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AIR COMPRESSED GRIPPER TECHNOLOGY FOR INDUSTRIAL AUTOMATION ROBOTS

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ABSTRACT: For handling of materials and mechanisms to pick and place are widely found in industrial automation and industrial manufacturing. There are mechanical grippers which are based on different motor technologies and have been designed and employed in various applications. The designed robotic gripper in this paper is a two jaw/finger actuated gripper which is different from conventional gripper in the way that controlled movement of the jaws is done with the help of pneumatic cylinders using air pressure. The air pressure generated in the cylinder is very gentle and is directly delivered to the jaws/finger in a compact way. The design, analysis and fabrication of the gripper model are explained in this research paper. The working of the model is checked for and observation for pay load is recorded at various pressures. The air compressed gripper model can be easily set at intermediate positions by regulating the pressure. Pneumatic grippers are easy to handle and are cost- effective because air hoses, valves and other pneumatic devices are easy to maintain.

I. INTRODUCTION

Compressed Air is the pressurized air having values much higher than that of the atmosphere. When this compressed air is released through a pressure valve, it can drive a piston, can be used in a jackhammer; can go through small air turbines to rotate shaft , can be used in a dental drill machine; or it can be released through a nozzle to produce a high velocity jet action such as in a paint sprayer. There are many pneumatic devices in which compressed air can be a source of energy for performing various operations which includes riveting of guns, air powered hammers, rock drills and other air powered tools. The compressed air can be used in coal mining tools, thus reducing any chances of explosion which occurs in case of electric tools which produces spark[1].

The parallel jaw gripper has two fingers which can be moved towards each other along one axis. Usually, the fingers can be moved independently from each other to prevent shifting of the object, and are able to perform simple operations like open and close[2]. A longitudinal or side movement is not possible.

The principles which are followed in parallel jaw gripper are:

A. THE FORCE GRIP CLOSURE:

The characteristic of the force grip closure is that the gripper keeps the object in a steady state by compensating all forces and torques created by the object. The summation of all forces and summation of all torques must equal zero ($\Sigma F=0$; $\Sigma M=0$)[3]. The force grip closure can be differentiated into a grip with and without friction. The force grip closure without friction is much idealized and not very common in daily use; therefore it is no further mentioned. The force grip closure with friction requires two contact points for gripping a planar object and 4 contact points for 3-D object[4].

B. THE FORM GRIP CLOSURE:

It is the second principle for gripping objects. This grip is possible, because the gripper is a negative model of the object or is a part of it which put limits to the movement of the object within the gripper in any direction, also while changing the gripper orientation[5]. The force is compensated on specified contact surfaces. Tangential load, pressure load and torque are not considered, but are reduced to surrounding forces. The gripper must either make use of a special geometry, or a significant number of fingers might be required. When air compressor releases compressed air through the pressure gauge, it flows into the 5/2 way valve. The desired pressure level is maintained by observing readings on the pressure/dial gauge. The maximum pressure for system operation is 10 bar, but mostly pressure levels are far below than that, preferably less than 7 bar[6]. The compressed air flows into the 5/2 way valve which when activated either manually or via solenoid electric circuit allows the compressed air into the inlet port of the two double acting air cylinder which are placed equally distant & opposite to each other. A 5/2 way valve is used to regulate the amount of compressed air flow, thus controlling the stroke length for the piston rods. The cylinder has a bore diameter of 50 mm and stroke of 50 mm[7]. The entry of compressed air into the cylinder pushes the piston and thus piston rods undergoes a power stroke to move outwards which increases the distance between the surfaces of gripper. Thus this movement of jaws opens the grippers which helps in releasing the object. On the other side, when the compressed air flow is reversed then the air flows out from the cylinder into the valve and back into the compressor through the regulator/pressure valve. This results into the return stroke of the piston rod which in turn helps to grasp the load as the distance between the surfaces of gripper decreases. The pressure is maintained as per the requirement of gripping force. The distance between the grippers depends on the size of the object which is required to be grasped.

