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Design and Fabrication of Motorised Scotch Yoke Mechanism

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Abstract:

The Scotch Yoke Mechanism can be a reasonably simple mechanism for ever-changing the linear motion of a slider into motility motion or vice-versa. The parts of this device include a sliding bar, a yoke on the bar with a slot cut out, and a smaller bar connected to the yoke and affixed by a pin through the yoke slot to the slippery bar. As the bar slides back and forth, or reciprocates, the smaller bar is forced to slip up and down within the yoke slot, making a motion movement. The converse of this motion relationship is also true; as the pin initiates a rotational movement, the slider correspondingly generates a reciprocal or back and forth movement. In operation, the reciprocating part is directly coupled to the sliding bar or yoke with a slot that engages the pin on the rotating part. The motion of the Scotch Yoke Mechanism is such that pure simple harmonic motion is produced by the mechanism when driven by an eccentric or crank. Because velocity and acceleration are derivatives of the displacement time curve these graphs also have a perfect wave form. Scotch Yoke Mechanism is most ordinarily utilized in management valve actuators in high oil and gas pipelines. Although not a common metal working machine nowadays, crude shapers also use Scotch yokes.

Keywords — **Scotch Yoke, mechanism, rotation, translation.**

I. INTRODUCTION

The scotch yoke may be a mechanism for changing the linear motion of a slider into motility motion or vice-versa. The piston or different reciprocatory half is directly coupled to a slippery yoke with a slot that engages a pin on the rotating half. The shape of the motion of the piston may be a pure wave over time given a continuing motility speed. This mechanism is associate degree inversion of the double slider crank mechanism. The inversion is obtained by fixing either the link one or link three. In fig, link 1 is fixed. In this mechanism when the link 2 (which corresponds to crank) rotates about b as centre, the link 4 (which corresponds to a frame) reciprocates. The fixed link 1 guides the frame. currently it's referred to as a scotch yoke as a result of, in America a minimum of a “scotch“ was a slotted bar that was slipped below a collar on a string of well-drilling tools to support them whereas a neighborhood was being additional.In 1940 Russell Bourke applied this mechanism to the interior combustion engine known as Bourke thirty engine. And because of the following reasons we are using this mechanism Scotch yoke mechanism is employed to convert the motion of the crank into slippery motion.As the crank rotates, the horizontal portion of the link slides or reciprocates in the fixed link.Scotch yoke mechanism is obtained once one

among the slippery links of a double slider-crank chain is fastened.The advantage of scotch yoke mechanism over the slider crank mechanism is that it's lesser moving components and sander operation.This mechanism is most commonly used in high pressure oil and gas pipelines. Now a day it is also used in various internal combustion engines such as Bourke engine, SyTech engine and many hot air engines and steam engines.

II. OBJECTIVE

- To demonstrate the action of a simple crank-driven Scotch Yoke mechanism.
- To determine graphically the relationship between the linear displacement of the scotch yoke and the angular displacement of the crank.

III. WORKING PRINCIPLE

It is a simple mechanism, the rotary motion of the pin convert into linear motion.First, the ability provided to be connected in DC motor, when the shaft to start in rotation moment, now the crank rotate the pin slider inside of yoke part and also move in forward direction. When the Crank will be rotate in clockwise direction and yoke will be displacement moment at forward. The maximum displacement of the yoke depends upon the length of crank.The crank is completed the dextrorotary revolution at identical time the yoke slippery fully emotional in forward.When this position takes more time to start return stroke, after some time, the crank will be rotate in continuously it to be come back in initial position of rotation. So the Yoke move in backward direction and comeback for initial position. Therefore the crank has full revolution to be completed, at the same time yoke will be complete the forward and backward movement of sliding. By means of the full revolution of crank, the yoke will be sliding through equal of double length of crank.The yoke displacement may be controlled by variable of crank length.

IV. COMPONENTS REQUIRED

The following components are required for the fabrication of a motorised scotch yoke mechanism.

- DC Motor(12V, 10kgf-cm, 500rpm)
- Disc
- Yoke
- Slotted part
- Cylinder
- Supporting Frame
- Joints & Screws
- Arm
- Piston

V. METHODOLOGY

The method by which the project is done is explained in a detailed manner. The design of the project consists of a Disc which is connected with a yoke provided with a slot at the centre, with the help of a pin. The alternative mechanisms which results in the same purpose and then as the advantages of Scotch Yoke mechanism outweighed all the other mechanisms, Scotch Yoke mechanism is selected. The general layout of the configuration is prepared and the methods of joining the individual components are selected. The detailed drawing is generated and is assembled properly.

VI. FABRICATION

Fig 1. Disc

Fig 2. Yoke

The heading of the Acknowledgment section and the References section must not be numbered.

Causal Productions wishes to acknowledge Michael Shell and other contributors for developing and maintaining the IEEE LaTeX style files which have been used in the preparation of this template. To see the list of contributors, please refer to the top of file IEEETran.cls in the IEEE LaTeX distribution.

