SELECTION AND ANALYSIS OF COMPONENTS OF PNEUMATIC BANDSAW MACHINE

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ABSTRACT

Bandsaw machine is used for cutting many objects like dies, pipes, meat,etc. It consists of bandsaw which cuts the objects with the help of motion given by rotating wheels. That rotating wheels are revolved by prime mover like electric motor. Kimplas piping company consists of bandsaw machine with electric motor. Due to voltage fluctuation in electric motor there was a problem of breakage of bandsaw and overheating of coils. Also they had problem of deburring idle time for deburring. To overcome this problem, we had selected air motor to replace with electric motor. Therefore, in this project report we had done the selection and analysis of air motor and required components of pneumatic system. After doing this analysis, we had conclude that if company implement this system in their cutting department they will get the benefit of easily and fastly deburring. And overheating and bandsaw breakage problems will also overcome.

Keywords:- *Electric Motor, Air Motor, Stress Analysis, Thermal Analysis*

1. INTRODUCTION

The main concern of Pneumatic Bandsaw Machine is to carry out processes of Cutting. Pneumatic system mechanization is upcoming technology in cutting system (Using band-saw). Benefit of system is to cut the pipe with comfort. The sequenced processes of the system must be accurately timed. The chief work of this system is to slice out huge number of jobs/tasks in pipe form rendering to the batch production. The arrangement of the pneumatic valves deployed in this system is accordance to the circuit planned. The choice of band saw is from existing machine. The material favored in this system is a HDPE (High Density Polyethylene) pipe. The band saw to be used in the machine system has been well-thought-out by calculating the torque essential for cutting HDPE object by help of the design data offered. With the help of this system the period required to slice the substances like the pipe will be fewer. The accuracy of slicing or cutting of the material will also be enhanced. The design of the machine is compact to be placed in small workshops. The worker during the working of this system should lone turn the switches on/off with the pneumatic valve and gather the sliced pieces. The price of manufacturing this machine is lesser as compared to other electronic devices used for cutting the job. The whole processes carried out in this section are controlled by air provided by compressor.

1.1 Problem Statement

Cutting department of Kimplas Piping Systems consists of one Band saw Machine which cuts the HDPE (High Density Poly Ethylene) pipes and operated on Electric motors. It is vertical band saw machine consists of a band saw having thickness 1 mm, which is supported on two flywheels. One of the two flywheels is rotated by one electric motor of 3 HP having rated 1440rpm. It consist of table having slots for mounting of clamps and workpiece. There was overheating problem of electric motor. Also there are more chances of breakage of bandsaw due to voltage fluctuation. They need to clean table every time after cutting pipe by brush.

1.2 Objective

- To decrease the overheating in machine by replacing electric motor by air motor.
- To remove burrs of pipes on tables by using exhaust air from air motor.
- To reduce stresses induced on bandsaw at the time of voltage fluctuation.
- To reduce electrical consumption.

1.3 Concept Of Proposed System

Cutting department of company consist of air compressor. So we had taken compressed air from air compressor to run air motor and also used that exhaust air from motor to deburr the debris of pipes from table. Air from compressor is compressed and stored in receiver and then send to air motor through FRL unit, control valves and gauges. After air motor runs, air from exhaust is given to nozzle at pipe cutting table to remove burr. Air motor is connected to rotating wheels on which bandsaw is mounted and pipe is cut by running bandsaw at required rpm.

2. LITERATURE REVIEW

Guy Negre, CEO and founder of Zero Pollution Motors, has pioneered this pneumatic system field since the late 1980s. Historically, many individuals have tried to apply pneumatic motors to the transportation industry. Recently Engine air has also developed a rotary motor for use in automobiles. Engine air places the motor immediately beside the wheel of the vehicle and uses no intermediate parts to transmit motion which means almost all of the motor's energy is used to rotate the wheel

Band saws, at the present, have been greatly improved, from manual band saws, semi-automatic and fully automatic band saws. They are a staple in the machine tool industry and have dramatically affected the productivity within general cutting trades – metal, wood or others.

3. METHODOLOGY

3.1 Components Of Old System

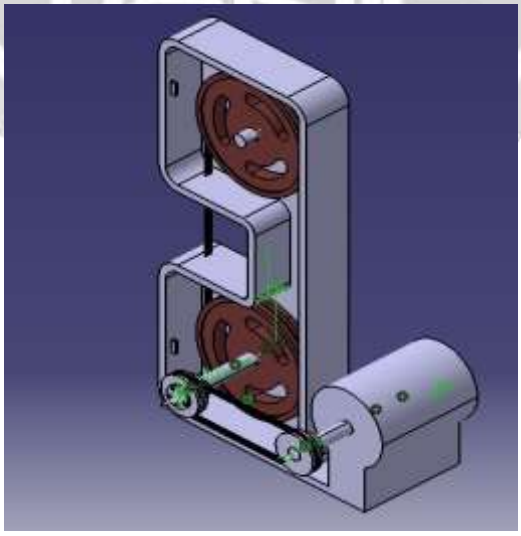


Fig 3.1 Components Of Existing System

3.1.1. Electric Motor

An electric motor is an electrical machine that converts electrical energy into mechanical energy. The reverse of this is the conversion of mechanical energy into electrical energy and is done by an electric generator.

