

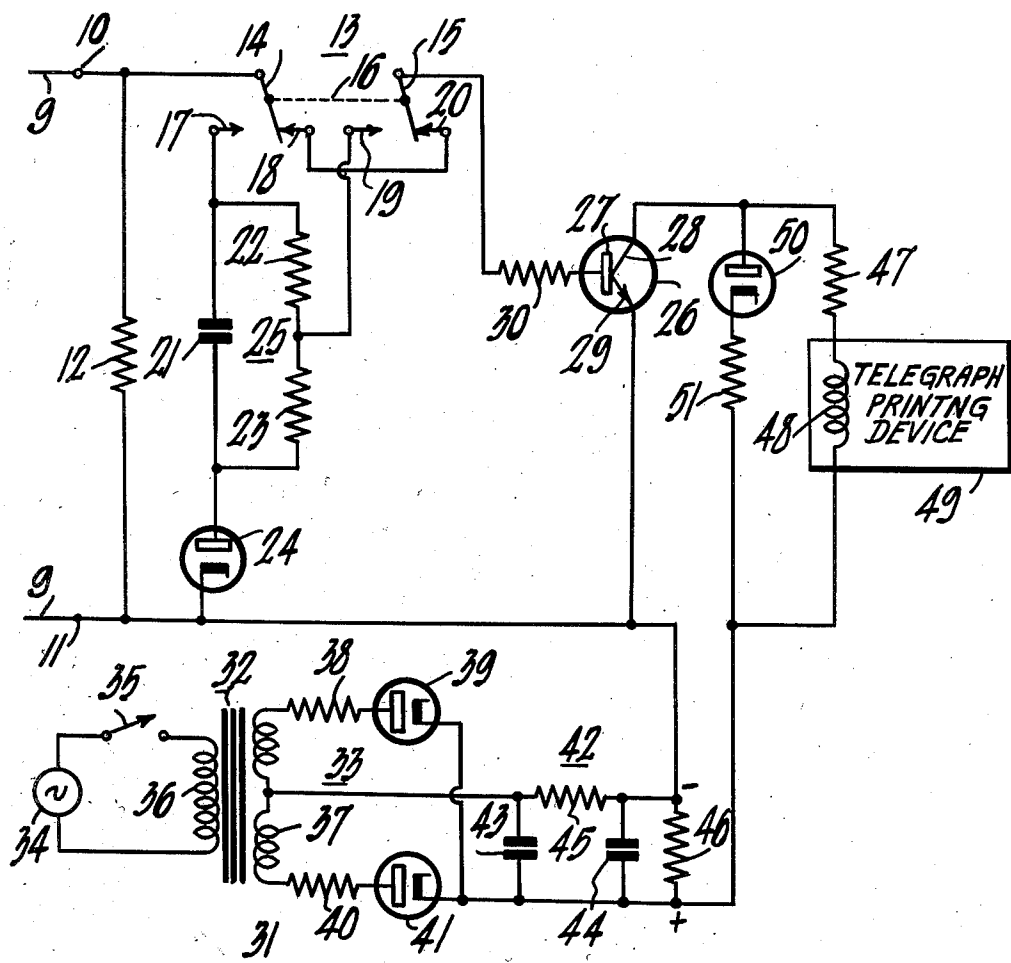
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COMMUNICATION SYSTEM

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COMMUNICATION SYSTEM

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The invention relates to pulse signalling and control circuits. It particularly relates to a circuit arrangement including a transistorized electronic relay adaptable for use in the driving circuit of telegraph devices.

Telegraph printing devices commonly used in the field of telegraphy are constructed so as to operate in response to a single current signal or, in other words, from a neutral circuit. Each pulse character of the signal fed to a printing device includes a number of mark, space, or mark and space elements arranged in a predetermined manner according to the particular telegraph code used. In a single current signal system, a mark is defined as an interval during which current is fed to the device, while a space is defined as an interval during which no current is fed to the device. The printing device, therefore, operates on a current amplitude basis rather than, for example, a polarity basis.

