DESIGN AND FABRICATION OF CAM COMPACTER WITH CONVEYOR SYSTEM

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Abstract

Nowadays the machine-like crusher being used at a very large scale in the mass production of concrete but these-machine are very costly and also produce the noise while working some of the crusher machines are like ball mill, gyratory crusher, compound crusher, impact crusher, cone crusher, VSI, and jam crusher, etc. This machine's cost is in lakhs. The aim of this work is to fabricate the bricks and stone crushing machine at a low cost that can be purchasable by the customer so these-customer can use this machine at a small scale of work. The machine can be used in numerous days to days application such as in construction sites, producing red sands, packing, and fillers, decorating walls, Floor filling. The concern of using a low-cost machine is to reduce the manpower effort and time-saving. When we saw some workers giving their time in breaking the bricks with a hammer and hence the idea was inculcated in us to build a machine which would break the brick with least human effort and it will be powered by a motor and it can also be connected by the cycle which can make it more feasible and the machine will have a conveyor system. The mechanism would follow a principle of energy conservation and it would be eco-friendly as no fuel will be used to power the machine to drive the camshaft.

Introduction

Nowadays the machine-like crusher being used at a very large scale in the mass production of concrete but these-machine are very costly and also produce the noise while working some of the crusher machines are like ball mill, gyratory crusher, compound crusher, impact crusher, cone crusher, VSI, and jam crusher, etc. This machine's cost is in lakhs. The aim of this work is to fabricate the bricks and stone crushing machine at a low cost that can be purchasable by the customer so these-customer can use this machine at a small scale of work. The machine can be used in numerous days to days application such as in construction sites, producing red sands, packing, and fillers, decorating walls, Floor filling. The concern of using a low-cost machine is to reduce the manpower effort and time-saving. When we saw some workers giving their time in breaking the bricks with a hammer and hence the idea was inculcated in us to build a machine which would break the brick with least human effort and it will be powered by a motor and it can also be connected by the cycle which can make it more feasible and the machine will have a conveyor system. The mechanism would follow a principle of energy conservation and it would be eco-friendly as no fuel will be used to power the machine to drive the camshaft.

The main concern of this study is to fabricate the bricks crushing machine by using the available equipments at a lower cost. There isa different crushing machine available in the market but they are very costly and they can't be usedat small scale works. Cam follower mechanism will be used to fabricate the crushing machine. Worm gear, ball bearing, induction motor other parts will be used the machine. crushing machine for use in the underground coal or mineral mines for accepting and pulverizing mined material and encouraging the squashed item to a stationary transport in the mine material vehicle framework. A transport has an upper, helping run moveable through the devastating area in the even plane. A couple of breaker drums are mounted quickly over the transport in the devastating area and are rotatable about transversely separated, parallel vertical tomahawks. Since the breaker drums are pivoting about vertical tomahawks, teeth on their peripheries move flat, parallel to the plane of the transport conveying run.[1] A gyratory cone smasher of the sort having a smasher head gathering mounted on a middle part upheld for revolving movement on a pole to create a gyratory movement of the smasher's head get together inside a bowl get together.The middle of the road part being upheld on the pole and the smasher's head gathering being bolstered on the halfway part by roller bearing congregations, the bearing congregations being greased up by a shut lube oil recycling framework, and an enemy of turn get together associated between the axle and the smasher's head get together, the counter turn get together acting naturally lining up concerning the smasher's head get together, and including a single direction grip both of the linkage or cam-type mounted in the shaft.[2]

Methodology

- Process and system, researching composting development.
- Finding machine design and parts and mechanical laboratory.
- Fabricating machine with proper alignment.
- Testing analysis like operating machine and checking output.

