DESIGN AND FABRICATION OF EL-BOW POWER TRANSMISSION WITH CUTTER

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Abstract-In this project "EL-BOW TRANSMISSION" being compact and portable equipment, which is skillful and is having practice in transmitting power at right angle without any gears being manufactured. The El-bow Mechanism transmits the input power towards the output side such a way that the angular forces produced in the slacks are transmitted with the help of rods which takes up the input power and the right angle drive is transferred towards the output slack and rod assembly. Hence very little friction plays while the power is being transmitted. Hunting and back lash errors are absent. Therefore, it is appreciated that efficiency as high as 90-92% are possible in gear less transmission mechanism. So, instead of using gears, this technology elegantly converts rotational motion using a set of cylindrical bars, bent to 90º .Both the input shaft and the housing have rotational axes. The rotational axis of the input shaft is disposed at an angle of 90 degree with respect to the rotational axis of the housing. As a result, rotation of the input shaft results in a processional motion of the axis of the bent link. The rotary and reciprocating motion of bent link transmit rotation of prime mover to 90 degree without any gear system to an output shaft. Then the output shaft is connected to the "SCOTCH YOKE MECHANISM" which will convert rotational motion into reciprocating motion so, we had made a cutting device with the help of hacksaw blade, which is welded with scotch mechanism. This sawing machine is faster and easier then hand sawing and will produce a accurate and desired cut on the work piece.

Keywords: EL-Bow , Scotch Yoke Mechanism, Cutter, Sawing Machine.

I.INTRODUCTION

1.1 EL-BOW POWER TRANSMISSION

Today's world requires speed on each and every field. Hence rapidness and quick working is the most important. Now a day for achieving rapidness, various machines and equipment are manufactured by man. Engineer is contently conformed to the challenges of bringing ideas and design in to reality. New machine and techniques are being developed continuously to manufacture various products at cheaper rates and high quality. The project "EL-BOW POWER TRANSMISSION" was being compact and portable equipment, which is skillful and is, having something, practices in the transmitting power at right angle without any gears being manufactured. Most of the material is made available by our college. The parts can be easily made in our college-shop its price is also less. This project gives us knowledge, experience, skill and new ideas of the manufacturing. It is a working project and having guarantee of the success. This project is the equipment useful to improve the quality of the gear being manufactured and can be made in less time, hence we have selected this project el-bow mechanism is an ingenious link mechanism of slider and kinematic chain principle. This is also called as "gearless transmission mechanism" this mechanism is very useful for transmitting motion at right angles. However in certain industrial application "gearless transmission at right angle" can also work at obtuse or accurate angle plane can be compared to worm and worm gear or bevel and pinion gear which are invariably used in the industry for numerous application. The main feature for mechanism comparatively high efficiency between the input and the output power shafts with regards to the gear efficiencies.

It has elaborately discussed in detail in the entire books of engineering that the gear drives have very low mechanical efficiencies. The El-bow Mechanism transmits the I/P power towards the O/P side such a way that the angular Forces produced in the slacks are simply transmitted with the help of pins which takes up the I/P power and the right angle drive is transferred towards the O/P slack and pin assembly. Hence very little friction plays while the power is being transmitted; the Hunting and back lash one absent. Therefore, it is appreciated that efficiency as high as90-92% are possible in gear less transmission mechanism. Here we are going to show two applications of El-bow mechanism. How it will become work, which we are showing by cutting the wood by attaching the wood cutter at the output shaft as well as we are also making it as compressor. It will suck the air from atmosphere, compressor it & delivers it at high pressure. As we were calculate the result obtained is we can get the compressed air at pressure2 bar. The first application of this mechanism was made use of the "Big Ben Clock" having four dials on the tower of London. This clock was installed some rotational motion around an axis usually involves gears, which can quickly become complicated, inflexible and clumsy-looking, often ugly. So, instead of using gears, this technology elegantly converts rotational motion using a set of cylindrical bars, bent to 90º, in a clever, simple and smooth process that translates strong rotational force even in restricted spaces. A gearless transmission is provided for transmitting rotational velocity from an input connected to three bent links. Both the input shaft and the housing have rotational axes. The rotational axis of the input shaft is disposed at an angle of 90 degree with respect to the rotational axis of the housing. As a result, rotation of the input shaft results in a processional motion of the axis of the bent link. The rotary and reciprocating motion of bent link transmit rotation of prime over to 90 degree without any gear system to an output shaft without gears. Includes an input shaft.

