ELECTROMAGNETIC COUPLER FOR A SWITCHING MATRIX

Hans Aicher, Munich, Germany, assignor to Siemens Aktiengesellschaft, Berlin, Germany
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ABSTRACT OF THE DISCLOSURE

The coupling device includes a generally U-shaped pin which is made of ferromagnetic material. The legs of the pins form an elongated, narrow air gap to minimize the reluctance of the coupler. In the preferred embodiment of the invention the inner sides of the legs of the U-shaped coupling device form two areas which face each other. This enlarges the areas which border on the air gap between the two legs thus reducing the magnetic reluctance of the device. Plugs of this type can be inserted into openings in a sheet of insulating material which has incoming lines on one side and outgoing lines on the other side.

CLAIM OF PRIORITY

Applicant claims priority from corresponding German application Ser. No. 97,930 filed July 1, 1965.

INTRODUCTION

The present invention relates to an electromagnetic coupler for transmitting electrical signals from an incoming line to an outgoing line of a switching matrix. More particularly, this invention relates to a U-shaped ferromagnetic coupler which can be plugged in at a juncture of an incoming line and an outgoing line of a telephone installation, for example, for connecting together lines for long distance communications.

STATE OF THE PRIOR ART

It is known to use switching matrices with incoming and outgoing lines which cross each other. In such systems the incoming electrical signal may be transmitted to an outgoing line by means of plug-in type coupling pins or plugs, usually made of ferromagnetic material. The ferromagnetic pins are used as coupling elements which can be plugged in at the intersection of the lines or close thereto to electromagnetically couple the two lines together.

It is desirable in the utilization of such switching matrices that the incoming as well as the outgoing lines be located at a crossing point where there is a low dispersion of the magnetic flux. However, such pin-shaping coupling elements result in a very high dispersion of the magnetic flux. In order to overcome this, in the past there have been arranged in the immediate vicinity of the coupling pins additional cylindrical reflux pins which decrease the dispersion of the magnetic flux by reducing the air gap. Designs of this sort are disadvantageous in that modification or expansion of the switching matrix is rather difficult. Also, the arrangement results in a very large number of individual elements including the coupling pins, together with their associated reflux pins. Even with the additional pins, the transmission of the ordinary electrical signal from the incoming line to the outgoing line is sometimes questionable due to the considerable air gap which still exists.

OBJECTS

Another object of the present invention is to provide an electromagnetic coupling device which reduces the dispersion of the magnetic flux and accordingly provides a better transmission of an electrical signal.

It is also a further object of the invention to provide an electromagnetic coupling device which has a relatively small air gap to minimize the reluctance and provide efficient transmission of electrical signals.

It is still another object of the invention to provide an electromagnetic coupling device which maintains the magnetic flux of lines in a generally U-shaped field thereby minimizing the leakage flux and the undesirable influence which leakage flux has on adjacent incoming and outgoing lines.

DRAWINGS

Other objects, advantages and aspects of the invention will become apparent by reference to the following detailed description and drawings of a specific embodiment thereof, wherein:

FIG. 1 is a schematic view of a device embodying the principles of the instant invention including incoming lines, outgoing lines and U-shaped electromagnetic couplers for connecting the two together; and,

FIG. 2 is a perspective view of a U-shaped coupling device of the instant invention.

DESCRIPTION OF THE INVENTION

In FIG. 1 there is shown a switching matrix typical of the type used in long distance telephone communications for connecting together incoming and outgoing lines. In such systems, incoming electrical signals are transmitted to the switching matrix and are conveyed from there via outgoing lines according to the particular switching arrangement which has been called for. In the particular embodiment shown (which is only one of the many possible arrangements) a three dimensional switching matrix consisting of two planar functionally interacting switching matrices 1 and 2 is shown. The switching matrices 1 and 2 consist of sheets of electrical insulating material which serve as supports or carriers for loop-shaped conducting lines. The switching matrices 1 and 2 may be in the form of printed circuit boards having incoming lines 3 printed on one side of the board and outgoing lines 4 printed on the other side of the board. The incoming lines 3 are arranged in a manner so that they cross the outgoing lines 4, and, therefore, can be inductively coupled to any one of a plurality of the outgoing lines depending on the position of electromagnetic coupling pins, designated 9.

