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Fixture for bundle cutting of tubes and rods in saw cutting machine

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Abstract-Indian public and government undertaking manufacturing sectors have been manufacturing products with the help of conventional type and semi-automatic type machines, jigs, fixtures since their inception.it is impossible to replace those machines with new advanced automatic machines because the organisation would need some decades to sum up the capital cost. So the absolute solution to increase the productivity to sustain in the market and to provide the global needs is to develop some newer fixtures and jigs. Likewise in the saw cutting machines and Band saw machines only one rod and tubes can be machined at a mean time. Saw cutting machine plays a vital role in manufacturing sectors to produce rods in required length, bushes, etc. So a new fixture should be developed which will improve the machining efficiency and reduce the time of manufacturing. Thus a new fixture has been developed which can manage to hold multiple rods and tubes while machining and the machining time will be reduced predominantly. This fixture will provide the Bundle cutting of tubes and rods which would be placed in as saw cutting machine by implementing this fixture the production cost, Power consumption, Human fatigue can be primarily reduced.
Keywords: Saw cutting machine, Bundle cutting fixture, multiple rods and tubes, Bushes, Band saw machine

I. INTRODUCTION

The typical horizontal band saw cutting machine it is a floor mounted machine used for simple mounting of solid metal rods and cylindrical objects. The Material to be cut is mounted in a vice attached to the bed of the machine. An electric motor drives the band saw blade through a belt and pulley arrangement from which three speeds may be obtained. The vice used to hold the material being cut is a quick positioning type and can be adjusted easily to any angle. An adjustable work piece stop is provided for rapid positioning of production work pieces. The band saw is only designed for holding a single rods within its vice. This machine can be suitable for industries having low requirements but considering industries like high pressure boiler

Plants and in automotive industries mass production of tubes and rods are required. For example, in the manufacturing of high pressure boiler there are about 50 to 100 headers in which 200 to 250 stubs are welded and 250 to 300 dummy pieces are required per header. In those type of industries the need for the band saw cutting machine is more for mass production of those stubs and rods. The existing band saw machine having only horizontal support and there is no vertical support and hence multiple rods and tubes cannot be placed at the vice at the same time. If the rods are placed between the vices without the vertical support the rods will roll over another while the machining with the saw blade and it will damage the blade and it costs around ₹5000 to ₹6000/Blade. So this not the exact method for mass production and tubes .Thus the alternative solution for this problem is fabricating new fixture which can hold multiple rods and tubes at a mean time by providing both vertical and horizontal support and allows for bundle cutting of tubes and rods at a mean time.

II. LITERATURE SURVEY

A. Horizontal Band Saw machine

The typical metal cutting horizontal band saw machine is a floor mounted machine used for simple cutting of solid steel, tubing, and odd shaped material. The Material to be cut is mounted in a vice attached to the bed of the machine. An electric motor drives the band saw blade through a belt and pulley arrangement from which three speeds may be obtained. The sewing machine frame, upon which the drive wheel, idler wheel, band saw blade, and motor are mounted, pivots from one corner of the sewing machine bed. The frame is counterbalanced by a tension spring between the frame and the bed. Feed is controlled by positioning a sliding weight along a bar fixed to the top side of the sewing machine frame. A dashpot is positioned between the frame and bed to stabilize the feed movement and prevent any quick movement of the frame that could cause damage to the band saw blade. The vice used to hold the material being cut is a quick positioning type and can be adjusted easily to any angle. An adjustable work piece stop is provided for rapid positioning of production work pieces.

The horizontal band sawing machine does the same job as the power hacksaw but does it more efficiently. The blade of the band

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saw is actually a continuous band which revolves around a drive wheel and idler wheel in the band support Frame. Two band guides use rollers to twist the band so that the teeth are in the proper cutting position. The guides are adjustable and should be adjusted so that they are just slightly further apart than the width of the material to be cut. This will give maximum support to the saw band and help assure a straight cut.

B. Fixture

A fixture is a device for locating, holding and supporting a work piece during a manufacturing operation. It is a production tool that locates, holds, and supports the work securely so the required machining operations can be performed. Fixtures have a much-wider scope of application than jigs. These work holders are designed for applications where the cutting tools cannot be guided as easily as a drill. With fixtures, an edge finder, centre finder, or gage blocks position the cutter. Examples of the more-common fixtures include milling fixtures, lathe fixtures, sawing fixtures, and grinding fixtures.

Moreover, a fixture can be used in almost any operation that requires a precise relationship in the position of a tool to a work piece. Fixtures are essential elements of production processes as they are required in most of the automated manufacturing, inspection, and assembly operations. Fixtures must correctly locate a work piece in a given orientation with respect to a cutting tool or measuring device, or with respect to another component, as for instance in assembly or welding. Such location must be invariant in the sense that the devices must clamp and secure the work piece in that location for the particular processing operation.