VII. CALCULATIONS

a. Stroke Length of the Piston

Radius of the crank, r = 100mm = 0.1m

L = 2r = 2*0.1

L = 0.2m

b. Angular Velocity of the Crank

VOLT(V)	SPEED(rpm)
1.5(min)	62
12(max)	492

Table1 Speeds corresponding to Voltage

Max Speed of the motor, N = 492rpm

$\omega = 2\pi rN/60 = (2\pi*0.1*492)/60$

$\omega = 5.152$rad/sec

c. Power Developed

Torque, T = 10kgf/cm

$P = 2\pi NT/60 = (2\pi*492*10)/60$

P = 515.22W

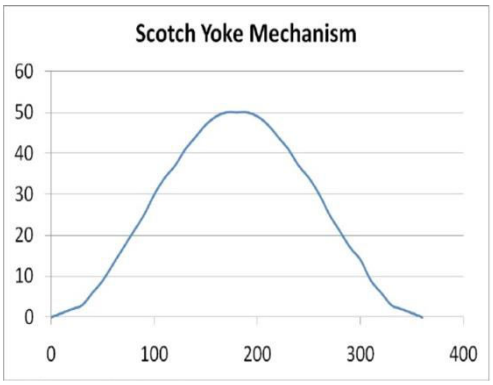

Fig.3: Variation of Length with Angles

Clockwise		Counterclockwise		Average Displacement (mm)
Angle (°)	Displacement (mm)	Angle (°)	Displacement (mm)	
0	0	0	0	0
10	1	10	1	1
20	2	20	2	2
30	3	30	3	3
40	6	40	6	6
50	9	50	9	9
60	13	60	13	13
70	17	70	17	17
80	21	80	21	21
90	25	90	25	25
100	30	100	30	30
110	34	110	34	34
120	37	120	37	37
130	41	130	41	41
140	44	140	44	44
150	47	150	47	47
160	49	160	49	49
170	50	170	50	50
180	50	180	50	50
190	50	190	50	50
200	49	200	49	49
210	47	210	47	47
220	44	220	44	44
230	41	230	41	41
240	37	240	37	37
250	34	250	34	34
260	30	260	30	30
270	25	270	25	25
280	21	280	21	21
290	17	290	17	17
300	14	300	14	14
310	9	310	9	9
320	6	320	6	6
330	3	330	3	3
340	2	340	2	2
350	1	350	1	1
360	0	360	0	0

Table 2: Variation of Displacement with Crank Angle

VIII. PHOTOGRAPH OF THE PROJECT

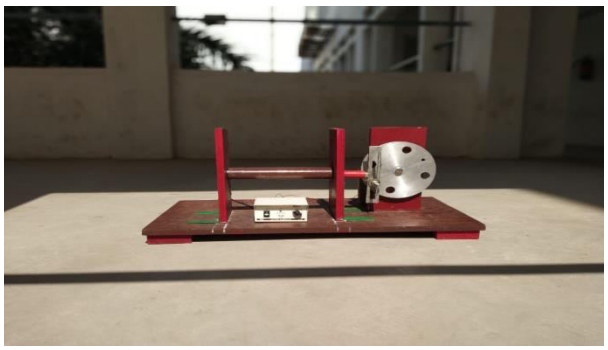

Fig. 4: Front View of Assembly

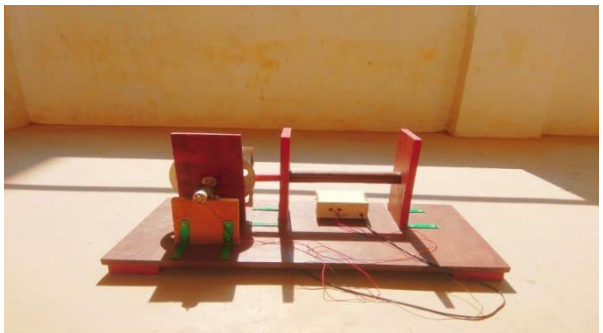

Fig. 5: Rear View of Assembly

IX. CONCLUSION

From the graph attained, we can determine graphically the relationship between the linear displacement of the sliding block and angular displacement of the input crank for a scotch yoke mechanism. This setup is most commonly used in control valve actuators in high pressure oil and gas pipelines. It has been used in various internal combustion engines such as the Bourke engine, SyTech engine, and many hot air engines and steam engines.

X. COST ESTIMATION

Aluminium plate	Rs. 1000
Wood work	Rs. 600
DC Motor(12V)	Rs. 500
Voltage Regulator	Rs. 350
Paint	Rs. 100
L Clamp & Screws	Rs. 85
Bolts and Nuts	Rs. 75
Adhesive	Rs. 40
Connecting Wires	Rs. 25
PVC pipe	Rs. 25
GRAND ESTIMATE	**Rs. 2800**

Table 3: Cost Estimation

XI. FUTURE SCOPE

Modifications can be made to the setup for exhibiting various applications like valve actuators, gas pipelines, compressors, water pump etc. The machine can be more portable. Cost can also be reduced to some extent by manufacturing it on a mass scale. With the help of regulator with high speed range we can operate the machine at any required speed

REFERENCES

1. *Frankfurt am Main., Multi-purpose machines ensure enhanced", 1 January 11*
2. *Ghosh & Mallik., Theory of Machines and Mechanisms*
3. *Khurmi & Gupta., Theory of Machines*
4. *T. Moriwaki., Multi-functional machine tool, Department of Industrial & Systems Engineering, Setsunan University, Neyawaga, Japan CIRP Annals-Manufacturing Technology*
5. *S.S. Rattan.,Theory of Machines*
6. *6. Dr. Toshimichi Moriwaki., Trends in Recent Machine Tool Technologies Professor Department of Mechanical Engineering Kobe University, NTN Technical Review No.74(2006)*