Fig 3.1.1 Electric Motor

Specifications And Calculations

Power of Electric motor= 3HP = 2.2 kw & Speed= 1440 rpm.

P= 2πNT/60 = 2200= 2*3.14*1440*T/60, T= 14.58 N-m.

Speed Reduction Ratio, G= d1/d2= N2/N1 =153/49= 1440/N1

Therefore, N1=460rpm & T=42.01 N-m.

3.1.2 Rotating Wheel

A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheels have an inertia called the moment of inertia and thus resist changes in rotational speed.

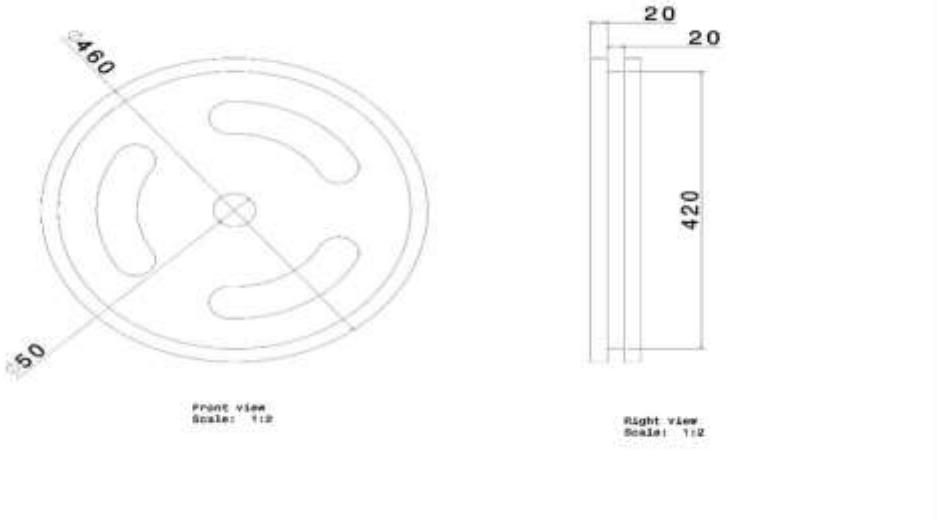


Fig3.1.2 Rotating Wheel on Autocad

3.1.3 Bandsaw

A **bandsaw** (also written **band saw**) is a saw with a long sharp blade consisting of a continuous band of toothed metal stretched between two or more wheels to cut material. They are used principally in woodworking, metalworking, and lumbering, but may cut a variety of materials.

Fig3.1.3 Bandsaw in Machine

Bandsaw Specifications:-

Length= 3.285 m Thickness= 1 mm

Width= 2 cm Material= Carbon Steel

3.1.4 Pulley

A **pulley** is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable, supporting shell is referred to as a "block."

Fig3.1.4 Stepped Pulley

3.1.5 V Belt

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel.

Fig 3.1.5 V Belt

3.2 Components Of Proposed System

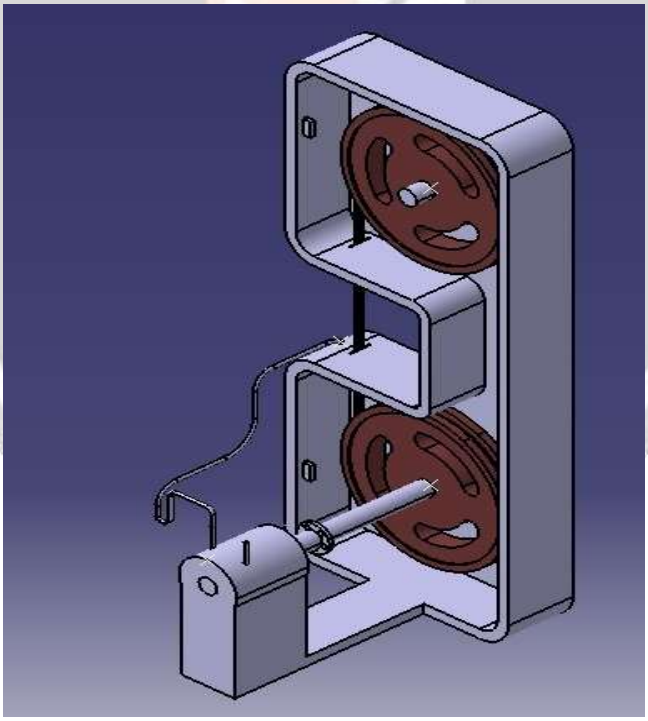


Fig.3.2 New Proposed System

3.2.1 Air Motor

3.2.1.1 Explanation of Air Motor

The air motor is a rotary actuator which works on air. A pneumatic air motor or compressed air engine is type of motor which does mechanical work by expanding compressed air. Pneumatic motors generally convert the compressed air energy to mechanical work through either linear or rotary motion. Linear motion can come from

either a diaphragm or piston actuator, while rotary motion is supplied by either a vane type air motor, piston air motor, air turbine or gear type motor.