There are many standard work holding devices such as jaw chucks, machine vices, drill chucks, collets, etc. which are widely used in workshops and are usually kept in stock for general

Applications. Jigs are similar to fixtures, but they not only locate and hold the part but also guide the cutting tools in drilling and boring operations. These work holding devices are collectively known as jigs and fixture.

Set blocks and feeler or thickness gauges are used with fixtures to reference the cutter to the work piece. A fixture should be securely fastened to the table of the machine upon which the work is done. Though largely used on milling machines, fixtures are also designed to hold work for various operations on most of the standard machine tools. Fixtures vary in design from relatively simple tools to expensive, complicated devices. Fixtures also help to simplify metalworking operations performed on special equipment.

III. EXISTING SYSTEM

Only a single rods and tubes can be placed in the bans saw cutting machine. The existing methods being practiced in the industries is shown in the Fig (i)

Fig (i) – single rod placed in vice

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S NO	Problems	Solution
1	Cutting rods or tube removing time is more	Make a new fixture for easily removing and setting the dummy pieces and tubes
2	Frequently setting rod or tubes	Make multi round piece or tubes holding fixture
3	Rod or tube clamping difficulties	Make easy mounting new fixture
4	Rod or tube unclamping difficulties	Make new fixture for easily unclamping rods or tubes
5	Single tubes or rod can be cut at a mean time	Multiple cutting of rods and tubes in the new fixture

Table 1

IV. PROPOSED FIXTURE

The fixture can hold multiple rods and provide support horizontally and vertically to the rods and tubes while sawing process. The proposed schematic diagram of the fixture from the top view is depicted in Fig (ii).

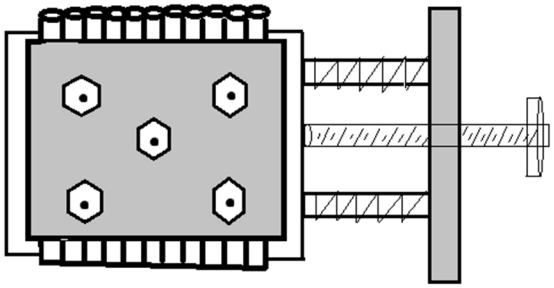

Fig (ii) proposed 2 D image of fixture

This fixture is an alternative for existing band saw cutting process. By using this fixture we can cut multiple tubes and rods at mean time. We can cut the tubes and rods in diameter ranges from 20-76.2 mm. Rods with various diameters can be machined at the mean time by placing a dummy piece over the rod. This image is shown in the Fig (iii)

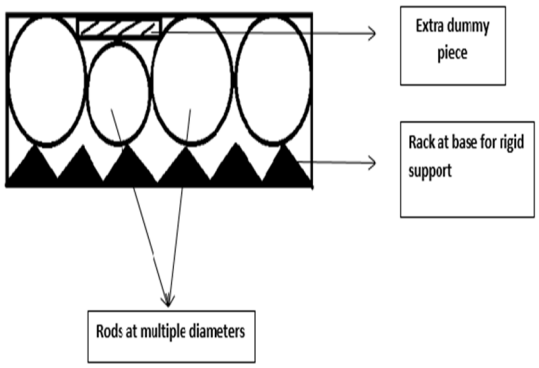

Fig (iii) Rods with multiple diameters with dummy piece

The base of the fixture is provided with a rack to give rigid support to the rods while holding and sawing process or it will start rolling even after the supports are tightened while machining. The 3-D and the assembly diagram of the proposed new fixture is given in the Fig (IV).the fixture has vertical movable jaw which will hit up to a certain limit arrested by a

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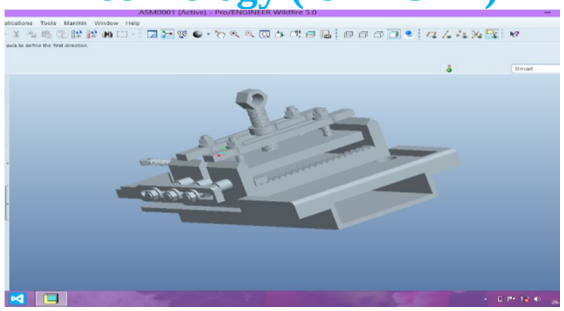


Fig (IV) Assembled model

Threaded rod and box nut. The base of the fixture is welded with two rack plates which will provide rigid support to the rods/tubes. The horizontal movable jaw is also a rack which moves towards the work piece and hold it rigid support. Those horizontal movable jaw is moved by a hydraulic piston which holding the rods and retracted back by the spring force provided at the end of the horizontal jaw.

