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TRANSISTORIZED KEYING AND MARK-HOLD UNIT

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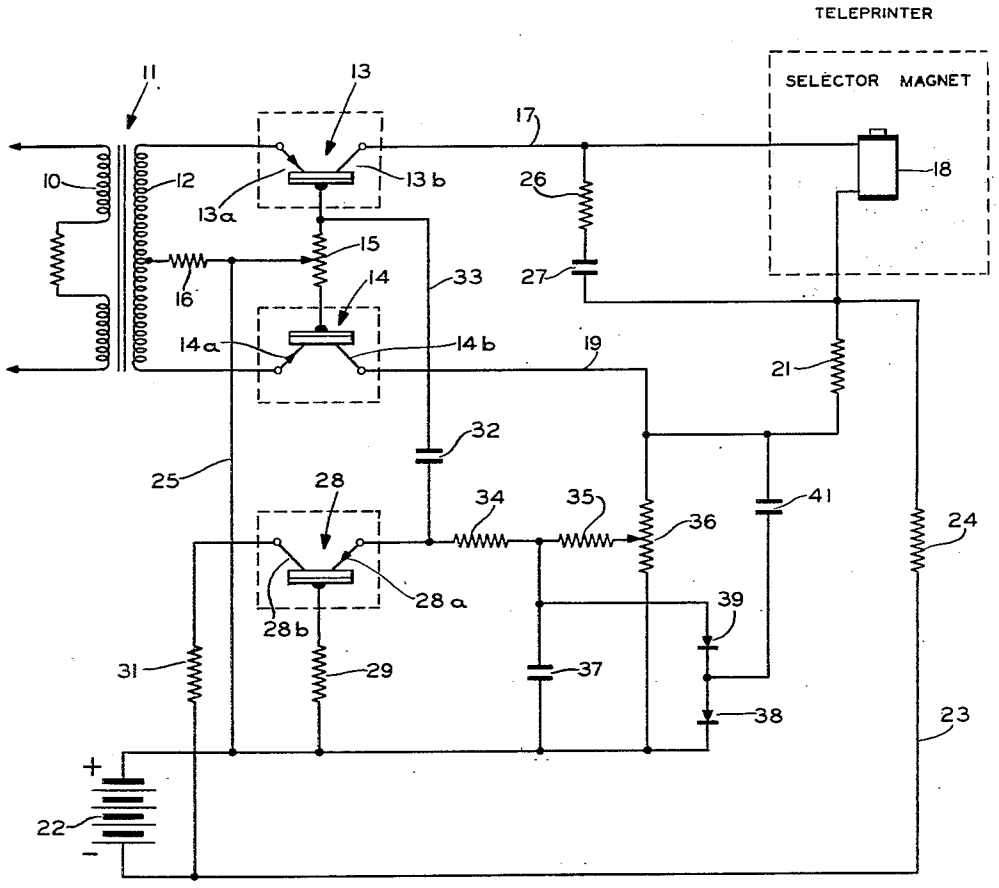

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TRANSISTORIZED KEYING AND MARK-HOLD UNIT

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The present invention relates to an electrical circuit for receiving pulses of opposite polarity and selectively passing pulses of one polarity to an actuating device. More particularly, the invention is especially adapted as a keying unit in a radio telegraph system wherein marking and spacing pulses are received and the marking pulses sent to the selector magnet of a teleprinter. Though the invention has particular utility in a telegraph system it is not to be considered as so limited since the function performed by the present novel circuit can be used in other systems and combinations. In conjunction with the keying unit which is selective to the marking and spacing pulses, a mark hold circuit is provided to insure a marking condition of the keying unit under certain conditions.

The invention has been designed for use in a portable telegraph system such as would be used by soldiers in the field. Under such conditions, it is highly desirable to minimize the weight and the bulk of the equipment that must be carried.

It is therefore a primary object of this invention to provide a light weight, compact keying and mark hold unit.

A further object of this invention is to provide an improved circuit for receiving pulses of opposite polarity and passing pulses of one polarity to a load device.

A further object of this invention is to provide an improved mark hold unit operating in conjunction with a keying unit to maintain the keying unit in the marking condition during extended periods of received spacing pulses.

In accordance with the above objectives, the invention contemplates a bi-stable circuit that assumes one condition upon the receipt of a marking pulse and another condition upon receipt of a spacing pulse. Three electrode semi-conductors now commonly known as transistors are employed. Two such transistors are connected in a push-pull arrangement to an input transformer. A positive marking pulse causes one of the transistors to conduct and the other to extinguish at which time a selector magnet in a conventional teleprinter is energized. A negative spacing pulse will operate to extinguish the conducting transistor and fire the previously non-conducting transistor. During this spacing condition the teleprinter selector magnet is permitted to deenergize.