A difficulty encountered in the use of such telegraph printing devices has been the deterioration in the operating margin of the devices when transmission lines over which a signal is fed to the devices are long or in poor condition. This difficulty also arises when a number of devices are connected in a network which is, in turn, connected to a single transmission line. Mechanical relays have been used in driving circuits associated with the printing devices to repeat an incoming signal as a means of increasing the operating margin. The use of relays, however, adds to the operating problems of the devices because of the need for adjustments and maintenance. Further, while the use of mechanical relays reduces the reactive appearance of the devices to a transmission line connected thereto, the reactive appearance is not removed. Electronic relays using multi-element vacuum tubes have also been used in driving circuits associated with the printing devices. A desirable non-reactive input is obtained by the use of tubes, but the use of tubes has the disadvantage of requiring high voltage power supplies and results in the undesirable production of heat resulting from the filament and plate dissipations of the tubes. Tube life is also a problem in maintaining the printing devices in operation.

In certain applications, it has been found desirable to transmit a telegraph signal as a two-current or polar signal over a transmission line which is connected at one end to a printing device, particularly, where long transmission lines are used. In a two-current signal, the mark and space elements are represented by voltages which are respectively identical in magnitude but opposite in polarity. As the telegraph printing devices are arranged to operate from a neutral electrical circuit in response to a single current signal, it is necessary when the two-current type of signal is used to provide in the driving circuit of the printing devices some means for converting the two-current signal into a single current signal before the signal is fed to the devices. For ease of design and operation, it is desirable, therefore, that a driving circuit of the printing devices be adaptable to operate in response to both a two-current, polar, signal and a single current,

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neutral, signal. A desideratum for such a driving circuit is that it should avoid the disadvantages and difficulties encountered in the use of the circuit arrangements now available in the art.

Among the objects of the invention are: To provide an improved circuit arrangement for use in the driving circuit of a telegraph printing device which will present a non-reactive appearance to the driving source; to improve the operation of the driving circuit of a telegraph printing device by an improved circuit arrangement including a transistorized electronic relay and means for operating the circuit in response to either a two-current or a single current input signal; to provide an improved circuit arrangement including a transistorized electronic relay operated by an isolated power supply so that the relay can be used in the driving circuit of a telegraph printing device and placed in series with any type of transmission line at any point along the line between the input terminals of the device.

The above and other objects are attained in a circuit arrangement including a power transistor, a low voltage isolated power supply and a switching circuit arranged to receive either a two-current or a single current signal supplied thereto over a transmission line. The switching circuit operates in response to either type of input signal to supply a two-current or polar signal to the input circuit of the transistor. A telegraph printing device is connected in the output circuit of the transistor. The transistor is operated by the power supply in response to a signal fed to the transistor from the switching circuit to supply an energizing signal to the operating circuit of the printing device. The energizing signal for the printing device is in the form of a single current signal. Since currently available transistors of adequate current rating are normally low voltage devices, a protective circuit is included in the output circuit of the transistor to prevent damage to the transistor by the voltage pulse generated by the inductive component in the operating circuit of the telegraph printing device during periods of transition from a current to no-current condition.

A detailed description of the invention follows with reference to the drawing in which the single figure is a schematic diagram of a circuit arrangement constructed in accordance with the principles of the invention.

Referring to the drawing, a transmission line 9 adapted to carry telegraph signals is connected to input terminals 10 and 11. There are many examples of this type of transmission line in the art, and the transmission line used does not, in itself, form a part of the invention. A resistance 12 is connected between the terminals 10 and 11, and may be an actual resistor or may represent the impedance of the transmission line 9 connected to the terminals 10 and 11. Also connected between the terminals 10 and 11 is a switching circuit 13. Included in the switching circuit 13 is a shunt network 25 and a single throw-double pole switch comprising a pair of armatures 14 and 15 connected to a mechanical arm 16. Armature 14 is positioned so as to be driven by arm 16 between two contacts 17 and 18, while armature 15 is arranged to be driven in the same manner between contacts 19 and 20. In one position of the arm 16, armature 14 engages contact 18, while armature 15 engages contact 20. In the other position of the arm 16, armature 14 engages contact 17, while armature 15 engages contact 19.

Contact 17 is connected to the upper end of the shunt network 25 which comprises a capacitor 21 and resistors 22 and 23 connected in series across the capacitor 21. The resistors 22 and 23 may be separate resistors, a single tapped resistor or a potentiometer having a variable tapping arm. Two resistors 22 and 23 are shown in the drawing, the contact 19 being connected to a junction

therebetween. The lower end of the shunt network network 25 is connected through a unidirectional current conducting device in the form of a vacuum tube rectifier 24 to terminal 11, the rectifier 24 being connected in series with the shunt network 25 across the terminals 10 and 11. The rectifier 24 may be in actual practice any known device which will present a low impedance at the operating frequency between the lower end of the shunt network 25 and the terminals 10 and 11. Contacts 18 and 20 are connected together by an electrical path.

