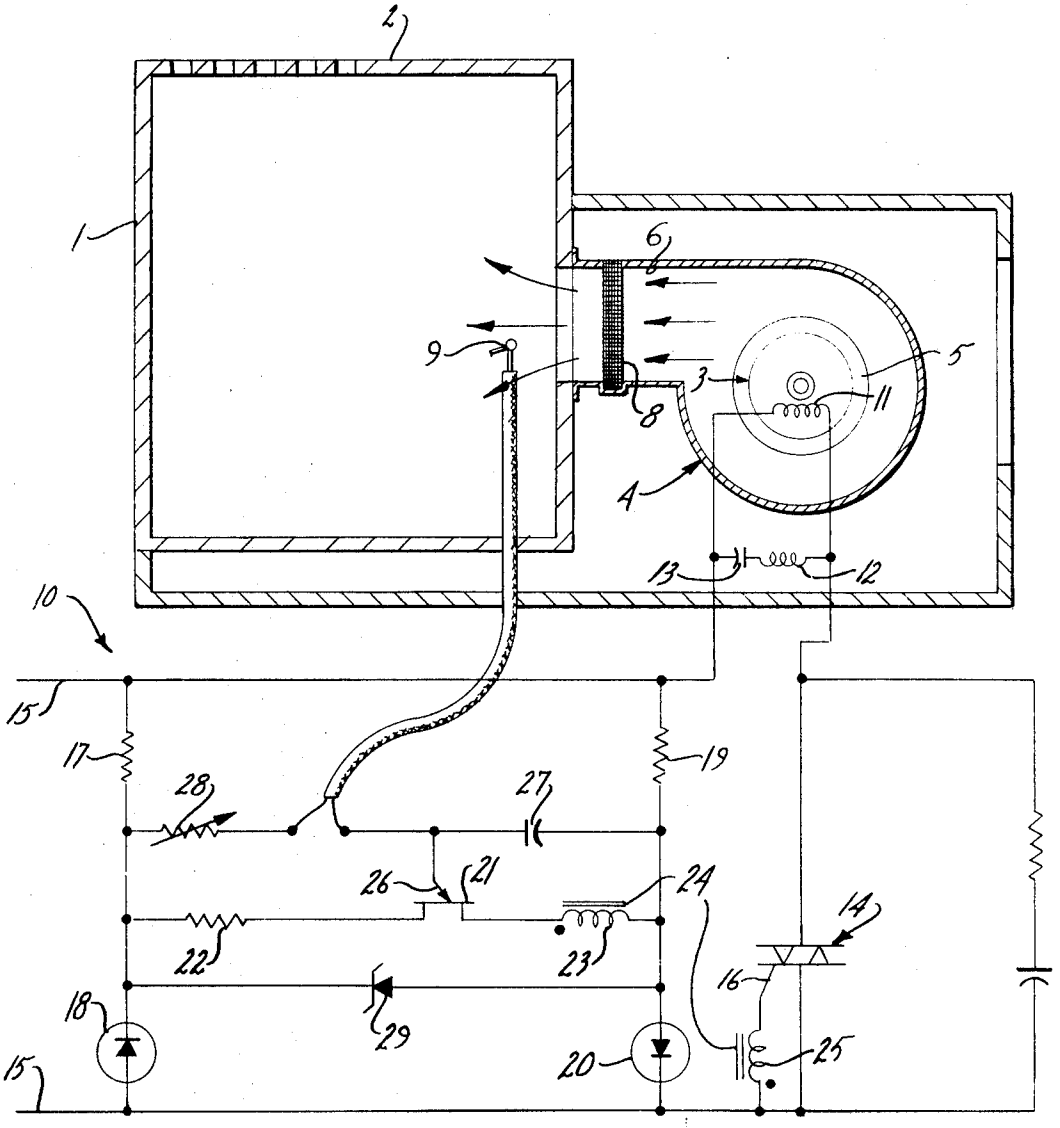
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AIRFLOW CONTROL FOR A DUST-FREE BENCH

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AIRFLOW CONTROL FOR A DUST-FREE BENCH

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ABSTRACT OF THE DISCLOSURE

A dust-free bench includes a working surface and a lower enclosing housing defining an air passageway for movement of air upwardly through a filter and the work area. A variable speed motor operated fan is controlled by a speed control circuit including a thermistor mounted to sense the velocity of the discharged air from the filter. Change in flow results in a proportionate change in the resistance of the thermistor which is connected to actuate a unijunction oscillator and thereby a change in the firing of a "Triac" or other solid state switching device connected in series in the motor energizing circuit to vary the speed of the motor. The motor speed is thus changd to maintain a constant air flow at the output side of the filter.

