DESIGN OF ELECTRICALLY CONTROLLED BEARING REMOVING MECHANISM

Submitted in partial fulfilment of the requirement for the degree

Bachelor of Engineering

By

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CERTIFICATE

This is to certify that the Synopsis of Project entitled "**Design of Electrically Controlled Bearing Removing Mechanism"** is a Bonafide work of **Shaikh Mohammed Raashid Mohammed Ilyas (16ME75), Shaikh Mohammed Faisal Asif (16ME70), Omprakash Murlidhar Singh (15ME116), Shaikh Ismail Obaidur Rehman (14ME112)**, submitted to the University of Mumbai in partial fulfilment of the requirement for the award of the degree of **Bachelor of Engineering in Mechanical Engineering**.

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PROJECT REPORT APPROVAL FOR B.E.

This project report entitled , "DESIGN OF ELECTRICALLY CONTROLLED BEARING REMOVING MECHANISM" By Shaikh Mohammed Raashid Mohammed Ilyas, Shaikh Mohammed Faisal Asif, Omprakash Murlidhar Singh, Shaikh Ismail Obaidur Rehman has been approved for the bachelor degree in Mechanical engineering under Mumbai university.

Examiners

1.

2.

Date :

Place : Panvel

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DECLARATION

We declare that this written submission represents our own ideas in our words and other's ideas or words have also been included, We have adequately referenced and cited the original source. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/date/source/fact in any submission. We understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the source which have thus not been properly cited or for whom proper permission have not been taken when needed.

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ABSTRACT

This study focuses in the development of the Electrically Controlled Bearing Puller. It highlights the electrical control of the bearing puller to motorize the pulling process of manual bearing puller. Time and efficiency were the matter of priority mostly for the operator maintenance. The study was made for the Bearing Puller easier through the newly designed Electrically Controlled Bearing Puller. The purpose of this prototype is to ensure and provide convenience to the maintenanceoperator. It allows easy pulling of the bearing with lesser time consumed. The steps of utilizing this device start with the control of the toggle switch to setup positioning and pulling process. The push button sets positioning and alignment via extension and retraction of the chuck. The pulling system button have maintaining contact to remove the bearing and when the bearing has reach the target position the limit switch the pulling process will be stop while it opens the grip to finish the process. After going through evaluation phase, the study was found to be reliable providing an easy way in dismounting bearing.

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1. INTRODUCTION

Electric motors top the industrial landscape as the most widely deployed asset driving processes and productivity. Despite the dependence on these motors and their vital roles in industry, electric motors can fail for many reasons leading to losses in productivity and associated profitability. Nevertheless, the health of electric motors might not be perceived as a top priority in day-to-day operations, even where predictive maintenance programs have been implemented to make timely maintenance fixes on critical machinery before catastrophic failures can occur. The universal reliance on electric motors underscores the inherent value in detecting, identifying and evaluating operating abnormalities. Without proper attention, the likelihood of failure increases, and it will likely come without warning and at an inopportune time [1].Do bearing-related problems causes motor failures?

When a motor fails, the operator must check its bearings - even if the motor windings are blackened and still smoking. It is possible the motor malfunction was due to a voltage problem, or an excessively hot, moist, or otherwise bad environment. But most of the time, a bearing- related problem is the root cause. For example, a bearing that is beginning to gall can place an extra load on the motor. That extra load would then, in turn, cause the motor to draw excessive current. Bearing-related problems are among the most common causes of motor failures. Solving those problems will reduce motor failures [2]. Thus bearing replacement should be done during preventive maintenance schedules.

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There are many ways to remove or install a bearing on a shaft. The best way is with a pressor a bearing puller tool. It's controlled and thereis little chance of nicking the shaft with the hammeror drift, or damaging the bearing. In somecases, a specialized press or puller is neededbecause no other method will work [3].

Due to the importance of bearing replacement and method of removal, the researcher come up with an Electrically Controlled Bearing Puller. It is designed to pull bearings out from the rotor of an electric motor without damaging the motor shaft.This study could bebeneficial to the operators byreducing the amount of labor forceand safety hazards, thus would lead to saving man power resources and time consumption on the removal process.

1.1Statement of the Problem

The main purpose of the study is to design an Electrically Controlled Bearing Puller that would be useful and convenient to the operator. This supports the answer the following questions.

1. How to design the Electrically Controlled Bearing Puller and its pulling parts?
2. How to develop the Electrically Controlled Bearing Puller?
3. How to evaluate the acceptability of the project?

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1.2 Conceptual Framework of the Study

The input process includes the information, data gathering, problem identification, and the expertise. The researchers identified the problems on how to pull the bearing of the motors to maintain its condition. Information's was gathered through other references and books. The process covers the planning, designing, fabrication, list of materials, and testing. A plan in making an Electrically

Controlled Bearing Puller was done to give efficiency in maintaining the Bearings of motors. The researcher's plans were made to evaluate the project by the help of the teachers and students. The output indicates the evaluation of the prototype and completed the prototype.