An electronic relay in the form of a power transistor 26 is connected in the output circuit of the switching circuit 13. The transistor 26 shown in the drawing is of P type conductivity and is, more particularly, an NPN junction transistor. The transistor 26 comprises a base electrode 27, a collector electrode 28 and an emitter electrode 29, the direction of the emitter arrow referring to the easy flow direction of conventional current in the emitter 29 under normal bias conditions. Armature 15 is connected through a current limiting resistor 30 to the base electrode 27.

A low voltage ungrounded power supply 31 is provided for operating the transistor 26. The power supply 31 includes an input transformer 32 and a push-pull rectifier circuit 33. A source of alternating current 34, for example, 120 volts-60 cycle energy, is connected in series with an on-off switch 35 and across the primary winding 36 of transformer 32. One side of the center-tapped secondary winding 37 of transformer 32 is connected through a resistor 38 to the anode of a rectifier 39. In the same manner, the other side of the secondary winding 37 is connected through a resistor 40 to the anode of a second rectifier 41. The cathodes of rectifiers 39 and 41 are connected together and to one side of a filter network 42. The other side of the filter network 42 is connected to the center-tap on the secondary winding 37. The network 42 is of conventional design and includes capacitors 43, 44 and a resistor 45 arranged in a simple single-section filter arrangement. First one and then the other of the rectifiers 39 and 41 conducts in response to the alternating voltage induced across the secondary winding 37, causing a unidirectional signal to be produced by the rectifier circuit 33 and to be fed through the filter network 42 across a load resistor 46 in the polarity shown in the drawing.

The collector electrode 28 of transistor 26 is connected through a resistor 47 and the winding 48 of the printer magnet in a telegraph printing device 49 to the positive end of resistor 46. The telegraph printing device 49 may be any of the types commonly used in the art. For example, a device known by the trade name Teletype Model 15 Printer may be used. The resistor 47 limits the current flow in the collector electrode circuit to a desired value. The resistor 47 may be a separate resistor or may be considered to be a symbolic indication of resistance included in the winding of the load reactance represented by winding 48. The emitter electrode 29 of transistor 26 is connected to the negative end of resistor 46 and to the terminal 11. The base electrode 27 is, therefore, the input electrode, and the collector electrode 28 is the output electrode. The emitter electrode 29 is common to both the input and output circuits, forming a transistor circuit wherein the emitter electrode 29 is common to both input and output circuits. A protective circuit is connected between the collector electrode 28 and the emitter electrode 29 including a unidirectional current conducting device in the form of a vacuum tube rectifier 50 and a resistor 51. As in the case of rectifier 24, other types of unidirectional current conducting devices could be used in place of the vacuum tube rectifier 50 shown in the drawing. As will be described in greater detail, the value of resistor 51 is adjusted to a suitable value which limits the potential applied to the collector electrode 28 to a safe value without causing any ill effects due to excessive circulating load.

In the operation of the circuit arrangement of the invention, two different types of telegraph signals could be available for application to the terminals 10 and 11. Either a two-current, polar, signal or a single current, neutral, signal could be so available. Assuming that a two-current signal is applied to the terminals 10 and 11, the polarity of the signal at terminal 10 at any instant is determined according to the sequence of mark and space elements included in each character contained in the incoming telegraph signal. In one embodiment, the mark elements could be designated by a voltage of positive polarity, while the space elements are designated by a voltage of negative polarity. It is clear, however, that in a particular application the polarities could be reversed. For the sake of description, it will be assumed that the first-mentioned arrangement of polarities is used in a two-current signal applied to terminals 10 and 11. The arm 16 is operated to position the armatures 14 and 15 in the manner shown in the drawing. Armature 14 is made to engage contact 18, and armature 15 is made to engage contact 20. An electrical path is completed including armature 14, contact 18, contact 20, armature 15 and current limiting resistor 30 over which the incoming signal of reversing polarity is fed from terminal 10 to the base electrode 27 of transistor 26. It will be remembered that the emitter electrode 29 is biased in the forward or current-conducting direction with respect to the base electrode 27, while the collector electrode 28 is biased in the reverse direction or non-conducting direction with respect to the base electrode 27. When a mark element or positive voltage is applied to the base electrode 27 relative to the emitter electrode 29, a current flow results between the base electrode 27 and the emitter electrode 29, causing the collector electrode 28 to conduct heavily. A current flow then occurs through the winding 48 of the printer magnet in the operating circuit of the telegraph printing device 49. The winding 48 is energized, and the operating circuit of the device 49 responds to the receipt of a mark element included in a character contained in the signal originally applied to terminals 10 and 11.