II. ROBOTIC GRIPPER

Few robots have the capability to grasp definite objects and then change position according to requirement. The robotic grippers are divided into two parts i.e. the manipulators and end effectors. The The working arm of the robots are the Manipulators and the hands of the robot are End Effectors[8]. In general the robots are connected with replaceable end effectors with the help of which they can perform wide range of operations with fixed manipulators[9]. The end effectors are actuated by various mechanisms such as mechanical drives, electrical drives, hydraulic drives and Pneumatic drives. Widely used gripper technology are the hydraulic grippers & pneumatic grippers (air compressed grippers) but the most favorable one is the pneumatic gripper (air compressed grippers). A robot gripper acts as end of arm tooling (EOAT)[10]. EOAT to pick up items and can be customized for different applications.

FIG.1: ROBOTIC GRIPPER

FORCE REQUIREMENTS OF GRIPPERS:

The type of jaws used in gripper play a major role in determining the force which is required proper operation of a gripper. The gripper jaws are of 2 types:

1. Friction grip
2. Encompassing grip.

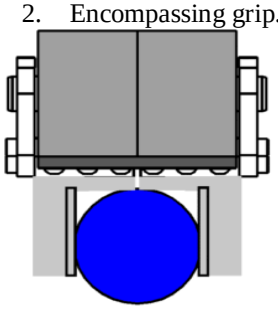

Fig.2: Friction grip

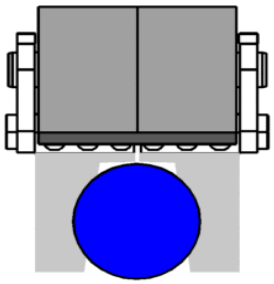

Fig.3: Encompassing grip

Gripping force: - 2μFg=mg

Max actuating force: - F= Pa*(πD2/4)

III. CIRCUIT CONNECTION

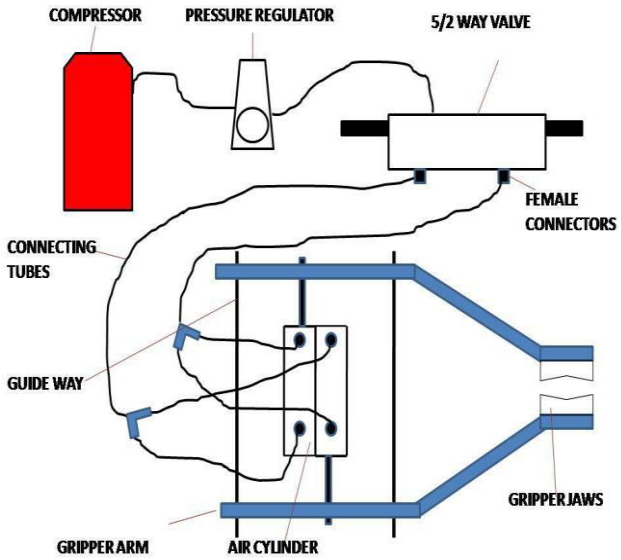

FIG.4: CIRCUIT CONNECTION OF A PNEUMATIC GRIPPER

IV. CONCLUSION

From the above discussion it is clear that pneumatic gripper (air compressed gripper) has many advantages and is advanced technique in the world of robotics for pick and place work and faster than the conventional techniques. Highly dynamic operation and high acceleration possible. Ease of handling low dimension materials which require good & careful handling. The Pneumatic grippers (air Compressed grippers) offers great features and are a common choice and this explanation can be inferred from the research work carried out in this paper. The gripper's arms are made of aluminum due to which the gripper is lightweight & reliable for machine loading of metal parts. Pneumatic grippers are low cost & maintenance is also less as air hoses, valves, and other pneumatic devices. Detachable fingers for the gripper fingers can be manufactured from various composite materials depending on requirement to ensure gentle gripping.

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