1.2 SCOTCH YOKE MECHANISM

1.2.1 THEORY OF MACHINE

It is a branch of engg. Which deals with study of relative motion between the various parts of machine & forces which acts on them?

1.2.2 APPLICATION OR SCOPE

It is very essential for an engineer in designing the various parts of a machine.

1.2.3 MECHANISM

- It is like skeleton & has definite motion between various links.
- It is model of machine.
- It is related to the motion.
- It may be many links e.g. Engine indicator, typewriter etc.

1.2.4 LINK OR KINEMATIC LINK OR ELEMENT

Each part of machine which moves relative to some other part is known as cinematic link or element. A link may have consisted of several parts which are manufactured as separate unit.

1.2.5 CHARACTERISTICS OF LINK

- It must be a resistance body.
- It should have relative motion.

1.2.6 TYPES OF LINK

- Flexible link
- Rigid link

1.2.7 KINEMATICS PAIR

Kinematics pair has two elements or link together which have relative motion between them. The motion between them completely or successfully constrained.

Classification of Kinematics pair:

- Lower pair
- Higher pair

On the basis of type of constraint: Closed pair , Unclosed pair .

On the basis of type of relative motion: Sliding pair , Screw pair , Turning pair , Spherical pair , Rolling pair.

1.2.8 INVERSION OF MECHANISM

When of the links is fixed in a kinematics chain ,it is called mechanism .so we can obtain as many mechanisms as the number of link in a kinematic chain by fixing ,in turn , different link in a kinematics chain . This method of obtaining different mechanism by fixing different links in a kinematic chain.

1.2.9 TYPES OF INVERSION

1. Four bar chain or quadric cycle chain:
   Beam engine, Coupling rod of locomotive , Watt's indicator mechanism
2. Single slider crank chain:
   Bull engine or pendulum engine , Oscillating cylinder engine , Rotary engine , Crank & slotted quick return mechanism , Whitworth quick return mechanism.
3. Double slider crank

Elliptical trammels , Scotch yoke mechanism , Oldham's coupling.The scotch yoke is a very simple mechanism for converting rotary motion into reciprocating (back and forth) motion using an absolute minimum of parts. The dark blue pin, sits in the slot in the yoke. The pin is as close to the width of the slot as possible. As the wheel turns the yoke is forced back and forth with in its two bushes (dark orange). The speed of motion follows that of a sine wave with the speed reaching a maximum at the middle of the travel and momentarily coming to a complete stop at each end of the travel. Scotch yokes have the advantage of being very simple and direct but the disadvantage of having a lot of parts rubbing together which can cause wear and friction. The Scotch Yoke Mechanism also known as slotted link mechanism m is a reciprocating motion mechanism converting the linear motion of a slider into a rotational motion or vice versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating parts. The location of the piston versus time in a sine wave of constant amplitude, and constant frequency given a constant rotational speed. The scotch yoke is a mechanism for converting the rotational motion of crank in linear Motion of slider. The reciprocating part is directly coupled to sliding yoke with a slot that engages a pin on the rotating part. When of the links is fixed in a kinematics chain ,it is called mechanism .so we can obtain as many mechanisms as the number of link in a kinematics chain by fixing ,in turn different link in a kinematics chain .This method of obtaining different mechanism by fixing different links in a kinematic chain. This mechanism is used for converting rotary motion into a reciprocating motion. The inversion is obtained by fixing either the link 1 or link 3. In figure link 1 is fixed. In this mechanism, when the link 2 (which corresponds to crank) rotates about B as center, the link 4 (which corresponds to a frame) reciprocates. The fixed links 1 guide the frame. The Scotch yoke, also spelled Scotch Yoke and scotch yoke, is a mechanism for converting the linear motion of a slider into rotational motion or viceversa. The other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The shape of the motion of the piston is a pure sine wave over time given constant rotational speed

1.3 MODELING

1.3.1 CREO PARAMERIC

Powerful and Flexible 3D CAD Software to Accelerate Product development Process. PTC Creo Parametric should be your first choice for product design. Built on the foundation of Pro/ENGINEER, the original Parametric 3D CAD, it is the most powerful and flexible 3D CAD software on the market. With the broadest range of powerful 3D CAD capabilities available, presented in a modern, streamlined, easy-to-use interface, you can design better products, faster.

