Automatic Cheese Winding Assistance For Dyeing Industries

J. Indra, P.J. Arun Prabhu, K. Hemaavardthini, R. Keerthana, S. Lavanya

Abstract: The design and fabrication of cheese winding assistance machine is useful to wind the non-woven paper and the thread over the cheese. In dyeing industries, a cylindrical spring tube called cheese is used over which the yarn to be dyed is winded. A non-woven paper and a thread have to be wound on the cheese so that the yarn is not damaged by the steel structure. This is mainly done to reduce yarn wastage. The above said process is done manually in all the dyeing industries that has cheese winding machines. This involves man power which doesn't require any special skill. Also, this process is a time-consuming one. This project aims to eliminate the man power; reduce the time consumes and to increase the productivity.

Index Term : Cheese, Dyeing, Locking, Non-woven paper, Winding, Yarn

1. INTRODUCTION

Dyeing is the application of dyes or pigments on textile materials such as fibres, yarns, and fabrics with the goal of achieving colour with desired colour fastness. The following are the common dyeing process of cotton yarn with reactive dyes in package form. The raw yarn is wound on a spring tube called cheese to achieve a package suitable for dye penetration. These softened packages are loaded on a dyeing carrier's spindle one after the other. The packages are pressed up to a desired height to achieve suitable density of packing. The carrier is loaded on the dyeing machine and the yarn is dyed. After dyeing, the packages are unloaded from the carrier into a trolley. Now the trolley is taken to hydro extractor where water is removed. The packages are hydro extracted to remove the maximum amount of water leaving the desired colour into raw yarn. The packages are then dried to achieve the final dyed package. After this process, the dyed yarn packages are packed and delivered. To minimize the yarn wastage, the process of winding a non-woven paper and thread over the cheese is done manually. This increases the time consumed and manpower in the process. This work aims to automate the above process using pneumatic cylinders. First the non-woven paper is placed over the conveyor. The thread is also loaded at the shaft of the yarn rotator. Here the final product can be used directly for winding the yarn, that has to be dyed.

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2. TECHNICAL DESCRIPTION

2.1 Functional Block Diagram

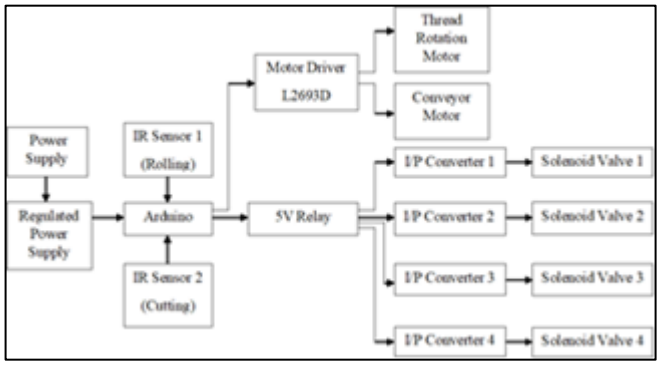

Fig. 1. *Functional Block Diagram*

First the 12 V DC power supply is given to the regulator, which gives a regulated 5V supply. This 5V supply is given to the arduino. IR sensors are used to detect the initial and final position of yarn rotator. The inputs for arduino are from IR sensors which detects the presence of yarn rotator's shaft. If IR sensor 1 is sensed, then thread starts to wind. If IR sensor 2 is sensed for the final rotation, a cutter cuts the excess thread. The output of arduino is given to a 4 channel 5V 10A relay module and a motor driver. The relay decides the ON and OFF conditions of the solenoid valves 1 to 4 through I/P converters 1 to 4 respectively.Fig.1 shows the functional block diagram of the work.

2.2 Process Flow Diagram

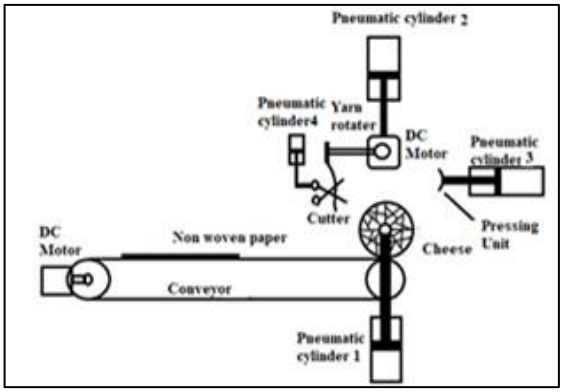

Fig. 2. *Process Flow Diagram*

Initially, the non-woven paper is placed on the conveyor. The thread feeder is loaded with a thread bundle. The cheese is inserted into the shaft. When supply is given, the conveyor moves, and the cheese which is in contact with the conveyor rotates. This makes the non-woven paper to get wounded over the cheese. Then, the pneumatic cylinder 1 lifts the cheese. Pneumatic cylinder 2 pushes the yarn rotator in front of the cheese. Pneumatic cylinder 3 actuates the pressing unit to hold the thread firmly. The IR sensor 1 senses the shaft of the yarn rotator in starting position which actuates the DC motor using arduino to wind the thread over the cheese. Pneumatic cylinder 4 gets actuated when IR sensor 2 senses the yarn rotator in ending position to cut the thread. Finally, the yarn rotator moves to its initial position. Fig.2 shows the process flow diagram of the work.