Figure 1 below shows the Input Process and Output of the Conceptual Framework

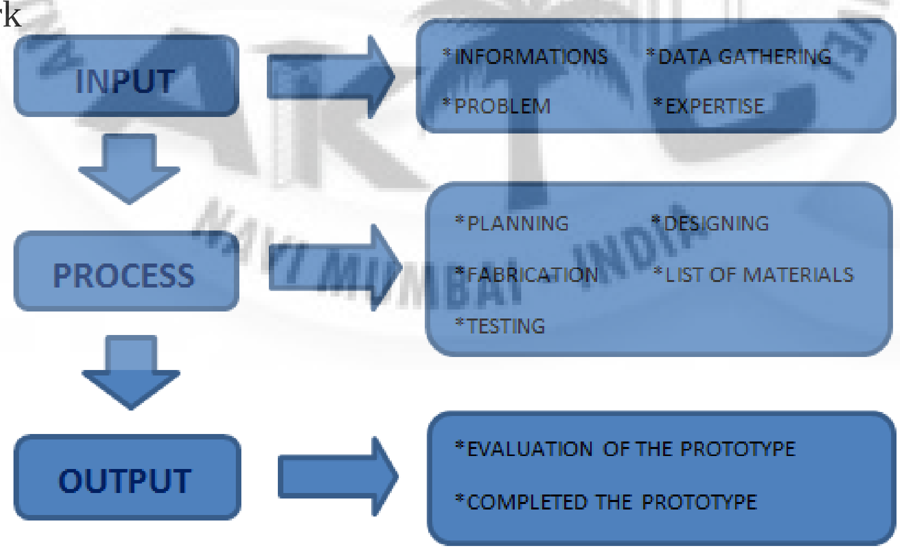

FIgure 1.1 Conceptual Framework of the Study

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Significance of the Study

The purpose of this study is to help maintenance personnel do their jobs easier and be convenient in dismounting the bearings. This also helps industries in maintaining the motor they use. Industries have their own way on dismounting bearings, but it takes time and effort to execute it without the damage of the rotor.

The Electrically Controlled Bearing Puller helps companies in maintaining electric motors. It could lessen the time in dismounting bearings as well as minimize the laborcost.

1.3 Scope of the Study

The main focus of the study is to design and develop the Industrial Motor's Electrically Controlled Bearing Puller. The size of the puller can only pulls from 1 ½ inches to 3 inches diameter. The puller only pulls bearing on external spread out on internal spread of the bearing. The bearing puller type has three legs externally spread bearing are only bearing that can be pulled. It can also be operated in one person only. Electrically Controlled Bearing Puller can only pull bearing that are

mounted on the industrial motor rotor . The maximum size of the motor's rotor.

The length is 6 inches, and 4 inches diameter. The smallest size of bearing can be pulled is 1½ inch diameter.

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1.4 OBJECTIVES

The main objective is to design and construct a device that automatically pulls the bearing using a gear motor control and sensor.

The specific objectives of the study are as follow:

- To design and develop the Electrically Controlled Bearing Puller and fabricate the pulling parts.
- To construct the Electrically Controlled Bearing Puller.

To evaluate the project in terms of predetermined parameters.

- In order to remove bearing safely we need to make modification in traditional method. The modification to be made should allow easy removal of bearing. The purpose of modification is, **Simplicity of operation**
- Removal of bearing done without damaging bearing surface.
- Skilled as well as unskilled personnel can perform the operation.

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1.5 REVIEW OF LITERATURE

1 .Nikolay A. Markov, Ilya A.Shipitko, Taras V. Benzrushko, Synthesis of the Position Controller for the Pneumatic Actuator, Siberian Conference on Control and Communications SIBCON, 2009

This journal deals with the positions of pneumatic actuators and its merits over other actuators. Pneumatic actuators offer several advantages over electromechanical and hydraulic actuators for positioning applications.

2 .Rakesh Y. Suryawanshi ,Pranay S. Ramteke , Niraj Patil , Deepak Kumar , Dr. A.V. Vanalkar Design and Fabrication of Hydraulic Bearing Puller and Pusher IJIRST –International Journal for Innovative Research in Science & Technology| Volume 1 | Issue 11 | April 2015 ISSN (online): 2349-6010.

This journal deals with the installation and removal of bearings with the hydraulic effort and how the hydraulic cylinders and control valves are installed for the effective mounting and unmounting of bearings.

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1.6 PROBLEM DEFINITION

The main purpose of the study is to design an Electrically Controlled Bearing Puller that would be useful and convenient to the operator. This supports the answer the following questions.

1. How to design the Electrically Controlled Bearing Puller and its pulling parts?
2. How to develop the Electrically Controlled Bearing Puller?
3. How to evaluate the acceptability of the project?

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2.CONVENTIONAL TECHNOLOGY

2.1 PNEUMATIC BEARING PULLER

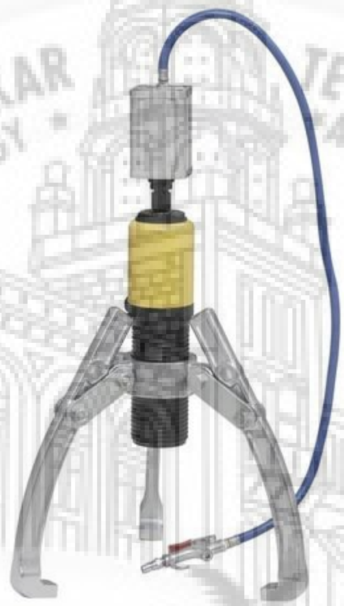

Fig 2.1 Pneumatic Puller

A bearing is a machine element that constrains relative motion to only the desired motion and reduces friction between moving parts. They are mostly associated with the rotating members. The wide user of bearings is the Automobile industry where the bearings are used in the engines, transmission system, and steering system and in other areas where rotation involves. The mounting and unmounting of a bearing from an engine or from a shaft is a tedious job as the conventional method is hammering which involves lot of human effort and there are many chances for bearings to get damaged. So to reduce these ambiguities the solution is brought with the help of pneumatic systems where air pressure is utilised to

