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INVERTED TEE SYMBOL GENERATOR

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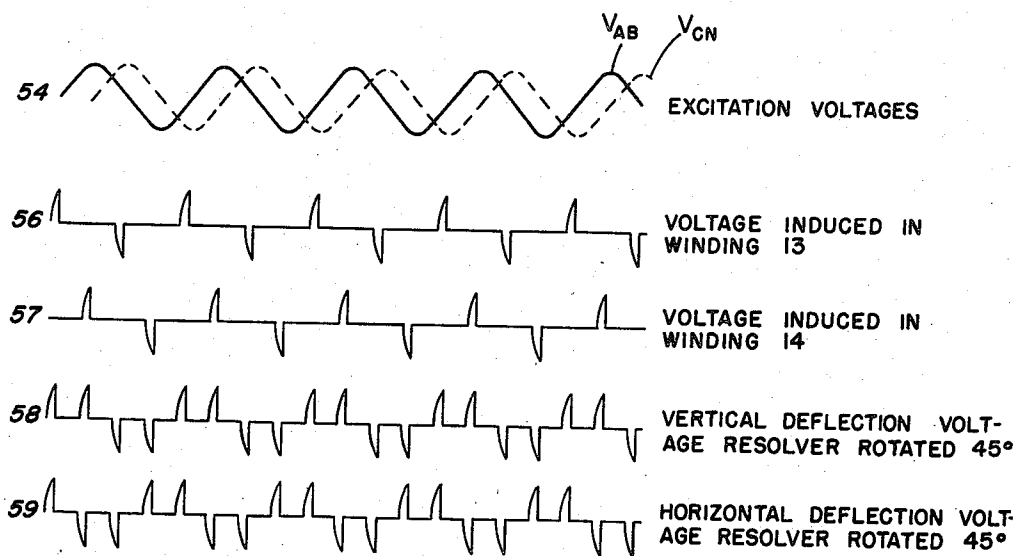
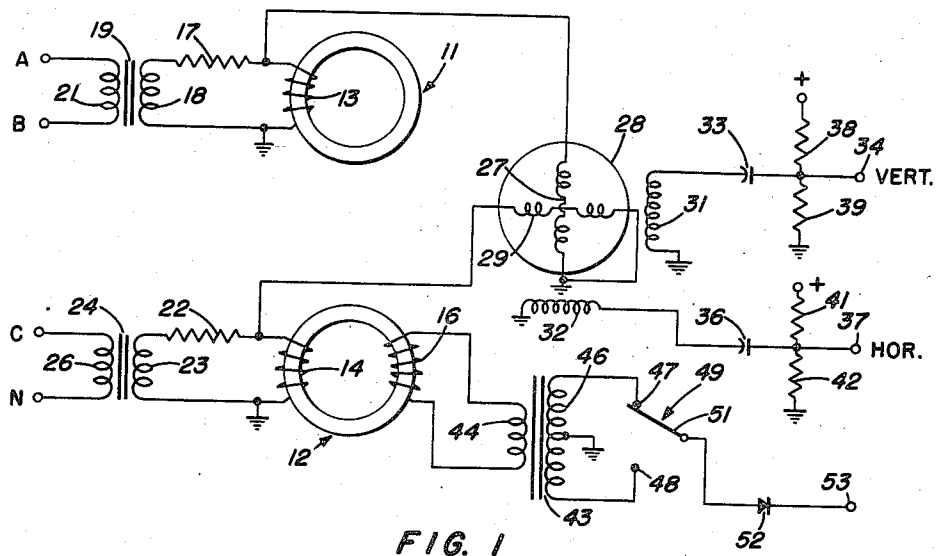


FIG. 2

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INVERTED TEE SYMBOL GENERATOR

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This invention relates to a system for forming a rotatable inverted T symbol and more particularly to a system of the character described embodying saturable core reactors and a polyphase synchro resolver to generate the symbol forming signals.

The visual display of certain radar fire control systems embody an inverted T flight symbol to represent a target aircraft. Known prior art symbol generators employ electronic or mechanical switching devices to combine component symbol forming signals to form the inverted T. Since these prior art systems generate the symbol as line components they require vacuum tubes which must track together to maintain the symbol intact as it is displaced about a cathode ray tube screen. The present invention overcomes this difficulty by providing a symbol forming system which generates the symbol as such without switching means being required. According to the invention, the symbol forming system includes a signal generator embodying two saturable core reactors having the windings thereof respectively energized by ninety degree phase displaced voltages and which are coupled to the rotor windings of a polyphase synchro resolver the stator windings of which are coupled to the deflection terminals of a cathode ray tube whereby the inverted T symbol is displaced upon the screen of the cathode ray tube and may be rotated thereon by rotation of the synchro resolver rotor.

