Design of Special Purpose Machine Head to Improve the Production of Engine Block

Prasad V. Bapat, S. Magbul Hussain

Abstract- Special purpose machine tools are designed and manufactured for specific jobs and such never producedin bulk such machines are finding increasing use in industries the techniques for designing such machine would obviously be quite different from those used for mass produced machine. A very keen judgment is essential for success of such machines. A special purpose machine was designed and manufactured at ABC Company which found beneficial in increasing production quantity & reducing manpower.

Keywords: - SPM, LOCUS CLEARANCE, MACHINE HEAD, CASTINGS BLOCKS

I. INTRODUCTION TO SPECIAL PURPOSE MACHINE

Broadly the special purpose machine tools could be classified as those in which jobs remain fixed in one position and those in which job moves from one station to other (Transfer machine).In first case the machine may perform either only one operation or more .In the second case,the product may be either moving continuously(as in the case of spraying,polishing,sanding etc) or intermittently(the most usual case in machining operation). Rotary intermittently motion transfer machine is very popular production machine and is described in brief bellow. Such a machine comprises a turret on whole periphery several heads are mounted to receive and locate the components for working.The turret rotates intermittently about its central axis which is provided with fine and sophisticated mechanisms to control its motion so that before stopping it is properly decelerated and desired positioning accuracy is attained at stationary positions around the usually mounted on a table are the several tools and unit which perform the machining operation. It is essential that all movements be completely synchronized in order to obtain desired product it is essential that all tools and units must have completed their operation and be withdrawn clear of the turret before it starts to index similarly the turret index precisely and come to rest before tools and units begin their work.

II. MECHANISMS

There are a variety of index machines and this need to be selected properly to suit the given requirement. A versatile indexing unit used in presses, drilling machines has number of indexes,speed of index and dwell time which can be readily changed in this mechanism.It operates by fluid power and uses ratchet and pawl mechanism.

Manuscript Received on August 21, 2014.

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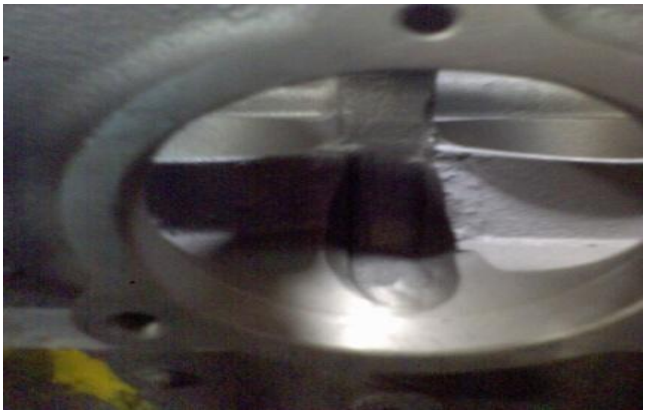
III. DESIGN OF SPECIAL PURPOSE MACHINE (SPM):- PROBLEM DEFINITION

The company was using various types of milling machines like horizontal milling machine,vertical milling machine angular milling machine and HMCs the company designs and manufactures the special purpose machines needed by it in house and intended to do the same in case of milling operations.The machine will be used in milling in4 cylinder 40HP engine block of Tata motor. The problem associated with the machine was that it was a tedious and time consuming part to mill the locus clearance in the engine block on three different machines. Also the most difficult task was to mill the portion in locus type pattern. So the machine is meant to be a rough milling machine, the clearance produced by it was not accurate and vibration produced was creating problem to the operator for achieving the required accuracy. Also the time taken for milling operation was quite large and there was a scope in reduction of machining time so by reducing these two parameters of vibration and machining time more outputcould be achieved. The above problem could be solved by designing a machine having a hydraulic type spindle having milling tool such that angular or rotational motion can be achieved. Though it will increase the cost of designing the new machine it will be nullified by reduction in machining time.



IV. DESIGN PROCEDURE FOLLOWED

1) Design of Spindle Unit
2) Design of Spindle Shaft
3) Selection of Bearing
4) Design of Gear Box
5) Selection of Lubricants
6) Sealing of Rolling Bearing
7) Assembly procedure of spindle unit
8) Assembly procedure for Gear Box
9) Inspection after Assembly

INPUTS OF MACHINE

SR. NO.	ENTITIES
1	DIAMETER OF LOCUS CLEARANCE BORE AS CAST (D) =30MM,TO BE MACHINED
2	CUTTING SPEED (V)= 40M/MIN
3	REVOLUTIONS PER MINUTE (N): WE KNOW, V= ΠDN/1000 40 = Π 30 N/ 1000 N = 40×1000/Π 30 N = 424.41RPM
4	FEED (F)=0.1 MM/TOOTH
5	FEED PER MINUTE (FM) =F×N= 42.44 MM/MIN
6	DEPTH OF CUT (T)= 5 MM
7	METAL REMOVAL RATE (Q)=F×T×V =20 CM^3 /MIN
8	APPROACH ANGLE (X^0) =90^0
9	AVERAGE CHIP THICKNESS (A_S) = F × SIN X^0= 0.1 MM
10	UNIT POWER (U) = 31 KW/ CM^3/MIN
11	CORRECTION FACTOR FOR FLANK WEAR (K_H) = 1.18
12	SIDE RACK ANGLEΓ^0 =0^0
13	CORRECTION FACTOR FOR RAKE ANGLE (KΓ) KΓ = 1.13
14	POWER AT THE SPINDLE (N) =U×KH_xKΓ×Q = 0.826 KW
15	EFFICIENCY OF TRANSMISSION (E) = 95%
16	POWER OF THE MOTOR (NEL) =N/E= 0.8694 KW
17	TANGENTIAL CUTTING FORCE (P_Z) =6120 N/V=1239.344N (1 KGF= 9.80665 N)