3. COMPONENTS REQUIRED

In this process the power supply unit comprises of 12V AC adapter, a 5V relay module and a rectifier circuit. The relay is used to actuate the solenoid valves and pneumatic cylinders. The 12V DC motor is used to rotate the conveyor and the yarn rotator. Fig 3 shows the cheese used in dyeing industries. The non-woven paper and thread are wounded over this. Fig 4 shows the non-woven paper that is used for winding over the cheese.

Fig. 3*. Cheese*

Fig. 4. *Non-woven paper*

3.1 Pneumatic Cylinder

Pneumatic cylinder is a mechanical device that uses the power of compressed gas to supply a force in a reciprocating linear motion. It's additionally referred to as air cylinder. In this work, double acting cylinders shown in the Fig 5 of 6" stroke length and 0.15-0.8mpa pressure and five port, four way solenoid valves are utilized. The naming for the cylinder came from the action of the air as it moves through the solenoid. The best combination of flexibility and use for double acting cylinders is a "five port, four way" solenoid.

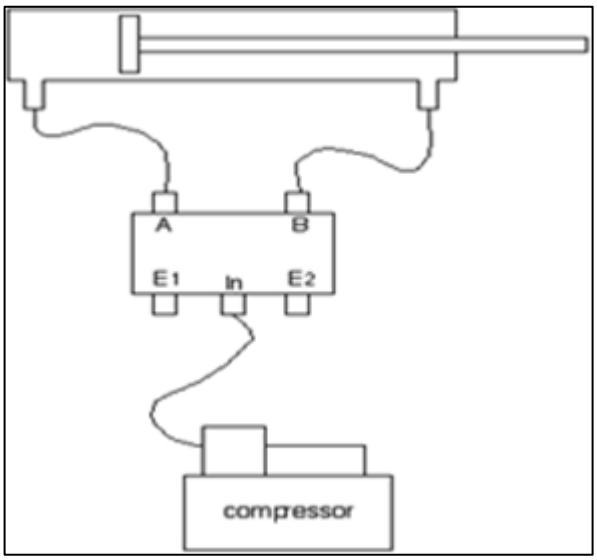

Fig. 5. *Pneumatic cylinder*

3.2 Air Regulator

Air regulator is a very important component. This unit sets the pressure for the ai-r system. A decent starting pressure is sixty psi or less. If it is a large air system with frequent popups and long airlines, 70-80 psi is not excessive. However, pressures beyond 80 psi will begin to 'stress' the entire system, and show itself in small leaks around fittings, wear and tear of popup mechanisms, and long running times for the compressor.

3.3 Specifications Of Dc Motor

Continuous Current: 1.2 amps
Continuous Torque: 0.2478 In-lbs
DC Voltage: 12 Volt
Motor Type: DC Motor

3.4 Spur Gear

Spur gears are the simplest and therefore the commonest style of gear. The teeth project radially, and with these straight-cut gears, the leading edges of the teeth are aligned parallel to the axis of rotation. These gears can only mesh properly if they are fitted to parallel axles. The torque ratio can be determined by considering the force that a tooth of one gear exerts on a tooth of the opposite gear.

3.5 Current To Pressure Converter

Current to Pressure convertor works on flapper nozzle methodology which is shown in figure 6. The input is 4 to 20mA signal and the equivalent output is 3 to 15 psi pressure. We additionally provide a continuous supply of 20 psi to the flapper nozzle assembly. As we give input current signal, electromagnet gets activated. If the current signal increases, then the power of magnet will get increased. The Flapper of the flapper-nozzle instrument is connected to pivot so that it will move up and down and a magnetic material was connected to other end of flapper and it is kept near the electromagnet. As the magnet gets activated, the flapper moves towards the electromagnet and also the nozzle gets closed to some extent. So, some part of 20 psi supplied can escape through nozzle and remaining pressure will come back as output. If the current signal is

high, then power of the magnet will increase, then flapper will move nearer to the nozzle, therefore less pressure will escape through nozzle and output pressure increases. In this way the output pressure will be proportional to the input current. For the input current of 4 – 20 mA we can get the output pressure of 3 – 15 psi, this is shown in Fig .6.