It is an object of the present invention to provide a simple and reliable system for forming a rotatable inverted T symbol.

It is a further object of the present invention to provide in a system of the character described a simple and reliable generator of symbol forming signals.

It is a further object of the present invention to provide a generator of the character described that does not require electronic or mechanical switching circuits.

Other object and many of the attendant advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a schematic circuit diagram of a preferred embodiment of the invention.

Fig. 2 is a graph illustrating certain waveforms occurring in the embodiment of Fig. 1.

Referring now to Fig. 1, there is shown a pair of saturable core reactors of the self-saturating type generally indicated by the reference numerals 11, 12. Reactor 11 is provided with a winding 13 and reactor 12 with a principal winding 14 and an auxiliary secondary winding 16. In the embodiment of the invention illustrated, reactor winding 13 is connected through a limiting resistor 17 to the secondary winding 18 of a transformer 19 the primary winding 21 of which is connected to phases A and B of a three-phase supply. Winding 14 of reactor 12 in like manner is connected through a limiting resistor 22 to the secondary winding 23 of a transformer 24 the primary winding 26 of which is connected to phase C

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and neutral of the three phase supply. Windings 13 and 14 are therefore respectively connected to a pair of voltages which are ninety degrees phase displaced. Other means of obtaining the desired phase displacement may be employed, for example an RC circuit, and are contemplated by the present invention but the mode indicated has the advantage that it is independent of frequency fluctuations in the supply voltage.

One rotor winding 27 of a polyphase synchro resolver 28 is connected across winding 13 of reactor 11 to ground while the other rotor winding 29 thereof (displaced ninety electrical degrees from winding 27) is connected across winding 14 of reactor 12 to ground. Synchro resolver 28 is further provided with a pair of ninety degree phase displaced stator windings 31, 32. One terminal of winding 31 is grounded while the other terminal thereof is coupled through a capacitor 33 to the vertical deflection terminal 34 of a cathode ray tube (not shown). In like manner, one terminal of winding 32 is grounded while the other terminal thereof is coupled through a capacitor 36 to the horizontal deflection terminal 37 of the cathode ray tube. Vertical deflection terminal 34 is further connected to the junction of voltage divider resistors 38, 39 to which is applied a D.C. positioning voltage. In like manner, horizontal deflection terminal 37 is connected to the junction of voltage divider resistors 41, 42 to which is likewise applied a D.C. positioning voltage.

The embodiment of the invention illustrated further includes a blanking circuit comprising a transformer 43 having a primary winding 44 connected to winding 16 of reactor 12 and a grounded center tap secondary winding 46 the end terminals of which are connected to stationary terminals 47, 48 of a single pole, double throw switch 49 the movable contact 51 of which is connected through a rectifier 52 to an output terminal 53. Appropriate circuit connections (not shown) are provided between terminal 53 and the cathode ray tube to modify the voltage applied to the vertical or horizontal deflection system of the cathode ray tube in order to provide a blanking voltage thereto as is more fully described below.

Referring to Fig. 2, the voltages applied to transformers 19 and 24, V_{AB} , V_{CN} , are shown in waveform 54. As shown in waveform 56, each time V_{AB} passes through zero a short, sharp pulse is induced in winding 13. In like manner, as shown in waveform 57, each time the voltage applied to transformer 24 passes through zero, a short, sharp pulse is induced in winding 14. In the example shown, the pulses induced in winding 13 lead the pulses induced in winding 14 by ninety electrical degrees (ABC sequence having been assumed). The waveforms appearing in rotor winding 27 will be substantially identical to the waveforms appearing in reactor winding 13 while the waveforms appearing in rotor winding 29 will be substantially identical to the waveforms appearing in reactor winding 14.

Pulse widths and amplitude may be determined by appropriate selection of circuit parameters, e.g., reactor core material, number of reactor winding turns, transformation ratios and values of the limiting resistors. The pulse width is made sufficiently narrow to provide good pulse separation and the pulse amplitude is sufficiently limited to prevent saturation of the resolver core.

As will be apparent to those skilled in the art, the voltages induced in stator windings 31, 32 will be proportional to the sine or the cosine of the rotor winding voltages. With the rotor of the resolver 28 disposed in the non-rotated position (as shown in Fig. 1) only cosine components will appear in stator windings 31, 32. The voltages induced therein will therefore respectively have the configurations shown in waveforms 56, 57.

If it be assumed that a positive pulse applied to vertical deflection terminal 34 will cause an upward deflection of the cathode spot, a negative pulse will cause a downward deflection of the cathode spot, and if it be further assumed that a positive pulse applied to horizontal deflection terminal 37 will cause the cathode spot to be deflected to the right and a negative pulse cause the cathode spot to be deflected to the left, it will be seen that if a chain of pulses is applied to vertical and horizontal deflection terminals 34, 37 having respectively the configurations illustrated in waveforms 56, 57, an X-shaped symbol will be generated on the screen of the cathode ray tube with the arms thereof respectively vertical and horizontal.

