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Elimination of Rough Milling and Grinding Machining Operation in Casting Bay Parts

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Abstract

This project involves the elimination of the rough machining and grinding operation by designing newer type of fixture for gear housing component (Vertical Machining Center). Various types of operations are involved in gear housing component. Some of them are rough milling, grinding, drilling, tapping, boring etc.. Here rough milling and grinding operation is pre-processed before it get machined in VMC center. In VMC (present method) three types of fixture are used to finish the gear housing component to required shape. With the help of newer type of fixture (proposed method) it not only eliminates the rough milling and grinding operation but also reduces the number of fixture into two. It automatically reduces the setup time and machining time. Newer type of the fixture is designed with the help of solid works software. As the rough machining and grinding operations are eliminated cycle time, fixture setup time, machining cost, man power will get reduced and productivity get increased.

Keywords: Vertical Machining center; Solidworks; Gear housing component.

Introduction

This project mainly focuses on designing the machining fixture for gear housing component. Machining fixture requires systematic design to fix, grip and guide the

tool during machining process. A fixture is a device which is used to locate, hold and to support the work piece during manufacturing operation. In manufacturing industries fixture plays a major role as it is the main component used in automated manufacturing process, inspection of the component etc..

A. Elements of Fixtures

The various elements of jigs and fixtures are

a) Location b) Clamping c) Guidance

d) Setting of cutters e) Securing to the machine table

First two is common for both jigs and fixtures, whereas third component is only for jig and the later two part is for fixtures.

Problem Statement

One of the major drawbacks in the manufacturing industries is increasing in the lead time of the component and also higher wastage of the material. Every company aims to produce a component with decreased lead time and less reduction of waste. Some of the features which lead to increase in lead time is setting time of fixture, inspection of the component, workers inability to machine the component. Setting time of the fixture is one of the major reasons for increasing in lead time. Our aim is to decrease the lead time and wastage of the material. This can be achieved by the elimination of the rough machining and grinding machining elimination by designing the newer type of the fixture.

The present method involves six stages of machining operation for the complete machining of the gear housing component. Our aim is to reduce the six stages of operation into three stages ofoperation by designing newer type of fixture.

Here in the present method three types of machines(Milling machine, Grinding machine, VMC centre) are used to produce the gear housing component. Rough milling and grinding machining process is pre-machined for gear housing component before it get machined at VMC centre.

It leads to

- increase in time consumption
- Decrease the productivity rate
- Increase of cost
- Increase in delivery time

A. Cycle time for present method

For rough milling operation and grinding operation, time taken is of about 20min. In the Vertical Machining Centre, three types of the fixture are used to machine the gear housing component.

B. First operation

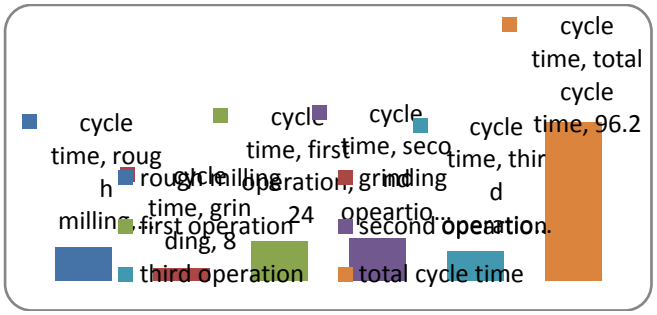
Various operations performed in the first fixture is drilling, spot facing, rough milling, surface grinding. The cycle time for this operation is around 20mins.

C. Second operation

In second fixture, some of the operations performed here are Taping, Reaming, End milling, Face milling, Finish boring, Spot facing etc. Total cycle time for this operation is around 22 min.

D. Third operation

The third fixture involves boring and drilling. The cycle time for this operation is around 12min.



New fixture Design For Gear Housing Component

In order to design the newer type of fixture it is required to know the complete description (Type of material used, various types of operations performed, Type of machine used)of the gear housing component.

Three dimensional model of gear housing component(Finished component)

A. Component Description

The component is Gear Housing.

Component material is FG 220 Cast iron

Composition of FG cast iron.

