Dec. 28, 1954 H. A. HOWELL 2,698,366

ELECTROMAGNETIC CHOPPER

Filed April 2, 1952

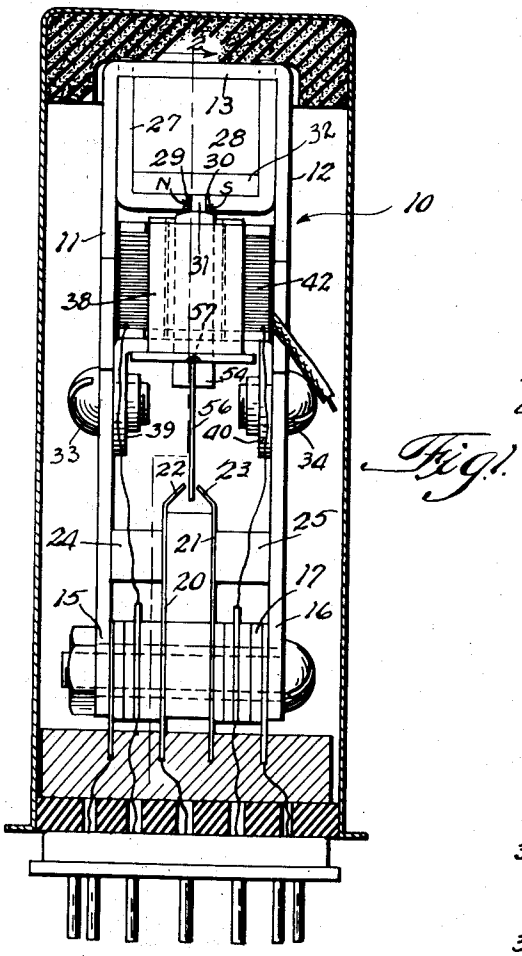

Fig. 1.

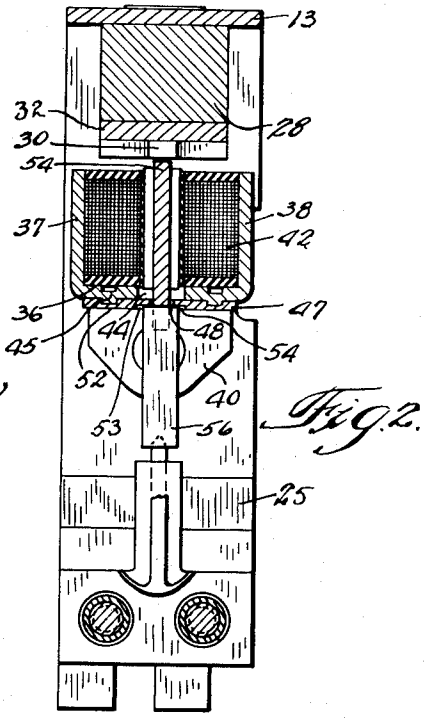

Fig. 2.

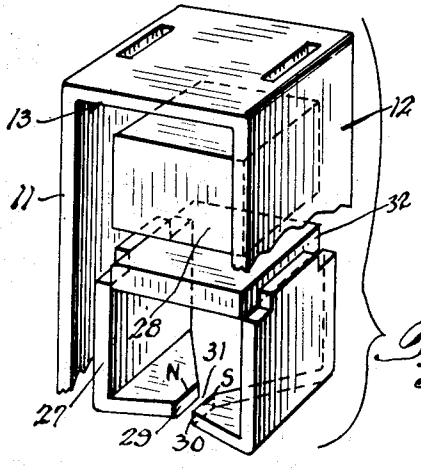

Fig. 5.

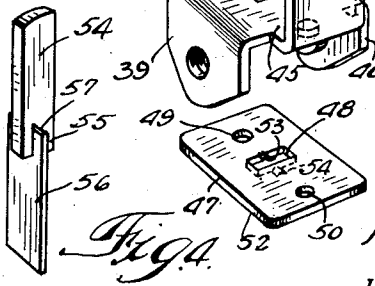

Fig. 4.

Fig. 3.

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ELECTROMAGNETIC CHOPPER

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4 Claims. (Cl. 200—90)

This invention relates to an electromagnetic chopper, and more particularly to a chopper for interrupting electric circuits at a relatively high rate. While the invention forming the subject matter of this application may have a wide variety of applications and uses, it is particularly designed for use in connection with interrupting a circuit at about 400 cycles per second or higher.

In aircraft equipment, it is customary to have a primary source of 400 cycle frequency, which source is used as a low power source for energizing choppers or other devices for rapidly making and breaking electrical circuits. The invention to be hereinafter described, relates to a chopper which may be fed any desired frequency up to as high as 400 cycles and even higher, this chopper controlling load circuits.