Machine component and parts

Gear

A gear (figure 4.1is used to control the direction of a power source, torque and speed. Meshing gears changes the torque values, as per the requirement.[3]–[5][6]

Figure 1. Gear

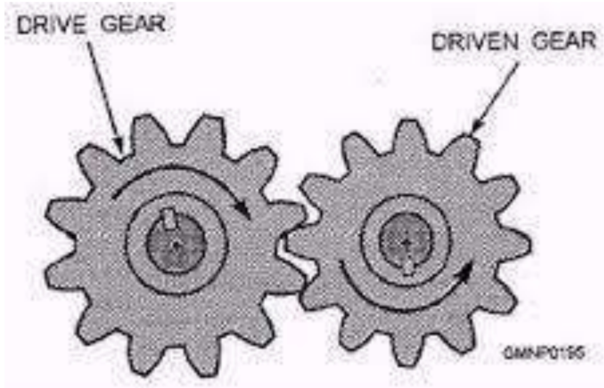

Figure 2. The Gear train

Worm gear

In this work, the worm gear us utilized as showing in figure 3. Worm gear is a preciseconfigurationof gear in which a worm meshes with a gearalike to a spur gear. The worm gear allows the user to control rotational speed and also permits for developed torque to be transmitted.[7], [8] This mechanism can be originated in devices at home and in heavy machinery.

Figure 3. Worm gear

Three different kinds of worm gear:

- Single-throated
- Double-throated
- Non-throated [9]

Bearings

A bearing as shown in fig 4 is a component of a machine that compels relative movement to the ideal movement and reduces the grinding of moving parts. For example, the bearing structure can accommodate free direct creation of the moving part or with the expectation of complimentary rotation around a fixed hub; or, by regulating typical vectors, it can anticipate a movement. Most headings encourage the ideal movement by limiting rubbing.[10]–[12]

Figure 4. Bearing

In this study we use the ball bearings as showing in figure, is a kind of rolling-element bearing.

Figure 5. Ball-bearing

A ball bearing's goal is used to friction in rotation. One race is stationary in full applications and the other one is connected to the rotating assembly.[13]

Induction motor

Three-phase induction motor is used in this machine as showing in figure 6.It comprises a cylinder of steel overlays, with aluminum or copper channels installed on its surface.[14]The non-turning stator winding in operation is connected with an alternating current power source; a pivoting magnetic field is generated by the replacement current in the stator. The rotor winding is started by the stator field and provides its own attractive field.[15]–[18]

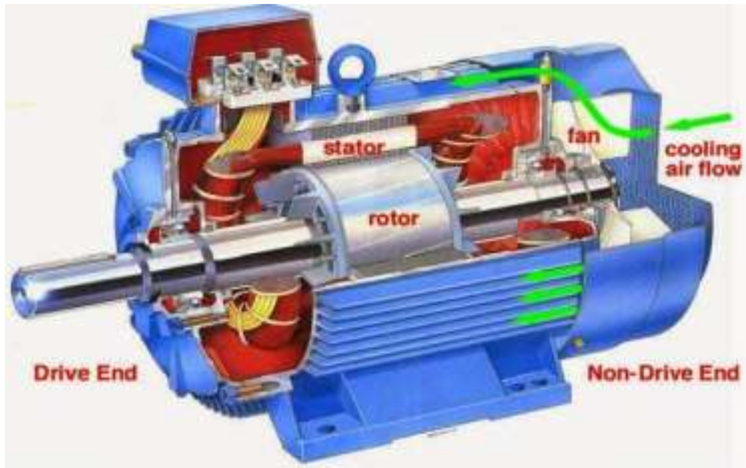

Figure 6. Three-phase induction motor

Design and Analysis

Cam and follower mechanisms are chosen because the mechanism can translate rotatory motion of the cam into the up and down motion of the cantilever beam to acquire the required potential energy.

Part of the machine

- Hammer.
- Cam and beam supporter (Base).
- Cam.
- Beam with Roller follower.

Table 1. Cam Dimensions

Name	Dimension
width	10 mm
Bigger diameter of the cam	150 mm
Shaft diameter through cam	20 mm