According to the invention, the transformation ratio of transformer 43 is properly selected with respect to the magnitude of the pulses induced in windings 31, 32 and the voltage appearing at terminal 53 is applied to either the vertical deflection terminal 34 or the horizontal deflection terminal 37, by appropriate circuitry, not shown, to thereby blank one-half of either the vertically disposed portion of the X-shaped symbol or the horizontally disposed portion thereof causing a T-shaped symbol to be displayed. Either portion of the vertical or horizontal component of the symbol may be blanked by positioning of switch arm 49 as desired.

If now the rotor of resolver 28 be rotated forty-five degrees, the voltage waveform appearing in stator winding 31 will be as shown in waveform 58 while the voltage waveform appearing in winding 32 will be as shown in waveform 59, since the sine and cosine of forty-five degrees are equal and, with the rotor of resolver 28 rotated from the neutral position shown in Fig. 1, each time a pulse occurs in either winding 27 or 28 a pulse will be induced in both windings 31 and 32. With waveforms 56 and 57 applied respectively to deflection terminals 34, 37, as will be apparent, the respective arms of the symbol will be disposed at an angle of forty-five degrees to the vertical and horizontal axis thereof. Further rotation of synchro resolver 28 will result in further rotation of the symbol about an axis determined by the D.C. positioning voltages applied to the cathode ray tube deflection terminals.

Rotation of the rotor of resolver 28 and actuation of switch 49 may be accomplished by the use of suitable servo mechanisms incorporated into the computer portions of a fire control system to which the invention may be applied. The external circuitry of resolver 28 may be suitably dampened to prevent overshoot which would distort the symbol.

There has thus been described a simple and reliable system whereby a rotatable T-shaped symbol may be generated on a screen of a cathode ray tube and translated about the face thereof while maintaining the symbol intact.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A symbol generator comprising: a first saturable core reactor having a first winding thereon, a second saturable core reactor having a second winding thereon, circuit means for respectively applying to said reactor windings a pair of ninety degree phase displaced voltages, a sine-cosine resolver having input means and output means, circuit means connecting said reactor windings to said sine-cosine resolver input means, output terminal means, and circuit means for connecting said output terminal means to said sine-cosine resolver output means.

2. A symbol generator comprising: a first saturable core reactor having a first winding thereon, a second saturable core reactor having a second winding thereon, circuit means for respectively applying to said reactor

windings a pair of ninety degree phase displaced voltages, a sine-cosine resolver having input means and output means, circuit means connecting said reactor windings to said sine-cosine resolver input means, output terminal means, circuit means for connecting said output terminal means to said sine-cosine resolver output means, a third winding on said second saturable core reactor in voltage inducing relationship to said second winding, and circuit means including switch means and substantially unidirectional conducting means connecting said third winding to said output terminal means.

3. A signal generator comprising: a first saturable core reactor having a first winding thereon, a second saturable core reactor having a second winding thereon, a synchro resolver having rotor windings and stator windings, circuit means for respectively applying to said reactor windings a pair of ninety degree phase displaced voltages, circuit means connecting said reactor windings to said rotor windings, output terminal means, and circuit means connecting said stator windings to said output terminal means.

4. A signal generator comprising: a first saturable core reactor having a first winding thereon, a second saturable core reactor having a second winding thereon, a synchro resolver having rotor windings and stator windings, circuit means for respectively applying to said reactor windings a pair of ninety degree phase displaced voltages, circuit means connecting said reactor windings to said rotor windings, output terminal means, circuit means connecting said stator windings to said output terminal means, a third winding on said second saturable core reactor in voltage inducing relationship to said second winding, and circuit means including a switching means and substantially unidirectional conducting means connecting said third winding to said output terminal means.

5. A signal generator comprising: a first saturable core reactor having a first winding thereon; a second saturable core reactor having a second winding thereon; a poly-phase synchro resolver having a first rotor winding, a second rotor winding displaced ninety degrees from said first rotor winding, a first stator winding and a second stator winding displaced ninety degrees from said first stator windings; circuit means for respectively applying to said first and second reactor windings a pair of ninety degree phase displaced voltages; circuit means connecting said first reactor winding to said first rotor winding; circuit means connecting said second reactor winding to said second rotor winding; circuit means connecting said first stator winding to an output terminal; and circuit means connecting said second stator winding to another output terminal.