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mount and unmount the bearings. This is achieved by using a pneumatic cylinder which is operated using a compressor and the plunger of the pneumatic cylinder is fitted with the corresponding pusher or puller depending upon the needs.The pneumatic cylinders are available in different ranges of operating pressures, so depending upon the load requirements the pneumatic cylinder can be chosen. The setup requires only less operating space and it is also portable, so that it can be connected with compressors which may be at different spots in an industry. This also consumes less time thereby increasing the productivity. The control of the Pneumatic cylinder is a hand lever valve which is used to determine forward or return stroke of the plunger fitted with the pusher or puller. The frame is so designed to house an engine casing and provisions for fixing vice to hold shafts. The pneumatic cylinder is fitted vertically by providing two columns in the either sides and a horizontal plate at the top.

Fig 2.2 Pneumatic Cylinder

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2.2 HYDRAULIC BEARING PUSHER

Fig. 2.3 Hydraulic Pullers

Bearings are used to reduce friction between rotating shaft and support. Bearings have a finite operating life, it requires periodic replacement and routine maintenance to prevent failure. Several factors impact the service life of a bearing or the frequency for required maintenance. For example, bearing loads, operating temperature, exposure to external environments, contamination, lubrication and even electrical currents acting on the bearing may impact a bearing's service life or the frequency that maintenance must be

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conducted.

The hydraulic bearing puller is a device which is used for removing bearing from the shaft. In the machine the press fit operations are very complicated to align the assembly. For this type of operations, we require heavy force for disassembly of the bearing from the machines. It can be used widely & effectively for removing the bearing. Bearings are made to exact tolerances and have very fine surface finishes. In order to maintain the geometrical precision, the surface integrity of ball, roller bearing raceways and rolling elements, it is mandatory that care in storage, handling and installation should be observed. The hydraulic bearing puller perform pulling operation of bearing safely and without damaging the bearing surface

Fig. 2.5 3- Jaw Puller

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2.3 Disadvantages of Conventional method

- Slower in Operation
- Leakage of Oil which also results in dirty surroundings.
- Which can also Cause Hazardous effect like Factory Fire.
- Pressure Relief required.

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3. DESIGN

3.1 METHODOLOGY

The Electrically Controlled Bearing Puller is designed and made for dismounting bearings of a motor's. The electrical system is made for the benefits of the maintenance personnel's dismounting bearings.

The prototype has a circuit breaker for the protection and safety in case of short circuit or overload. Using the toggle switch, the operator can control the single-phase motor to operate forward and reverse manually to set the puller to pull the bearing of the rotor. Toggle switch also used to operate Auto pull. The circuit has a stop button for manual stop. The closing and opening of the puller was driven by a small motor. The Limit switch is used to grip open and Jog button for the grip close.

The researchers use two motors the main motor and the 2nd motor. On this operation the toggle switch selects the pulling control and the other is the manual forward reverse jog control. First is to set the toggle switch to move forward and set-up the rotor center alignment of motor shaft.Afterthe setup, a push button of a bearing puller can now be pressed to energize the 2nd motor to clamp the claw to the bearing.This movement will stop after reaching the limit depending on the size of the bearing to be pulled.

The operator can now switch the toggle switch to start pulling the bearing out of the shaft. After reaching maximum pulling position state the limit switch stops the main motor and the 2nd motor to open the legs and the process ends.

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3.2 PART DESCRIPTION

3.2.1 DC MOTOR

- **Features** DC MOTOR HAS A BIG STARTING TORQUE AND EXCELLENT MOBILITY AND WHEN COMPARING WITH THE SAME SIZED AC MOTOR, THE OUTPUT IS BIG AND THE EFICIENCY IS HIGH. IT IS EASY TO CONTROL THE SPEED AND CHANGE THE NORMAL/REVERSE ROTATION. COMPARING TO AC MOTOR, IT IS AVAILABLE TO MANUFACTURE LOW VOLTAGE MOTOR WHICH CAN BE APPLIED TO PORTABLE MACHINE WHICH USES VARIOUS SPEC., ESPECIALLY BATTERY POWER (126, 246).DUE TO THE WEAR OF BRUSH, THERE IS A LIMIT IN THE SERVICE LIFE.

DUE TO BRUSH AND COMMUTATOR, NOISE GENERATES WHEN STARTING.

Current, Torque and Speed (r/min)

WHEN THE VOLTAGE OF POWER SUPPLY IS FIXED, DC. MAGNET MOTOR SHOWS THE CHARACTERISTIC IN THE RELATIONSHIP BETWEEN TORQUE, SPEED AND CURRENT AS BELOW.

THE RELATIONSHIP IS ALMOST LINEAR SHOW AS THE ABOVE, AND THE SPEED DECREASES, AND CURRENT INCREASES CONVERSELY WHEN INCREASING THE TORQUE TO THE OUTPUT SHAFT MOTOR. IT IS SAME UNTIL THE OUTPUT SHAFT OF MOTOR IS DONE A STALL, WHEN IGNORED HEAT GENERATION IN THE MOTOR.