When a space element or negative voltage is applied to the base electrode 27 relative to the emitter electrode 29, the collector electrode 28 appears as an open circuit, thus reducing the current flow in the circuit of the collector electrode 28 to zero. The winding 48 of the printer magnet is deenergized, and the telegraph printing device 49 responds to the receipt of a space element. In other words, the transistor 26 operates to convert a two-current signal into a single current signal for application to the telegraph printing device 49. The application of a two-current or polar signal between the base electrode 27 and the emitter electrode 29 causes current to flow through winding 48 whenever the voltage applied to base electrode 27 is positive and no current to flow through winding 48 whenever the voltage applied to the base electrode 27 is negative. It is preferred that the value of resistor 30 be set so that the magnitude of current applied to the base electrode 27 is such that the transistor 26 is at or near the point of saturation or maximum current-conducting condition during periods in which the collector electrode 28 is conducting. In this condition, the transistor 26 is basically a switch which is not required to dissipate any considerable amount of power during the periods in which the collector electrode 28 is conducting.

When the voltage applied to the base electrode 27 goes negative and the conduction of the collector electrode 28 ceases, the stored energy in the load inductance represented by winding 48 will tend to raise the potential of the collector electrode 28 with respect to the positive side of resistor 46 to an abnormal value. To prevent damage to the transistor 26 by this condition, a rectifier 50 and resistor 51 are series connected across the resistor 47 and the winding 48 of the telegraph printing device 49. The rectifier 50 is connected with the proper polarity so

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that it conducts whenever the voltage applied to the collector electrode 28 becomes more positive than the voltage supplied by the power supply 31. This conduction causes the magnetic energy to be dissipated as electrical loss in the resistors 47 and 51. The value of resistor 51 is adjusted to a value which causes the protective circuit including rectifier 50 to limit to a safe value the potential of collector electrode 28. In some cases the value of resistor 51 may be set at zero.

When the telegraph signal applied to terminals 10 and 11 is a single current or neutral signal, the input circuit to the transistor 26 must be altered. Transistor 26 is designed according to the invention to be driven by a two-current or polar signal fed to the input or base electrode 27 thereof. Arm 16 is operated to cause armature 14 to disengage contact 18 and engage contact 17. Simultaneously, the armature 15 is caused to disengage contact 20 and engage contact 19. The single current signal applied to terminals 10 and 11 comprises mark elements designated by a flow of current with a voltage of positive polarity and space elements designated by an absence of current flow. It will be assumed that terminal 10 becomes positive with respect to terminal 11 for the duration of each mark element included in a character contained in the incoming signal. Therefore, when a mark element is received at terminal 10, an electrical path is completed including armature 14, contact 17, capacitor 21 and rectifier 24 over which current flows between the terminals 10 and 11. Capacitor 21 becomes charged to a level corresponding to the level of the positive voltage appearing at terminal 10. The upper plate of capacitor 21 in the drawing becomes positive relative to the lower plate thereof. During each mark element, rectifier 24 will conduct. Because of the low forward resistance of the rectifier 24, the lower plate of capacitor 21 is at the ground or reference potential of terminal 11. The term ground, as used in the specification, refers to a point of fixed or zero alternating reference potential.