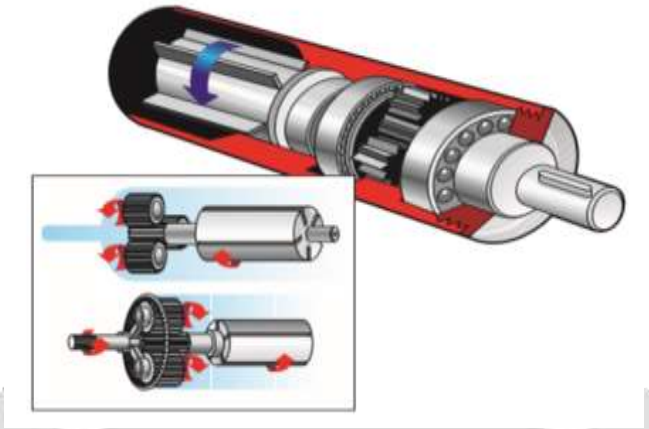


Fig. 3.2.1.1 LZB 77 Air motor

3.2.1.2 Selection Of Air Motor

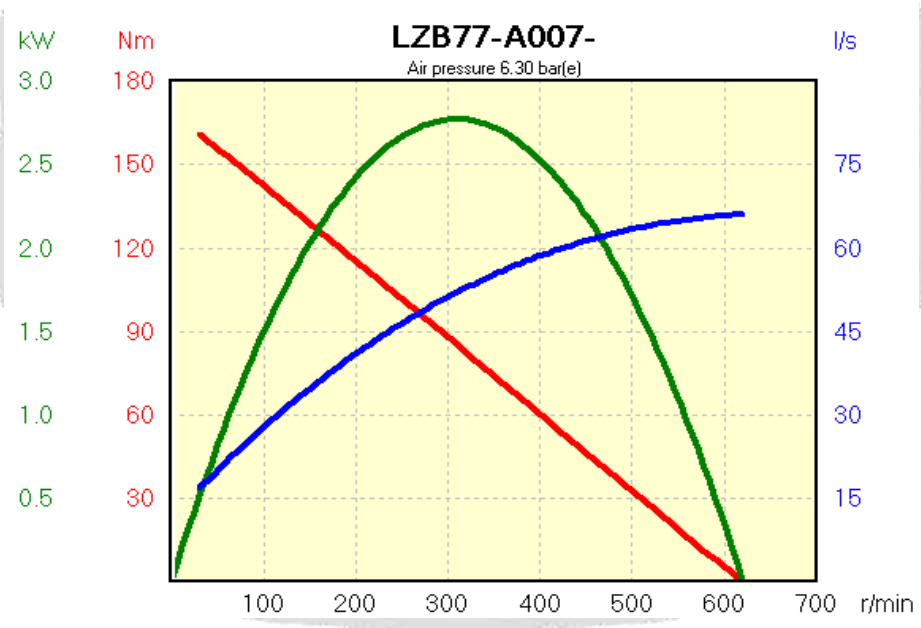


Figure. 3.2.1.2 Performance curves

We had used Atlas Copco selection software for selection of air motor:-

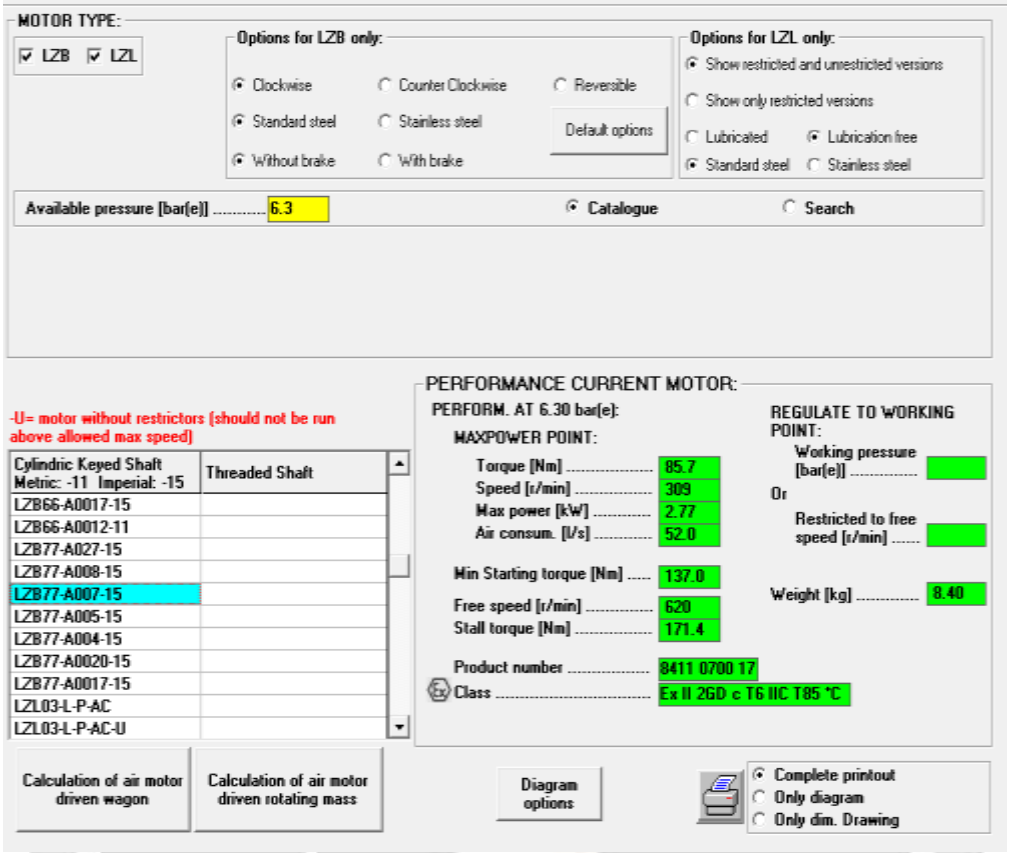


Table.3.2.1.2 Selection Table Of Air Motor

3.2.2 Air Compressor

When air is compressed, it is under pressure greater than that of the normal atmospheric pressure and it characteristically attempts to return to its normal state. Since energy is required to compress the air, energy is released as the air expands and returns to atmospheric pressure. Air compressors were designed to compress air to higher pressures and harness this potential energy source.

Figure. 3.2.2 Air Compressor

Specifications:-

Air Compressor-

Model name= Ingersoll Rand Air Compressor,

Maximum Working Pressure= 100psi,

Power of Motor= 3 HP.

Discharge= 58 Lps

Air Reciever-

Length of Tank = 1500mm,

Diameter of Tank = 480mm,

Volume= 0.271433 cubic metres = 271.43 Litres

3.2.3 Flow Control Valve

FCV is used to control the flow of pneumatic system. It maintains the discharge of the system.

Fig 3.2.3 Flow Control Valve

3.2.4 Direction Control Valve

DCV is used in this machine to control the ON/OFF switch. DCV used is 2/2 direction control; valve.

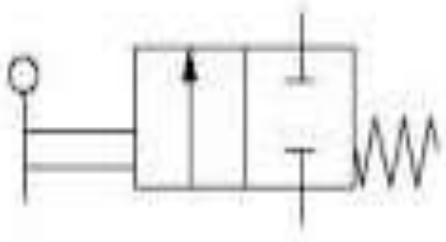


Fig.3.2.4 Symbol Of 2/2 Dcv

3.2.5 Filter, Regulator & Lubricator

3.2.5.1 Filter