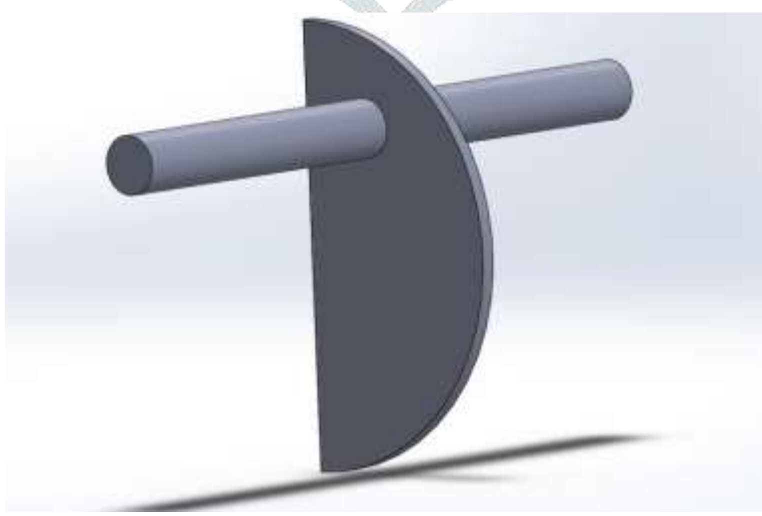

Figure 7. Cam with shaft

Table 2. Follower & Beam dimension

Name	Dimension
Length	590 mm
breath	30 mm
Follower diameter	10 mm
width	30 mm

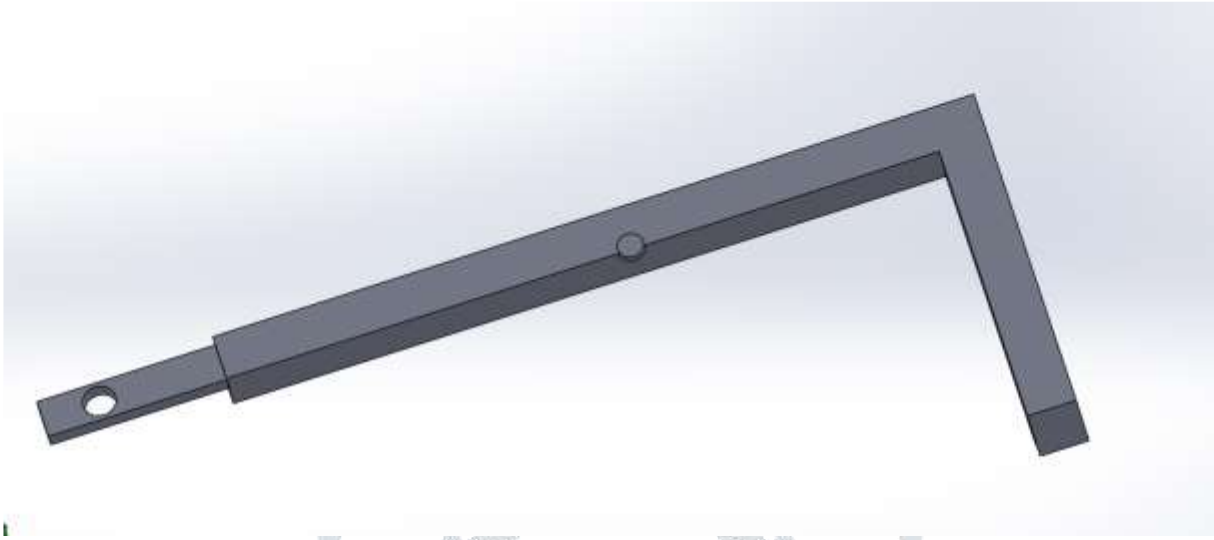

Figure 8. follower and beam

Table 3. Hammer Dimension

Name	Dimension
Length	210 mm
height	30 mm
breadth	30 mm