(IT IS POSSIBLE TO CONTROL THE TORQUE BY CONTROLLING THE CURRENT.)

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ACCORDING TO INCREASE OF CURRENT (TORQUE), HEAT GENERATION IN THE MOTOR INCREASES. GENERALLY, WHEN THE TEMPERATURE OF COMPONENT PARTS IN THE MOTOR IS BELOW THAN ALLOWABLE TEMPERATURE AFTER IT WAS SATURATED, IT IS POSSIBLE TO KEEP CONTINUOUS OPERATION.

WHEN IT WAS NOT SATURATED IN THE ALLOWABLE TEMPERATURE, THE TIME TO EXCEED THE TEMPERATURE IS RATING TIME OF MOTOR AND IT IS SHORT–TIME RATING SPECIFICATION.

ACCORDING TO SIZE AND THE SPECIFICATION, EACH MOTOR MODEL HAS DIFFERENT CURRENT (TORQUE) VALUE TO BE POSSIBLE CONTINUOUS OPERATION.

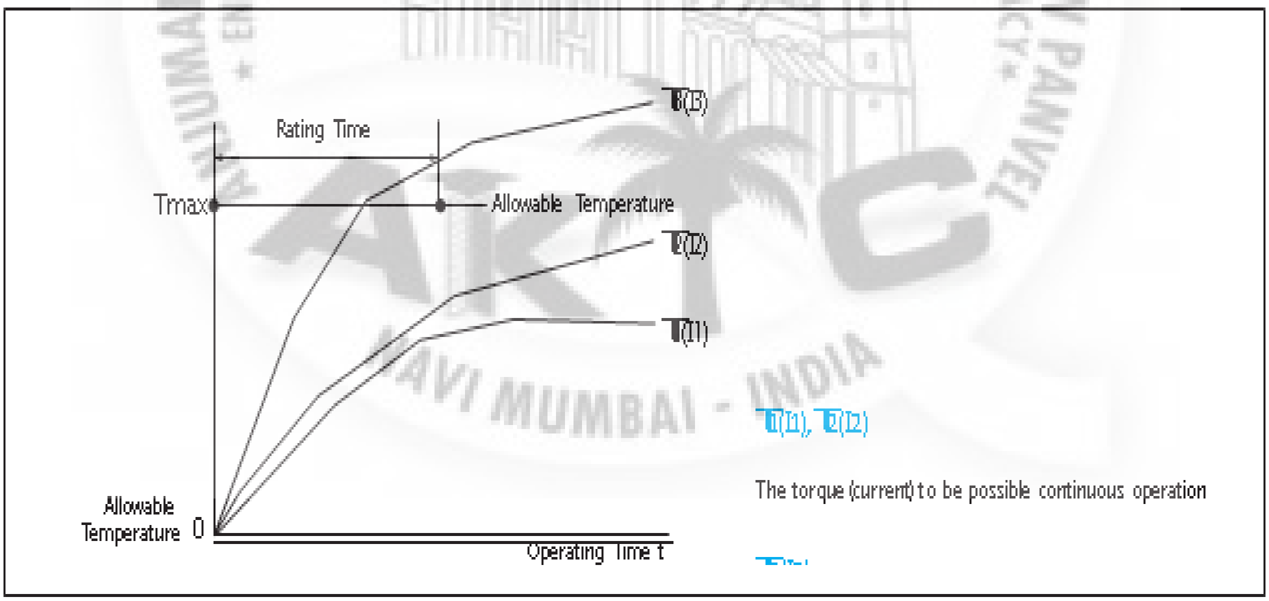


Fig. 3.2 Graph for Rating Time

40W

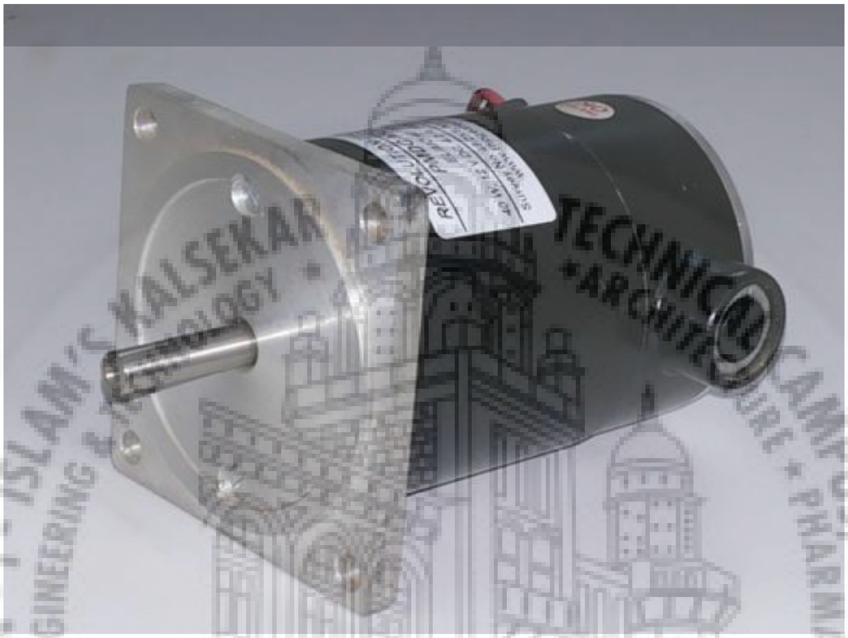


Fig. 3.3 DC Motor

DIMENSIONS

MOTOR	
Power	40 Watt
Torque	2.4Nm
Speed	160 rpm

Table 3.1 Motor Description

Motor Specification

Model 8DCG(W)□–40–30: Gear Type Shaft 8DCD□-40-30: D-Cut Type Shaft	Output W	Voltage V	Starting Current A	Starting Torque kgfcm	N.m	No Load		Rated Load			
						Current A	Speed r/min	Current A	Speed r/min	Torque kgfcm	N.m
8DCG(W)12-40-30	40	12	47.00	15.00	1.500	1.50	3300	4.80	3000	1.30	0.130
8DCG(W)24-40-30	40	24	37.00	23.00	2.300	0.60	3250	1.90	3000	1.30	0.130
8DCG(W)90-40-30	40	90	1.50	24.00	2.400	0.03	3400	0.60	3000	1.30	0.130

Table . 3.2 Motor Specification

Fig.3.4 Motors

Performance Curve

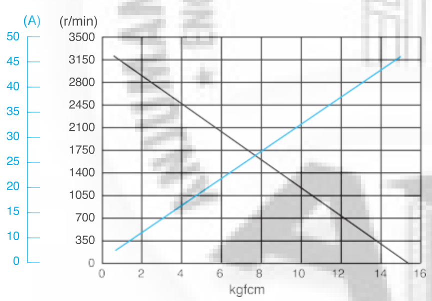
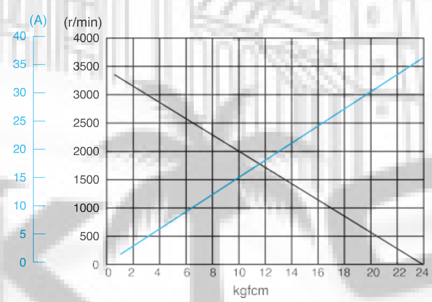
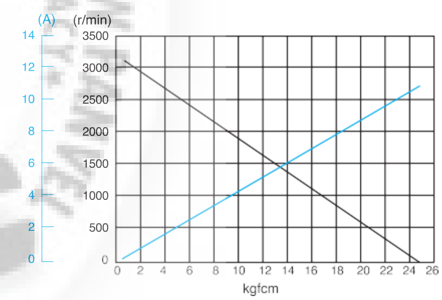
8DCG12–40–30	8DCG24-40-30	8DCG90-40-30
		

Table. 3.3 Performance Curve

Fig. 3.5 Gear Reducer

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3.2.2 CHUCK

A **chuck** is a specialized type of clamp used to hold an object with radial symmetry, especially a cylinder. In drills and mills it holds the rotating tool whereas in lathes it holds the rotating workpiece. On a lathe the chuck is mounted on the spindle which rotates within the headstock. For some purposes (such as drilling) an additional chuck may be mounted on the non-rotating tailstock.