Ingersoll-Rand compressed air filters are designed to remove solid and liquid airborne contaminants that can plug small orifices and hinder performance, or cause excessive wear and premature equipment failure.

3.2.5.2 Regulator

Ingersoll-Rand airline regulators provide controlled, consistent air pressure as required for specific pneumatic equipment connected to the air system.

3.2.5.3 Lubricator

Ingersoll-Rand fog-type lubricators help ensure that pneumatic devices receive the required lubrication to maintain operating performance, reduce wear, and prolong service life.

Fig.3.2.5 FRL

FRL is selected on basis of port size & pressure of air flowing.
Port Size= 1/2" & Pressure= 91 psi.
FRL unit selected is Ingersoll- Rand ARO Heavy Duty Series ½" NPT Port size having discharge 58 Lps in filter, 71 lps in regulator and 52 lps in lubricator.

NPT Port Size	Flow – cfm (dm³/s)					Pressure Range in Regulator psig (bar)
	Standard Filters	Coalescing Filters	Regulator	Piggyback	Lubricator	
Ingersoll-Rand ARO Compact Series						
1/4"	54 (25)	40 (17)	100 (47)	93 (44)	75 (35)	5 – 125 (0.4 – 8.6)
3/8"	100 (47)	51 (24)	130 (61)	135 (64)	100 (47)	5 – 125 (0.4 – 8.6)
1/2"	122 (58)	53 (25)	150 (71)	140 (66)	110 (52)	5 – 125 (0.4 – 8.6)

Table No.3.2.5 – Selection Of FRL Unit

3.2.6 Hose

A hose is a flexible hollow tube designed to carry fluids from one location to another. Hoses are also sometimes called pipes (the word pipe usually refers to a rigid tube, whereas a hose is usually a flexible one), or more generally tubing. The shape of a hose is usually cylindrical (having a circular cross section).