Taper angle	45º

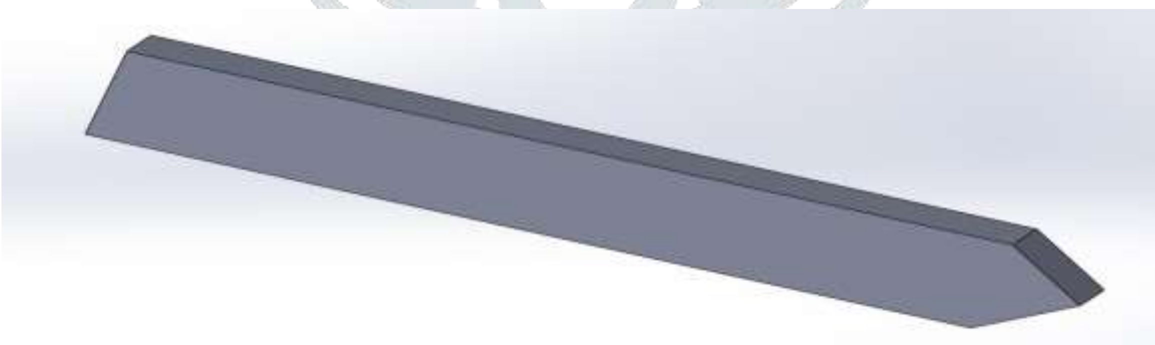

Figure 9. Hammer

Frame

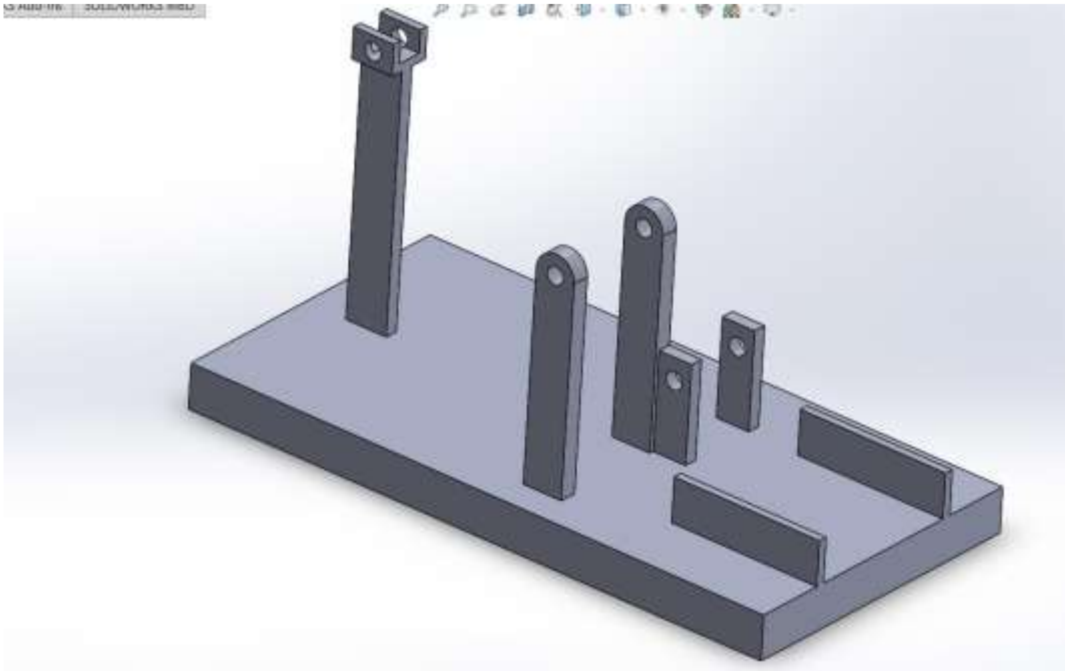

Figure 10. Frame(base)

Assembly

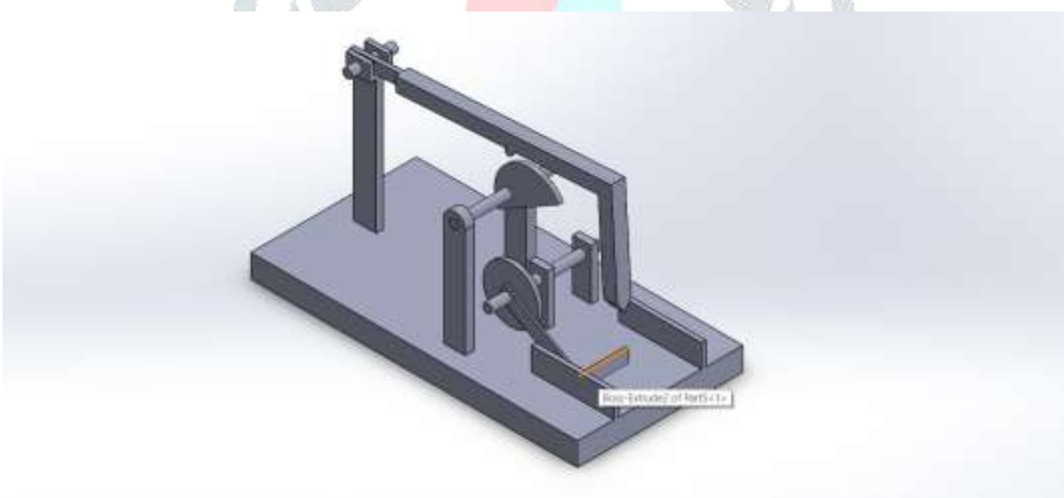

Figure 11. Assembly

Figure 12. Final setup

Formulation

If object of mass m kg,is released from height h meter then the velocity= √(2*g*h)

