SINGLE-PLATE HYDRAULICALLY OPERATED AUTOMATIC TRANSMISSION CLUTCHES

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Abstract

Time consumption in assembling process plays a vital role in improving the production. The assembling process, nowadays are mostly automated but some process have not yet been due to the involvement of complex sequences and operations like process of loading the damper springs in clutch driven plate sub assembly is difficult and consumes more time. In the existing manual system, the compressed damper spring should be loaded in accordance with the plate window exactly. The seating of the spring takes place by expanding force of the spring. Using the latest electro pneumatic components a new system was designed to overcome the above limitation. This system was automated but the spring should be placed manually in clamping vice it consists of 3-point pneumatic grippers that load and unloads the driven plate. A linear / rotary actuator is used for indexing as well as up and down movement of plate. Two clamping vices are used to compress and release the spring simultaneously using a double-ended cylinder and these arrangements are rotated by a rotary cylinder (rack & pinion type).

Keywords: *Single-Plate Hydraulically Operated, Automatic Transmission Clutches*

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1. INTRODUCTION

An assembly system comprises normally an integrated structure of machine and operations to achieve assembly of subsystem. The integration is achieved by using a process where necessary operations are integrated in respect of materials, energy and information. Automatic assembly system-make use of mechanized and automated devices to substitute for manual operations. For automated assembly, the following interlinked and consecutively performed tasks undertaken are.

- Placing the parts (to be assembled) into loading and handling devices in right sequence and moving previously oriented parts to the next assembly station.
- Location and orienting the parts at the assembly station with required accuracy.
- Mating the part surfaces with a view to achieve assembly
- Controlling the assembly operation.
- Moving the partially assembled unit to the next station removing the completed parts to the point of storage.

On undertaking the above consecutively performed tasks a new system was design. This system operates through pneumatic actuators and controlled by electro pneumatic components with integration of programmable logic controller (PLC), which this system locates the spring one by one by self-turning of clamping table as well as self-induction of driven plate in plate handling system.

2. REQUIREMENT OF CULTCH

2.1 Torque Transmission

The clutch should be able to transmit the maximum torque of the engine under al conditions. It is usually designed to transmit 125 to 150 percent of the maximum engine torque.

As the clutch slip during the engagement, the clutch facing is a heated. Clutch temperature is the major factor of the limiting clutch capacity. This requires that the clutch facing must maintain a reasonable co-efficient of friction with the mating surface under al working conditions. More over the friction material should not crush at high temperature and clamping loads.

2.2 Gradual Engagement

The clutch should positively take the drive gradually without the occurrence of sudden jerks.

2.3 Heat Dissipation

During clutch application, large amounts of heat are generated. The rubbing surfaces should have sufficient area and mass to absorb the heat generated. The proper design of clutch should ensure proper ventilation or cooling for adequate dissipation of heat.
To reduce effective clamping load on the carbon thrust bearing and wear off, sufficient clutch free pedal must be provided.

2.4 Purpose Of Damper Spring

In order to absorb and overcome the shock, vibration and impact loads on the clutch system during engagement and disengagement of power.

2.5 Driven Plate

The driven plate is made up of tempered steel and the surface is coated with phosphate. At spline hole side two discs each on either sided are riveted with the plate.

3. EXISTING MANUAL PROCESS

3.1 Description

The existing process as shown in figure no (3) consists of a clamping vice and a double acting cylinder mounted on a table suspended by using suitable base. The clamping vice are used to compress the spring and releases to locate the spring in the driven plate window.

The vice is made up of mild steel having two jaws one is fined jaw and other is movable jaw. The movable jaw is connected with piston rod by suitable attachment; also the opening distance between two jaws can be adjustable in movable jaw with the help of adjustable stop. This stop makes adjustable stroke length of piston according to the length of spring to be compressed. On setting the stop to required distance the maximum opening distance between two jaws can be set with the movable jaw.

The system operates at 7.5 bar pressure required to compress the spring at 74 Kg load.

The clamping and decamping of vice is operated through a 3/2 direction control value (hand lever operated)

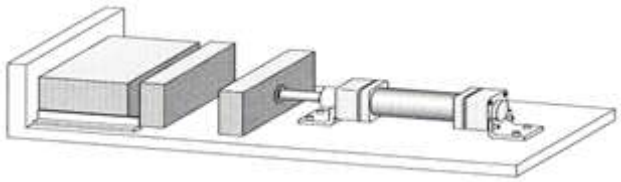

Fig: 1 Existing Manual System (From Pneumatic Basic Level TP 101)

4. SEQUENCE OPERATION

1. Two locating plates are kept each on either side of spring, while place the locating plate, inner end and outer end should be carefully identified and located.
2. The spring with locating plate is placed between the gaps of clamping vice. While placing, in order to avoid any misalignment the spring with locating plate should be handled properly until it is clamped.
3. The spring window of the driven plate is inserted with the clamped (or) compressed spring at every hole. For this the length of window should be greater than the compressed to the length and less then window length so that it can be easily inserted.
4. The vice is decamped and the spring along with locating plate is located in the driven plate window and adjusted to center in window.

The sequence 1 to 4 is repeated for 8 times for locating the damper remaining seven windows. Thus the driven plate is completely loaded with damper spring.