1.3.2 CREO SOFTWARE

PTC Creo is a scalable, interoperable suite of product design software that delivers fast time to value. It helps teams create, analyze, view and leverage product designs downstream utilizing 2D CAD, 3D CAD, parametric & direct modeling.

1.3.3. CREO

Creo is a family or suite of design software supporting product design for discrete manufacturers and is developed by PTC. The suite consists of apps, each delivering a distinct set of capabilities for a user role within product development.

1.3.4 USE OF PRO E

PTC Creo, formerly known as Pro/ENGINEER is a parametric, integrated 3D CAD/CAM/CAE solution created by Parametric Technology Corporation (PTC). It was the first to market with parametric, feature-based, associative solid modeling software.

1.3.5 NX software

NX, formerly known as NX Unigraphics or usually just U-G, is an advanced high-end CAD/CAM/CAE software package originally developed Unigraphics, but since 2007 by Siemens PLM Software

1.3.6 PRIMARY FEATURES AND BENEFITS

Quickly and easily create 3D models of any part or assembly Create manufacturing drawings automatically with complete confidence that they will always reflect your current design Combine the power of parametric modeling with the flexibility of direct modeling Improve design aesthetics with comprehensive surfacing capabilities Repurpose neutral and non-PTC CAD data from customers and suppliers easily, avoiding the need to convert files or recreate 3D models from scratch Get instant access to comprehensive learning materials and tutorials from within the product to get productive faster.

II.LITRETURE REVIEW

[1]**Atish Lahu Patil ,Vinay Prabhakar Jadhav , Sagar Padmakar Patil, Roshan Suresh Shelar et al** During working on experimental setup and after a long discussion it is observed that proposed arrangement used for any set of diameters with any profile of shafts for skew shafts of any angle but the shaft's must be having the rotational motion about his own axis, transmission of motion is very smooth and desirable and used only for the equal R.P.M. of driving shaft and driven shaft by employing links or given type of links for appropriate joints for revolute pair.

[2]**Jagushte G. S, Kudalkar Hrishikesh, Patil Vikas, Varak Vishal et al** This paper represent real time study of gearless transmission mechanism. This transmission system is to be analyzed in solid works software to study reaction of elbow rods and hub and then the fabrication of mechanism is carried out. The real time study is carried out by applying a motor to one of the shafts which drives the output shaft. The analysis is performed by applying the force on hub according to given Revolution per minute. Similar analysis carried out at different higher revolutions per minute and forces are applied. As a result response of elbow rod and hub investigated to find permissible speed of mechanism.

[3]**Mahantesh Tanodi , S. B. Yapalaparvi , Anand. C. Mattikalli , D. N. Inamdar , G. V. Chiniwalar et al** The Gearless transmission for parallel shafts is a device for transmitting motions between the Parallel shafts. The synthesis of this mechanism would reveals that it comprises number of pins would be in between 3 to 8, if more the pins smoother the operation. These pins rotate inside hollow cylinders thus formatting a rotary pair. The Z-pins (or Z-links) are free to rotate in the holes, which are drilled parallel to the axis of shafts. The angle for which the pins are bent to must precisely the same for each one, and the holes in the shafts must be accurately drilled, both radially and tangentially. All parts of this coupler move when the shafts rotate. This is a very smooth-acting device, and the minimal power loss. It can be run at nearly any speed, even at high speed, and is very quiet. It is fascinating to watch in action, with the pins rotating in holes as it rotates. Unlike universal joints, there is no performance loss by increasing shaft offset.

[4]**Amit Kumar et al** In this arrangement motion is transmitted between the co-axial shafts of different diameters. The synthesis of this mechanism reveals that the no. of pins used in this arrangement should be even, 2, 4, 6, and 8. If more pins used motion will be smoother, but increase in no. of pins not at the cost of strength of shaft. Pins are fixed(may be permanent or temporary) in the drilled holes at the both shaft ends due to which motion is transferred .elbow pins or Z-pins or link used for this arrangements. The bent angles for the all pins are given very precisely, holes drilled very accurately & the axis of both the shafts must be co-axial. Proposed arrangement used for any set of diameters with any profile of shafts but the shafts must be co-axial and having rotational motion along the common axis. Working of this arrangement is very smooth & use very effectively with very minimum amount of power losses.