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18	TORQUE AT THE SPINDLE (TS) = 975×N/N=18.6088×10^3 N-MM

JUSTIFICATION OF NEW SPM LOCUS CLEARANCE MILLING FOR OLD MILLING MACHINE

SR. NO.	PARAMETERS	QUANTITY
1	WORKING HOURS/SHIFT	8
2	NO. OF WORKING DAYS IN WEEK	6
3	NO. OF OPERATORS	3
4	WORKING DAYS PER MONTH	25

STANDARD TIME PER UNIT PER SHIFT PER MONTH

SR. NO.	PARAMETERS	MIN.
1	MACHINE TIME	12
2	OPERATOR TIME	3
3	TOTAL TIME/UNIT	15

Calculations

Machine time =12/0.85
=14.11
Operator time =3 min.
Total time/unit =17.11
No. of units produced/shift/month
=8×60×25/17.11
=**701 units.**

No. of units produced per months

=701×3 (Three sifts per day)
=2103 units.

FOR NEW MILLING MACHINE

STANDARD TIME PER UNIT PER SHIFT PERMONTH

SR. NO.	PARAMETERS	MIN.
1	MACHINE TIME	4.12
2	OPERATOR TIME	0.45
3	TOTAL TIME/UNIT	5.3

Calculations

Machine time =4.12/0.95
=4.33
Operator time =1 min.
Total time/unit =**5.33**
No. of units produced/shift/month
=8×60×25/5.33
=**2264 units**

No. of units produced per months

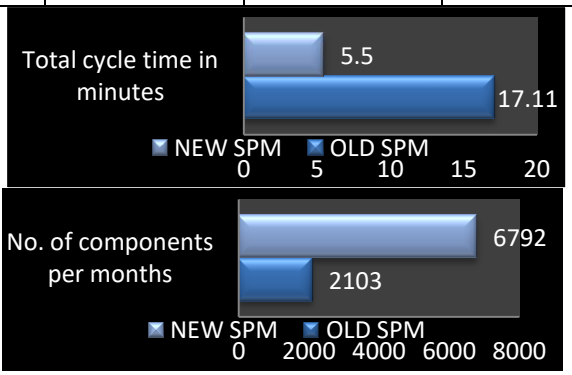
= 2264×3 (Three sifts per day)
= 6792 units

Op^n No.	Machine	Total Cycle time In min	No. of Components per month	Operators Per shift	Machining cost per unit	Machining cost per month
1	OLDSPM	17.11	2103	3	20	1, 01,880
2	NEWSPM	5.5	6792	1	15	42,060

Table No. 15.1 Justificationof new SPM locus clearance milling

Total cost saving per month : 59,820/-

Total cost saving per year : 7, 17,840/-



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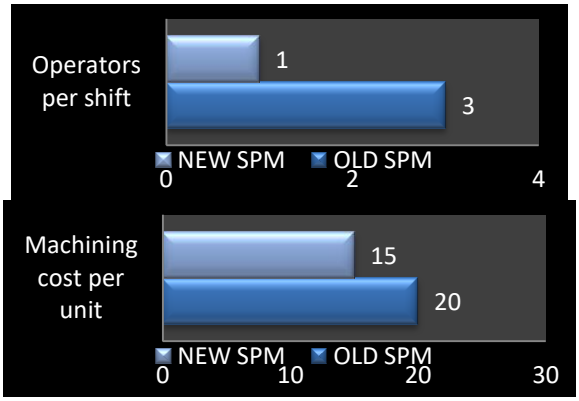

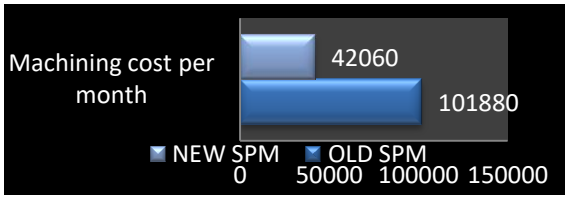

Fig. Graphical Representation of the Data Obtained

V. CONCLUSION

From the overall procedure we followed in designing of the spindle unit and gear box , we conclude that design is safe , accordingly the design could be brought into practice while designing we have successive in keeping the cost factor to minimum total net savings per year after new SPM is Rs.**7,17,840.** Previously for the locus clearance machine three men were utilized for each machine all operation will be done on one SPM and for that one man will be required therefore saving in manpower will be 3-1= 2 men saved per day also there will be saving in space, power consumed, wages paid, handling and machining time etc.this will result into increase productivity and profit. The company can machine additional unit produced per year and meet the customers demand.

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