Hose size up to 3m length.

Motor Type	Inlet connection thread (BSP) (NPTF)	Exhaust connection thread (mm)	Inlet hose diameter (mm)	Exhaust hose diameter (Non-reversible) (mm)
LZB 14	1/8" -	1/8"	5.0	8.0
LZB 22	1/8" -	1/4"	6.3	10.0
LZB 33	1/4" -	1/4"	8.0	10.0
LZB 42	1/4" -	1/2"	10.0	13.0
LZB 46	1/4" -	1/2"	10.0	16.0
LZB 54	3/8" -	1/2"	13.0	16.0
LZB 66	3/8" -	3/4"	13.0	20.0
LZB 77	1/2" 1/2" - 14	-	16.0	-

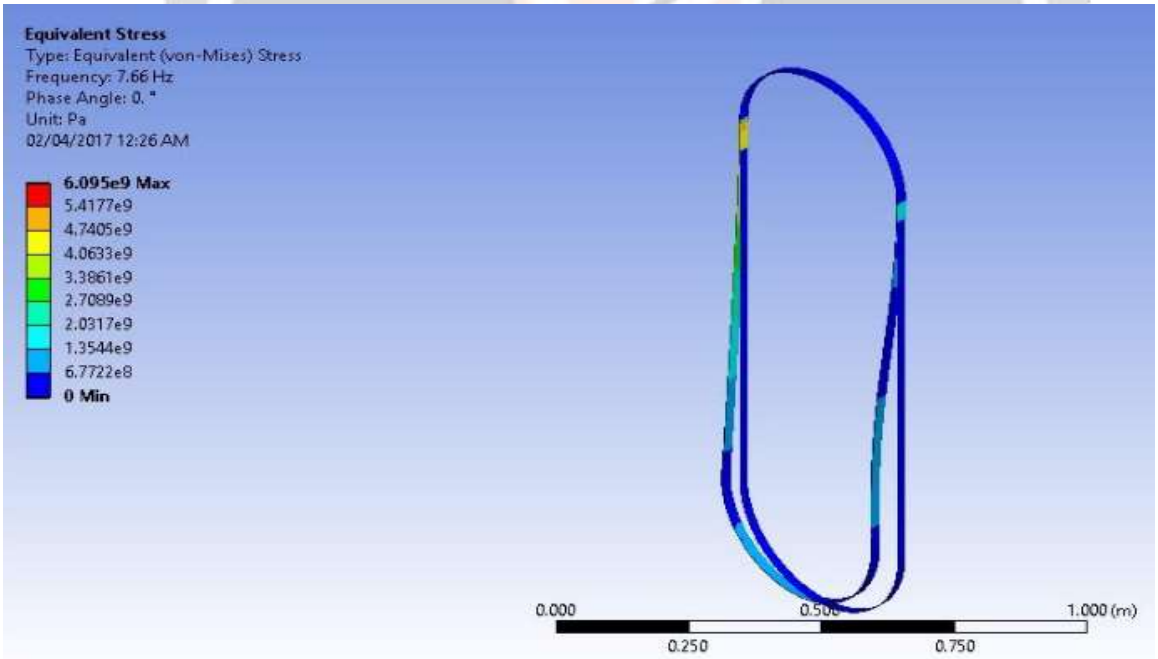
Table 2

ATLAS COPCO AIR MOTORS 13

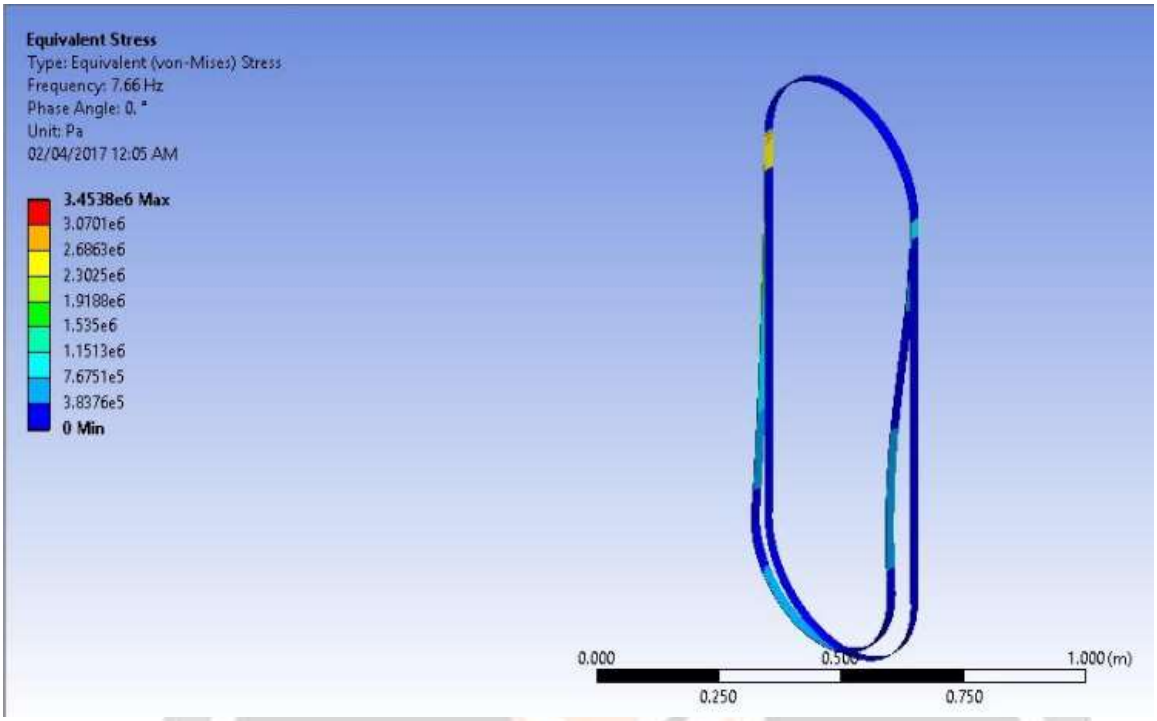
Table No. 3.2.6 Selection of Hose Diameter

