United States Patent

Klann

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[54] VENETIAN BLIND WITH AUTOMATIC CONTROL OF ROOM BRIGHTNESS

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 792,629, Jan. 21, 1969, abandoned.

[52] **U.S. Cl.** **160/168,** 160/5

[51] **Int. Cl.** **E06b 9/26,** E06b 9/30

[58] **Field of Search** 160/1, 5, 168–178

[56] **References Cited**

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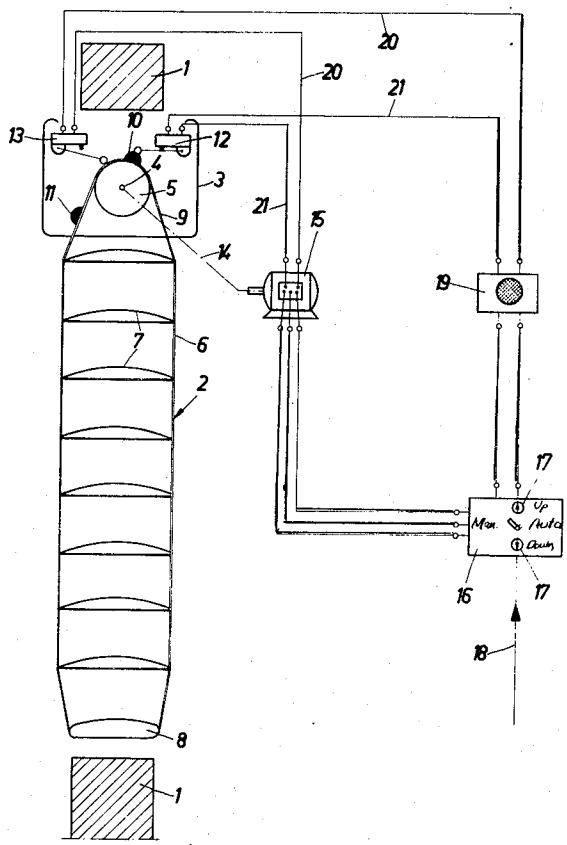
[57] **ABSTRACT**

A venetian blind is provided with an electric motor to run the blind up and down. The motor also tips the slats one way or the other automatically to control the amount of light admitted to a room as detected by a control circuit having a photosensitive device in the room.