At each of the crossing points of the incoming lines 3 and the outgoing lines 4 the sheets of insulating material are provided with openings 5 and 6 into which the coupling pins 9 can be inserted. There is also shown a twostep coordination switch 7, 8 which is shown in the art.

The coordination switch 7, 8 is effective to connect the incoming lines 3 to a signal emitter (not shown). The transmission of the incoming electrical signal from the incoming line 3 to the outgoing line 4 is effected by the U-shaped ferromagnetic coupling pins 9. A pin 9 is plugged in with one leg 10 (FIG. 2) in an opening 5 at the crossing point of the lines 3 and 4; the other leg 12 is inserted into an opening 6 which is located remotely from the crossing point. The legs 10 and 12 are connected by a crosspiece 11.

The length of the legs 10 and 12 is such that an elongated, narrow air gap is formed. In this manner the magnetic reluctance of the air gap between the legs 10 and 12 is considerably decreased so that upon exciting the pin(s) 9 a strong magnetic field having very little dispersion is achieved. Instead, the magnetic field assumes the shape of the pins 9. This greatly favors the transmission of the electrical signal on the incoming lines 3 to the outgoing line 4.
in that it makes possible almost a closed iron loop. A strong magnetic flux is also achieved due to the fact that the inner sides of the legs 10 and 12 form two large areas which face each other.

The switching matrix 2 is also provided with plugs 9 in accordance with the coupling plan which is desired. The switching matrices 1 and 2 are also provided with rectifiers 13 in the incoming lines 3. The rectifiers 13 assure that there is no inadvertent inductive coupling between the adjoining incoming lines 3 since the current carrying direction of the rectifiers is opposite to the current which would be so induced.

A plurality of amplifiers are shown and are designated 14, there being one amplifier provided for each outgoing line 4 of the switching matrix 1, and the corresponding outgoing line of the switching matrix 2. The outgoing signals from the amplifiers 14 can be used for various purposes such as the controlling of relays, or the like.

It is to be understood that a different arrangement of the switching matrices 1 and 2 can be provided, for example, a three dimensional matrix is possible. Where the crossing points are arranged together very close the lines 3 and 4 can be disposed in a serpentine manner on the sheets of insulation.

I claim:

1. In combination with a switching matrix of the type having incoming lines (3) and outgoing lines (4) which are spaced apart and which are arranged to cross each other, and wherein said lines are connectable together in a selectable manner by pins so as to transmit an electrical signal from an incoming line to an outgoing line, the improvement which comprises:

   said pins being in a U-shape (9) and having legs (10, 12) which form an elongated, narrow air gap between the distal ends of the legs, said pin being positioned adjacent to a line crossing to transmit the electrical signal from the incoming line to the outgoing line.

2. A switching matrix which comprises:

   a sheet of insulating material having an array of apertures (5, 6) which extend therethrough;

   a plurality of electrically conducting input lines (3) on one side of the sheet and extending adjacent to the apertures;

   a plurality of electrically conducting output lines (4) on the other side of the sheet, said output lines extending adjacent to the apertures and crossing at least some of the input lines; and

   U-shaped pins (9) having legs (10, 12) which are insertable into said apertures for electromagnetically coupling an electrical signal in said input line to said output line.

3. Apparatus as recited in claim 2 wherein said input and output lines are generally perpendicular to each other.

4. Apparatus as recited in claim 2 wherein said input and output lines extend across the sheet in one direction and return in an opposite direction to form loops; and wherein half of said apertures (5) are located at the positions where the loops cross and the other half of said apertures (6) are located at a position remote from where said loops cross so that one of the legs (10) of said U-shaped pins (9) is insertable into an aperture (5) at the crossing position and the other leg (12) is insertable into an aperture (6) at the remote position.

5. Apparatus as recited in claim 4 wherein said legs having inner sides which face each other and provide a narrow air gap for reducing the reluctance of the coupling pins.

References Cited

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DONALD J. YUSKO, Primary Examiner

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