The mark hold unit comprises essentially one transistor connected in circuit to operate as a relaxation oscillator. The oscillator functions to bring the keying unit into its marking condition when a prolonged spacing signal is received or when no readable signal is received. There are two normal conditions during which the oscillator must be held inoperative, one when a steady marking signal is received and the other when normal spacing and marking signals are received.

For purposes of circuit analysis, a marking pulse is designated as positive and a spacing pulse as negative throughout the specification. However, it should be understood that these designations are for descriptive purposes only and are not absolute since a positive pulse at one point in the circuit may appear as a negative pulse at another point. This will be apparent from the following description.

Referring now to the drawing, the incoming signals of opposite polarity are fed to the primary **10** of the transformer **11**. The secondary **12** of the transformer is connected to the emitters **13***a* and **14***a* of two point contact type transistors **13** and **14** respectively. The base electrodes of the transistors are joined through a resistor **15**. The center tap of secondary **12** is connected to the adjustable center contact of resistor **15** through resistor **16**. Collector electrode **13***b* is connected by wire **17** to the selector magnet **18** of a teleprinter. The printer is of well-known construction and therefore will not be described in detail since it forms no part of the present invention. Collector electrode **14***b* of transistor **14** is connected by wire **19** to resistor **21** which constitutes a dummy load. Operating potential is supplied by a 26-volt battery **22**, the negative side of which connects to the junction point of selector magnet **18** and dummy load **21** by wire **23** and common resistor **24**. The positive side of the battery is connected by wire **25** to the center contact of resistor **15**.

It will be apparent to those skilled in the art that an oppositely poled two-coil teleprinter selector magnet may be used in place of the single coil shown. When the present invention is thus employed, the second coil of the printer magnet is connected in place of the dummy load resistor **21**.

A positive marking pulse will apply a positive potential to the emitter electrode **13***a* and a negative potential to emitter electrode **14***a*. This biasing of the emitters will tend to cause transistor **13** to conduct while tending to prevent transistor **14** from conducting. As the marking transistor **13** conducts, current passes through the upper part of resistor **15** resulting in a voltage drop which tends to make the base electrode of the marking transistor **13** more negative with respect to its emitter electrode **13***a*. This action is cumulative and further insures the conductance of transistor **13** during the reception of a marking pulse.

The current flowing in the emitter **13***a* of transistor **13** develops a voltage drop across resistor **16**. This voltage drop also appears at the emitter **14***a* of transistor **14** making said electrode negative with respect to the base electrode of transistor **14**, further insuring the non-conductance of transistor **14** during reception of a marking pulse.

When transistor **13** conducts, a current is passed through the selector magnet **18** corresponding to the received marking pulse. During this period with transistor **14** non-conducting, little or no current passes through the dummy load resistor **21**. When the keying unit is transferred to its other bi-stable condition, current flows through the dummy load and substantially no current flows through the selector magnet. It is seen, therefore, that the keying unit flip-flops back and forth as a result of the received marking and spacing pulses. A resistor **26** in series with a capacitor **27** is connected across the selector magnet. The purpose of this is to dissipate the energy stored in the high inductance selector magnet upon discharge thereof when the unit changes to its spacing condition. In this manner, transistor **13** is protected from the high voltage transient that would otherwise occur.

The mark hold unit comprises a transistor **28** connected as a relaxation oscillator. The base electrode connects to the positive side of the battery through a resistor **29**. The collector electrode **28***b* is connected to the negative side of the battery through resistor **31**. Emitter electrode **28***a* connects to the base electrode of the transistor **13** through a capacitor **32** and wire **33**.

The emitter is also connected to a series combination of resistors 34 and 35 which connect to the adjustable contact of a resistor 36 one end of which is connected to collector 14*b* and the other end of which connects to positive battery. A voltage doubler network comprising capacitor 37 and diodes 38 and 39 is connected through capacitor 41 to the dummy load 21 and collector electrode 14*b*.