2 Claims, 2 Drawing Figures



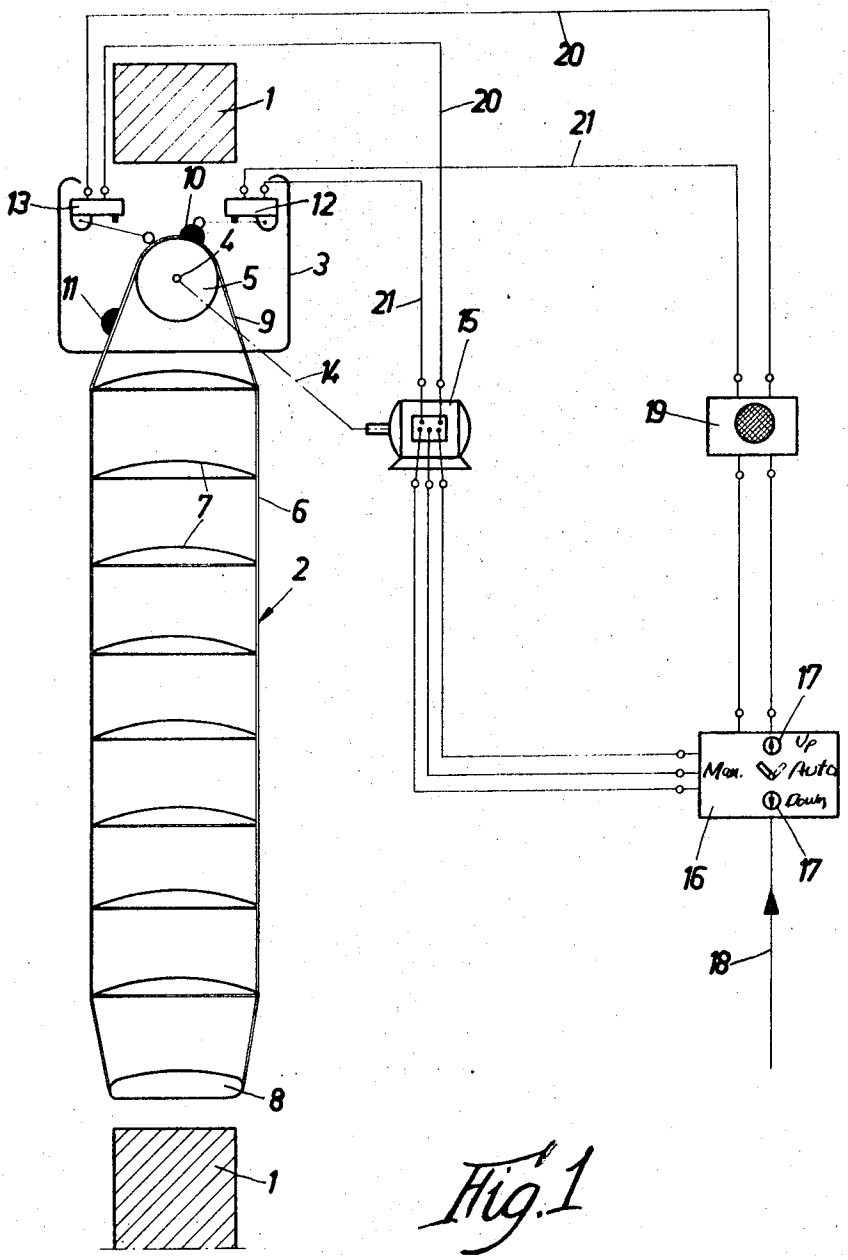


Fig. 1

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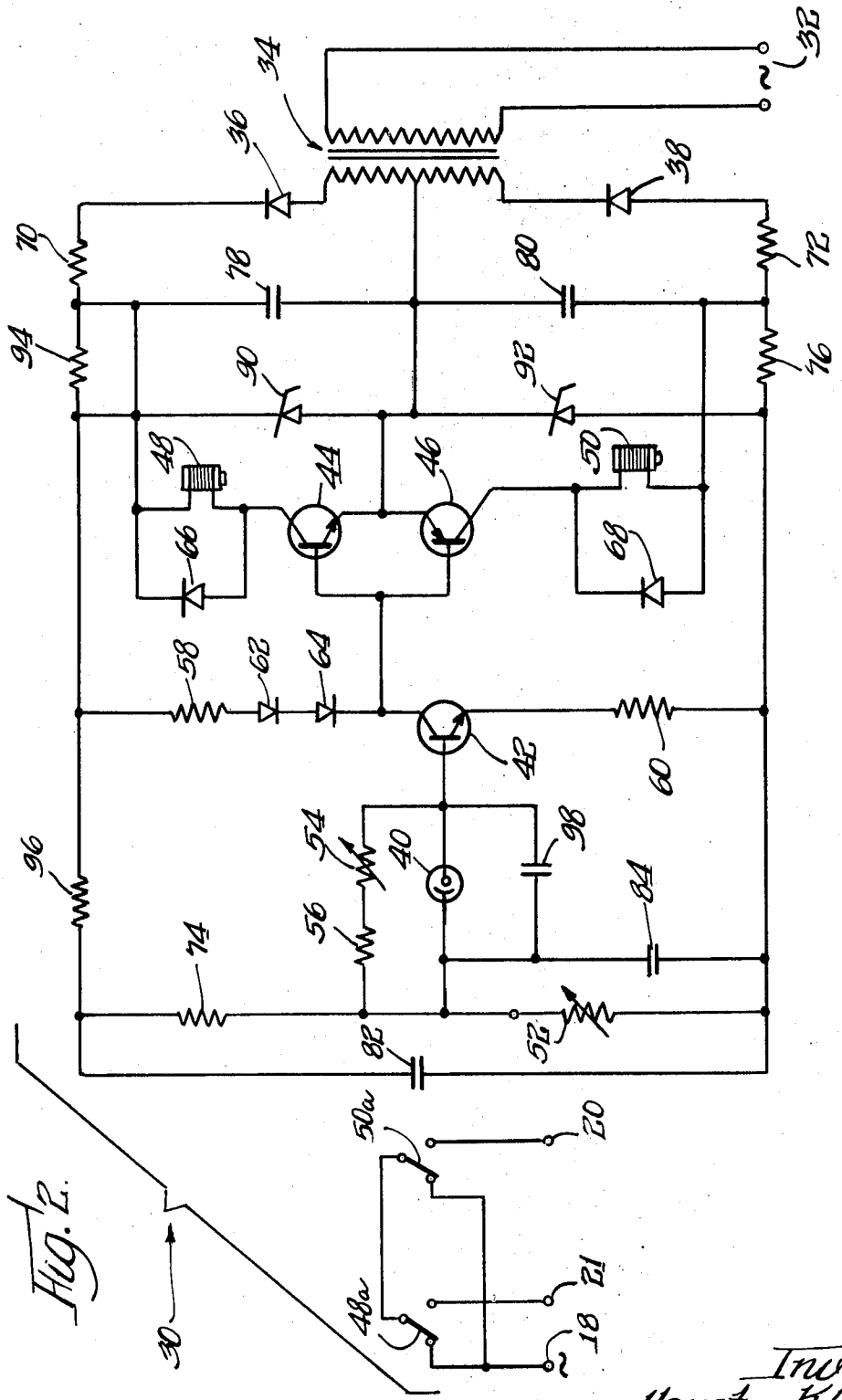