1. Carbon
2. Silicon
3. Manganese
4. Chromium
5. Nickel
6. Molybdenum

B. Main Elements of Fixture

The various elements of fixture which are used here is given below

1. Fixture plate
2. Rest pad
3. Clamping bolt
4. L-Bracket
5. Bush
6. Handle
7. Screw rod

8. Locknut
9. Diamond pin

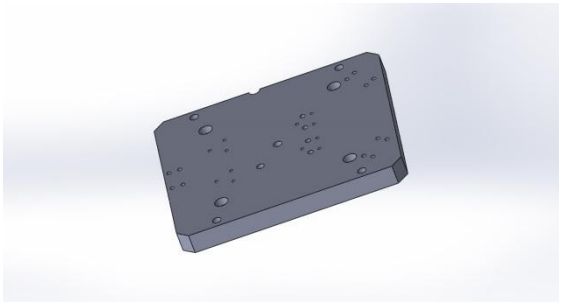
C. Component & Machine Details

Component	:	Gear Housing
Material	:	Cast iron ,Mildsteel, En8
Machine used	:	VMC - MAZAK - FJV 35/60
Operation	:	Rough milling, Drilling, Boring, Tapping, Reaming, Spot facing, End milling etc.

Construction of Newer Fixture Model

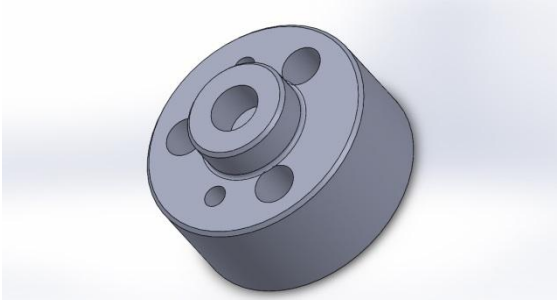
A. Fixture base plate

It is rectangle in shape and various holes of required dimensions are drilled for mounting rest pad, diamond pins, bracket assembly and locating clamps. It firmly supports the various parts of the fixture with perfect resistance to deformation. The material used here is Mild steel. The slots are provided in the base for clamping the fixture to the mill table. The base plate also has keyways along with length of the base for two keys. These keys are used to align the fixture on the milling machine table.



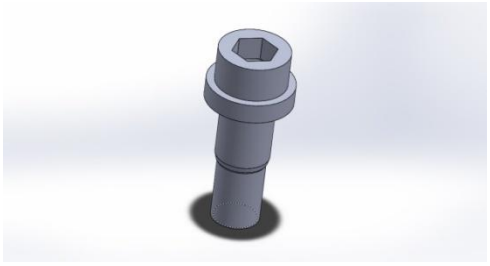
B. Rest pad

Rest pad is one of the part of the fixture which is ideal for contact, position, and wear points on fixture. It also act as the gripper which provide superior holding power. The material which is used to make rest pad is EN8. These are usually in the form of pins, pads or plates that are accurately placed in the base of fixture.



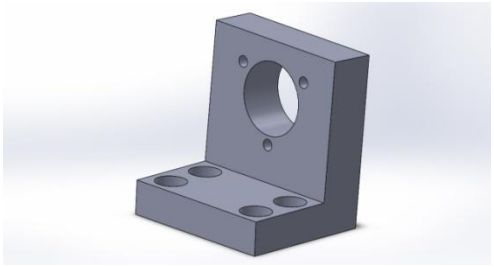
C. Clamping bolt

The material used here is En8. It is used to clamp the work piece material in to the fixture.



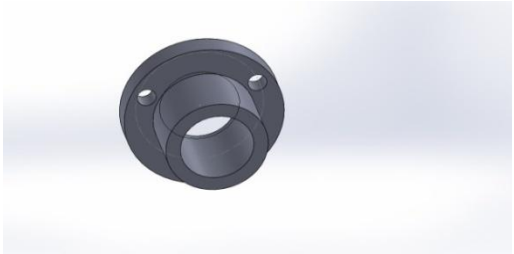
D. L-Bracket

In L-bracket various holes of required dimensions are drilled for assembling it with screw rod, locknut and handle.

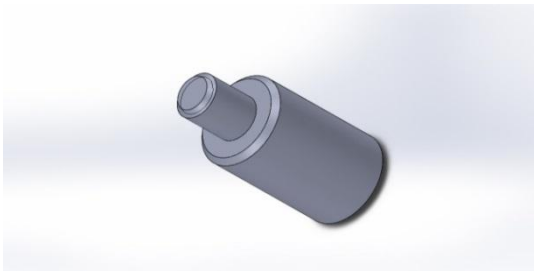


E. Bush

It is a type of guiding part for the purpose of clamping joints of materials usually at right angles.

