

[54] **SPEED CONTROL FOR D. C. MOTORS**

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[58] **Field of Search** 318/341, 345; 331/107,
331/108, 111-113, 143, 144

[56] **References Cited**

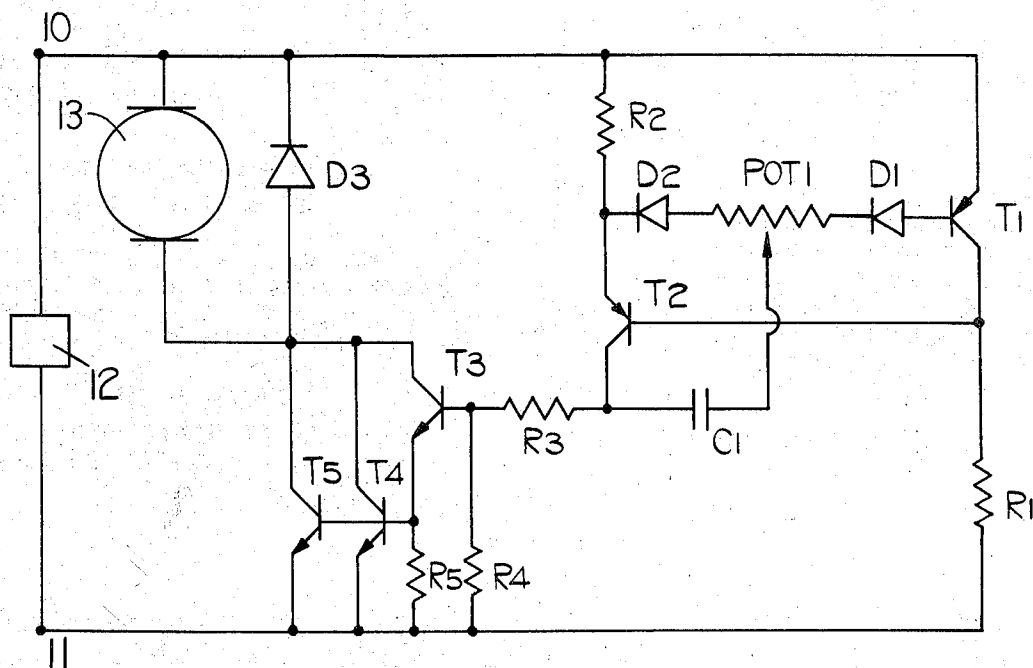
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[57] **ABSTRACT**

A control circuit for a D.C. motor comprises an oscillator having a variable mark space ratio and including a pair of transistors, means for adjusting the mark space ratio of the oscillator a third transistor for connection in series with the motor and a source of supply, the conduction of said third transistor being controlled by the oscillator whereby said means can act to vary the current flowing in the motor.

9 Claims, 3 Drawing Figures



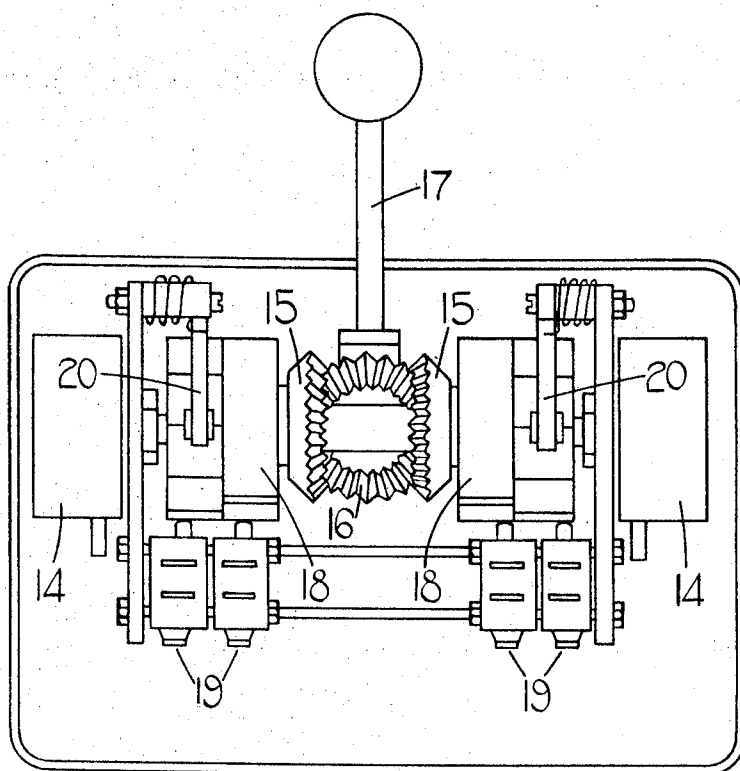


FIG. 2.