Fig. 2.

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VENETIAN BLIND WITH AUTOMATIC CONTROL OF ROOM BRIGHTNESS

This application is a continuation-in-part of my copending application, Ser. No. 792,629, filed Jan. 21, 1969, now abandoned.

The subject matter of the present invention comprises a venetian blind which has slats or lamellae which are actuated by an electric motor. The slats or lamellae can be tiltably adjusted in their positions. This adjusting of the slats serves for the regulation of the incident light as the sunlight arriving changes in intensity with the time of day, etc. and as one wishes to have the room which lies behind the venetian blind lighter or darker.

The invention has approached the solution of the problem of how to control such venetian blinds automatically such that the slats will always have a position that the room beyond the venetian blinds always has the same brightness, and trial and error (blinds opened too wide, blinds opened not enough) are to be avoided. Adjusting and regulation maneuvers which serve no purpose shall never take place.

In order to accomplish this, the invention provides that at least one terminal switch is placed in the circuit of a driving motor for the slats-adjusting device to limit the operational path of this device, so as to get an automatic regulation of the brightness in the room which is protected against direct sunlight by the venetian blind. The actuation of the driving motor is subjected to the control of an instrument (photosensitive device) which measures the brightness of the room.

Devices which adjust the brightness of a room are known wherein a curtain is pulled more open or more closed. Contrasted with such prior art device, the one according to the invention is distinguished in that the venetian blinds always are fully let down and the regulation occurs by an adjustment of the position (slant) of the slats. Only if the light arriving from the outside would really be subjected to very heavy fluctuations would it be necessary to pull up or let down the venetian blinds, and then subject this act to a regulation. However, this type of adjusting will hardly ever be required, because a set of venetian blinds, when fully pulled up, will hardly allow more light to pass than the same set with all of the slats in the "full open" position. By aid of the arrangement of the invention it is possible to limit the adjusting effect of the motor for the slat adjusting device, which is subjected to the control by the room brightness measuring instrument, to the range of slat settings in which the adjusting of the slats brings about a change of the light passage in the desired sense. Movement of the slats beyond their positions of maximum or minimum light flux through them is avoided, if an adjusting of the slats, which is induced by the instrument which measures the brightness in the room, would not lead within the useful moving range of the slats to a change of the amount of light passing through them, in the full extent desired.