Choppers generally utilize reeds of spring steel or other highly elastic material rigidly secured at one end with a free end free to vibrate. In order to obtain a reed which will vibrate at 400 cycles per second and fulfill other mechanical considerations necessary in a device of this character, it is essential that the reed be quite stiff. Operation of the reed at such high frequency and at necessary amplitudes makes it difficult to provide reeds which will operate for long periods of time.

In accordance with this invention, I provide a construction whereby the force of magnetic attraction is utilized for supporting a reed in a vibratable position. The reed is not biased to any one contact-making position as is customary with conventional choppers.

For a fuller understanding of the invention, reference will now be made to the drawing, wherein an exemplary embodiment is shown, it being understood, however, that variations in the structure may be made without departure from the spirit of the invention.

Figure 1 shows an elevation of a chopper embodying the invention, the base and enclosing can being shown in section;

Figure 2 shows an elevation along line 2—2 of Figure 1;

Figure 3 is an exploded perspective view of certain parts;

Figure 4 is a perspective view of the top part of the frame and permanent magnet system in exploded form.

The chopper comprises frame generally indicated by numeral **10** having a generally U-shape. Frame **10** may be made of brass or other non-magnetic material and have sides **11** and **12** joined together by bight portion **13** at the top of the chopper. Sides **11** and **12** have end portions **15** and **16** between which there is secured stack **17**. Stack **17** is generally of conventional construction similar to the stacks of vibrators used in connection with automobile radios, an example of which is illustrated in Patent 2,252,882.

Stack **17** includes stationary contact members **20** and **21** extending upwardly from the stack and having tapering inwardly disposed contact tip portions **22** and **23** respectively. These contact members may be made of spring copper, brass, spring silver or any other suitable material and preferably should have substantial stiffness. Blocks **24** and **25** of vibration-absorbing material are disposed between contact members **20** and **21** on the one hand and the opposing inner faces of the frame. The vibration-absorbing material may be of rubber of suitable plastic, or felt.

Staked in frame **10** are pole pieces **27** of iron. Permanent magnet **28** is wedged between the pole pieces. Pole pieces **27** have tapering tips **29** and **30** which are

disposed opposite each other and provide air gap **31**. For convenience, the letters N and S are provided to indicate the existence of a permanent magnetic field. Spacer member **32** of any non-magnetic material may be disposed above the pole tips and below the permanent magnet to prevent the magnet from dropping and bridging the air gap. It is understood that the poles of the permanent magnet are at the wedged ends of the magnet.

Secured in frame sides **11** and **12**, as by bolts **33** and **34**, is support member generally indicated by numeral **35** and consisting of central portion **36**, oppositely disposed upwardly extending arms **37** and **38** and oppositely disposed downwardly extending arms **39** and **40**. Upwardly extending arms **37** and **38** extend upwardly between frame sides **11** and **12**, and together with the frame sides support winding **42**. Winding **42** consists of insulated copper wire wound upon a suitable bobbin and is adapted to be supplied with alternating current of the desired frequency, such as for example, 400 cycles. The terminals of the winding are connected by wires to suitable plates in the stack. The top end of the winding is close to the magnetic air gap. It is understood, that the winding is rigidly clamped in position to be free of vibration in any direction during chopper use.

Downwardly extending arms **39** and **40** are suitably apertured as shown and cooperate with bolts **33** and **34** for supporting the member in position. Preferably, the bolt apertures in either the frame or the mounting member, or both, are enlarged in comparison to the bolt to permit adjustment of the member either vertically or transversely thereof.

Body portion **36** of the supporting member is provided with rectangular aperture **44**, this aperture being oriented as shown namely, with the length extending between downwardly extending arms **39** and **40**. Immediately below body portion **36** of the support member is plate **47** having generally rectangular aperture **48**. Plate **47** is rigidly attached to member **35** just below body portion **36** by any suitable means. Thus, plate **47** may have apertures **49** and **50** through which correspondingly shaped and located parts of the metal of which member **45** is made may be pressed to engage said apertures. Any other method of joining the two plates rigidly together may be utilized. In certain instances, plate **47** must be insulated from the frame. Member **35** is preferably of steel or soft iron. Plate **47** may be of any suitable material preferably softer than member **35** and is also of material having good electrical conductivity. Thus plate **47** may be of copper having a silver plate thereon or may be of coin silver.

Rectangular window **48** in plate **47** may conveniently be of the same size as window **44** in member **35** and should register therewith. In addition, plate **47** has the lower face thereof **52**, this face being remote from coil **42**, provided with two V-shaped recesses **53** and **54**. These recesses are substantially midway between the length of window **48** and are shaped to provide a rocking or knife edge support.

