

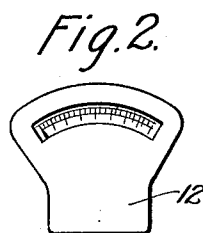
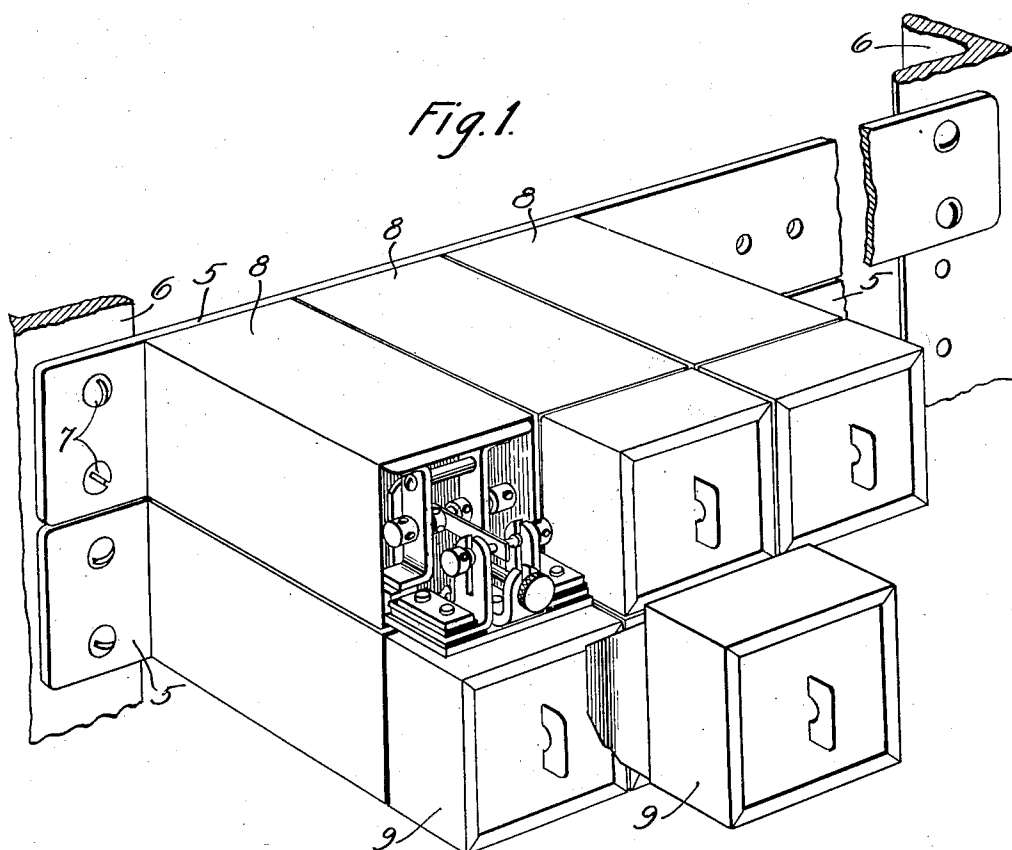
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D. D. MILLER

MAGNETIC SHIELD

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UNITED STATES PATENT OFFICE.

DANIEL D. MILLER, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO
WESTERN ELECTRIC COMPANY, INCORPORATED, A CORPORATION OF NEW YORK.
MAGNETIC SHIELD.

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This invention relates to magnetic shields and particularly to magnetic shields for protecting electrical apparatus from the effects of the earth's magnetic field or stray magnetic fields produced by the operation of nearby apparatus.

In the operation of such electrical apparatus it is often necessary to guard against false operation resulting from the operation of electromagnetic apparatus which is mounted nearby. This is particularly true in the case of sensitive relays employed in telephone central offices where it is the practice to mount the relays in close proximity to each other on relay racks. Heretofore, it has been the practice to provide iron covers to serve as magnetic shields for such relays which are susceptible to stray fields, but under certain conditions it has been necessary not only to largely increase the separation between adjacent relays but to provide only partial shielding for the apparatus since to provide satisfactory shielding with an iron cover would require such a massive cover as to be impractical even though the necessary space were available.

Again in the case of portable measuring instruments which may be used in the vicinity of stray magnetic fields, efficient shielding must be provided if high sensitivity is to be obtained and to accomplish a satisfactory result with an iron shield requires a shield of such thickness as to be highly objectionable for a portable instrument.

It is an object of the present invention to effectively shield sensitive electrical apparatus from extraneous magnetic fields. It is a further object of the invention to obtain satisfactory shielding without resorting to the use of shields which are of such size and weight that their use is objectionable if not impossible for satisfactorily shielding electromagnetic devices which are of necessity mounted in close proximity to each other.