In most current motor-operated venetian blinds, the motor which pulls up the blinds is simultaneously the motor for the slats adjusting-device. The adjusting members of the blinds are passed, such as by aid of special bearing loops, across the windup shaft or the windup drum. When this shaft turns, the adjusting members become entrained due to friction. Because the number of revolutions for the driving motor for the pullup motion is chosen such that the pulling up and the letting down of the venetian blinds occurs rather rapidly, a short time switching-in of the driving motor for the purpose of adjustment of the slats will lead to such a thorough change of the slat position that the desired position is overstepped, and the slat undergoes oscillations (more open, more closed, more open, more closed) around the position to which it actually becomes adjusted. In accordance with the present invention, means is provided, once the motor has been switched on by the instrument which measures the brightness of the room, to reduce the r.p.m. of the motor within the operation limits determined by one switch or the switches present. In this way, the slat adjustment takes place in a finer, more sensitive manner. The means which cut down the r.p.m. of the motor may consist, for example, of a condenser which is switched into the circuit

which feeds the motor. Alternatively, a special gear system or drive, or a motor with reversible poles may be provided.

Preferably two limit switches are attached in the head channel of the venetian blinds, being actuated by switching cams in the adjustment setup.

The invention, both as to its structure and mode of operation, will be better understood by reference to the following disclosure and drawings forming a part thereof wherein:

FIG. 1 is a schematic view of the venetian blind in combination with an automatic room brightness control; and

FIG. 2 is a schematic diagram of a control circuit utilized with the venetian blind of FIG. 1.

A venetian blind 2 made up of slats is located in a window opening, which is schematically indicated only as parts of the wall 1. The venetian blind includes a head channel 3 which is secured at the top of the window opening in known fashion. Inside the channel, drawn schematically only, is the pullup and turnover shaft 4 with the hoisting drum 5. The slats 7 are maintained between guide bands or guide cords 6. The weight of the lower listel 8 pulls the venetian blind 2 down as far as the pullup elements (not shown) permit.

The bands or cords 6, particularly the supporting loops 9 thereof, are placed across the hoisting drums 5 and collaborate therewith as a slipper clutch. If, e.g., the hoisting drums 5, are moved by the shaft 4 in one direction of revolution so that the blinds 2 are moved down (closed), then the supporting loops 9 are entrained long enough to tilt the slats in this direction to their most slanted position. The reverse is true when the shaft 4 is driven such that it pulls up the venetian blind.

According to the present invention attached upon two switch cams (trip cams) 10 and 11 are secured to one of the supporting loops 9 and respectively cooperate with the switches 12 and 13, located in the head channel 3. These switches are connected in circuit with the device for measuring the light value which depends upon the position of the slats 7. It will be seen in the drawing that the switch cam (trip cam) has actuated the switch 12 after the slats 7 of the venetian blind 2 have reached their position of maximum opening, i.e., the position in which they pass the greatest amount of light and therefore create the greatest possible brightness in the room which lies behind the venetian blind.

As will be understood the trip cam 11 actuates the switch 13 when turning of the shaft 4, and therefore also of the drums 5, clockwise correspondingly shifts the supporting loops 9 and the slats 7 have become tilted into this position in which the venetian blind 7 is closed completely.

The shaft 4 is driven through suitable driving connections 14 (which has been indicated in broken lines) by the electric motor 15. When the motor 15 is manually actuated by the pushbuttons 17 which are located at the switch box 16, for the purpose of raising or lowering the venetian blind 2, then it will drive the shaft 14 with the ordinary, rated r.p.m. Actuation by one of the trip cams 10 or 11 of the corresponding switch 12 or 13 at this time has no influence upon the act of pulling-up or of letting-down of the venetian blind 2.

However, the motor 15 may be energized from the city mains 18 in a different manner, namely by means of the room-brightness-measuring instrument or photosensitive device 19, which will be described in more detail hereinafter. The device 19 may be adjusted in a manner to be described below to predetermine the desired brightness at the spot where this instrument is placed or hung. The energizing circuit from the room-brightness-measuring instrument 19 to the motor 15 includes in series connection the two switches 12 and 13 which in the example shown act as off contacts. Each switch when not actuated, is closed. Each one of the two leads which goes from the room-brightness-measuring instrument to the motor 15 will cause the starting of the motor in a different sense of rotation when voltage is applied to it by the room-brightness-measuring instrument 19. When the instrument 19 supplies a voltage to the lead 20, the motor 15 is excited across the switch 13 (which in the drawing is shown as closed) whereu-

pon the shaft 4 turns in a clockwise direction. The slats then will be moved to their "closed" position. It will be seen that the leads 20 is energized by the room-brightness-measuring instrument 19 only if the brightness in the room becomes greater than a certain, preselected value.