The function of the mark hold unit is to set up a marking condition for the teleprinter during a prolonged spacing interval. During a steady marking condition, it is of course unnecessary for the mark hold unit to function, hence it is held inoperative by the collector of the spacing transistor 14 which is in a non-conducting condition. With this transistor non-conducting and therefore no current passing through the dummy load 21, emitter 28*a* is held sufficiently negative to bias transistor 28 off. During the normal reception of spacing and marking pulses, an A. C. component passes through capacitor 41 to the voltage doubler network to maintain capacitor 37 in a charged condition which also biases emitter 28*a* sufficiently negative to prevent oscillations. It is seen, therefore, that during a marking condition the non-conductance of transistor 14 disables the oscillator and during normal spacing and marking pulses the voltage doubler network disables the oscillator.

During the reception of a long spacing interval resulting in conduction of transistor 14 and a voltage drop across resistor 21, the emitter 28*a* of transistor 28 becomes sufficiently positive to cause oscillations to start. This is brought about by the bleeding off through resistor 34 of the negative charge on capacitor 32 thereby permitting transistor 28 to conduct. Upon the firing of transistor 28, a negative pulse is passed through capacitor 32 to the base electrode of transistor 13 which again charges capacitor 32 to a negative value sufficient to stop conduction of transistor 28. With the base electrode of transistor 13 negative with respect to the emitter 13*a*, a condition is established similar to that of a marking pulse. Transistor 13 thereupon conducts to pass current through the selector magnet and extinguish the spacing transistor 14 as previously described. If the pulse to the transistor 13 is ineffective to produce a marking condition or if the marking condition once produced ceases, a positive potential will again build up on the emitter of transistor 28 by reason of the bleeding off of the negative charge on capacitor 32 and the above cycle will reoccur.

While the present invention has been described with reference to a specific embodiment thereof, it is understood that various substitutions of equivalents and modifications may be made without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A keying unit for a telegraph system comprising a bi-stable circuit including input means, a first semi-conductor device and a second semi-conductor device, each of said semi-conductor devices having an emitter electrode, a collector electrode and a base electrode, said emitter electrodes being connected to said input means, resistor means connecting the base electrode of each of said first and second semi-conductor devices, means for connecting a signal responsive device in the collector circuit of said first semi-conductor device and impedance means connected in the collector circuit of said second semi-conductor device.

2. A keying unit for a telegraph system comprising a bi-stable circuit including input means, a first semi-conductor device and a second semi-conductor device, each of said semi-conductor devices having an emitter electrode, a collector electrode and a base electrode, said emitter electrodes being connected to points of opposite polarity of said input means, a resistance network connecting the base electrode of each of said first and second semi-conductor devices and said input means, a signal responsive device connected in the collector circuit of said first semi-conductor device, impedance means connected in the collector circuit of said second semi-conductor device whereby conduction of said first semi-conductor causes an energizing current to flow through said signal responsive device and conduction of said second semi-conductor causes current to flow through said impedance means.

3. A system for keying a teleprinter comprising a bi-stable circuit including input means for receiving positive marking pulses and negative spacing pulses, a first semi-conductor device and a second semi-conductor device, each of said semi-conductor devices having an emitter electrode, a collector electrode and a base electrode, said emitter electrodes being connected to points of opposite polarity of said input means, a resistance network connecting the base electrode of each of said first and second semi-conductor devices and said input means whereby a positive marking pulse causes the first semi-conductor to conduct and a negative spacing pulse causes the second semi-conductor to conduct, a teleprinter selector magnet connected in the collector circuit of the first semi-conductor, impedance means connected in the collector circuit of the second semi-conductor whereby a positive marking pulse causes energization of the said selector magnet and a negative spacing pulse causes current to flow through said impedance means.

4. A system for keying a teleprinter comprising a bi-stable circuit including an input transformer having a center-tapped secondary winding and a primary winding for receiving positive marking pulses and negative spacing pulses, a first semi-conductor device and a second semi-conductor device, each of said semi-conductor devices having an emitter electrode, a collector electrode and a base electrode, said emitter electrodes being connected respectively to the outer points of said secondary winding, resistance means connecting the base electrode of each of said first and second semi-conductor devices to the center tap of said secondary winding whereby a positive marking pulse causes the first semi-conductor to conduct and prevents conduction of said second semi-conductor device and a negative spacing pulse causes said second semi-conductor device to conduct and prevents the first semi-conductor device from conducting, a teleprinter selector magnet connected in the collector circuit of the first semi-conductor, impedance means connected in the collector circuit of the second semi-conductive device whereby a positive marking pulse results in energization of said selector magnet and a negative spacing pulse causes current to flow through said impedance means, the impedance of said selector magnet being approximately equal to the impedance of said impedance means.