To accomplish these objects the invention contemplates a magnetic shield composed of a material having extremely high permeability at low magnetizing forces of the order of those resulting from stray fields against which protection is to be provided.

The invention may be more clearly understood by reference to the accompanying drawing in which Fig. 1 shows a bank of relays provided with magnetic shields embodying the features of this invention, and Fig. 2 dis-

closes such a shield applied to a portable measuring instrument.

In telephone central offices it is common practice to mount a large portion of the apparatus on racks as shown in Fig. 1 of the drawing. The individual relays are mounted in close proximity to each other on mounting plates 5—5 which in turn are secured to vertical mounting bars 6—6 by means of screws 7—7 or other similar means. Each relay is enclosed by means of a cover 8 and a cap 9 which serve to protect the relay from dust and to shield it from stray magnetic fields resulting from the operation of adjacent or nearby relays. The covers 8—8 practically surround the magnetic circuit of the relay and are composed of a nickel-iron alloy having a permeability much higher than that of iron for low magnetizing forces. The caps 9 which cooperate with the covers 8 to form a dust proof enclosure are made easily remountable to facilitate adjustment of the apparatus. In order that adjustment, when once made will not be altered by replacing the cap, these caps are made of brass or similar non-magnetic material.

The covers are composed of a nickel iron alloy preferably containing 78½% nickel and 21½% iron, which is given a special heat treatment to develop high permeability therein. This material is prepared by fusing nickel and iron together preferably in the proportion of 78½% nickel to 21½% iron, good commercial grades of these materials being suitable for the purpose. The fused composition is poured into a mold and is worked and rolled into sheets of the desired thickness. These sheets are then cut to size and formed to produce the covers 8 which are then given a heat treatment to develop the highest permeability possible at low magnetizing forces. According to present practice this is done by heating the desired sheets to a temperature of 900° C. or above, maintaining it at that temperature for a few minutes to insure uniform temperature throughout, then slowly cooling to a temperature of about 600° C. which is just above the critical or transition temperature of the alloy, that is, the temperature at which the magnetic properties disappear by heating and reappear on cooling and finally cooling from that temperature more rapidly but at a different rate depending upon the ratio of nickel to iron in the alloy. A convenient method of securing

the desired rate of cooling after the material has been maintained for a few minutes at a temperature of 900° C. or above has been found to be a rapid withdrawing of the material from the furnace and placing it in a blast of air which is controlled to secure a desired rate of cooling. The necessary cooling will always be at a rate intermediate that required for annealing and that at which strains would be set up in the material which would lower its permeability below the desired value. Although the proportions of nickel and iron mentioned above appear to give maximum permeability, other proportions may be used and other materials may be added to the alloy—such as chromium or manganese. Such alloys may be somewhat less sensitive to heat treatment. For an extended discussion of nickel-iron alloys of this character see an article by H. D. Arnold and G. W. Elmen, entitled "Permalloy", Journal of the Franklin Institute, May 1923.

It has been found that under practically all conditions, satisfactory shielding will result if these covers have a thickness of .015" while to obtain the same degree of shielding with an iron cover would require a thickness of from .3 to .5 of an inch and the resulting weight would be such as to necessitate complete redesign of the mounting equipment. Furthermore, a cover of this thickness would necessitate mounting the relays farther apart than is now the practice and would make interchangeability in many cases impossible.

Referring to Fig. 2 there is disclosed a measuring instrument such as a voltmeter the cover 12 of which is made of the material described above, thereby providing a degree

of shielding which, if the cover were made of iron, would require a thickness of 20 to 30 times as great, and thus would be highly objectionable particularly in the case of portable instruments.

What is claimed is:

1. A magnetic shield for electrical apparatus comprising a cover portion composed of a material having a permeability higher than that of iron for low magnetizing forces and a cap portion cooperating therewith to form a dust-proof housing, said cap/portion being composed of a non-magnetic material.

2. A magnetic shield for an electromagnetic device comprising a cover portion surrounding the magnetic circuit of said device and composed of a material having a permeability higher than that of iron for low magnetizing forces and a non-magnetic cap portion surrounding the adjustable portions of the device and cooperating with said cover portion to form a dust-proof housing.

3. In an assembly of electromagnetic relays on a relay rack the design of which does not provide enough space between relays to permit the use of sufficiently thick iron shields to prevent the transfer of disturbing magnetic energy from one relay to another, a magnetic shield about each relay, comprising a fixed portion composed of a nickel-iron alloy having a permeability higher than that of iron for low magnetizing forces surrounding the main body of the relay, and a non-magnetic removable cap portion surrounding the adjustable portions of the relay.

In witness whereof, I hereunto subscribe my name this 21 day of January A. D., 1925.

DANIEL D. MILLER.