This invention relates to a dust-free bench and particularly to such a structure wherein a continuous flow of clean air is provided over the working surface.

In many applications, it is highly important that the work be done in an essentially dust-free atmosphere and clean air is continuously passed over the area that any dust, dirt or other foreign objects will be prevented from the work area. In order to provide essentially dust-free air, relatively fine air filters are employed. U.S. Pat. 3,251,177 discloses such a dust-free bench structure wherein air is drawn through a blower and passed through successive filter stages and then passed outwardly through the top of the bench. Continuous flow of a predetermined volume of air is required to continuously remove the dirt generated during the assembly operation and thus maintains a clean dust-free working area.

The present invention is particularly directed to a simple and reliable means for maintaining a selected constant air volume by varying the input air supply pressure in accordance with the condition of the filter. In particular, the present invention employs a thermistor or similar airflow sensitive device to sense the condition of the air filter and in turn to vary the speed of a motor or the like to maintain the same airflow as the filter becomes clogged.

The thermistor, in accordance with the present invention, is connected in a suitable variable speed motor control circuit; for example, the thermistor can be connected in the firing circuit for a unijunction transistor which in turn will provide a series of pulses to a triggered switch means connected in the energizing circuit of an alternating current fan motor.

The present invention has been found to provide a reliable and inexpensive means for maintaining a clean bench airflow system having a preselected constant airflow.

The drawing furnished herewith illustrates a preferred construction of the present invention in which the above advantages and features are clearly disclosed as well as others which will be clear from the following description.

The drawing is a diagrammatic illustration of a dust-free bench incorporating a variable speed motor and a schematic circuit diagram of a control for such motor to maintain a constant air flow through a filter.

Referring to the drawing, a bench housing **1** is provided having an upper working surface **2** and a lower wall. An alternating current variable speed motor **3** is housed in the lower portion of the housing and forms a part of a blower **4** having an inlet opening **5** for drawing air from outside of the housing. A blower outlet opening **6** terminates within the housing and the air passes upwardly through apertures **7** in the working surface of the bench.

The incoming air may be partially filtered with a rough filter, not shown, and finally filtered by a very fine filter **8** in the outlet passageway or opening **6** to essentially remove all dust particles. A similar filtering system is shown in the previously referred to U.S. Pat. 3,251,177 and might be satisfactorily employed.

The fine filter **8** in particular is subject to being clogged as a result of the picking up of fine particles. Such clogging will reduce the volume of discharged air assuming a constant speed of the blower **4** and thus reduce the effectiveness of the removal of dust from the work area.

In accordance with the present invention, a thermistor or other similar velocity sensor **9** is mounted adjacent the discharge side of the filter **8** to sense the velocity of the air discharged through the filter **8**.

The thermistor **9** is connected in a speed control circuit **10** to vary the speed of the motor **3**.

The motor **3** is schematically shown as a permanent split capacitor type motor having a main running winding **11** in parallel with a starting winding **12** in series with a capacitor **13**. The speed of the motor **3** is directly proportional to the energization thereof.

The speed control circuit **10** in the illustrated embodiment of the invention is similar to that disclosed in applicant's copending application entitled Condition Responsive Motor Control, which was filed on Oct. 22, 1965 with Ser. No. 500,966, now U.S. Pat. 3,403,314, and generally includes a "Triac" **14** or similar triggered device connected in series with the motor windings **11** and **12** directly across a set of incoming alternating current power lines **15**. The "Triac" **14** includes a single gate **16**. An appropriate trigger signal during either half cycle of the incoming power establishes conduction for the balance of such half cycles in accordance with well known functioning and no further description of the "Triac" is given.

"Triac" **14** is triggered from a pulse source including the thermistor which determines the frequency of the pulse signals applied to the "Triac." The proportion of the alternating current power supplied to the motor **3** is directly determined by the pulse rate such that the energization and speed of motor **3** is varied. The output of the pulse circuit as previously noted is controlled by the thermistor **9** and consequently the motor speed is increased or decreased to maintain a constant airflow to the clean bench working surface **2**.