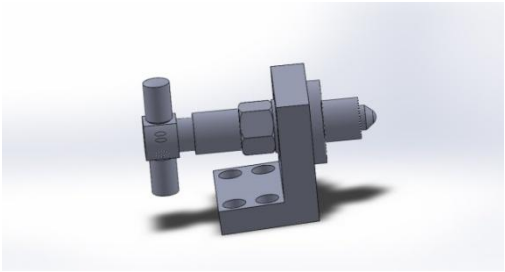


F. Handle



G. Stopper Assembly

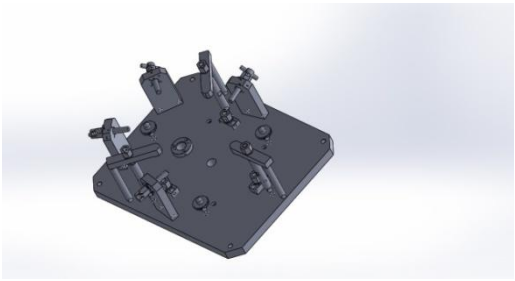
In the stopper assembly L- bracket, locknut, screw rod, handle are assemble together to clamp the work piece precisely.



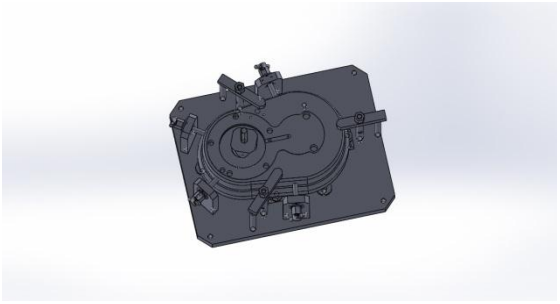
H. Diamond pin

It is a type of locator which is used to mount two extremely precise holes in the work piece, with the use of this perfect alignment is obtained. Material used here is EN32.

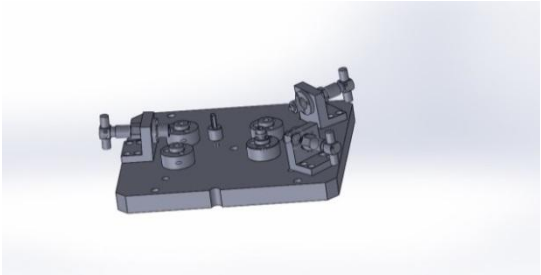
I. Assembly diagram of fixture without gearhousing component(1st operation)



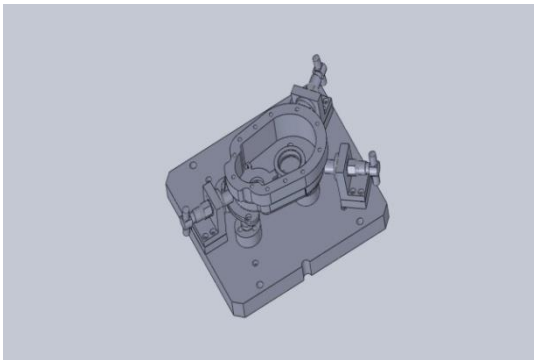
J. Assembly diagram of fixture with gearhousingcomponent(1st operation)



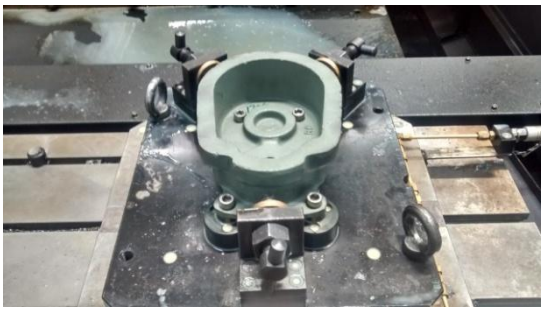
k. Assembly diagram of fixture without gear housing component(2nd operation)
This is the assembled three dimensional model of the newly designed fixture.



