April 2, 1963 H. REIFEL ETAL 3,084,235

TUNING FORK TYPE RELAYS

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Fig. 1.

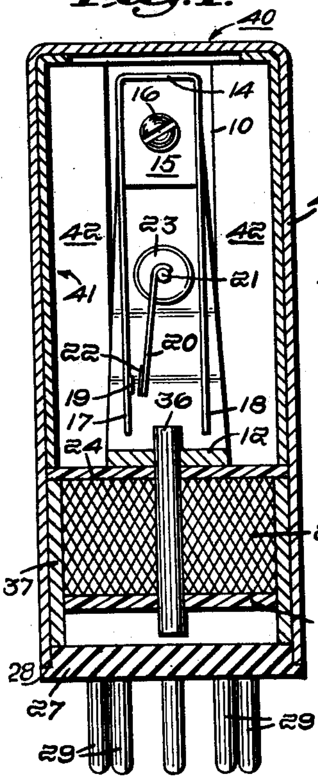


Fig. 2.

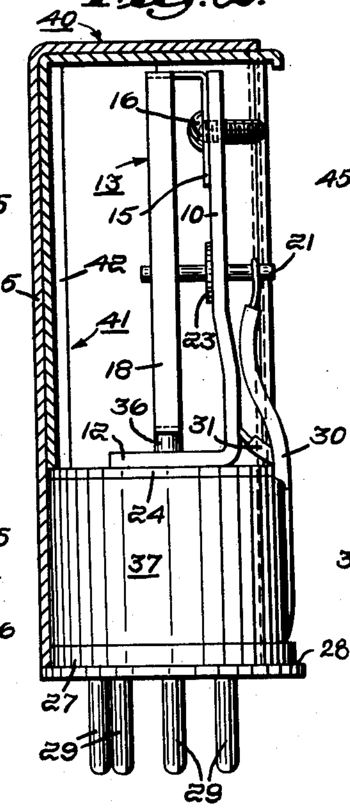


Fig. 3.

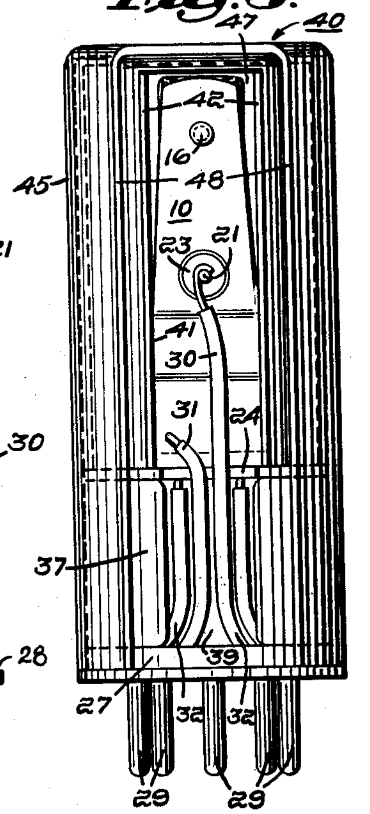
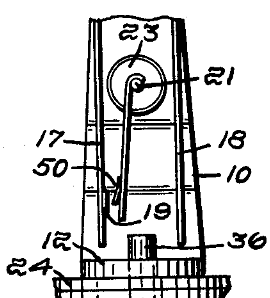


Fig. 4.



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TUNING FORK TYPE RELAYS

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This invention relates to electromagnetic relays, and relates more particularly to electromagnetic relays having tuning fork type, vibratory tynes.

This invention uses a tuning fork having its tynes and base stamped in one piece from magnetic sheet metal. An electromagnet has a permanent magnet pole piece in the form of a rod having one end midway between the free ends of the tynes, and which magnetizes the latter to opposite polarities. A.C. at the resonant frequency of the tuning fork is applied to the coil of the electromagnet, and causes the free ends of the tynes to be alternately attracted by and repelled by the magnet in synchronism with the applied A.C. Since the tynes vibrate out-of-phase, there is less vibration transmitted to a support than where a single vibratory reed is used.