On the other hand, voltage is supplied to the lead 21 by the room-brightness-measuring instrument 19 when the brightness in the room has not reached the preselected value. In the example drawn however, the maximum possible opening of the slats 7 has been reached and the trip cam 10, by actuating the switch 12, has interrupted the operative connection between the room-brightness-measuring instrument 19 and the motor 15. The motor 15 therefore in this state will not start even if voltage is fed to the lead 21.

In a known manner (not shown) which was discussed above, upon the switching on of the motor 15 across one of the leads 20, 21 the r.p.m. of the motor is considerably lowered below the rated value, so as to bring about a sensitive adjusting of the slats 7. If after a slow tilting of the slats 7 the room brightness has become sufficiently close to the preselected value, the corresponding contact of the room-brightness-measuring instrument 19 opens again and removes voltage from the lead 20 or 21, which is switched-in off the feedline 18, so that the motor 15 stops at once and the slats 7 remain in the position to which they have been adjusted.

In accordance with an important feature of the present invention, an electrical control circuit 30 representing a preferred embodiment of the room-brightness-measuring instrument 19 is shown schematically in FIG. 2. The circuit is operated by an alternating current source 32, which may be tapped from the city main 18, and which is transformed down to a relatively low operating potential by a transformer 34 having its primary winding connected across the source. The alternating current operating potential is thereafter rectified by a pair of diodes 36 and 38 appropriately connected to opposite ends of the secondary winding of transformer 34 for providing direct current to the circuit.

The electrical control circuit comprises a photoconductive cell 40, preferably of the cadmium sulfide type, appropriately positioned to measure light transmitted by the venetian blind 2 and a switching circuit including three transistors 42, 44 and 46 and two electromagnetic relay coils 48 and 50 having associated contacts 48*a* and 50*a*. As will be seen hereinafter, the switching circuit is electrically connected to reversible motor 15 through relay contacts 48*a* and 50*a* and responsive to the light measured by photoconductive cell 40 for providing either forward or reverse energization to the motor for tilting the slats 7. Thereafter, the motor will be deenergized when the slats reach a desired position so that the venetian blind transmits only a predetermined amount of light.

The photocell 40 is of a known type having internal resistance which varies inversely with the intensity of light falling thereon and is connected intermediate the base of transistor 42 and a voltage dividing network comprising two variable resistors 52 and 54 and a fixed resistor 56, all of which are connected across the source of power 32. The emitter and collector of transistor 42 are also connected across the source of power through current limiting resistors 58 and 60 and temperature compensating diodes 62 and 64. As will be seen in more detail hereinafter, the degree of conduction across the collector and emitter junctions of transistor 42 is dependent upon the internal resistance value of photoconductive cell 40 and the values of variable resistors 52, 54 and fixed resistor 56.

The output of transistor 42 is applied to transistors 44 and 46, which in conjunction with transistor 42 form a direct current differential amplifier type circuit. That is, in the event that the current across the collector and emitter junctions of transistor 42 goes above a predetermined value, which value is dependent upon the values of the voltage dividing network and photoconductive cell, the output or emitter and collector junctions of transistor 46 will become conductive. If the current across the output of transistor 42 goes below a predetermined value, the output or emitter and collector junctions of transistor 44 will become conductive.

The electromagnetic relay coils 48 and 50 are respectively connected across the output of transistors 44 and 46 for energization thereof when their corresponding transistor is in its conduction state so as to move their respective contacts 48*a* and 50*a* from a deenergized position, as indicated by a solid line in FIG. 2, to an energized position, as indicated by a dotted line. In order to avoid peaks of reverse current generated by the inductivity of the relay coils, respective spike suppressing diodes 66 and 68 are connected across the relay coils.

As seen in FIG. 2, the leads 20 and 21 are connected to the city main 18 through relay contacts 50*a* and 48*a* when these contacts are in their deenergized positions, the paths to reversible motor 15 are opened so that the motor remains deenergized. When the contacts are, alternatively, in their energized positions, the reversible motor is driven in opposite directions for tilting the slats 7 in a manner described hereinabove.