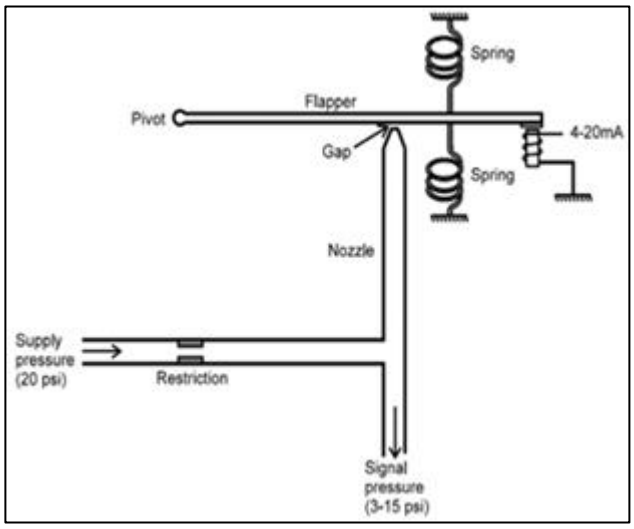

Fig. 6. *Current to pressure converter*

3.6 IR Sensor

IR sensor are extremely susceptible to ambient light and is suitably covered to reduce effect of ambient light on the sensor. The sensor features a maximum range of around 40-50 cm indoors and around 15-20 cm outdoors. During this project, the IR sensors are used to detect the initial and final position of the yarn rotator's shaft.

3.6.1 Specifications of IR sensor

Operating voltage: 5V
Ambient light and RGB colour sensing
Proximity sensing
Gesture detection
Operating range: 10-20 cm
12C Interface (12 C Address: 0x39)

3.7 Specifications Of Arduino Uno

Microcontroller: Microchip ATmega328P
Operating voltage: 5 volts
Input voltage: 7 to 20 volts
Digital I/O Pin: 20mA
Analog input pins:6
DC current per I/O pin: 20 mA
DC current for 3.3V pin: 50 mA
Flash memory: 32 KB
SRAM: 2 KB
EEPROM: 1 KB
Clock speed: 16MHz
Length: 68.6 mm
Width: 53.4 mm
Weight:25g

4. CIRCUIT DIAGRAM

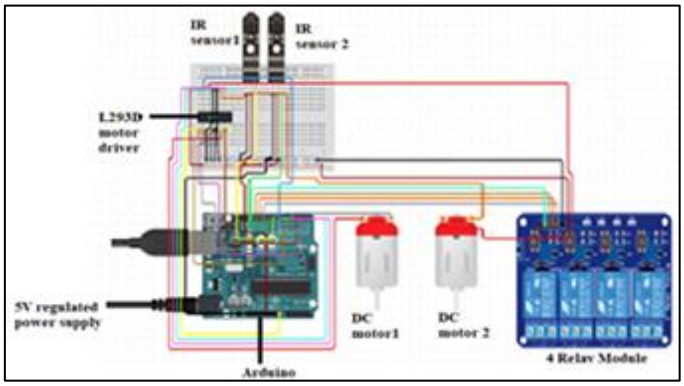

Fig. 7*. Circuit Diagram*

The 5V regulated power supply is given to the arduino. The DC motor 1 is the conveyor motor. The non-woven paper wounds over the cheese as the conveyor moves. After some delay, the shaft which is holding the rod is pushed up by a pneumatic piston. A pressing unit holds the cheese firmly. The IR sensor 1 senses the presence of cheese. If it is detected, the yarn rotator starts to wind the thread over the cheese. After completion of 5 cycles of winding, the IR sensor 2 detects the shaft of yarn rotator for cutting the excess thread. Then, a cutter actuated by a pneumatic piston cuts the excess thread. The IC L293D employed in the driver circuit is used to drive the gear motors used for conveyor movement and yarn rotator. The regulator is used to give a regulated power supply of 5V DC. The relay module is used for ON and OFF operation. According to the Arduino program, the relay actuates the pneumatic pistons. Thus, in accordance with the Arduino programming, paper and thread winding processes are done. When the conveyor motor rotates, the paper winds over the cheese. The presence of cheese is detected by the IR sensor, and then the yarn rotator winds the thread over the cheese. Fig 7 shows the circuit diagram of the work.

5. CONCLUSION

The design and development of paper and thread winding machine will be very useful for small and medium scale industries. Installation of this machine in dyeing industries will take a step ahead in industrial automation. This automation reduces the time taken for paper and thread winding process. It also excludes the man power.

6. FUTURE SCOPE

- Implementation for large dyeing industries is possible.
- Automatic placing and removing of cheese can be done.
- Automation of non-woven paper cutting can be implemented.

7. ACKNOWLEDGEMENTS

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