[5]**Ashish Kumar, Puneet Pawar, Sagar Rana, Shishir Bist et al** the modern gear drives has been widely applied due to excellent accuracy and reliability. However, the major downside of even the most efficient gear drive is the low efficiency due to errors like backlash and considerable vibrations. These vibrations engender noisy operation and cause more wear and tear resulting in low life span. The development of a more efficient multi-angular gearless drive has been explored relatively unsuccessfully and negligently regardless of its advantages over both gear drives and simple gearless drives. Recent advances in technologies, material, analytical modeling and simulation capabilities has opened the possibility of major advances towards the design and development of a reliable, cost effective and ultra-efficient multi-angular gearless drive.

[6]**Navneet Bardiya, karthik.T, L Bhaskara Rao et al** This paper presents the real time study of mechanism. The system is to be analyzed in Solid Works package software to watch the response of the elbow rods and the also the hub (coupled with shaft). The real time study is carried out by applying a motor to one of the shafts supported on bearings. Motion analysis is performed by running the mechanism at 15 revolutions per minute; reaction forces and reaction moment are plotted against clock run of 5 seconds by using post processor. Similar motion analysis is carried out at different higher revolutions per minute and peak values of forces and moments are taken from the plot and compared with allowable stress. Theoretical calculations are made to obtain allowable stress by making use of design data values. As a result, response of elbow rod and hub is investigated to find the permissible speed of mechanism. Further simulation is performed to verify the motion analysis results.

[7]**Shadab Husain, Mohammad Shadab Sheikh et al** Nowadays in India, recycling is one of the areas which is rapidly increasing day by day. The amount of waste coming is in a tremendous quantity. Aluminium cans and Tin plate cans are one of the important product which is being recycled on an increasing scale. For carrying out this recycling can crushers are used . For recycling of these cans , manual operation is being carried out in industries, which is a time consuming process and ultimately it leads to the reduction of production rate. In order to crush the cans in a less time ,we are designing a can crusher machine using scotch yoke mechanism having multi or two side crushing ability. A can crusher machine is used for crushing aluminium soda cans for recycling purpose and also for easy storage in recycling bins. The scotch yoke mechanism converts the rotating motion into reciprocating motion, this is the principle which we are using in our can crusher.

III.METERIAL SELECTION

3.1 SELECTION OF MATERIAL

SI.NO	PARTS NAME	MATERIALS	QUANTITY	DESCRIPTION
1	Frame	Mild steel	1	465x315x235(mm)
2	Motor	Standard	1	3650rpm (input)
3	Shaft	Mild steel	2	Dia=19mm & L=530mm
4	Cylinder	Mild steel	2	Dia=115mm & L=10mm
5	Bent link	Stainless steel	4	Dia=8mm & L=4x300mm
6	Bearing	Cast iron	4	P204
7	Scotch disc	Mild steel	1	Dia=145mm
8	Yoke	Mild steel	1	L=170mm& B=55mm

3.1.1 FRAME

It's the structure made up of several bars welded together for the basic support of our project. The parts like bearings and motor are mounted on it with the help of nuts& bolts. The dimensions of the frame that we have used in our project are ,

Length of the frame (l) = 465 mm
Height of the frame (h) = 235 mm
Width of the frame (w) = 315 mm

The frame is made up of mild steel material.

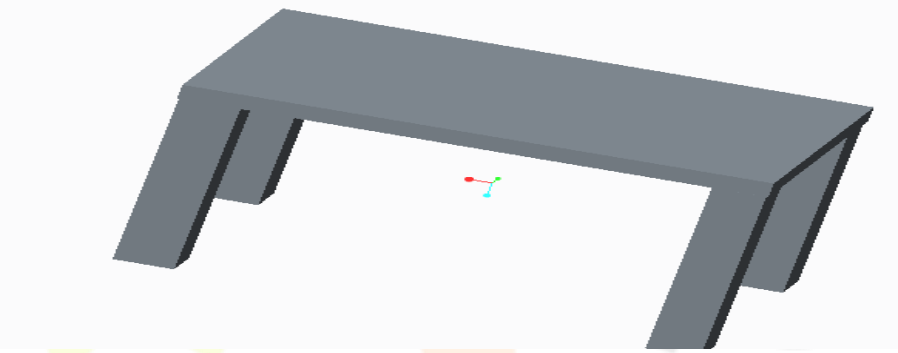

Fig 3.1 Frame

3.1.2 MOTOR

The motor is a device which will convert electrical energy into mechanical energy; the motor is the source, which will produce rotary motion for the input shaft in our project. We have used a mixer motor which generates 3650rpm (input).