5. A system for keying a teleprinter comprising a bi-stable circuit including input means for receiving positive marking pulses and negative spacing pulses, a first semi-conductor device and a second semi-conductor device, each of said semi-conductor devices having an emitter electrode, a collector electrode and a base electrode, said emitter electrodes being connected to points of opposite polarity of said input means whereby a positive marking pulse causes the first semi-conductor to conduct and a negative spacing pulse causes the second semi-conductor to conduct, a teleprinter selector magnet connected in the collector circuit of the first semi-conductor, impedance means connected in the collector circuit of the second semi-conductor whereby a positive marking pulse causes energization of the said selector magnet and a negative spacing pulse causes current to flow through said impedance means, and means responsive to prolonged conduction of said second semi-conductor to bias said first semi-conductor to conduction and extinguish said second semi-conductor.

6. The system defined in claim 5 wherein said responsive means comprises a third semi-conductor device nor-

mally biased to inoperative condition and circuit means connecting said third semi-conductor to the collector electrode of said second semi-conductor whereby conduction of said second semi-conductor controls said third semi-conductor.

7. A system for keying a teleprinter comprising a bi-stable circuit including input means for receiving positive marking pulses and negative spacing pulses, a first semi-conductor device and a second semi-conductor device, each of said semi-conductor devices having an emitter electrode, a collector electrode and a base electrode, said emitter electrodes being connected to points of opposite polarity of said input means whereby a positive marking pulse causes the first semi-conductor to conduct and a negative spacing pulse causes the second semi-conductor to conduct, a teleprinter selector magnet connected in the collector circuit of the first semi-conductor, impedance means connected in the collector circuit of the second semi-conductor whereby a positive marking pulse causes energization of the said selector magnet and a negative spacing pulse causes current to flow through said impedance means, and means to control said bi-stable circuit, said means to control comprising a third semi-conductor device normally biased to inoperative condition, circuit means connecting said third semi-conductor to the collector electrode of said second semi-conductor, means including a capacitor connecting the emitter of said third semi-conductor to the base electrode of said first semi-conductor whereby prolonged conduction of said second semi-conductor causes said capacitor to discharge to bias said first semi-conductor to conduction condition.

8. A telegraph unit of the character described comprising a keying circuit for receiving marking and spacing pulses of opposite polarity, said keying circuit comprising a bi-stable circuit including a first semi-conductor device and a second semi-conductor device, means whereby a marking pulse of one polarity causes said first semi-conductor to conduct and renders said second semi-conductor nonconducting, means whereby a spacing pulse of opposite polarity causes said second semi-conductor to conduct and renders said first semi-conductor nonconducting, a marking condition hold unit comprising a third semi-conductor, means controlled by conduction of said third semi-conductor to bias said keying unit to the marking pulse condition, means to fire said third semi-conductor upon a prolonged spacing pulse condition of said keying circuit, and means to prevent firing of said third semi-conductor during the marking pulse condition of said keying circuit.

9. The telegraph unit as defined in claim 8, including means to prevent firing of said third semi-conductor during normal reception of marking and spacing pulses by the keying circuit.

10. A bi-stable circuit comprising input means, a first semi-conductor, a second semi-conductor, each of said semi-conductors having an emitter electrode, a collector electrode and a base electrode, said emitter electrodes being connected respectively to points of opposite polarity of said input means, output means, said collector electrodes being connected to said output means, first resistance means connecting the base electrodes of said first and second semi-conductors and second resistance means connecting said first resistance means and said input means.

11. A bi-stable circuit comprising an input transformer having a center tapped secondary winding, a first semi-conductor device, a second semi-conductor device, each of said semi-conductor devices having an emitter electrode, a collector electrode and a base electrode, said emitter electrodes being connected respectively to the outer points of said secondary winding, a resistance network connecting the base electrode of each of said first and second semi-conductor devices to the center tap of said secondary winding and output means connected to the collector electrodes of said semi-conductors.

12. A keying unit for a telegraph system comprising input means, a first semi-conductor device and a second semi-conductor device, each of said semi-conductor devices having an emitter electrode, a collector electrode and a base electrode, said emitter electrodes being connected to points of opposite polarity of said input means, a signal responsive device connected in the collector circuit of said first semi-conductor device, impedance means connected in the collector circuit of said second semi-conductor device whereby conduction of said first semi-conductor causes an energizing current to flow through said signal responsive device and conduction of said second semi-conductor causes current to flow through said impedance means, and means responsive to prolonged conduction of said second semi-conductor to bias said first semi-conductor to conduction and extinguish said second semi-conductor.

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