Here this relation is derived by considering the condition right before impact.

i.e. At the surface before impact we have PE = KE

m*g*h = 0.5*m*v^2,g=9.81m/s

v=$\sqrt{2*g*h}$

Again, we can calculate KE = (1/2) *m*v^2

The effect of kinetic energy immediately beforehand is equal to the height-to-point gravitational potential energy. However, this alone does not allow us to quantify the impact force.Here it is to be noted that Kinetic energy is the key factor So, the flow of calculation goes as

Height of drop to the velocity of a falling object with appropriate mass gives Energy of Impact. Research says, when the load of 30kg is applied to the brick-breaking occur so technically we need much lesser amount of load to hammer brick

Details required

1). Mass of brick.

2). The dimension of brick.

3). Breaking load

4). Mass of dropping the load.

5). Height of drop.

6). Effectiveness of impact on breaking of brick.

Details and calculation

1) Considering the mass of modular bricks, it weighs from 3.2kg to 3.5kg.

2) Load on brick and breaking point/ mass of dropping load.

As we have already discussed already, we need weight of hammer much lesser than 30 kg to a broken brick. Also, here we have designed our hammer-like following figure so that maximum impact and proper braking can be achieved.

3). Height of drop and its effectiveness.

On doing cross-reference and assumptions

If objectmass m= 3 kg is released from height h= 10 cm, then the velocity before impact is velocity= 1.4 m/s. Just before impact, the kinetic energy is equal to its gravitational potential energy at the height it is dropped from.

K.E= *3J*

In addition, calculate impact force may be calculated using the work-energy principle to be,

$W=\Delta KE=0.5\times m\times v^2 f-0.5\times m*v^2 i$

Thus,the average impact force as per the above values is 30N force and this amount of force is the required amount to complete our breaking task.

Camshaft mechanism

It consists of a round and hollow bar with different elliptical flaps jutting from it, one for each valve, running the length of the cylinder bank. By pushing on the valve or something in the middle of the road system, the cam projections power the valves open as they pivot.[19]Camshafts cam is made from a few product types. These include: cool iron castings: commonly used in the generation of high volume, cool iron camshafts have great wear opposition as they are solidified by the chilling procedure. Until throwing, various components are applied to the iron to make the metal more suitable for its use. Different types of steel bar can be used, one Design such as EN40b. The camshaft will also be heated by gas nitriding when making a camshaft from EN40b, which changes the material's microstructure.[20]–[23]The surface hardness of 55-60 HRC and isemployed in elite motors.

Procedure

- ❖ Iron is used in overall construction of the project.
- ❖ A Three-phase motor is used to run the mechanism.
- ❖ Worm gears are used to connect camshaft to the motor, it helps in increasing or reducing rpm according to need.
- ❖ The hammer is an integral part of the system it is actuated by the cam profile which is powered by the motor.

- There is a shaft connected to the main camshaft using a belt drive to form a clearing mechanism.
- A baseplate forms the base where the brick is broken using the hammer.

Results

The machine's main principle of breaking an object with free-falling is achieved by the use of the cam and follower mechanism and the pieces of the bricks broken is transferred using a conveyer system and this is entirely operated using a single mechanism of the rotatory motion of the sprocket connected to the shaft of the cam.