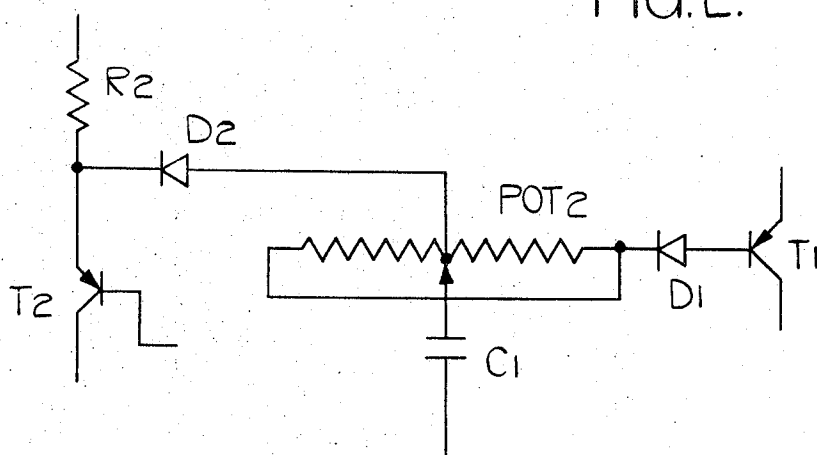


FIG. 3.

SPEED CONTROL FOR D. C. MOTORS

This invention relates to a speed control for a d.c. motor and has for its object to provide such a control in a simple and convenient form.

A speed control in accordance with the invention comprises in combination, first and second transistors connected together to form a square wave oscillator, means for adjusting the markspace ratio of the oscillator and a third transistor for connection in series with the motor and a source of supply, the conduction of said third transistor being controlled by said oscillator; whereby said means can act to vary the current flowing in the motor.

One example of a speed control will now be described with reference to the accompanying drawings in which:

FIG. 1 is a circuit diagram of the speed control together with the motor,

FIG. 2 illustrates a portion of a control device in which the speed control is utilised, and

FIG. 3 shows a modification of the circuit of FIG. 1.

With reference to FIG. 1 of the drawings there are provided terminals 10 and 11 for connection respectively to the positive and negative terminals of a source of d.c. supply 12. Also provided is a p-n-p transistor T1 having its emitter connected to the positive terminal 10 and its collector connected to the negative terminal 11 by way of a resistor R1. The collector of transistor T1 is connected to the base terminal of a further p-n-p transistor T2 the emitter of which is connected to the positive terminal 10 by way of a resistor R2. The base of transistor T1 is connected to the anode of a diode D1 the cathode of which is connected to one end of the resistance element of a potentiometer POT1. The other end of the resistance element of the potentiometer is connected to the anode of a diode D2 having its cathode connected to the emitter of transistor T2. The wiper terminal of the potentiometer is connected to one plate of a capacitor C1 and the other plate of this capacitor is connected to the collector of transistor T2.

The collector of transistor T2 is connected to the negative terminal 11 by way of resistors R3 and R4 in series and the junction of these two resistors is connected to the base of an n-p-n transistor T3. The emitter of this transistor is connected to the negative terminal 11 by way of a resistor R5 and the collector of transistor T3 is connected to the anode of a diode D3 the cathode of which is connected to the positive terminal 10. In parallel with the diode D3 is the motor 13 which may be of the permanent magnet type or a wound field type. Moreover, the emitter of transistor T3 is connected to the base terminals of n-p-n transistors T4 and T5. The emitters of these two transistors are connected to the negative terminal 11 whilst the collectors thereof are connected to the collector of transistor T3.

In operation, when the terminals 10 and 11 are connected to the source of supply the capacitor C1 charges by way of resistors R3, and R4, the right hand portion of the resistance element of the potentiometer, the diode D1 and the emitter base path of transistor T1. By virtue of current flowing, transistor T1 is rendered conductive and this has the effect of raising the base voltage of transistor T2 so that the latter is rendered non-conductive. As the capacitor charges transistor T1 will

begin to turn off and this will reduce the base voltage of transistor T2 which thereby starts to conduct and raises the base potential of transistor T3. This also conducts and at the same time causes conduction of transistors T4 and T5 so that current flows in the motor.

Capacitor C1 discharges through the collector emitter path of transistor T2 at a rate dependent upon the resistance offered by the left hand portion of the resistance element of the potentiometer, and when the capacitor has discharged transistor T1 again starts to conduct and switches transistor T2 off so that in turn transistors T3, T4 and T5 are turned off. The rate of charge of the capacitor is determined largely by the resistance offered by the right hand portion of the resistance element of the potentiometer and the rate of discharge of the capacitor is determined largely by the resistance of the left hand portion of the potentiometer. Thus by varying the position of the slider the charge and discharge time of the square wave oscillator varies inversely whilst the overall frequency of operation of the oscillator remains substantially constant. Thus it will be seen that by varying the position of the slider of the potentiometer so that the mean value of the current flowing in the motor and therefore its speed, can be varied.

Diode D2 is provided to ensure that the charging current for the capacitor flows only through the right hand portion of the resistance element of potentiometer POT1 and diode D1 is provided to protect transistor T1 against reverse base emitter voltage when transistor T2 is switched on.