Fig. 3.6 Chuck

Many chucks have jaws, (sometimes called dogs) that are arranged in a radially symmetrical pattern like the points of a star. The jaws are tightened up to hold the tool or workpiece. Often the jaws will be tightened or loosened with the help of a chuck key, which is a wrench-like tool made for the purpose. Many jawed chucks, however, are of the keyless variety, and their tightening and loosening is by hand force alone. Keyless designs offer the convenience of quicker and easier chucking and unchucking, but have a lower gripping force to hold the tool or workpiece, which is potentially more of a problem with cylindrical than hexagonal shanks. Collet chucks, rather than having jaws, have collets, which are flexible collars or sleeves that fit closely around the tool or workpiece and grip it when squeezed.

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Chucks on some lathes have jaws that move independently, allowing them to hold irregularly shaped objects. A few chuck designs are even more complex, involving specially shaped jaws, higher numbers of jaws, quick-release mechanisms, or other special features.

CHUCK	
Material	Stainless Steel
Diameter	120mm
Volume	4.524 x 10^5 mm
Height	50mm
Speed	6000 rpm
Mass	4 Kg

Table 3.4 Chuck Specification

Magnetic and vacuum chucks are also made, with typically flat surfaces against which workpieces or tools are firmly held by the pressure of their respective force.

To chuck a tool or workpiece is to hold it with a chuck, in which case it has been chucked. Chucking individual slugs or blanks on a lathe is often called chucking work. In bar work or bar feed work the stock protrudes from the chuck, is worked upon, then parted off (cut off) rather than sawn. Automatic lathes that specialize in chucking work are often called chuckers.