The simulation carried out in the project using solid works software led us to evaluate our projects entire design and its force impact analysis

As per the results obtain

The impact velocity = 1.4 m/s

Considering our Suspended iron mass = 3 kg

As per the analysis results

For cantilever Beam and Cam Shaft: 100 N force

Deflection = 4.63×10^{-3} mm Deflection = 6.63×10^{-3} mm

Conclusion

The project was mainly undertaken to minimize the effort that our workforce put into breaking bricks in construction sites hence with the introduction of such machines it would increase the overall efficiency of the whole construction workforce. This machine could cut down the use of motors and electricity by using the bicycle arrangement in the synchronization mechanism for the cam to rotate. The ecofriendly and cost- cut oriented machine would bring tremendous positive outcome in day to day use. The machines used in today's construction sites are electricity driver so our work was to focus on the conventional method of breaking the brick into pieces. The machine would be used to break breaks, use the brick as red sand in decorating, use it as fillings in construction of roads and so on. The cost of fabricating of this machine is around 12k. The basic principle of the working mechanism is conservation of energy and using a simple cam and follower mechanism to break the brick using the potential energy due to the drop of a suspended string attached with a pointed hammer at its lower end.

References

[1] P. Jan, "' UNITED .sTAT-Es PATENT -," vol. 12, no. 19, pp. 2–4, 1943.

[2] P. Number, "i g & A st is," no. 19.

[3] "Gear - Wikipedia." [Online]. Available: https://en.wikipedia.org/wiki/Gear.

[4] J. J. Coy, D. P. Townsend, and E. V. Zaretsky, *Gearing*. NASA Scientific and Technical Information Branch, 1985.

[5] "How Gears Work," *howstuffworks.com*, Nov. 2000.

[6] "183,714 Search Results - Keywords(gear) - ScienceDirect." [Online]. Available:

https://www.sciencedirect.com/search/advanced?qs=gear.

[7] "Worm drive - Wikipedia." [Online]. Available: https://en.wikipedia.org/wiki/Worm_drive.

[8] "Worm gears: What are they and where are they used?" [Online]. Available: https://www.motioncontroltips.com/worm-gears-what-are-they-and-where-are-they-used/.

[9] "Types of Gears | KHK Gears." [Online]. Available: https://khkgears.net/new/gear_knowledge/introduction_to_gears/types_of_gears.html.

[10] "Bearing (mechanical) - Wikipedia." [Online]. Available: https://en.wikipedia.org/wiki/Bearing_(mechanical).

[11] Merriam-Webster, "headwords 'bearing' and 'bear,'" *Merriam-Webster's Coll. Dictionary, online Subscr. version*.

[12] T. A. Harris, *Rolling bearing analysis*. John Wiley, 2001.

[13] "Thin Section Ball Bearing | Precision Thin Section Bearings." [Online]. Available: https://www.carterbearings.co.uk/silverthin/thinsection-bearings/?gclid=Cj0KCQiAz53vBRCpARIsAPPsz8VBOBsEIz9nA9X3STqmUD6EPdyfE3zylFDNxcBgal0WrraSIMoSGdwaAmyTEALw_wcB.

[14] "3 Phase AC Induction Motor working and its Controlling using svpwm." [Online]. Available: https://www.elprocus.com/three-phase-ac-induction-motor-control-using-svpwm/.

[15] "Induction motor - Wikipedia." [Online]. Available: https://en.wikipedia.org/wiki/Induction_motor.

[16] J. Keljik, *AC/DC motors, controls, and maintenance*. Delmar Cengage Learning, 2009.

[17] X. Liang and O. Ilochonwu, "Induction motor starting in practical industrial applications," *IEEE Trans. Ind. Appl.*, vol. 47, no. 1, pp. 271–280, Jan. 2011.

[18] G. W. D. Ricks, "Eelectricity supply meters," *J. Inst. Electr. Eng.*, vol. 25, no. 120, pp. 57–77, Mar. 1896.

[19] "How Camshafts Work | HowStuffWorks." [Online]. Available: https://auto.howstuffworks.com/camshaft.htm.

[20] G. N. Georgano and T. R. Andersen, *The New encyclopedia of motorcars, 1885 to the present*. Dutton, 1982.

[21] *Camshaft definition by Merriam-Webster*. Merriam-webster.com, 2010.

[22] B. R. Kimes and J. H. Cox, *Walter L. Marr : Buick's amazing engineer*. .

[23] "Camshaft - Wikipedia." [Online]. Available: https://en.wikipedia.org/wiki/Camshaft.