One of the tynes has a fixed contact on its inner surface adjacent to its free end, and a strap forming the frame of the relay, has a resilient contact strip cantilever supported thereto, with its free end opposite the contact on the one tyne. As the one tyne moves inwardly at or near its resonant frequency, it touches the free end of the resilient contact, closing a circuit in which the contacts are connected. The resilient contact has a resonant frequency much higher than that of the tuning fork. This has the advantage that since the resilient contact does not load the tyne it touches, the so-called "hold region" is a minimum. By "hold region" is meant the increase in band width to which the tynes respond when the relay is in operation. It is desired that the tynes respond to a very narrow band of frequencies centered about their resonant frequency, but when loaded by stiff, fixed contacts, the response band increases excessively during operation. This has the disadvantage that the tuning fork vibrates and closes its contacts at frequencies outside its desired operating range, and is not sufficiently selective.

The construction of the relay is simplified, and its cost is reduced by using as a frame, a single strap of non-magnetic material, to the outer end of which the base of the tuning fork is attached, and by constructing the tuning fork in a single piece from sheet metal. The strap has a flange on its inner end which is cemented to a plastic disc on the adjacent end of a coil of an electromagnet, which is concentric with and has a larger diameter than that of the coil. A plug in type base has a recessed inner end at the other end of the coil, having the same diameter as the disc. A metal collar having an outside diameter equal to that of the disc and the recessed end of the base, extends around the coil with its edges in contact with the disc and base. A brass shield has a parti-cylindrical outer portion with an open end which fits snugly around the recess in the collar and the disc and collar, and has a parti-cylindrical, inner portion which has spaced-apart segments with ends which contact the side of the disc which is cemented to the flange. The inner shield portion forces the disc against the collar and the latter against the base, and the outer shield portion snugly contacts the outer surfaces of the discs, the collar, and the recess base portion, securing these components tightly together without the necessity for screws or bolts.

An object of this invention is to reduce the "hold region" of a tuning fork type relay.

Other objects of this invention are to simplify and to reduce the costs of tuning fork type relays.

This invention will now be described with reference to the annexed drawings, of which:

FIG. 1 is a side elevation, in section, of a relay embodying this invention, showing the edge of the tuning fork, and the contact side of the support strap;

FIG. 2 is a side elevation, with the shield shown in section, of the relay rotated 90° about its axis from the position shown by FIG. 1;

FIG. 3 is a side elevation of the relay looking at the side opposite that shown by FIG. 1, and

FIG. 4 is a fragmentary view of the relay, showing an alternative form of fixed contact structure.

A strap **10** of non-magnetic metal has a flange **12** on its inner end. A tuning fork **13** formed in one piece from magnetic sheet metal, has a base **14** with an extension **15** which is attached by a screw **16** to the outer end of the strap **10**. The tuning fork has spaced-apart tynes **17** and **18**. The tyne **17** has a contact **19** on its inner surface adjacent to its free end. A fixed contact strip **20** of resilient metal, having a higher resonant frequency than the tuning fork, is cantilever supported by a pin **21** in a disc **23** of insulation fitted in an opening in the strap **10**. The strip **20** has a contact **22** near its free end, opposite and normally spaced from the contact **19**.

A circular disc **24** of plastic material is cemented on one side to the flange **12**, and on its other side to one end of cylindrical coil **25**, to the opposite end of which a smaller, concentric, circular disc **26** of plastic material is cemented. The discs **24** and **26** can be ends of a plastic spool for the coil. The disc **26** and the coil **25** have the same diameter.

A circular base **27** of insulation is opposite the disc **26**, and has socket pins **29**, one of which is connected by wire **30** to the pin **21** and through the latter to the contact strip **20**, another of which is connected by wire **31** to the strap **10**, and others of which are connected by wires **32** to the ends of the winding of the coil **25**. The base **27** has a larger diameter than the disc **24**, and has an inner, circular, recessed portion **28** which has the same diameter as that of the disc **24**.

A permanent magnet **35** in the form of a rod extends through the coil **25** along its axis, and forms the polepiece of the coil. One end of the magnet **35** extends through the disc **24** and the flange **12** to a position midway between the free ends of the tynes **17** and **18**.

A parti-cylindrical collar **37** of non-magnetic metal has the same external diameter as that of the disc **24** and the recessed base portion **28**, extends around the coil **25** with one of its edges in contact with the disc **24**, and its other edge in contact with the base **27**. The collar has spaced-apart ends with an opening **39** therebetween.