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Fig.3.7 Parts of Chuck

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3.2.3 RACK AND PINION:

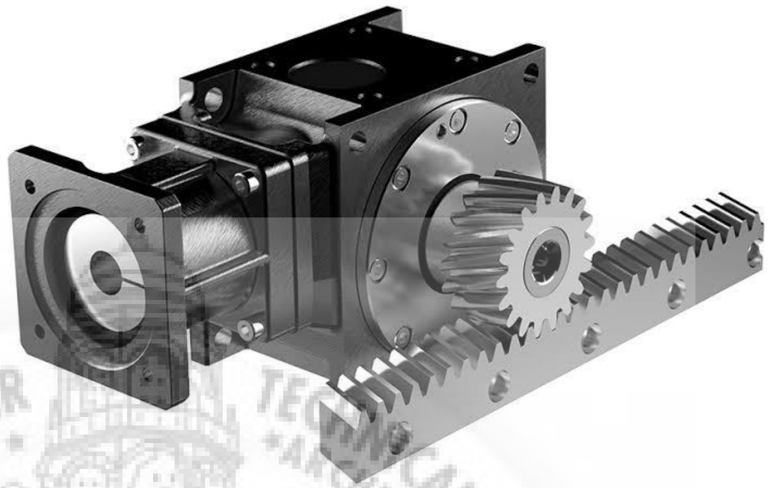

Fig. 3.8 i Rack and Pinion

Gear racks are utilized to convert rotating movement into linear motion. A gear rack has straight teeth cut into one surface of a square or round section of rod and operates with a pinion, which is a small cylindrical gear meshing with the gear rack. Generally, gear rack and pinion are collectively called “rack and pinion”. There are many ways to use gears. For example, as shown in the picture, a gear is used with the gear rack to rotate a parallel shaft.

To provide many variations of rack and pinion, KHK has many types of gear racks in stock. If the application requires a long length requiring multiple gear racks in series, we have racks with the tooth forms correctly configured at the ends. These are described as “gear racks with machined ends”. When a gear rack is produced, the tooth cutting process and the heat treatment process can cause it to try & go out of true. We can control this with special presses & remedial processes.

There are applications where the gear rack is stationary, while the pinion traverses and others where the pinion rotates on a fixed axis while the gear rack moves. The former is used widely in conveying systems while the latter can be used in extrusion systems and lifting/lowering applications.

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SHAFT (RACK)	
Diameter	9.5 cm ~ 95mm
Length	30cm ± 5
Teeth	27

Table 3.5 Rack Specification

As a mechanical element to transfer rotary into linear motion, gear racks are often compared to ball screws. There are pros and cons for using racks in place of ball screws. The advantages of a gear rack are its mechanical simplicity, large load carrying capacity, and no limit to the length, etc. One disadvantage though is the backlash. The advantages of a ball screw are the high precision and lower backlash while its shortcomings include the limit in length due to deflection.

PINION	
Material	40Ni2CrMo28
Gear Type	Spur
Module	4mm
Teeth	18

Table 3.6. Pinion Specification

Rack and pinions are used for lifting mechanisms (vertical movement), horizontal movement, positioning mechanisms, stoppers and to permit the synchronous rotation of several shafts in general industrial machinery. On the other hand, they are also used in steering systems to change the direction of cars. The characteristics of rack and pinion systems in steering are as follows: simple structure, high rigidity, small and lightweight, and excellent responsiveness. With this mechanism, the pinion, mounted to the steering shaft, is meshed with a steering rack to transmit rotary motion laterlly (converting it to linear motion) so that you can control the wheel. In addition, rack and pinions are used for various other purposes, such as toys and lateral slide gates.

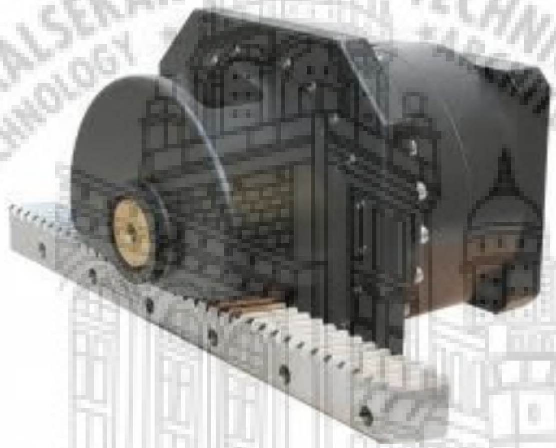

Fig. 3.9 1 Rack and Pinion

3.2.4.MECHANICAL PULLER

- **Multifunctional:** These Mechanical pullers are ideal for pulling a wide variety of parts, including bearings, bushings, wheels, gears and pulleys. Applications for Mechanical pullers will be found in motor repair shops, service companies, maintenance shops, industry, mining, paper mills, chemical plants, shipping, off- shore, etc.

Fig. 3.10 Mechanical Puller

User-Friendly: Unique, patented double-acting pump body to provide pushing and pulling force.

Unique jaw design for mounting and outer ring pulling without removing and changing.

Three-jaw structure always provides an even and constant force, whether mounting, outer ring pulling or inner ring pulling.

Depends on user requirements - the extension bars can be used where necessary for extra reach.

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Compact: The self contained mechanical pump and cylinder save space, as you don't need a separate pump, hose or puller.

- **Strong:** The harder the force, the tighter the jaws grip. The arms cannot bend or deflect.
- **Economical:** 2/3-arm combination puller, 2 pullers for the price of one.
- **Safe:** The improved integral safety release valve prevents overloading and ensures that you will never exceed the maximum power capacity.
- The built-in safety valve ensures user safety and prevents damage to tool and job.
- The built-in safety valve prevents the user from being harmed and the job from being damaged as rated pressure cannot be reset or adjusted.
- Most parts are forged of SCM440 alloy steel, creating a very safe and durable product.
- **Versatile:** Various accessories are available. Sets are supplied in practical PE case

Cost-reducing

- Built-in safety valve ensures the tool is always opera- ted as per the rated pressure, significantly extending tool life.
- Three-in-one design reduces preparation, tool-reset time and duration of operation.
- This push puller is ideal for fitting and removing a wide variety of press-fit parts, including bushings, wheels, bearings, gears and pulleys.

and consist of a puller block, connecting rods and a set of bearing splitters.