4. STRESS ANALYSIS

4.1 Stress Analysis of Bandsaw when there is voltage fluctuation in Electric Motor

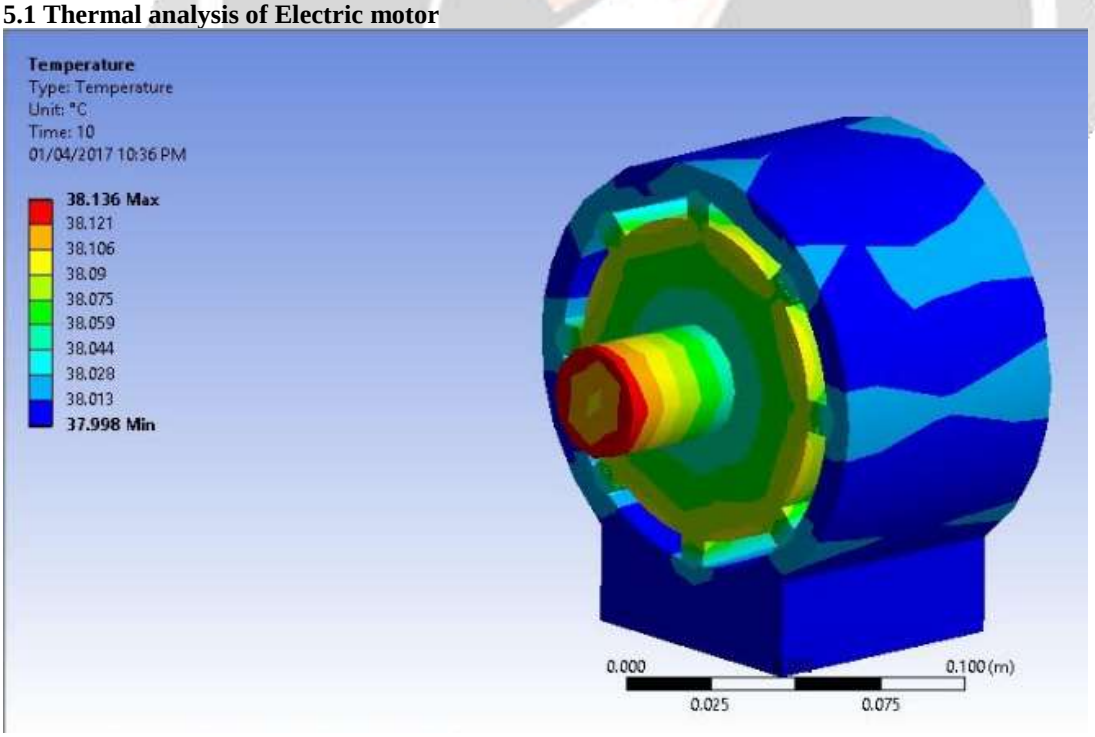


4.2 Stress analysis of bandsaw when air motor is used

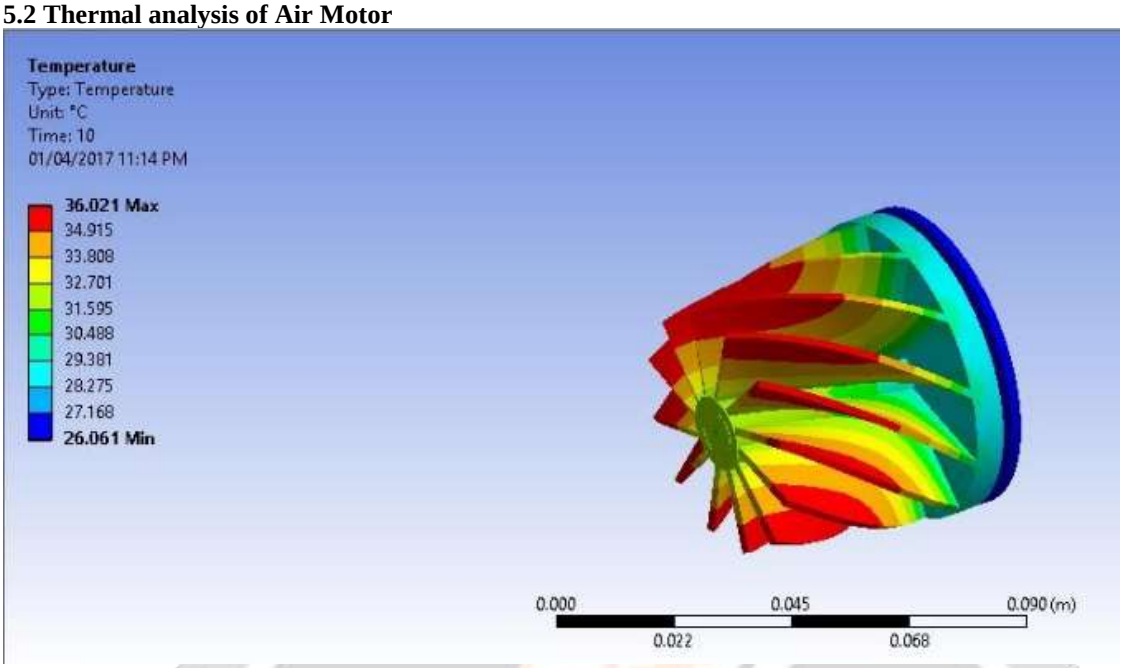


5. THERMAL ANALYSIS

5.1 Thermal analysis of Electric motor



5.2 Thermal analysis of Air Motor



6. COMPARISON OF STRESSES AND BANDSAW

6.1 Comparison of Stresses and deformation of Bandsaw at the time of Electric motor and Air motor

		Electric Motor		Air Motor	
Sr No.	Parameters	Maximum	Minimum	Maximum	Minimum
1	Total Deformation	0.47311	0	0.0002681	0
2	Equivalent Stress	6.095e09	0	3.45e06	0
3	Shear Stress	9.98e08	-9.9e08	5.65e05	-5.61e05
4	Principal Stress	6.2366e09	-2.51e08	3.53e06	-1.42e05
5	Temperature	38.136	37.998	36.021	26.061

Table No. 6.1 Comparison of stresses and deformation of bandsaw

By comparing above parameters of electric motor and air motor, we found that all stresses and deformation of bandsaw at the time of electric motor are more than that of air motor.

