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Design And Fabrication Of Typical Pipe Cutting Machine

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ABSTRACT

The Machine we designed and fabricated is used for cutting any shape of object like Circular, Rectangular, and Polygon. Hence our project namely Typical Pipe Cutting Machine is a Special type of Machine. According to the type of material to be cut, the cutting tool can be changed. This project gives details of Cutting various shapes and sizes of components. This machine can be widely applied in almost all type of industries. The pipe cutting process is a main part of the all industries. Normally the cutting machine is manually hand operated one for medium and small scale industries. In our project is pneumatically operated "**TYPICAL PIPE CUTTING MACHINE".** Automation in the modern world is inevitable. Any automatic machine aimed at the economical use of man, machine, and material worth the most. In our project is hand operated D.C valve and flow control valve is used for semi-automation. The pipe cutting machine works with the help of pneumatic double acting cylinder. The piston is connected to the moving cutting tool. It is also used to cut the small size of sheet metal. The machine is portable in size, so easy transportable.

Keywords

Pipe cutting machine, Automation, Pneumatic cylinder. Flow control valve, check valve.

1. INTRODUCTION

This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased. Degrees of automation are of two types, viz.

Full automation.

Semi automation.

In semi automation a combination of manual effort and mechanical power is required whereas in full automation human participation is very negligible.

Need for Automation

Automation can be achieved through computers, hydraulics, pneumatics, robotics, etc., of these sources, pneumatics form an attractive medium for low cost automation. The main advantages of all pneumatic systems are economy and simplicity. Automation plays an important role in mass production.

- Reduction of lab our and material cost

Reduction of overall cost

Increased production

- Increased storage capacity
- Increased safety
- Reduction in fatigue
- Improved personnel comfort Automation or automatic control is the

use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching in telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention. Some processes have been completely automated.

The biggest benefit of automation is that it saves labour, however, it is also used to save energy and materials and to improve quality, accuracy and precision. The term automation, inspired by the earlier word automatic (coming from automaton), was not widely used before 1947, when General Motors established the automation department. It was during this time that industry was rapidly adopting feedback controllers, which were introduced in the 1930s. Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, and electronic and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques.

1.1. Types of automation

One of the simplest types of control is on-off control. An example is the thermostats used on household appliances. Electromechanical thermostats used in HVAC may only have had provision for on/off control of heating or cooling systems. Electronic controllers may add multiple stages of heating and variable fan speed control. Sequence control, in which a programmed sequence of discrete operations is performed, often based on system logic that involves system states. An elevator control system is an example of sequence control. The advanced type of automation that revolutionized manufacturing, aircraft, communications and other industries, is feedback control, which is usually continuous and involves taking measurements using a sensor and making calculated adjustments to keep the measured variable within a set range.

AUTOMATION TOOLS

Introduction

Engineers can now have numerical control over automated devices. The result has been a rapidly expanding range of applications and human activities. Computer-aided technologies (or CAx) now serve as the basis for mathematical and organizational tools used to create complex systems. Notable examples of CAx include Computer-aided design (CAD software)and Computer-aided manufacturing (CAM software).

The improved design, analysis, and manufacture of products enabled by CAx have been beneficial for industry. Information, together with industrial machinery and processes, can assist in the design, implementation, and monitoring of control systems. One example of an industrial is a programmable logic controller (PLC). PLCs are specialized hardened computers which are frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events.

Different types of automation tools exist:

- ANN - Artificial neural network
- DCS - Distributed Control System
- Instrumentation
- Motion control
- Robotics
- PLC – Programmable Logic Controller
- HMI – Human Machine Interface

When it comes to Factory Automation, Host Simulation Software (HSS) is a commonly used testing tool that is used to test the equipment software. HSS is used to test equipment performance with respect to Factory Automation standards (timeouts, response time, and processing time).

1.2. Current limitations

Many roles for humans in industrial processes presently lie beyond the scope of automation.Human-level pattern recognition, language comprehension, and language production ability are well beyond the capabilities of modern mechanical and computer systems. Tasks requiring subjective assessment or synthesis of complex sensory data, such as scents and sounds, as well as high-level tasks such as strategic planning, currently require human expertise. In many cases, the use of humans is more cost-effective than mechanical approaches even where automation of industrial tasks is possible. Overcoming these obstacles is a theorized path to post-scarcity economics.

1.3. Benefits of Industrial Automation

Automation, robotics, industrial automation, process control, and numerical control is the use of control systems such as computers to control industrial machinery and processes. Some advantages are repeatability, tighter quality control, and waste reduction, integration with business systems, increased productivity and reduction of labour. Some disadvantages are high initial costs and increased dependence on maintenance. Major benefits of industrial automation technology are the latest fieldbus developments. The most popular protocols are Device Net, Profibus and ASi and the emerging Industrial Ethernet. Implementation of industrial automation provides capital expenditure savings associated with cable elimination (multiple devices share wire-pairs and communicate over the bus network) and other savings are also available through speedier commissioning.

A major advantage of industrial automation and process control is the increased emphasis on flexibility and convertibility in the manufacturing process. Manufacturers are increasingly demanding the ability to easily switch from manufacturing a wide range of products without having to completely rebuild the production lines. Warehouses benefit from the marriage of automated guided vehicle technology and conventional industrial trucks. This system combines a very narrow aisle truck with guidance controls and software directed by the system controller. The driverless operation is capable of complete “lights out” operation from the warehouse receiving area to the shipping dock. Best of all, the vehicles can be introduced into current operations, using existing racking and floor.