Generally, the illustrated pulse forming circuit includes a bridge circuit or network including a resistor **17** and a diode **18** connected in series across the incoming power lines and a similar resistor **19** and inversely connected diode **20** connected in parallel therewith. A unijunction transistor **21** has its main elements connected across the direct current (D.C.) terminals of the bridge network with a resistor **22** in series with one of the elements and the primary winding **23** of a pulse transformer **24** in series with the opposite element. The secondary winding **25** of the pulse transformer **24** is connected to the gate **16** of the "Triac" **14**. Whenever the unijunction transistor is fired, a pulse flows through the transformer **24** and triggers the "Triac" **14**.

The gate or emitter **26** of the unijunction transistor **21** is connected to a resistance-capacitance timing network connected in parallel with its main circuit and including a timing capacitor **27** connected in series with the

thermistor **9** and an adjustable resistor **28** directly between the D.C. terminals of the bridge network. A Zener diode **29** is connected across the D.C. terminals to provide a voltage limting feature.

In operation, the thermistor **9** may be of a negative temperature coefficient variety utilizing a decrease in resistance with an increase in temperature in accordance with a standard characteristic. The current flowing through the thermistor **9** causes self heating in accordance with the well known square of the current and the basic resistance value. In operation, the thermistor **9** reaches an equilibrium temperature with the ambient at which the heat dissipated by the flowing air is equal to the self heat. As a result, the thermistor **9** will have a selected temperature at a given airflow. The timing network is charged during each half cycle and at a related phase or time triggers the unijunction transistor **21** to provide a pulse through the transformer **24** to trigger the "Triac" **14** and thereby energize the motor **3** at a preselected point in each half cycle to maintain a desired airflow.

As the filter begins to clog, the airflow is reduced with the previously established motor speed. The reduced airflow results in a reduced cooling of the thermistor and the temperature of the thermistor increases with a corresponding decrease in resistance. The decrease in resistance reduces the time constant of the timing network resulting in an earlier firing of the unijunction transistor **21** and pulsing of the "Triac" **14**. As a result, the motor **3** is energized at an earlier period in each half cycle and the speed increases. The increased speed of the motor **3** results in an increase in the velocity of the air which in passing over the thermistor **9** reduces its temperature thereof, increasing the resistance and returning the device to the desired flow rate.

The thermistor **9** acts as a velocity sensor for controlling the motor which in turn actuates the blower system to establish essentially constant airflow and thereby establish a closed loop control system.

In the illustrated embodiment of the invention, it is assumed that the air temperature remains constant such that the only variable is the velocity. This is generally a satisfactory assumption. If for any reason the air temperature is not sufficiently constant to warrant the above assumption, a thermistor bridge type circuit may be employed to eliminate the ambient temperature as a factor in the output signal. For example, a thermistor bridge circuit can be provided having a compensating thermistor connected in the circuit and subjected to the ambient temperature to cancel the effect of the ambient temperature.

Further, if desired, the thermistor can be arranged to respond to a humidity control. A saturated enclosure may be placed over the sensing thermistor and the evaporative cooling effect will be dependent upon the velocity of airflow and the relative humidity of the air. By providing a preselected constant liquid flow to the membrane just sufficient to provide a balanced condition with a selected airflow, a decrease in airflow will result in an increased wetting of the unit. The increased relative humidity will provide a corresponding change in the cooling effect which in turn will control the motor.

The present invention provides a simple and reliable airflow control for a clean bench.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. A dust-free workbench comprising a housing having a horizontal apertured work surface, the housing having an inlet spaced therefrom, an electrically controlled variable volumetric flow air source connected to the inlet, air filtering means positioned between said air source and the apertured work surface to filter the air passing from said air source to the apertured work surface, the improvement comprising an electrical circuit connected to said air source and including a temperature sensor means which is positioned between the filtering means and the apertured work surface, the temperature sensor means being energized and increasing in temperature with reduced airflow and decreasing in temperature with increased air flow and correspondingly varying in electrical resistance to vary the output of the electrical circuit to the electrically controlled air source to increase and decrease the airflow by the air source to the filtering means to maintain constant velocity to the work surface.

2. The dust-free workbench of claim **1** wherein said temperature sensor means is a thermistor.

3. The dust-free bench of claim **1** wherein said flow source is a blower driven by a variable speed alternating current motor having the motor speed proportional to the average input voltage applied thereto, an alternating current input means, a triggered solid state switch connected in series with said motor and said alternating current input means, and said control circuit includes a pulse forming circuit connected to said switch and establishing a train of trigger signals with the period proportional to the impedance value of said impedance means.

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