The supporting or circuit enhancing elements of electrical control circuit 30 includes resistors 70, 72, 74 and 76 which, in conjunction with condensers 78, 80, 82 and 84, form normal filter networks which eliminate undesired AC transients and which are necessary since circuit 30 operates on direct current. In order to maintain the input voltage at a fixed value, two zener diodes 90 and 92 are connected across the circuit. Finally, resistors 94 and 96 provide current limiting means to the circuit and condenser 98 is used to limit maximum switching frequency.

Operationally, the variable resistor 52 is adjusted so that the reversible motor 15 will remain deenergized when the desired intensity of light is transmitted by the venetian blinds. This may be accomplished in a well-known manner, for example, by precalibrating the variable resistor or by trial and error. Variable resistor 54 is also adjusted for setting the sensitivity of photoconductive cell 40. With these adjustments made, and assuming that the desired amount of light is transmitted by the venetian blinds, the internal resistance of photoconductive cell 40 will control the base current of transistor 42 such that the potential at the collector of transistor 42 leads to only a small quiescent current through transistors 44 and 46, which current is insufficient to excite or energize relay coils 48 and 50. Therefore, contacts 48*a* and 50*a* will remain in their deenergized positions so that reversible motor 15 remains off and the slats 7 remain stationary.

Assuming that the brightness within the room increases above the desired value, causing the resistance of photoconductive cell 40 to decrease, the base current and collector current of the transistor 42 will both increase. Therefore, the voltage at the collector of transistor 42 will decrease so that the transistor 44 becomes completely nonconductive while transistor 46 becomes conductive thereby energizing relay coil 50. The contact 50*a* is moved to its energized position and closes the path through lead 20 for operating the motor 15 and closing the venetian blind. This condition remains until the brightness within the room decreases or until the internal resistance of photoconductive cell 40 increases to its initial value, at which time the circuit deenergizes the motor.

Now assuming that the brightness within the room decreases below the setting of variable resistor 52 or the desired value, the internal resistance of photoconductive cell 40 increases with the consequence of a decreased base current and collector current across transistor 42. Therefore, the voltage at the collector of this transistor will rise bringing transistor 46 into a completely nonconductive state, while driving transistor 44 to a conductive state, whereupon relay coil 48 will be energized for driving motor 15, in an opposite direction, through contact 48*a* and lead 21. The venetian blind slats will open until the brightness within the room reaches the desired value or the slats reach maximum possible opening positions, at which point the motor will cease from operating.

While a particular embodiment of the invention has been shown, it should be understood, of course, that the invention is not limited thereto since many modifications may be made. It is therefore contemplated to cover by the present application any such modifications as fall within the true spirit and scope of the appended claims.

The invention is claimed as follows:

1. In combination a venetian blind and control circuit for tilting a plurality of slats of said venetian blind to a desired position so that the venetian blind transmits a predetermined intensity of light, said control circuit comprising reversible motor means operatively connected to said slats for tilting said slats in one direction when said motor means is forwardly energized and for tilting said slats in an opposite direction when said motor means is reversely energized; power supply means; a light sensitive device connected to said power supply means and responsive to the intensity of light transmitted by said venetian blind for emitting an electrical signal at its output which has a value proportional to the light intensity illuminated thereon; and switching circuit means electrically connected to the output of said light sensitive device, operatively connected to said reversible motor means and responsive to the value of said signal for providing forward and reverse energization to said motor means for tilting said slats and for deenergizing said motor means when said slats reach said desired position, wherein said switching circuit means includes a first transistor electrically connected to the output of said light sensitive device and responsive to the value of said signal for emitting a second signal having a value proportional to the value of said first signal, a second transistor connected to the output of said first transistor and responsive to said second signal for energizing said motor means in one direction in the event the value of said second signal exceeds a predetermined value, and a third transistor connected to the output of said first transistor and responsive to said second signal for energizing said motor in an opposite direction in the event the value of said second signal goes below said predetermined value.

2. A control circuit according to claim 1 including relay means electrically interconnecting said second and third transistors and said motor means for energizing said motor means in one direction and in said opposite direction depending upon the value of said second signal.

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