of gaps such as 50, 51, the primary gaps 50 are calculated first and then the secondary gaps are calculated and any adjustment in value which becomes necessary can be made in the latter by changing the area of their working pole faces without upsetting the other factors for the primary gap calculation.

By making the secondary gaps larger than the primary gaps their optimum angle value becomes larger and a larger pole surface area is required to produce the optimum value sought. Manipulation of the secondary pole surface area is found to be generally a convenient factor to vary, once the optimum value for the primary gaps has been decided upon.

In Fig. 14 the normal "pull axis" is seen to lie at an acute angle to the "pivot axis" I-a, while in Fig. 16 the normal pull axis is F_N and the resultant pull force acts

along the axis of F_2 . In the latter case the angle α is the optimum working angle between the moving pole face of 24 and the effective pull axis F_2 .

It should be understood also that there can be an optimum working angle for the old acute-angle diagonal system, and that this angle can be found by the methods described above and application of Formula 4.

I claim:

1. In a relay, a pivoted armature system comprising: a pair of elongated diametrically-crossed armature members having slotted interfit at their mid-regions along a common pivotal axis, said interfit including mutual clearance permitting each said member to move individually a limited amount pivotally relative to said axis, said members also being pivotable jointly relative to said axis; and a plurality of stationary pole pieces situated in spaced relation at positions radial of said axis and each opposite a limb of one of said members of the armature system; together with a single coil means common to all said pole pieces for magnetically energizing same jointly, whereby to set up a magnetic moment acting upon both of said armature members and tending to pivot the same relative to said axis.

2. A relay construction according to claim 1 and further characterized by the provision of spring means acting upon each of said armature members to urge the same contrary to said moment into a normal starting position.

3. A relay construction according to claim 2 in which said spring means acts upon all armature members with equal force such that said armature members move jointly responsive to said magnetic moment.

4. A relay construction according to claim 2 wherein said spring means acts with a force upon one armature member which is different from the spring force exerted upon the other said member, whereby said one member will pivot in response to a magnetic moment of different value from that which is effective to pivot said other member.

5. A relay according to claim 4 in which said coil means is a single winding which is energizable by currents of different magnitude to selectively set up magnetic moments of the different value set forth.

6. A relay according to claim 2 wherein a plurality of relatively stationary pole pieces are spaced at relatively different distances from coacting juxtaposed pole areas one one and the same limb of one of said armature members to provide multiple air gaps of different length.

7. In a relay, diametrically crossed armature members supported pivotally at their crossing intersection such that each said member has a limb on an opposite side of the pivotal axis, each said limb having several offset pole faces, together with stationary pole means opposite each said pole face; a magnetically-permeable casing for said relay and enclosing said armature and a coil for energizing said pole means, a portion of said casing constituting the stationary pole means for at least one pole face for each of said armature limbs.

8. In a relay, a symmetrical composite armature structure comprising: elongated armature members interfitted in diametrically-crossed relation, such that each said member has a pair of arms projecting respectively radially of a common central axis which extends through a centrally-located slot formation in each armature member, the slot formation in one armature member interfitting movably with the like slot formation of another said armature member in the composite union thereof defining said structure; means providing stationary pole elements arranged symmetrically about said axis and each situated in juxtaposition to a radially-offset pole portion of one of each of said armature members; coil means for magnetizing said stationary pole elements to pivotally attract the juxtaposed armature member; and bearing means pivotally supporting said armature structure as a composite unit for pivotal movement relative to said axis, said bearing means including a single bearing member supportably

engaging one of each of the two sides of said composite armature structure along said axis, and each bearing member supportably engaging each one of the armature members at that particular side of the composite unit at which it is situated, whereby said diametrically-crossed armature members are each individually borne by a single pair of bearing members which is common to the entire armature structure.

9. The construction set forth in claim 8 further characterized in that said slot formations in the several armature members are dimensioned for mutual clearance in such manner that each armature member is pivotable on said bearing means individually as well as in concert with other armature members relative to the appertaining stationary pole elements for individual and joint pivotal displacement responsive to selective magnetization of all or less than all of said pole elements.

10. In a relay, elongated, diametrically crossed armature members all having angularly offset polar end portions at each of the two opposite end regions thereof said crossed armature members forming a swastika-like pattern and said polar end portions each defining a working pole face.

11. An armature structure according to claim 10 in which said armature members each have a lateral slot at its mid-region and said members are interfitted at said slots, and said members each have two notches in the side edges thereof opposite the appertaining slot, and are pivotally supported in said interfitted condition by opposite, aligned bearing members each fitting into a pair of aligned notches each appertaining to one of the interfitted armature members.

12. The construction of claim 11 further characterized in that said slots are tapered to narrow from the mouth inwardly to the bottom root thereof and said notches each have straight side walls making substantially point contact with the appertaining bearing member fitting therein, such that said armature members have predetermined independent pivotal motion relative to each other and jointly relative to said bearing members, and laterally to rock at said root portions thereof.

13. The construction according to claim 11 in which said slots have straight opposite sidewalls which are approximately parallel inwardly from the mouth to the bottom root thereof, and said notches have curved sidewalls to interfit rotatably with the curvature of said bearing members therein, such that said armature members have limited movement axially of the axis through said bearing members and jointly about said axis and substantially zero rocking freedom laterally thereof and relative to each other.

14. In a relay, a pivoted armature having end portions offset to provide at least two working pole faces each at a different radial distance from the pivotal axis but on the same side of said axis, and each said face lying in a different plane but said planes being substantially parallel to said axis, and a relatively stationary complementary working pole face for, and each situated in, a plane substantially opposite each of said armature pole faces.

15. In a relay, an elongated armature member pivotally mounted between its opposite ends and each of said ends having at least two angular offsets both of which constitute working pole faces, and both of which pole faces at each end lie in planes paralleling the pivotal axis, and means providing cooperative working pole faces for all of the armature pole faces aforesaid, and said cooperative pole faces likewise all lying in planes respectively and substantially parallel to said pivotal axis.

16. In a relay, a pivoted, diagonally-moving armature having at least two working pole faces respectively located at different radial distances from the same side of the pivotal axis, and a relatively stationary pole means for each said pole face and having working pole faces respectively adapted to coact with said armature pole faces,

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all of said pole faces being disposed in planes which are parallel to the pivotal axis, and one of said armature pole faces being disposed in a plane at approximately right angles to the other armature pole face.

17. In an electromagnetic relay, a diagonally-moving armature having at least two working pole faces located respectively at different radial distances from the pivotal axis on the same side of the latter, one of said pole faces being located at the radially outer end portion of the armature remote from said axis and being offset to lie in a plane at approximately a right angle to the other said pole face, and electromagnetic means including stationary pole means cooperable with each of said pole faces and respectively having pole faces disposed for cooperation with said armature pole faces in diagonally-moving relation as set forth.

18. The construction of claim 17 further characterized in that said stationary pole means includes a salient pole member magnetized by said electromagnetic means

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and located to cooperate with the armature at a position between said axis and said pole face which is located at said remote end portion, and a magnetically-permeable cover for said relay to contain said electromagnetic means and armature with a wall portion disposed to provide the stationary pole means which is cooperable with said armature pole face at said outer end portion of the armature, said cover being included in the magnetic circuit between the armature and electromagnetic means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,882,460

April 14, 1959

Hans Sauer

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 7, line 46, claim 6, for "one one" read -- on one --.

Signed and sealed this 18th day of August 1959.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

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