L. Assembly diagram of fixture with gear housing component(2nd operation)

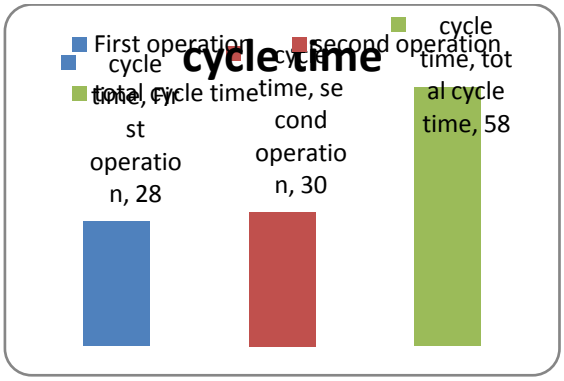


M. Image of fixture with gear housing component(2nd operation)



N. Image of fixture with gear housing component(1st operation)

O. Cycle time graph for present method



Result and Conclusion

A. Cycle time for the newly proposed method

Table: Cycle time for the newly proposed method

S. No	**Identified kaizens**	**Action plan**	**Status**	**Before cycle time in mins**	**After cycle time in mins**
1	Rough milling gear housing face	To eliminate the process and same will be accommodated in finish operation	Completed	20.2	0
2	Grinding	To eliminate the process and same will be accommodated in finish operation	Completed	8	0
3	VMC 1	New fixture developed to achieve quality	Completed	24	28
4	VMC 2	New fixture developed to achieve quality	Completed	26	30
5	VMC 3	New fixture developed to achieve quality	Completed	18	0
			Total	**96.2**	**58**

Cycle time for the newly proposed method is calculated and it is found that there is a reduction of cycle time for about 39.70%. Rough milling and grinding machining

operations are eliminated with the help of the newer type of the fixture as all the machining operations for gear housing component is performed with the help of these two fixtures. So the entire setup of three fixture is reduced into two. Therefore there will be a reduction of fixture setup time. Labour cost and machining cost is also reduced as rough milling and grinding operation is eliminated with the help of proposed method.

B. Cost Analysis For The Present Method(In Mins)

Machine	**Description**	**Set Up Time**	**Batch Qty**	**Setup Comp**	**Run Time**	**Opn Time**	**M\C Hr Rate**	**Cost\Part In Rs**
Furnance	Stress Reliving	11	5	2.2	22	24.2	422.5	170.4
Shot Blasting Machine	Shot Blasting	3	5	1.8	2	3.8	401.2	25.4
Paint Booth	Primer Painting	3	5	3	1	4	41.2	27.3
Ymc Milling Machine	Milling Rough	1	5	0.2	20	20.2	771.8	259.9
Grinding – Surface	Grinding-Surface	5	5	1	6.99	8	385.1	51.3
Vmc-Fjv 35\60=Ii	1st Operation	20	5	4	20	24	1095.1	438
Vmc-Fjv 35\60=11	2nd Operation	20	5	4	22	26	1095.1	474.5
Vmc-Fjv 35\60=11	3rd Operation	20	5	4	14	18	1095.1	328.5
Deburring	Deburring	0	0	0	5	0	0	0
Final Inspection	Final Inspection	0	5	0	10	10	0	0
			Total	**20.2**	**122.99**	**138.19**		**1775.44**

C. Cost analysis for the proposed method(in Mins)

Machine	**Description**	**Set Up Time**	**Batch Qty**	**Setup Comp**	**Run Time**	**Opn Time**	**M\C Hr Rate In Rs**	**Cost\Part In Rs**
Furnance	Stress Reliving	2	5	0.4	7	7.4	422.5	52.1

Shot Blasting Machine	Shot Blasting	1	5	0.2	2	2.2	401.5	14.7
Paint Booth	Primer Painting	1	5	0.2	1	1.2	410.5	8.2
Vmc-Fjv 35\60=11	1st Operation	20	5	4	24	28	1095.1	511
Vmc-Fjv 35\60=11	2nd Operation	30	5	6	24	30	1095.1	547
Deburring	Deburring	0	0	0	5	0	0	0
Final Inspection	Final Inspection	0	5	0	10	10	0	0
			Total	**10.8**	**73**	**78.8**		**1133.62**

Total cost of the gear housing component for the present method is of about Rs.1775 per part. Cost of the gear housing component for the proposed method is of about Rs.1133 per part. Total machining cost saving per part is about Rs641. Yearly volume of production (Gear housing component) is 733. Yearly savings is of around Rs.470450. With the implementation of this method it helps in increasing the productivity of the component. Quality of the process sequence can be improved. Cost of the component is reduced. Delivery time of the component can be decreased. Decrease in cycle time of the component. Decrease in labour cost(Rough milling and grinding operation is eliminated). Part queuing time and part waiting time is eliminated.

Acknowledgment

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