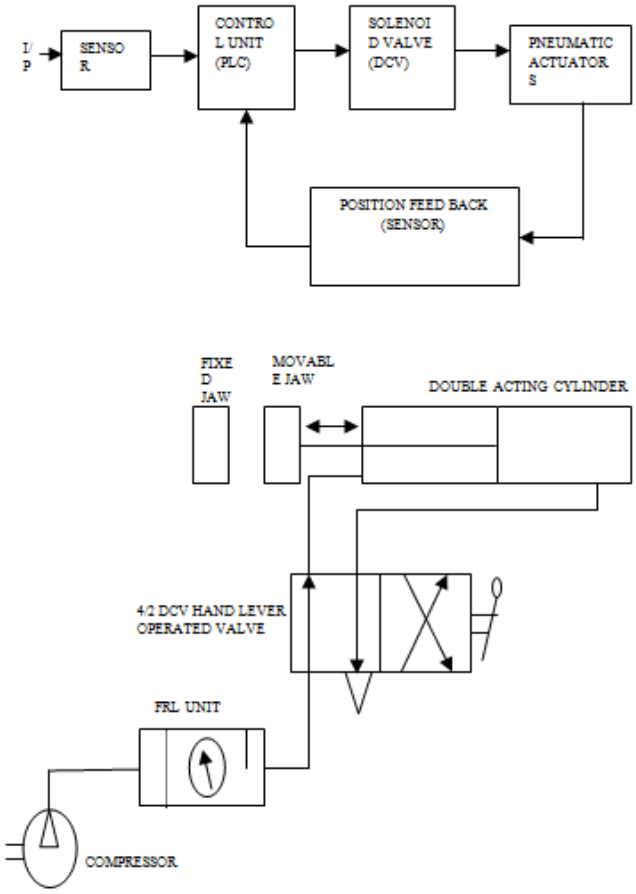

Fig: 2 Pneumatic Circuits for Existing Process

5. WORKING PRINCIPLES

5.1 Basic Operational Principle of the System

The system operates on the basic principle of position feedback system (Closed loop system)

The input signals are sensed by the sensor the control unit accepts the sensed input signal and gives out control signal. The PLC processor performs the control functions or decision making and gives the control signal to actuating devices. The actuating devices are the solenoid operated Direction Control Valves that directs the flow of air to pneumatic actuators to perform the operation. The end position of each operation is sensed by the position feedback sensors and feeds to control unit to start next operation sequence.

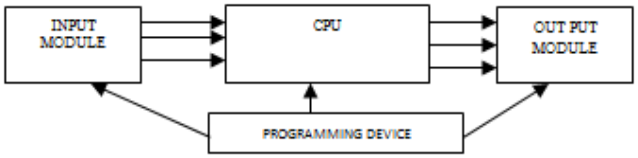

Fig: 3 Basic Operational Principle of System

To increase the production the old system should be discarded and newly designed system should be implemented. The system operates based on the principle of positioning feedback system (closed loop system). Different types of pneumatic actuators are employed to achieve various operations on loading the damper spring in driven plate windows. Totally the system consists of two arrangements.

1 Plate Handling Arrangement
2 Spring Compressing Arrangement

5.1.1 Plate Handling Arrangement

This arrangement performs pick and place operation of driven plate and indexing during the intermediate stage before unloading the springs located plate. To locate the spring sequentially position ofter the plate the spring is then lifted up and then indexing is performed ofter each spring is located

Position – 1: To take the Driven plate without spring (empty plate).
Position – 2: First position the plate over compressed spring in clamped jaw and then lifted up after locating. The spring secondly indexes the plate at 450 to next spring.
Position – 3: Unloading the spring loaded plate.

These actuators are mounted using suitable mounting accessories and held in over hanging beam construction with necessary base.

5.1.2 Spring Compressing Arrangement

This arrangements consists of two clamping vice, a double ended cylinder and a rotary drive (rotary cylinder) each clamping vice consists of two jaws fixed jaw and movable jaw. Of both the vice is fixed with both the ends of piston rod in double ended cylinder, each jaw on either end. The vices and double ended cylinder are mounted on the turning table. The shaft of turning table is connected to the pinion shaft of rotary cylinder. The entire table with double ended cylinder and clamping vices is mounted on the vertical column with the help of bearing support. The rotary cylinder is mounted on the vertical column with necessary attachments and the pinion shaft of rotary cylinder is engaged with table shaft using spur gear arrangements of equal speed ratio. This rotary cylinder rotates the table to ± 1800.

5.2. Condition

The driven plate (type T310) consists of eight damper spring windows. So eight springs should be placed in their windows.

5.3 Parts of a PLC

A typical PLC can the divided into three parts as illustrated. Their three components are the central processing unit (CPU), the input/output (I/O) section, and the programming device.

6. CONCLUSION

Production industries have to meet the challenges through technological innovations. Advanced processes, material and methodologies will emerge to meet the challenges in production. Production system improvements can benefit an organization in dealing with this challenge. This is one of the advanced technologies with advanced product ranges, miniaturization of products/parts and higher levels of accuracy applicable for assembly line. On implementing this newly designed system the production can be increased to 251% i.e. 2.5 times compared with the existing system. The implementation of this technology will definitely have greater benefits in productivity in the assembly lines by consuming less time.

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