7. CIRCUIT DIAGRAM OF PROPOSED SYSTEM

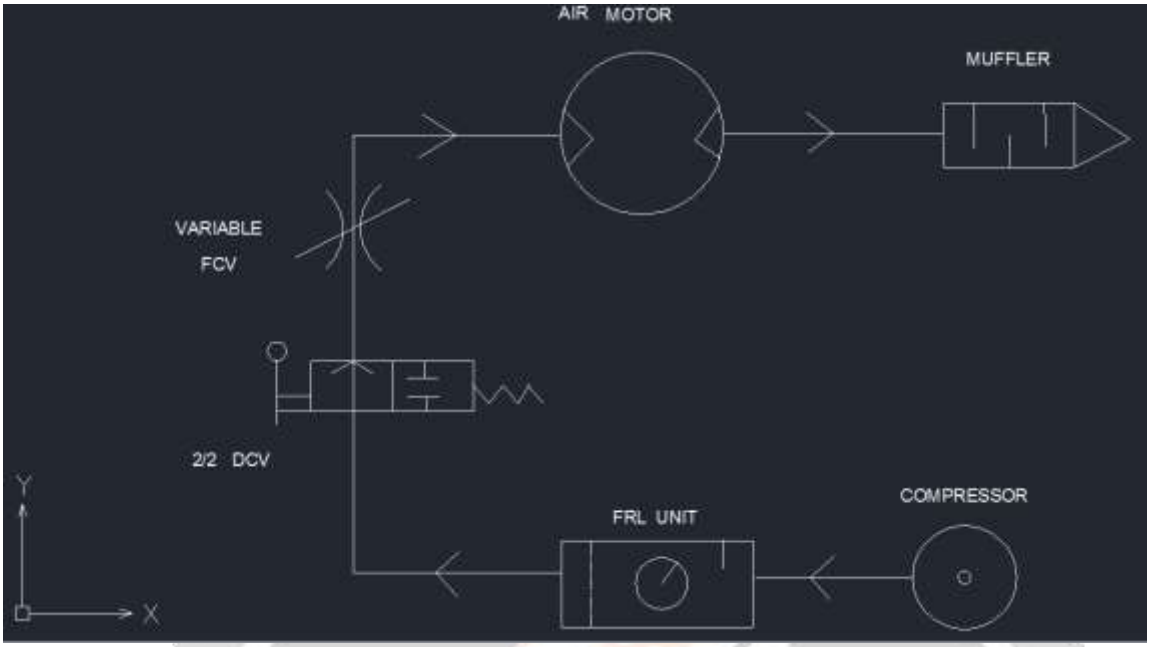


Fig. 7.1 Open circuit

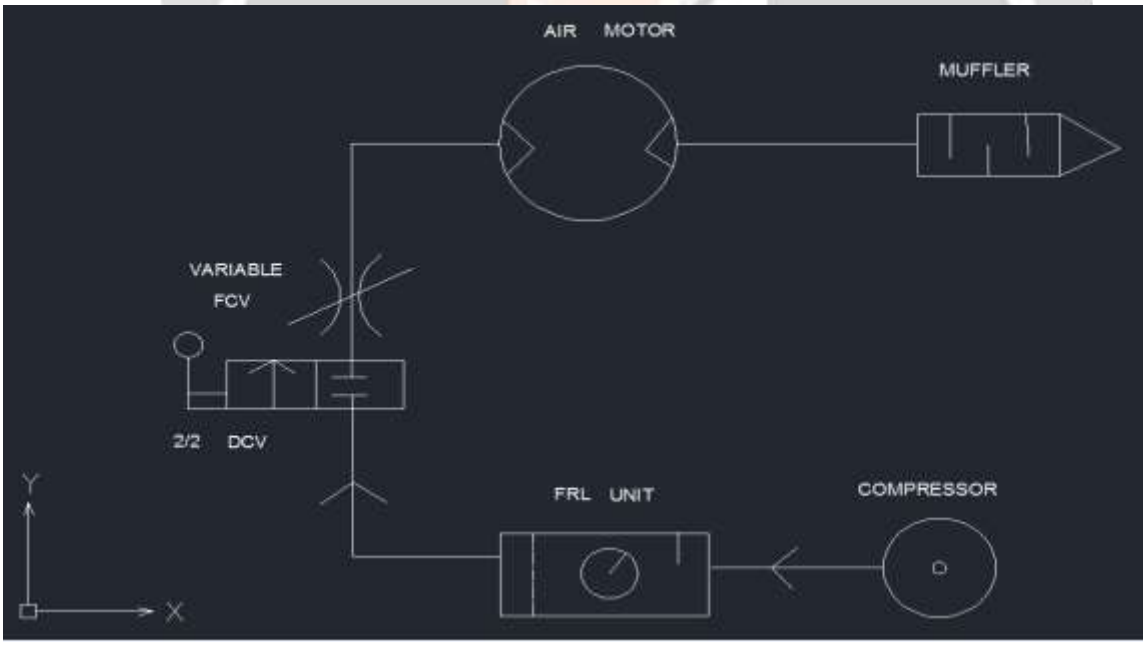


Fig. 7.2 Closed circuit

8. ADVANTAGES OF PROPOSED PNEUMATIC BANDSAW MACHINE

1. When we will use air motor instead of electric motor, then equivalent, shear, principal stresses and total deformation of bandsaw reduces.
2. As we will use air motor, overheating problem of motor reduces.
3. By using pneumatic system, we can also use that compressed air for deburring of pipe material on table.
4. Due to replacing electric motor with air motor, chances of burning of motor reduces and hence cost associated with life of motor reduces.
5. As stresses and chances of breakage of bandsaw will reduce hence bandsaw cost will also reduce.

9. LIMITATIONS OF PROPOSED PNEUMATIC BANDSAW MACHINE

1. As we already have air compressor motor of 2 HP and we are using it to run compressor, it will consume more time to compress air. So the system is time consuming.
2. As time consuming is high and also we know that cost required to compress air is also high, electrical consumption cost will also be high.

10. FUTURE SCOPE

If company use air motor instead of electric motor, then chances of breakage of bandsaw will reduce as we saw in analysis of bandsaw. In future if company implement this pneumatic system, they will get advantage of reducing idle time of deburring and also will increase life of bandsaw, hence reduces cost of bandsaw. In future, after implementing they will also get advantage of less chances of overheating.

11. CONCLUSION

1. By doing analysis, we found that if we implement air motor and as voltage fluctuates it will not affect the surface finish and breakage of bandsaw.
2. By doing thermal analysis, we also found that by replacing electric motor with air motor temperature rise of motor and overheating problem reduces.
3. We conclude that deburring of unwanted particles of pipe will be done easily and in less time.

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