When a space element is received at terminal 10, the resistor 12 serves to reduce the potential between terminals 10 and 11 to zero. Rectifier 24 becomes non-conducting. The upper plate of the capacitor 21 is now connected through the impedance of the transmission line 9 via terminal 10 to some point of ground or reference potential located in equipment connected to the other end of the transmission line 9 or connected directly to the transmission line 9. The lower plate of capacitor 21 becomes negative with respect to the point of reference potential at a level corresponding to the charge on the capacitor 21. Resistors 22 and 23 are series connected across the capacitor 21, the junction of the resistors being connected by means of an electrical path including contact 19, armature 15 and resistor 30 to the base electrode 27 of transistor 26. Assuming that resistors 22 and 23 are of equal value, the potential of the junction with respect to terminal 11 is always half the potential difference across the capacitor 21. In this connection, it should be noted that the time constant of the shunt network 25 should be long with respect to the anticipated maximum continuous spacing interval. It will be seen, therefore, that the voltage applied to the base electrode 27 is positive during each mark element and negative during each space element. A balanced polar voltage is applied from the switching circuit 13 to the input circuit of the transistor 26. If the values of resistors 22 and 23 were unequal, the output of the switching circuit 13 would be an unbalanced polar voltage with the degree of voltage unbalance equal to the degree of resistance unbalance. Having converted the incoming single current signal to a two-current or polar signal, the operation of the transistor 26 and of the remainder of the circuit arrangement of the invention is the same as described above.

Reference has already been made to the use of the ungrounded or isolated power supply 31 in the circuit ar-

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range of the invention. By using this type of power supply in connection with the transistor 26, the proper operating voltages can be applied to the respective electrodes of the transistor 26 without regard to the potential difference existing between the terminals 10 and 11 with respect to a point of reference potential. For example, the circuit arrangement of the invention may be used in a telegraph signalling circuit which may or may not have returns at ground potential. The invention permits considerable ease of design, because the circuit arrangement as described herein can be inserted in series with any transmission line to provide a driving circuit for a telegraph printing device without undesirably affecting the normal operation thereof. If, in a particular application, only direct current sources are available to operate the power supply 31, inverter means including vibrators, vacuum tubes and so on could be used followed by a suitable rectifier circuit to produce the same operation as described in connection with the embodiment shown in the drawing. Further, if the circuit arrangement of the invention were to be used in an application in which a single current or neutral signal was fed to terminals 10 and 11, a number of rectifiers arranged in a bridge could be inserted in the input circuit of the switching circuit 13 to insure that the correct polarity of signal is applied to the switching circuit 13 or neutral-to-polar conversion arrangement.

The circuit arrangement of the invention may be constructed for operation in response to only either a single current or a two-current input signal. The switching circuit 13 is removed from the arrangement, and the proper connections are made in the input circuit of transistor 26 according to the particular type of input signal which is to be fed to the input circuit of the transistor. The connections made for each type of input signal are the same as have been described in connection with the drawing. In the application in which a single current input signal is used, the resistor 30 could be eliminated. The resistance values of resistors 22 and 23 could be set at the proper value to provide the required resistance in the circuit of the base electrode 27.

The embodiment of the invention described herein uses an NPN junction transistor. A transistor of N type conductivity such as a PNP junction transistor could also be used in a specific application. It would then be necessary to reverse the polarity of the power supply 31 and of the rectifiers 24 and 50. In all other respects, the circuit arrangement of the invention would operate in the same manner as has been described.

While the power supply 31 is shown in the drawing connected between the emitter electrode 29 and the load, the power supply 31 could also be connected between the collector electrode 28 and the load, as long as the proper polarity is maintained. In certain applications, the use of the power supply 31 in the latter manner provides the advantage of a direct, electrical, common connection between the input and output circuits of the invention.

The invention is a circuit arrangement adaptable for use in the driving circuit of telegraph printing devices with advantages not previously realized by using the circuit arrangements now found in the art. The operational difficulties encountered in the use of mechanical relays, vacuum tubes and so on are avoided. By operating the transistor 26 from a polar circuit, the transistor 26 is caused to assume a state of conduction or non-conduction according to the polarity of the signal fed to the base electrode 27 thereof. If a single current or neutral signal were fed to the base electrode 27 of transistor 26, a small amount of current would continue to flow in the transistor 26 during the space intervals when no current flow is desirable. The application of a zero voltage would not cause the transistor 26 to reduce conduction to a negligible value as is the case when a voltage of the proper polarity is applied to the base electrode 27,

according to the type of transistor used. An advantage of the circuit arrangement of the invention is that, when a single current or neutral signal is received over transmission line 9, the effective signal fed to the load represented by winding 48 is the same as a signal which would have been produced as the result of the reception of a two-current or polar signal over transmission line 9. However, none of the usual complications of providing a two-current or polar signal and adapting a transmission line to carry the signal are encountered, when the present invention is employed.