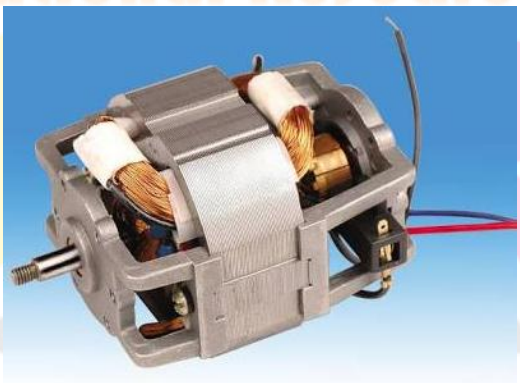

Fig 3.2 Motor

3.1.3 SHAFT

They are the elements which support the rotating parts like disk and motor (according to our project) and in turn are themselves supported by the bearings resting in the frame. The shaft performs the function of transmitting power from one rotating part to another member by connected to it. Thus, they are subjected to torque due to power transmission and bending moment due to the reactions on the members that are supported by them. We have used a hallow shaft are,

Where,
Total diameter of the shaft (d) = 19 mm
Total length of the shaft (l) = 530 mm
The material of the shaft is mild steel.

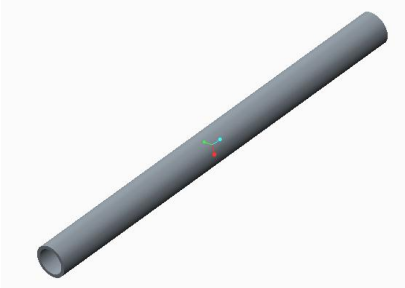

Fig 3.3 Shaft

3.1.4 CYLINDRICAL DISK

It is the disks of thickness 10mm and the diameter of 115mm each. These disks is welded with the both input shaft and output shaft separately .These disks are drilled for generating 4 holes in such a way that the angle between each holes are 90 degree and these holes are at equal distanced from each hole . These holes are generated on the both disks for inserting the bent links. This hole is drilled with 9mm diameter tool piece and the material of the cylindrical disk is mild steel.

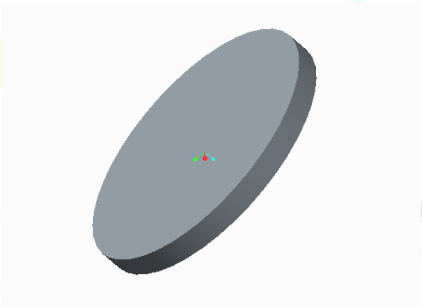

Fig 3.4 Cylindrical disk

3.1.5 BENT LINKS

The bent links are made up of stainless steel, these rods are bended to L shape or to 90 degree at the midpoint of the rods, each rod is 300mm long and the diameter of the rod is 8mm. This rods will reciprocate while the motion transmission between two shafts. These rods are the main reason for the project's title el-bow power transmission; this rod will connect two shafts and transfer motion or power from input shaft to output shaft.

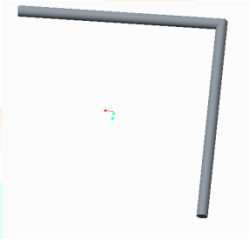

Fig 3.5 Bent links

3.1.6 BEARINGS

We have used two bolts flange bearings which has diameter of 20mm , the bearing is a mechanical element that constrain relative motion to only the desired motion, and reduce friction between moving parts, rotary bearing holds rotating components such as shaft within mechanical system.

Fig 3.6 Bearing

3.1.7 SCOTCH YOKE

The scotch yoke or slotted link mechanism is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion, or vice versa. The cutter reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part.