Effects of Automation

Automation is suited to the developed countries of the world which have attained a state of full employment phenomenon. In those countries, automation becomes necessary because of scarcity of manpower. Automation is not suggested for a developing country like India because here the state of unemployment is visualized and automation will increase this state of unemployment. But automation should be introduced in post offices, railways, banks where the increased workload necessitates quick and accurate service to the public. Automation leads the following effects:

Automation results in the state unemployment because human labour is replaced by mechanical work.

It requires huge investment and as such it goes beyond the capacity of small scale firms to afford for automation.

It brings about a complete change in the organizational structure and involves a great deal of additional cost.

WORKING PRINCIPLE

The compressed air from the compressor is used as the force medium for this operation. There are pneumatic double acting cylinders, Direction control valve and flow control valve. The arm from the compressor enters to the flow control Valve. The controlled air from the flow control valve enters to the D.C valve. The function of D.C valves to enter the air into the pneumatic cylinder.

The 5/2 D.C valve is used. In one position air enter to the cylinder and pusses the piston, so that the cutting stroke is obtained. The next position air enters to the other side of cylinder and pusses the piston return back, so that the releasing stroke is obtained. Figure 1 and 2 shows the typical pipe cutting machine

1.4. Applications

- This machine is very useful for small and medium scale industries
- This machine is used to cut the plastic pipes
- All Industrial Application

1.5. Disadvantages

- While working, the compressed air produces noise therefore a silencer may be used.
- High torque cannot be obtained
- Load carrying capacity of this unit is not very high.(<50 N)

1.6. Advantages

- The pneumatic is more efficient in the technical field
- Quick response is achieved
- Simple in construction
- Easy to maintain and repair
- Cost of the unit is less when compared to other machine
- No fire hazard problem due to over loading
- Comparatively the operation cost is less

Figure .The typical pipe cutting machine

2. PNEUMATIC CYLINDER

Pneumatic cylinders (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Like hydraulic cylinders, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. 85 Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage. Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. For example, in the mechanical puppets of the Disney Tiki Room, pneumatics is used to prevent fluid from dripping onto people below the puppets.

2.1. Cylinder design

The basic, rod-style industrial cylinder consists of a tube sealed by end caps. A rod attached to an internal piston extends through a sealed opening in one of the ends. The cylinder mounts to a machine and the piston rod acts upon the load. A port at one end of the cylinder supplies compressed air to one side of the piston, causing it (and the piston rod) to move. The port at the other end lets air on the opposite side of the piston escape — usually to atmosphere. Reversing the roles of the two ports makes the piston and rod stroke in the opposite direction. Rod-style cylinders function in two ways:

2.2. Force output

Another key selection criterion is how much force a cylinder generates. Determine this from the air pressure and bore size (the ID of the cylinder.).A general rule of thumb is that for vertical and high-friction applications, the required force should be twice the load to be moved. In some cases additional force is necessary to compensate for friction.

Designers can calculate cylinder force by multiplying the effective piston area by the working pressure. The effective area for push force is the cylinder bore. For pull, it's the bore area less the cross-sectional area of the piston rod. Thus, theoretical push force is:

$$F = \pi (D2/4 - d2/4)$$

where

F = force, lb;

D = cylinder bore, in.; and

P = pressure, psi.

2.3. Air consumption

Calculating a cylinder's air consumption is often necessary on fast-cycling equipment to ensure enough supply air is available. There are two parts to cylinder air consumption. One is the volume the piston displaces. The other is the unswept volume from end-cover cavities, cylinder ports, connecting tubing, and valves. The unswept portion is likely to be a small percentage of the total and will vary with the installation.It's best to ensure the compressor has sufficient capacity to supply pneumatic equipment under "worst-case" conditions. Otherwise, air starvation at critical times will cause performance to suffer.

2.4. Additional considerations

After sizing a cylinder for force and stroke, engineers have a lot of leeway in tweaking a cylinder so it best fits an application. Here are a few considerations.

Port sizes and locations are usually dictated by bore size, but can be adjusted in custom designs. Envelope dimensions. The National Fluid Power Assn. and International Standards Organization have established standards for many cylinder dimensions, letting engineers interchange cylinders from different manufacturers. Many models also have unique dimensions.

2.5. Cylinder materials.

The operating environment is the major factor that governs material choice. Pneumatic cylinders are typically made of steel, aluminum, stainless steel, brass, or engineered plastics. Some models combine several materials.

Seal materials. Cylinder manufacturers use a variety of methods to seal the end caps and rod. Designers can specify alternative seal materials for applications that operate in extreme high or low ambient temperatures or are exposed to caustic chemicals.

3. CONCLUSION

Pipe cutting, or pipe profiling, is a mechanized industrial process that removes material from pipe or tube to create a desired profile. Typical profiles include straight cuts, mitres, saddles and midsection holes. These complex cuts are usually required to allow a tight fit between two parts that are to be joined via arc welding.

Cutting is performed by means of a thermal torch (plasma or ox fuel) and is mounted to the last axis of a multi-axis machine. The axes of the multi-axis machine are powered by electric motors and are synchronized to create a path for the torch and pipe that yield a desired profile. The synchronization of axes is accomplished either mechanically, via cams, levers and gears, or electronically, via microprocessors and controllers.

Pipe cutting machines are popular in offshore, pipe processing, ship building, pressure vessel, structural and mechanical contracting manufacturing because of the complex cuts and profiles typical required in their respective industries. Some common pipe cutting applications are: pipe work, offshore jackets, industrial steel structures, stadiums, cranes, nozzles, and pipe laying stingers.

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