What is claimed is:

1. A circuit arrangement for driving a load comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a base-emitter circuit, a collector-emitter circuit, said load being series connected in said collector-emitter circuit, a switching circuit, an input circuit connected in said base-emitter circuit and including said switching circuit, means for feeding a telegraph input neutral signal to said switching circuit, means for operating said switching circuit in response to said input signal to feed said input signal as a telegraph polar signal to said input circuit, means connected in said collector-emitter circuit for biasing said emitter and collector electrodes in the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said load, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said load.

2. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a base-emitter circuit, a collector-emitter circuit, a telegraph printing device, said device including a printer magnet having a winding, said winding being series connected in said collector-emitter circuit, a switching circuit, an input circuit connected in said base-emitter circuit and including said switching circuit, means for feeding a telegraph input neutral signal to said switching circuit, means for operating said switching circuit in response to said input signal to feed said input signal as a telegraph polar signal to said input circuit, means connected in said collector-emitter circuit for biasing said emitter and collector electrodes in the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding.

3. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a base-emitter circuit, a collector-emitter circuit, a telegraph printing device, said device including a printer magnet having a winding, said winding being series connected in said collector-emitter circuit, a switching circuit, an input circuit connected in said base-emitter circuit and including said switching circuit, means for feeding a telegraph input neutral signal to said switching circuit, means for operating said switching circuit in response to said input signal to feed said input signal as a telegraph polar signal to said input circuit, means connected in said collector-emitter circuit for biasing said emitter and collector electrodes in the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding, and a unidirectional current conducting device connected across said winding and poled in the proper direction to conduct

whenever the level of the bias applied to said collector electrode exceeds a predetermined value.

4. A circuit arrangement for driving a telegraph printing device as claimed in claim 3 and including a current limiting resistor connected in series with said winding, said unidirectional current conducting device being connected across said resistor and said winding.

5. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a base-emitter circuit, a collector-emitter circuit, a telegraph printing device, said device including a printer magnet having a winding, said winding being series connected in said collector-emitter circuit, a switching circuit, an input circuit connected in said base-emitter circuit and including said switching circuit, means for feeding a telegraph input neutral signal to said switching circuit, means for operating said switching circuit in response to said input signal to feed said input signal as a telegraph polar signal to said input circuit, an ungrounded power supply connected in said collector-emitter circuit, means for operating said power supply to apply biasing voltages to said collector and emitter electrodes in the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding.

6. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a base-emitter circuit, a collector-emitter circuit, a telegraph printing device, said device including a printer magnet having a winding, said winding being series connected in said collector-emitter circuit, a switching circuit, an input circuit connected in said base-emitter circuit and including said switching circuit, means for feeding a telegraph input neutral signal to said switching circuit, means for operating said switching circuit in response to said input signal to feed said input signal as a telegraph polar signal to said input circuit, an ungrounded power supply connected in said collector-emitter circuit, means for operating said power supply to apply biasing voltages to said collector and emitter electrodes in the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding, and a unidirectional current conducting device connected across said winding and poled in the proper direction to conduct whenever the level of the voltage applied to said collector electrode exceeds a predetermined value.

7. A circuit arrangement for driving a telegraph printing device as claimed in claim 6 and including a current limiting resistor connected in series with said winding, said unidirectional current conducting device being connected across said resistor and said winding.

8. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a base-emitter circuit, a collector-emitter circuit, a telegraph printing device, said device including a printer magnet having a winding, said winding being series connected in said collector-emitter circuit, a neutral-to-polar signal conversion circuit, an input circuit connected in said base-emitter circuit and including said conversion circuit, means for feeding a neutral telegraph signal to said conversion circuit, means for operating said conversion circuit to convert said neutral signal to a polar signal and to feed said polar signal to said input circuit, means connected in said collector-emitter circuit for applying voltages to said emitter and collector electrodes in the proper

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polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding.

9. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a base-emitter circuit, a collector-emitter circuit, a telegraph printing device, said device including a printer magnet having a winding, said winding being series connected in said collector-emitter circuit, a neutral-to-polar signal conversion circuit, an input circuit connected in said base-emitter circuit and including said conversion circuit, means for feeding a neutral telegraph signal to said conversion circuit, means for operating said conversion circuit to convert said neutral signal to a polar signal and to feed said polar signal to said input circuit, an ungrounded power supply connected in said collector-emitter circuit, means for operating said power supply to apply bias voltages to said emitter and collector electrodes in the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding, and a unidirectional current conducting device connected across said winding and poled in the proper direction to conduct whenever the level of the voltage applied to said collector electrode exceeds a predetermined value.

10. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a telegraph printing device, said device including a printer magnet having a winding, a switching circuit, an input circuit connected to said base electrode and including said switching circuit, means for feeding a telegraph input neutral signal to said switching circuit, means for operating said switching circuit in response to said input signal to feed said input signal as a telegraph polar signal to said base electrode, means for applying a voltage to said emitter electrode so as to bias said emitter electrode in the forward direction with respect to said base electrode, means for applying a voltage to said collector electrode through said winding so as to bias said collector electrode in the reverse direction with respect to said base electrode, the voltages applied to said collector and emitter electrodes being of the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding.

11. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a telegraph printing device, said device including a printer magnet having a winding, a current limiting resistor, means for connecting said winding and said resistor in series to said collector electrode a switching circuit, an input circuit connected to said base electrode and including said switching circuit, means for feeding a telegraph input neutral signal to said switching circuit, means for operating said switching circuit in response to said input signal to feed said input signal as a telegraph polar signal to said base electrode, means for applying a voltage to said emitter electrode so as to bias said emitter electrode in the forward direction with respect to said base electrode, means for applying a voltage to said collector electrode through said winding so as to bias said collector electrode in the reverse direction with respect to

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said base electrode, the voltages applied to said collector and emitter electrodes being of the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding and said resistor, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding and said resistor, and a unidirectional current conducting device connected across said winding and said resistor and poled in the proper direction to conduct whenever the level of the voltage applied to said collector electrode exceeds a predetermined value.

12. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a telegraph printing device, said device including a printer magnet having a winding connected to said collector electrode, a switching circuit, an input circuit connected to said base electrode and including said switching circuit, means for feeding a telegraph input neutral signal to said switching circuit, means for operating said switching circuit in response to said input signal to feed said input signal as a telegraph polar signal to said base electrode, an ungrounded power supply, means for operating said power supply to apply a voltage of given polarity to said emitter electrode so as to bias said emitter electrode in the forward direction with respect to said base electrode, said power supply also operating to apply a voltage of given polarity through said winding to said collector electrode so as to bias said collector electrode in the reverse direction with respect to said base electrode, the voltages applied to said collector and emitter electrodes being of the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding.

13. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a telegraph printing device, said device including a printer magnet having a winding, a neutral-to-polar signal conversion circuit, an input circuit connected to said base electrode and including said conversion circuit, means for feeding a neutral telegraph signal to said conversion circuit, means for operating said conversion circuit to convert said neutral signal to a polar signal and to feed said polar signal to said base electrode, means for applying a voltage to said emitter electrode so as to bias said emitter electrode in the forward direction with respect to said base electrode, means for applying a voltage to said collector electrode through said winding so as to bias said collector electrode in the reverse direction with respect to said base electrode, the voltages applied to said emitter and collector electrodes being of the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding, and a unidirectional current conducting device connected across said winding and poled in the proper direction to conduct whenever the level of the voltage applied to said collector electrode exceeds a predetermined value.

14. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, a collector electrode, and an emitter electrode, a telegraph printing device, said device including a printer magnet having a winding, a neutral-to-polar conversion circuit, an input circuit connected to said base electrode and including said conversion circuit, means for

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feeding a neutral telegraph signal to said conversion circuit, means for operating said conversion circuit to convert said neutral signal to a polar signal and to feed said polar signal by said input circuit to said base electrode, an ungrounded power supply, means for operating said power supply to apply voltages of opposite polarity to said emitter electrode and through said winding to said collector electrode, said emitter electrode being biased by said voltage applied thereto from said power supply in the forward direction with respect to said base electrode, said collector electrode being biased by the voltage applied thereto from said power supply in the reverse direction with respect to said base electrode, the voltages applied to said collector and emitter electrodes from said power supply being of the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said winding, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said winding, and a unidirectional current conducting device connected across said winding and poled in the proper direction to conduct whenever the level of the voltage applied to said collector electrode exceeds a predetermined value.