6. A signal generator comprising: a first saturable core reactor having a first winding thereon; a second saturable core reactor having a second winding thereon; a poly-phase synchro resolver having a first rotor winding, a second rotor winding displaced ninety degrees from said first rotor winding, a first stator winding and a second stator winding displaced ninety degrees from said first stator windings; circuit means for respectively applying to said first and second reactor windings a pair of ninety degree phase displaced voltages; circuit means connecting said first reactor winding to said first rotor winding; circuit means connecting said second reactor winding to said second rotor winding; circuit means connecting said first stator winding to an output terminal; circuit means connecting said second stator winding to another output terminal; a third winding on said second saturable core reactor in voltage inducing relationship to said second winding; and circuit means including a switching means and a substantially unidirectional conducting means connecting said third winding to an output terminal.

7. A symbol forming system comprising: a cathode ray tube having a pair of deflection terminals, a first saturable core reactor having a first winding thereon, a second saturable core reactor having a second winding

thereon, circuit means for respectively applying to said reactor windings a pair of ninety degree phase displaced voltages, a sine-cosine resolver having input means and output means, circuit means connecting said reactor windings to said sine-cosine resolver input means, and circuit means for connecting said deflection terminals to said sine-cosine resolver output means, whereby a symbol is formed on the screen of said cathode ray tube.

8. A symbol forming system comprising: a cathode ray tube having a pair of deflection terminals, a first saturable core reactor having a first winding thereon, a second saturable core reactor having a second winding thereon, circuit means for respectively applying to said reactor windings a pair of ninety degree phase displaced voltages, a sine-cosine resolver having input means and output means, circuit means connecting said reactor windings to said sine-cosine resolver input means, circuit means for connecting said deflection terminals to said sine-cosine resolver output means, whereby a symbol is formed on the screen of said cathode ray tube, a third winding on said second saturable core reactor in voltage inducing relationship to said second winding, and circuit means including switch means and substantially unidirectional conducting means connecting said third winding to said deflection terminals whereby a portion of said symbol may be blanked.

9. A symbol forming system comprising: a cathode ray tube having a pair of deflection terminals, a first saturable core reactor having a first winding thereon, a second saturable core reactor having a second winding thereon, a synchro resolver having rotor windings and stator windings, circuit means for respectively applying to said reactor windings a pair of ninety degree phase displaced voltages, circuit means connecting said reactor windings to said rotor windings, and circuit means connecting said stator windings to said deflection terminals, whereby a rotatable symbol is formed on the screen of said cathode ray tube.

10. A symbol forming system comprising: a cathode ray tube having a pair of deflection terminals, a first saturable core reactor having a first winding thereon, a second saturable core reactor having a second winding thereon, a synchro resolver having rotor windings and stator windings, circuit means for respectively applying to said reactor windings a pair of ninety degree phase displaced voltages, circuit means connecting said reactor windings to said rotor windings, circuit means connecting said stator windings to said deflection terminals, whereby a rotatable symbol is formed on the screen of said cathode ray tube, a third winding on said second saturable core reactor in voltage inducing relationship to said second winding, and circuit means including a switching

means and substantially unidirectional conducting means connecting said third winding to said deflection terminals whereby a portion of said symbol may be blanked.

11. A symbol forming system comprising: a cathode ray tube having a pair of deflection terminals; a first saturable core reactor having a first winding thereon; a second saturable core reactor having a second winding thereon; a polyphase synchro resolver having a first rotor winding, a second rotor winding displaced ninety degrees from said first rotor winding, a first stator winding, and a second stator winding displaced ninety degrees from said first stator windings; circuit means for respectively applying to said first and second reactor windings a pair of ninety degree phase displaced voltages; circuit means connecting said first reactor winding to said first rotor winding; circuit means connecting said second reactor winding to said second rotor winding; circuit means connecting said first stator winding to one of said deflection terminals; and circuit means connecting said second stator winding to the other of said deflection terminals whereby a rotatable symbol is formed on the screen of said cathode ray tube.

12. A symbol forming system comprising: a cathode ray tube having a pair of deflection terminals; a first saturable core reactor winding thereon; a second saturable core reactor having a second winding thereon; a polyphase synchro resolver having a first rotor winding, a second rotor winding displaced ninety degrees from said first rotor winding, a first stator winding, and a second stator winding displaced ninety degrees from said first stator windings; circuit means for respectively applying to said first and second reactor windings a pair of ninety degree phase displaced voltages; circuit means connecting said first reactor winding to said first rotor winding; circuit means connecting said second reactor winding to said second rotor winding; circuit means connecting said first stator winding to one of said deflection terminals; circuit means connecting said second stator winding to the other of said deflection terminals whereby a rotatable symbol is formed on the screen of said cathode ray tube; a third winding on said second saturable core reactor in voltage inducing relationship to said second winding; and circuit means including a switching means and a substantially unidirectional conducting means connecting said third winding to one of said deflection terminals whereby a portion of said symbol may be blanked.

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