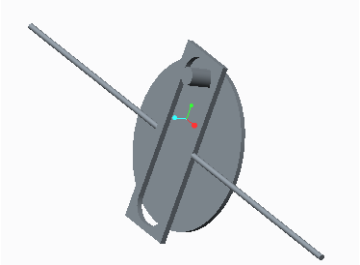

Fig 3.7 Scotch Yoke

IV.DESIGN AND FABRICATION OF EL-BOW POWER TRANSMISSION IN CREO MODELING

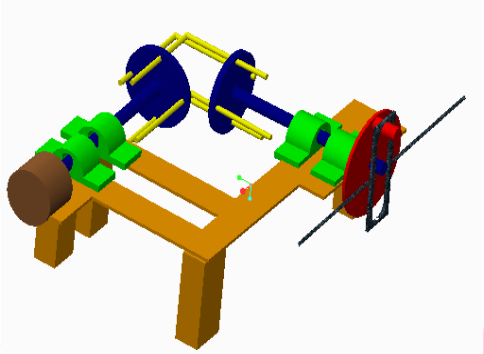

Fig 4.1 Design and Fabrication of El-Bow Power Transmission in Creo – Modeling

4.1 WORKING OF EL-BOW POWER TRANSMISSION

The Gearless transmission or El-bow mechanism is a device for transmitting Motions at any fixed angle between the driving and driven shaft. The synthesis of this mechanism would reveal that it comprises of a number of pins would be between 3 to 8 the more the pins the smoother the operation. These pins slide inside hollow cylinders thus formatting a sliding pair. Our mechanism has 4 such sliding pairs. These cylinders are placed in a Hollow pipe and are fastened at 90^0 to each other. This whole assembly is mounted on steel table. Power is supplied by an electric motor. The working of the mechanism is understood by the diagram. An unused form of transmission of power on shaft located at an angle. Motion is transmitted from driving to the driven shaft through the rods which are bent to conform to the angles between the shafts. These rods are located at in the holes equally spaced around a circle and they are free to slide in & out as the shafts revolve. This type of drive is especially suitable where quite operation at high speed is essential but only recommended for high duty. The operation of this transmission will be apparent by the action of one rod. During a revolution. If we assume that driving shaft "A" is revolving as indicated by arrow the driven shaft B will rotate counter clockwise. As shaft A turns through half revolution C shown in the inner and most effective driving position slides out of both shafts A & B The first half revolution and rod "C" then will be at the top then during .

The remaining half this rod "C" slide in wards until it again reaches to inner most position in the meanwhile the other rods have of course passed through the same cycle of movements all rods are successively sliding inwards and outwards. Although this transmission is an old one many mechanics are skeptical about its operation, however it is not only practicable but has proved satisfactory for various applications when the drive is for shafts which are permanently located at given angle. Although this illustration shows a right angle transmission this drive can be applied also to shafts located at intermediate angle between 0* and 90*.In making this transmission, it is essential to have the holes for a given rod located accurately in the same holes must be equally spaced in radial and circumferential directions, be parallel to each rod should be bent to at angle at which the shaft are to be located. If the holes drilled in the ends of the shafts have "blind" or closed ends, there ought to be a small vent at the bottom of each rod hole for the escape of air compressed by the pumping action of the rods.

The power transmission occur between the input shaft and output shaft, Then the scotch yoke mechanism which is attached or welded with the output shaft also starts rotate while the output shaft rotate.Scotch yoke mechanism is a simple type mechanism which will convert the rotational motion into reciprocating motion, the power is supplied by the DC motor which will start the rotational motion in input shaft which is welded with the cylindrical disk that consisting of four holes and the four el-bow rods are inserted in those four holes of first cylindrical disk, then the second end that el-bow rods is inserted into the another four holes of the second cylindrical disk which is welded with output shaft , due to this el-bow connections the output shaft rotates so the scotch yoke also starts rotating , this mechanism convert the rotational motion of the cam disk into the reciprocating motion of the yoke, then the yoke is welded with the hacksaw blade which will also reciprocate while the yoke reciprocate.

Due to the reciprocating motion of the hacksaw blade the cutting process induced in this machine.