15. A circuit arrangement for driving a telegraph printing device as claimed in claim 14 and including a current limiting resistor connected in series with said winding, said unidirectional current conducting device being connected across said resistor and said winding.

16. A circuit arrangement for driving a load comprising, in combination, a transistor having an input, output and control electrode, said load being connected to said output electrode, a switching circuit including a shunt network having a capacitor connected in series with a device arranged to pass current in only one direction, a resistor connected across said capacitor, means for feeding an input signal to said network, said network responding to said input signal to feed to said input electrode a two-current signal representative of said input signal and having intervals of different polarity, means connected to said control and output electrodes for biasing said control and output electrodes in the proper polarities with respect to that of said input electrode to cause said transistor to operate in response to one polarity of said two-current signal to produce a current flow through said load, said transistor operating in response to the other polarity of said two-current signal to reduce to a negligible value the current flow through said load.

17. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, collector electrode and an emitter electrode, a telegraph printing device connected to said collector electrode, a switching circuit including a shunt network and a single throw-double pole switch, said shunt network including a capacitor connected in series with a device arranged to pass current in only one direction, a resistor connected across said capacitor, means for feeding a telegraph input signal to said switching circuit, said switching circuit responding to said input signal to feed a polar signal representative of said input signal to said base electrode, an ungrounded power supply connected to said collector and emitter electrodes and operated to bias said emitter and collector electrodes in the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said telegraph printing device, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said telegraph printing device.

18. A circuit arrangement as claimed in claim 17 and wherein a second current limiting resistor is connected in series with said collector electrode and said telegraph printing device, a second device arranged to pass current

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in only one direction connected across said second resistor and said telegraph printing device and poled in the proper direction to conduct whenever the level of the bias applied to said collector electrode exceeds a predetermined value.

19. A circuit arrangement for driving a load comprising, in combination, a transistor having an input electrode output electrode and a control electrode, said load being connected to said output electrode, a switching circuit including a capacitor connected in series with a device arranged to pass current in only one direction, a resistor connected across said capacitor, means for connecting a tapping point on said resistor to said input electrode, means for feeding a neutral input signal to said switching circuit, said switching circuit responding to said input signal to feed a polar signal from said tapping point to said input electrode, means connected to said output and control electrodes for biasing said output and control electrodes in the proper polarities with respect to that of said input electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said load, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said load.

20. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, collector electrode and emitter electrode, said device being connected to said collector electrode, a switching circuit including a shunt network and a single throw-double pole switch, said network including a capacitor connected in series with a device arranged to pass current in only one direction, a resistor connected across said capacitor, means for connecting a tapping point on said resistor to said base electrode, means for feeding a telegraph input neutral signal to said switching circuit, said network responding to said input signal to feed a polar signal representative of said input signal from said tapping point to said base electrode over said connecting means, an ungrounded power supply connected to said collector and emitter electrodes operated to apply biasing voltages to said emitter and collector electrodes in the proper polarity with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said telegraph printing device, said transistor operating in response to the other polarity of said polar signal to reduce to a negligible value the current flow through said telegraph device.

21. A circuit arrangement for driving a telegraph printing device comprising, in combination, a transistor having a base electrode, collector electrode and an emitter electrode, said device being connected to said collector electrode, a signal conversion circuit including a capacitor connected in series with a device arranged to pass current in only one direction, first and second resistors connected in series across said capacitor, means for connecting a tapping point in the connection between said resistors to said base electrode, means for feeding a telegraph input neutral signal to said conversion circuit, said conversion circuit responding to said input signal to feed a polar signal from said tapping point to said base electrode over said connecting means, an ungrounded power supply, means for operating said power supply to apply voltages to said emitter and collector electrodes, said emitter electrode being biased by said voltage applied thereto in the forward direction with respect to said base electrode, said collector electrode being biased by the voltage applied thereto in the reverse direction with respect to said base electrode, the voltage applied to said collector and emitter electrodes being of the proper polarities with respect to that of said base electrode to cause said transistor to operate in response to one polarity of said polar signal to produce a current flow through said telegraph printing device, said transistor operating in response to the other

polarity of said polar signal to reduce to a negligible value the current flow through said telegraph printing device, and a second device arranged to pass current in only one direction connected to said collector electrode and across said telegraph printing device and poled in the proper direction to conduct whenever the level of the bias voltage applied to the collector electrode exceeds a pre-determined level. 5

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