- **Easy-to-Use:** The tri-section plates are specially designed to be used in conjunction with the three-armed pullers. The unique and patented swivel design creates maximum spread and applies even force at the most efficient point. The plates grip behind the inner and outer rings of the bearing, preventing the pulling force from being transmitted through the moving parts, minimizing the risk of bearing damage

Fig. 3.11. 3-Jaw Mechanical Puller 1

- **Advantages of self-centering pullers:**

Prevents damage to shaft and workpiece being pulled.

Efficient and saves time.

Can be used in any position.

Adapters included.

4, 6, 8, 12, 20 and 30 ton capacity!

Fig.3.12 3-Jaw Mechanical Puller 2

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4. CIRCUIT

4.1 CIRCUIT DESIGN

The Electrically Controlled Bearing Puller is evaluated using descriptive statistics using survey, observation or analysis of the subject and measures the data gathered from a range of selected respondents.

In Figure the bar graph shows the mean responses of the Electrically Controlled Bearing Puller base on the different categories the mean result on the category Aesthetic is 4.6 thus, it implies that the respondent rated moderately acceptable in terms of the overall appearance of the machine is presentable. Also the machine effectiveness has the numerical rating of 5.0 corresponding to highly acceptable adjectival rating which implies that the overall operation of the machine is convenient and easy for the respondents. Moreover the efficiency in processing of the machine is 5.0 numerical rating was rated by the respondents corresponding to a highly acceptable adjectival rating indicates the efficiency in processing the machine. Furthermore, on the functionality is 5.0 thus, it implies that the respondents rated highly acceptable in terms of giving the exact functionality of the machine

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PARAMETER	MEAN
AESTHETICS	4.6
EFFECTIVENESS	5.0
EFFICIENCY	5.0
FUNCTIONALITY	5.0
AVERAGE MEAN	4.9

Table 4.1 Circuit Performance

4.2 Motor Control and Power Diagram

Figure shows the Main Motor control Forward Reverse of Electrically Controlled Bearing Puller. The Toggle Switch is the selector, either to pull the bearing ready or to position the puller to grip. Push button 1 and 2 are jog buttons for extension and retraction. The push button 4 is the pull button and the relay contact normally closes one to stop the forward.

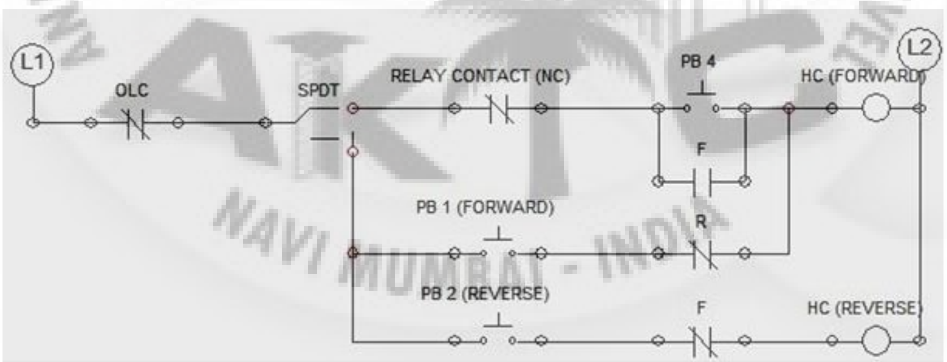

Figure 4.1 Motor Control Forward Reverse Operation

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Figure shows the Main Motor Power Circuit of Electrically Controlled Bearing Puller. The main motor is a single phase capacitor start motor that uses a forward reverse contactor.

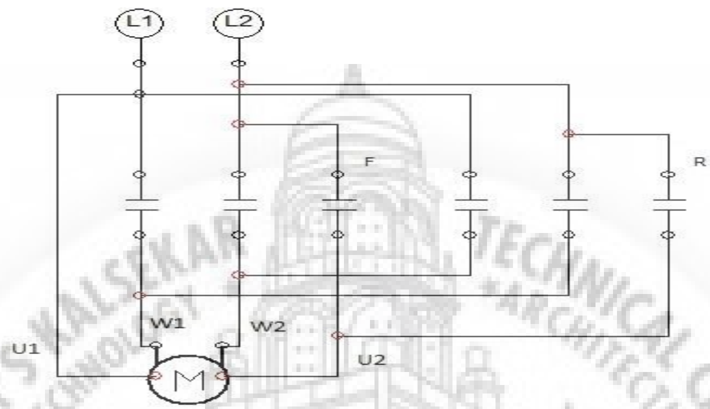

Figure 4.2 The control circuit of the Gripper of the Electrically Controlled Bearing Puller