4.1.1 FORMULA'S USED:

DESIGNING OF HOLLOW SHAFT

$P = 2\pi NT/60$

Where,

P = power
N = rpm of Motor in 1660
T = Torque transmitted

CALCULATION OF TORQUE TRANSMITTED,

$T = (\pi/16)\ (\tau)\ [(D_o^4-D_i^4)/D_o]$

Where,

τ = Shear stress (Assume= 45)

D_o =Outer diameter in mm

D_i =Inner diameter in mm

CALCULATION OF BENDING MOMENT

$M_b = (\pi/32)\ (\sigma_b)\ [(Do^4-Di^4)/Do]$

Where,

σ_b =Bending stress in N/mm^2

AREA OF CYLINDER:

$A = 2\pi r^2$+h $(2\pi r)$

Where,

r = radius of the cylinder in mm

h = height of the cylinder in mm

MODEL CALCULATION OF HOLLOW SHAFT

$T = (\pi/16)\ (\tau)\ [(D_o^4-D_i^4)/D_o]$

Where,

Shear stress (τ) =$45N/mm^2$ (assume)

Outer diameter (D_o) =19mm

Inner diameter (Di) =15mm

CALCULATION OF POWER

$P = 2\pi NT/60$

Where,

Motor N =1660 rpm

P =64.42 watts

CALCULATION OF BENDING MOMENT

$M_b = (\pi/32)\ (\sigma_b)\ [(D_o^4-D_i^4)/D_o]$

Where,

Bending stress σ_b = $35N/mm^2$ (assume)

$M_b = 14.41 \times 10^3$ N-mm

CALCULATION OF THE CYLINDER

AREA OF THE CYLINDER

$A = 2\pi r^2$+h $(2\pi r)$

Where,

Radius (r) = 57.5mm

Height (h) = 10mm

A =24386 mm^2

4.2 ADVANTAGES

1) Mechanism is very simply due to elimination of value mechanisms.
2) Mechanism is small.
3) No crank & crank shaft are necessary.
4) Lesser vibration because the reciprocating force are perfectly balanced.
5) Smooth & high speed operation can be easily obtained by cause of elimination of the value setting linkage.
6) Complete freedom of Interchangeability.
7) Power could be transferred to any desired angle.
8) Low cost manufacturing.
9) Simple cooling system.
10) Portability of parts.

4.3 APPLICATION

The featured product has its widest application as an extension for a socket wrench. Here the design makes it easy to reach fasteners in the automotive and other mechanical industries, where direct access to bolts and screws is often limited. However, the possible applications for

this technology extend into numerous fields. Just think of the possibilities for power transmission in push bikes, toys and hand-cranked equipment, or for movement transmission in store and outdoor signage.

1) The mechanism is invariable used for multiple spindle drilling operation called the gang drilling
2) Used for angular drilling between 0 to 90 degree positions.
3) Lubrication pumps for C.N.C. lathe machines.
4) The mechanism is very useful for a reaching a drive at a clumsy location.
5) Air blower for electronic and computer machine.
6) The mechanism has found a very usefully use in electronic and computer technology for multiple.
7) The year 1685 for the famous London tower clock. The gearless drive is capable of transmitting motion at any fixed angle between 0* to 90^0. This desired effect is also possible with help of bevel gearless different a great extent not only in their manufacturing method or working principle but also in other aspects etc.

Table No 4.1Cost Estimation

S.NO	COMPONENT	MATERIAL	QUANTITY	COST IN Rs
1	Cylinder	Mild steel	2	150
2	Shaft	Mild steel	2	400
3	Bent links	Stainless steel	4	400
4	Bearings	Cast iron	4	400
5	Scotch yoke	Mild steel	1	100
6	Motor	-	1	850
7	Frame	Mild steel	1	450
8	Nuts and bolts	Mild steel	8	120
9	Hacksaw blade	Mild steel	1	15
Other cost				115
		Total =		3000

4.5 PHOTO COPY OF EL-BOW POWER TRANSMISSION

Fig 4.2 Photo Copy of El-Bow Power Transmission

V.CONCLUSION

Some successful mechanical devices function smoothly however poor fly they are made while other does this only by virtue of a accurate construction & fitting of their moving parts. This projects which looks very simple & easy to construct was actually very difficult to conceive & imagine without seeing an actual one in practice. It is an event a fact in the creative mental process nit the forces, which predominate among the schemes of the active tinkers. Motions demands to be studied first &we have done that very thing. We find that while acceptable analysis for existing mechanism can often be made quite easily we cannot without insight & imagination make effective synthesis of new mechanism hence we are mould to present this project El-bow power transmission at 90^0 and scotch yoke mechanism works well to transmit motion to hacksaw blade, hence the accurate and perfect cut has been given out by our machine which we have managed to successfully device after long & hard input in conceiving its working principle.

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