A shield can **40** of non-magnetic metal, closed at its outer end, has a parti-cylindrical inner portion **41** having an outer diameter equal to that of the disc **24**, with three, equally spaced-apart segments **42** having aligned inner ends which contact the side of the disc **24** which is cemented to the flange **12**. The can **40** has a parti-cylindrical, outer portion **45** having an inner diameter the same as the outer diameter of the collar **37**, and the same as that of the disc **24** and the recessed base portion **28**, and has an inner end portion which fits snugly around the disc **24**, the collar **37** and the recessed base portion **28**. The can portion **45** has an edge thickness equal to the difference between the diameter of the base **27** and its recessed portion **28**, so that the outer surface of the can extends flush with the outer surface of the base **27**.

The outer shield portion **45** by fitting snugly around the disc **24**, the collar **37** and the recessed base portion **28**, and the inner shield portion **41** by pressing the disc **24** against the collar **37**, and the latter against the base **27**, secures these components tightly together, in addition to acting as the usual electrostatic shield.

Two adjacent segments **42** of the inner shield portion have a space **47** between their longitudinal edges, which is aligned with the space **39** between the ends of the collar **37**. The outer shield portion **45** has spaced-apart longitudinal edges **48** with a space therebetween which is wider than the space **47** but centered therewith. These spaces provide access to the wires and their connections.

The fixed contact strap **20** should have a much higher resonant frequency than that of the tynes **17** and **18** for reducing the "hold region," and in some cases, the length and stiffness of the strip **20** may prevent its resonant frequency from being as high as it should. In such cases, an additional, much shorter strap **50** of resilient metal is cantilever attached to the strap **20**, and its free end is opposite and normally spaced from the contact **19** on the tyne **17**.

In the operation of FIGS. 1–3, A.C. at the resonant frequency of the tynes **17** and **18** is applied through the wires **32** to the ends of the winding of the coil **25**, producing an alternating magnetic field at the inner end of the magnet **36** acting as the polepiece of the coil, causing the free ends oc the tynes to be attracted towards and repelled away from the magnet. At the end of its inward swing during each half-cycle, the tyne **17** moves its contact **19** against the fixed contact **22**, closing a circuit which is not shown, in which the contacts are connected. The operation of FIG. 4 would be the same except that the contact **19** at the end of the inward swing of the tyne **17** would touch the free end of the contact strip **50**.

What is claimed, is:

1. A tuning fork type relay comprising a frame, a tuning fork having its base attached to one end of said frame and having its tynes extending towards the other end of said frame, a coil of an electromagnet attached to said other end of said frame opposite and spaced from the free ends of said tynes, said coil having a parmanent magnet polepiece with one end extending midway between said free ends, a contact surface on the inner surface of one of said tynes, and a fixed contact strip of resilient metal insulatedly attached at one end to said frame between said tynes and having a contact surface at its other end extending into the space between said tynes opposite and normally spaced from said first mentioned contact surface.

2. A tuning fork type relay comprising a frame, a tuning fork having its base attached to one end of said frame and having its tynes extending towards the other end of said frame, said other end of said frame having a flange thereon, a plastic disc cemented to said flange, a coil of an electromagnet supported by said disc, said coil having a polepiece with one end extending midway between the free ends of said tynes, a contact surface on the inner surface of one of said tynes, and a fixed contact strip of resilient metal insulatedly attached at one end to said frame between said tynes and having a contact surface at its other end opposite and normally spaced from said first mentioned surface.

3. A tuning fork type relay comprising a frame having a flange at one end, a tuning fork having its base attached to the other end of said frame and having its tynes extending towards said one end, a circular, plastic disc cemented to said flange, a cylindrical coil of an electromagnet supported by said disc, said coil having a polepiece with one end extending through said disc and flange midway between the free ends of said tynes, a contact strip surface on the inner surface of one of said tynes, a fixed contact of resilient metal insulatedly attached at one end to said frame between said tynes and having a contact surface at its other end opposite and normally spaced from said first mentioned surfaces, a circular base having contact pins connected to said frame, said fixed contact and to the ends of the winding of said coil, at the other end of said coil, and a collar around said coil in contact with said disc and base.

4. A tuning fork type relay as claimed in claim 3 in which said collar has an outer diameter the same as that of said disc, in which said base has a recessed inner edge having the same diameter as that of said disc, and in which a shield can is provided which has an outer portion in contact with said disc, said collar and said recessed edge of said base.

5. A tuning fork type relay as claimed in claim 4 in which said can has an inner portion with an end which contacts the side of said disc which is cemented to said flange.

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