One application for such a control circuit is to control the speed of one of the motors of a pair of motors for a wheel chair or the like, it being appreciated that a similar circuit is provided to control the other motor. The two motors are coupled to wheels on opposite sides of the wheel chair respectively and a special form of control is provided which couples the potentiometers and at the same time provides for switching of the motor input terminals to achieve reverse rotation thereof.

The potentiometer POT1 as shown in FIG. 1 is modified for this purpose as shown in FIG. 3 and as will be seen from this Figure the resistance element of the potentiometer POT2 is provided with a centre tapping which is connected to the anode of diode D2, the opposite ends of the resistance element are connected together and to the cathode of diode D1. When the slider of the potentiometer is in the middle position as shown, the capacitor will charge slowly and be discharged quickly so that the mean value of the current flowing in the associated motor will be so small as to cause no rotation of the motor. The mean value of current increases as the slider is moved away in either direction from the mid position.

Referring now to FIG. 2 the potentiometers are indicated at 14 and they are operatively coupled to an opposed pair of pinions 15 of a differential gear which includes a pinion 16 meshing with the pinions 15. The pinion 16 is coupled to a control lever 17 and this is movable angularly about the axis of rotation of the control members of the potentiometers 14 and also about an axis normal to the aforesaid axes. In addition the pinions 15 are coupled to cams 18 which control the operation of switches 19. The switches 19 are included in the connections to the motors and are provided for reversing the polarities of the supply terminals to

achieve reversal of the motors. Also associated with the cams are spring loaded cam followers 20 which bias the cams and also the lever 17 to the central position as shown in the drawings.

In operation, when the lever is moved in the forward or reverse direction the motors are energised in the appropriate manner and the motors rotate to drive both wheels in the same direction, the extent of movement of the lever controlling the speed of the motors. If the lever is moved laterally from the mid position then the cams 18 and the sliders of the potentiometers 14 will rotate in opposite directions and one motor will drive in the forward direction and the other in the reverse direction so that the wheel chair will move about a central axis. Movement of the lever in the lateral direction whilst it is for instance in a forward position will effect a variation in the relative speed of the motors to provide a steering action.

I claim:

1. A speed control apparatus for a D. C. motor comprising, in combination, a D. C. motor whose speed is desired to be controlled, and means for controlling the speed of said D. C. motor, said speed control means comprising:

Oscillator means comprising first and second transistors and a capacitor for producing a square wave oscillating signal;

Means coupling said first and second transistors for effecting opposite respective conductive states thereof during operation;

A third transistor connected in series with said D. C. motor and a source of supply, means connecting said second transistor to said third transistor such that conduction of said second transistor effects conduction of said third transistor; said oscillator means including:

First circuit means including the base emitter path of said first transistor and an adjustable resistance element for charging said capacitor, said first circuit means being connected across said source of supply for charging said capacitor immediately upon the activation of said supply, said first transistor being rendered conductive during charging of said capacitor and being rendered non-conductive when said capacitor is charged;

Second circuit means including the collector emitter path of said second transistor and an adjustable resistance element for discharging said capacitor; and

Wherein the mark-space ratio of said oscillator means is controlled by varying said adjustable resistance elements.

2. A speed control as claimed in claim 1 in which said resistance elements are connected in series and form the resistance element of a potentiometer.

3. A speed control as claimed in claim 2 in which one plate of said capacitor is connected to the slider of the potentiometer.

4. A speed control as claimed in claim 3 including switch means operable to reverse the flow of current through the motor thereby to achieve reversal of the motor.

5. A speed control as claimed in claim 4 in which the opposite ends of the potentiometer are connected together and a fixed tapping from the centre of the resistance element connects the resistance element to the discharge circuit of the capacitor.

6. A speed controller for a pair of d.c. motors comprising a pair of speed controls as claimed in claim 5 associated with the motors respectively, a differential gear including a first gear pinion and a pair of oppositely disposed pinion in mesh therewith, means interconnecting said pair of pinions with the potentiometers respectively and an operating lever coupled to said first pinion and movable about the axis of said first pinion to achieve opposite movement of the sliders of the potentiometers and about the common axis of the pair of pinion to achieve movement of the sliders in the same direction.

7. A speed controller as claimed in claim 6 including cam means coupled to said pair of pinions respectively said cam means operating said switches whereby upon angular movement of the lever about the axis of said first pinion from an intermediate position the motors will operate in opposite directions, the speed of operation increasing as the lever is moved further from the intermediate position.

8. A speed control as claimed in claim 5 in which the discharge circuit of the capacitor includes a diode acting to prevent charging current flowing to the capacitor from circuit components associated with the discharge path of the capacitor.

9. A speed control as claimed in claim 2 in which the discharge circuit of the capacitor includes a diode acting to prevent charging current flowing to the capacitor from circuit components associated with the discharge path of the capacitor.

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