Loosely disposed within the core of winding **42** is soft iron armature **54** of the shape shown. Armature **54** has a generally rectangular cross section and is small enough so that it is loose in registering windows **44** and **48** of member **35** and plate **47**. The armature is long enough to extend beyond the ends of the winding. Armature **54** is also sufficiently wide so that, as shown in Figure 1, it has a greater width than the air gap along one dimension thereof. As shown in Figure 2, the thickness of armature **54** need not necessarily be as great as the corresponding air gap dimension. The armature extends beyond the end of the winding up to the air gap.

Rigidly supported by armature **54** at bottom end **55** is movable contact member **56**. This consists of a thin, generally rectangular strip of metal, such as silver or silver-plated copper or brass. It will be noted that the thickness of movable contact member **56** is perpendicular to the corresponding dimension of armature **54**. The two may conveniently be connected by having end **55** of the armature slotted, as shown, and inserting the contact member into the slot. The two are rigidly joined together, such as by solder or the like.

Movable contact member **56** has top edge portion **57**

tapered and the edge rounded to fit into recesses **53** and **54**. Thus a sort of blunted edge support is provided. By proper proportioning of armature **54** and contact member **56** with reference to the pole pieces of the magnetic system, it is possible for the top end of armature **54** to be adjacent the air gap and the armature maintained in position, as shown in Figures 1 and 2. It will be seen that the width of armature **54** is perpendicular to the rocking axis of the armature system as a whole and that this dimension is the one which is larger than the corresponding air gap dimension. This relationsihp is illustrated in Figure 1. Thus there will be no tendency for the magnetic field to move the armature on any axis perpendicular to the rocking axis defined by contact edge **57**. The armature system, consisting of armature **54** and movable contact member **56**, has a definite rest position where the movable contact is between the fixed contacts.

Currents fed to the winding will tend to distort the permanent magnet field and cause the armature to move depending upon the polarity of the field produced by the coil. An alternating current fed to winding **42** will cause the armature to vibrate and thus cause the movable contact member to travel back and forth between the two fixed contacts. The permanent magnet system produces a field whose direcion is such that the pull on the armature is generally longitudinally thereof and thus maintains the armature system in position on what might be termed rocking edge supports. The intensity of the field, due to the permanent magnet, will of course be very much greater than the intensity of the field produced by winding **42**. Thus, the modulating action of winding **42** will at no time interfere with the retention of the armature system in proper position.

The entire structure may be supported in rubber cushions, as shown, and carried upon a conventional vibrator base. A suitable container is provided and leads from the various parts of the chopper, to a conventional tube base, may be used. Inasmuch as the mounting of the chopper is conventional, no attempt is made to describe this.

It is understood that the chopper circuit has frame **10** as one terminal and the fixed contact members as the other terminals. The winding has its terminals, one of which may be grounded to the frame if desired.

I claim:

1. A chopper comprising an elongated frame, a stack at one end of said frame, said stack including at least one fixed contact member extending toward the other frame end, magnet means including pole pieces having portions extending transversely of the frame and terminating in faces defining an air gap for creating a magnetic field across said gap transversely of said frame length, said magnet means being disposed remote from said stack, a winding having its axis perpendicular to the gap axis extending between the opposed faces, said winding being between said pole pieces and stack and having one end thereof in proximity to said air gap and having an open axial region, an armature assembly comprising an elongated armature disposed within said winding region, said armature having its length disposed generally axially of the winding and having no part thereof disposed in the air gap proper but having one end thereof adjacent the air gap so that magnetix flux must bend outside of the air gap proper to enter the armature, said armature extending away from the pole pieces toward the stack and having its other end extending beyond the winding, a movable contact member carried by said armature for cooperation with said fixed contact and means providing a rocking edge support for said armature assembly at a region between the air gap and stack, said armature assembly being loose on said edge support and being supported solely by the force created by the magnetic flux at the air gap entering said armature and pulling the armature longitudinally toward the air gap and maintaining the armature on a rocking edge with the rocking edge providing an axis about which the armature rocks during chopper operation.

2. The chopper according to claim 1, wherein said stack has two fixed contact members and wherein the movable contact is in line with the armature and moves between said fixed contacts.

3. The construction according to claim 2, wherein said rocking-edge-supporting means includes a slotted plate having aligned recesses in one side thereof adjacent the slot and wherein the movable contact member has the edge portion shaped to rest in said recesses.

4. The chopper according to claim 1, wherein said armature has one transverse dimension greater than the distance between the opposed pole faces and wherein the rocking axis is perpendicular to this transverse dimension whereby any variation in magnetic flux in the armature due to the modulating action of the winding will rock the armature along the rocking axis only.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,333,247	Cummings	Mar. 9, 1920
1,798,922	Ytterberg	Mar. 31, 1931
2,433,740	Collins	Dec. 30, 1947
2,461,360	Vincent	Feb. 8, 1949
2,471,365	Pall-Finn Beer	May 24, 1949
2,486,394	Eannarino	Nov. 1, 1949
2,547,026	Winkler	Apr. 3, 1951