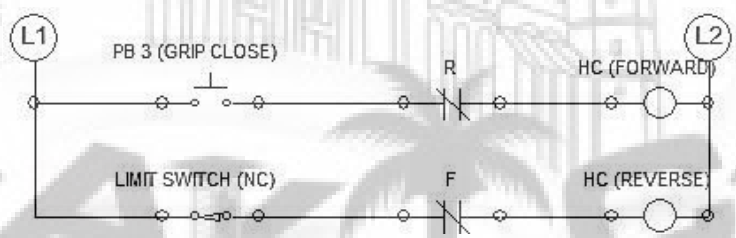

Figure 4.3 Control Circuit

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5. CALCULATION

P= 40 W

V= 90

T= 2.4 Nm

$$P = \frac{2\pi NT}{60}$$

N= 160 rpm

$$z_1 = \frac{2}{sin^2 \alpha}$$

$Z_1 \approx 18$

i = 1.5

$$\frac{z_2}{z_1} = i$$

$Z_2 = 27$

Selecting Material from PSG 8.5

40Ni2Cr1Mo28

σ_b = 4000 Kgf/cm^2

σ_u = 155 Kgf/mm^2

$Y = \pi[0.154 - \frac{0.912}{z1}]$ - PSG 8.50

Y = 0.3246

$[M_t] = M_t. K. K_d$ - PSG 8.15

$K.K_{d = 1.5}$

$[M_t] = 97420 \text{ x } \frac{KW}{n} \text{ x Sf}$

$= 97420 \text{ x } \frac{(40\times10^{-3})}{160} \text{ x } 1.5 \text{ x } 1.2$

$[M_t] = 43.839$

$m \geq 1.26 \sqrt[3]{\frac{[M_t]}{y\cdot\sigma_b\cdot\Psi m\cdot z_1}}$

$\Psi = \frac{b}{m} = 10$

$m \geq 1.26 \sqrt[3]{\frac{43\cdot831}{0.3246\times4000\times10\times18}}$ - PSG 8.13 A

m = 1.23

m ≈ 2

unsafe at m = 2.

Taking m = 4.

$a = \frac{m}{2}(Z1 + Z2)$

= 9 cm

$b = \psi . m = 10 \text{ x } 4$

= 40 mm

$\sigma_C = \frac{0.74\,(i \pm 1)}{a} \sqrt{\frac{(i+1)E\,[Mt]}{i.b}}$ - PSG 8.13

$= \frac{0.74\ X\ 2.5}{9} \sqrt{\frac{2.5\,(2.5\ X\ 10^6)(43.839)}{(2.5)\,(4)}}$

$\sigma_c = 1012.39 \text{ Kgf/cm}^2$

Dynamic load Fd :

Fd = Ft. Cv

$$Ft = \frac{HP \ X \ 75}{Vm}$$

$Vm = \pi \ d_p \ n$

$d_p = m \ x \ Z_1$

$= 0.072$

$$Vm = \frac{\pi \ X \ 0.072 \ X \ 160}{60}$$

Vm = 0.60 m/sec

Cv - barth velocity factor - PSG 8.51

$$Cv = \frac{3+Vm}{3}$$

$$Cv = \frac{3+0.60}{3}$$

Cv = 1.2

$$Ft = \frac{75 \ X \ P \ X10^3}{746 \ X \ Vm}$$

$$= \frac{75 \ X \ 40 \ X10^3}{746 \ X \ 0.60}$$

Ft = 6702.41

Fd = 6702.41 x 1.2

Fd = 8042.89

Wear Load Fw: - PSG 8.51

Fw = Dp . b. Q. k

$$K = \frac{\sigma_c 2 \ \sin \ \alpha \ [\frac{1}{E1} + \frac{1}{E2}]}{1.4}$$

K = 1.4

$$Q = \frac{2i}{i+1}$$

$$= \frac{2(1.5)}{1.5+1}$$

Q = 1.2

Fw = 12045.81

Fw > Fd

SATISFIED

Fs : - PSG 8.51

Fs = σ_b . m .b. Yp

= 4000 x 4 x 40 x 0.3246

Fs = 20774.4

Fs > Fd

SATISFIED.

GEAR PROPOTION **PSG – 8.22**

MODULE , M ,MM	M = $\frac{2a}{Z1+Z2}$
CENTRE DISTANCE , A	a = 9 cm

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HEIGHT FACTOR , FO	$f_o = 1$
TOOTH DEPTH , H	h = 2.25 mm h = 1.9 mm for Stud
PITCH DIAMETER,	$d_1 = m. Z_1$ = 72 mm
TIP DIAMETER, DA	$d_a = (Z_1 + 2f_o).m$ = 80 mm
ROOT DIAMETER, DF	$d_f = (Z_1 + 2f_o).m – Z_c$ = 64 mm

Table. 5.1 Gear Proportion

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6. CONCLUSION

The final chapter is dedicated to the summary of findings which is the totality of the work. The conclusion was determined through the most remarkable findings. The recommendation is based on the conclusion made and actions to be done by people so that the problem can be solved.

The important opinions were bound on the design, development, implementation and evaluation of the Industrial Motors Electrically Controlled Bering Puller. The machines circuit is electronically functions through the input and output devices connected together to perform the bearing puller. Limit switch, toggle switch, pilot lamp and push buttons were the input devices of the machine. The motor is determined to be the output component because it controls the process of the machine. The technical evaluation of the machine was conducted in such a way that the physical profile, operability and significance were evaluated using descriptive statistics. This was conducted using a prudently planned questionnaire distributed to individuals who have knowledge about the bearing puller who are mostly residents of Cagayan de Oro City.

The machine was potentially accepted due to its noticeable aesthetics and influence on the bearing puller as well as the consumers. The economic impact of the machine provides reliable marketability. On the other hand, the Electrically Controlled Bearing gives convenience to the Industry.

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