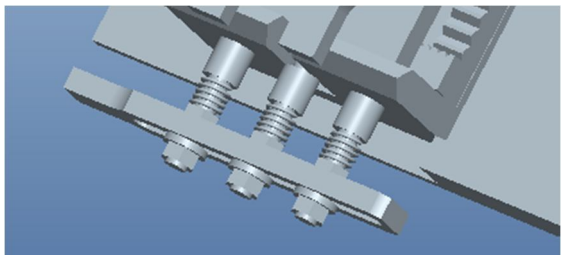


Fig (v) spring support outside

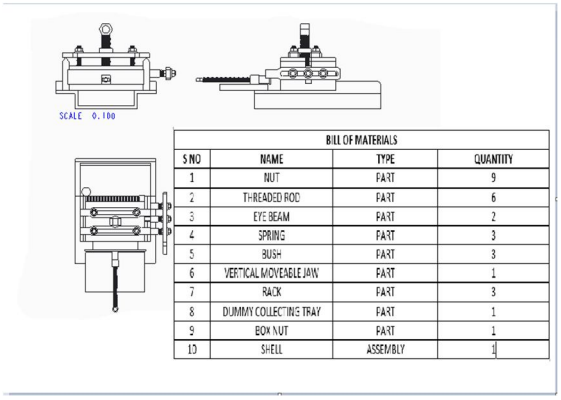
Then a coolant collecting tray is provided at the rear end of the fixture for collecting the coolant to the sump and a base collecting tray is provided to collect all the small flat pieces. Those small flat pieces are collected in the tray attached below and saved the piece collecting time which costs in the total machining time. There is a limit stopper provided at the front end of the fixture and which holds the rods from the front with proper clearance should be given. The limit stopper rolls over an internally threaded box and a threaded rod leads over it. Some machining allowances should be given i.e. 1 mm clearance should be provided between the rods and the vertical movable jaw to ensure the free flow movement of the horizontal movable jaw. For example, if a rod is to be machined as a 10 mm length flat piece means, the rod length placed between the limit stopper and the base is should be

Total length = original length + Allowance

(10mm + 1.6 mm)

Allowance is the blade thickness (1.5 mm) and to compensate the blade thickness the 1.6 mm allowance is provided.

V. FIXTURE DESIGN



BILL OF MATERIALS

S NO	NAME	TYPE	QUANTITY
1	NUT	PART	9
2	THREADED ROD	PART	6
3	EYE BEAM	PART	2
4	SPRING	PART	3
5	BUSH	PART	3
6	VERTICAL MOVEABLE JAW	PART	1
7	RACK	PART	3
8	DUMMY COLLECTING TRAY	PART	1
9	BOX NUT	PART	1
10	SHELL	ASSEMBLY	1

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A. Horizontal movable jaw

Length, l = 375 mm
Thickness, t = 24 mm
Breadth, b = 50 mm
Maximum opening of jaw = 453mm
Minimum opening of jaw = 388 mm
Number of rods at different diameters

For 20 mm dia rod = 453/20= 22 or 23 rods

For 51 mm dia rod = 453/51= 8 or 9 rods

Maximum of 76.2 mm rods can be placed

For 76.2 mm dia rod= 453/76.2= 5 or 6 rods

B. Vertical movable jaw

Length, l = 500 mm

Breadth, b = 325 mm

Thickness, t = 40 mm

Max allowable motion of jaw = 80 mm

Total vertical length inside = 170 –breadth of (rack +vertical Movable jaw)

= 170 – (50 + 40)
= 80 mm

VI. TIME STUDY

Time study conducted before the implementation of the fixture are shown in Table 2

S NO	Job Dia	A min	B min	C Min	D Min	Average for 10 NOS of cut	Average for 1 NOS of cut
1	31	30	10	10	65	115	11.5
2	51	60	10	10	65	145	14.5

Table 2- Time study before fixture implementation

Time study conducted after the implementation of the fixture are shown in Table 3

S NO	Job Dia	A min	B min	C Min	D Min	Average for 10 NOS of cut
1	31	3.0	3.0	3.0	0.5	9.5
2	51	6.0	3.0	3.0	0.5	12.5

Table 3- Time study after fixture implementation

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A-Dummy cutting time B-Rod clamping time

C-Rod unclamping time D-Rod setting time

VII. COMPARISON RESULT

Time study has been conducted and the comparison results are analysed. The machining time is reduced to 1/10 of the existing method. Time study taken for 10 number of machined pieces. For **31 dia 115 minutes to 9.5 minutes.** Therefore the time reduction is about **91.74%**.

VIII. CONCLUSION

The implementation of the fixture for bundle cutting of tubes/rods in saw cutting machine reduces the human work, saves power, increases productivity and profit to the industry. Most of the materials are collected from the scrap. This fixture can be used for all tubes/rods cutting saw machines. Even though there are some minor demerits such as this fixture this not frequently used but it reduces production time by **91.74%**.Thus an efficient model is designed and implemented in the industry,

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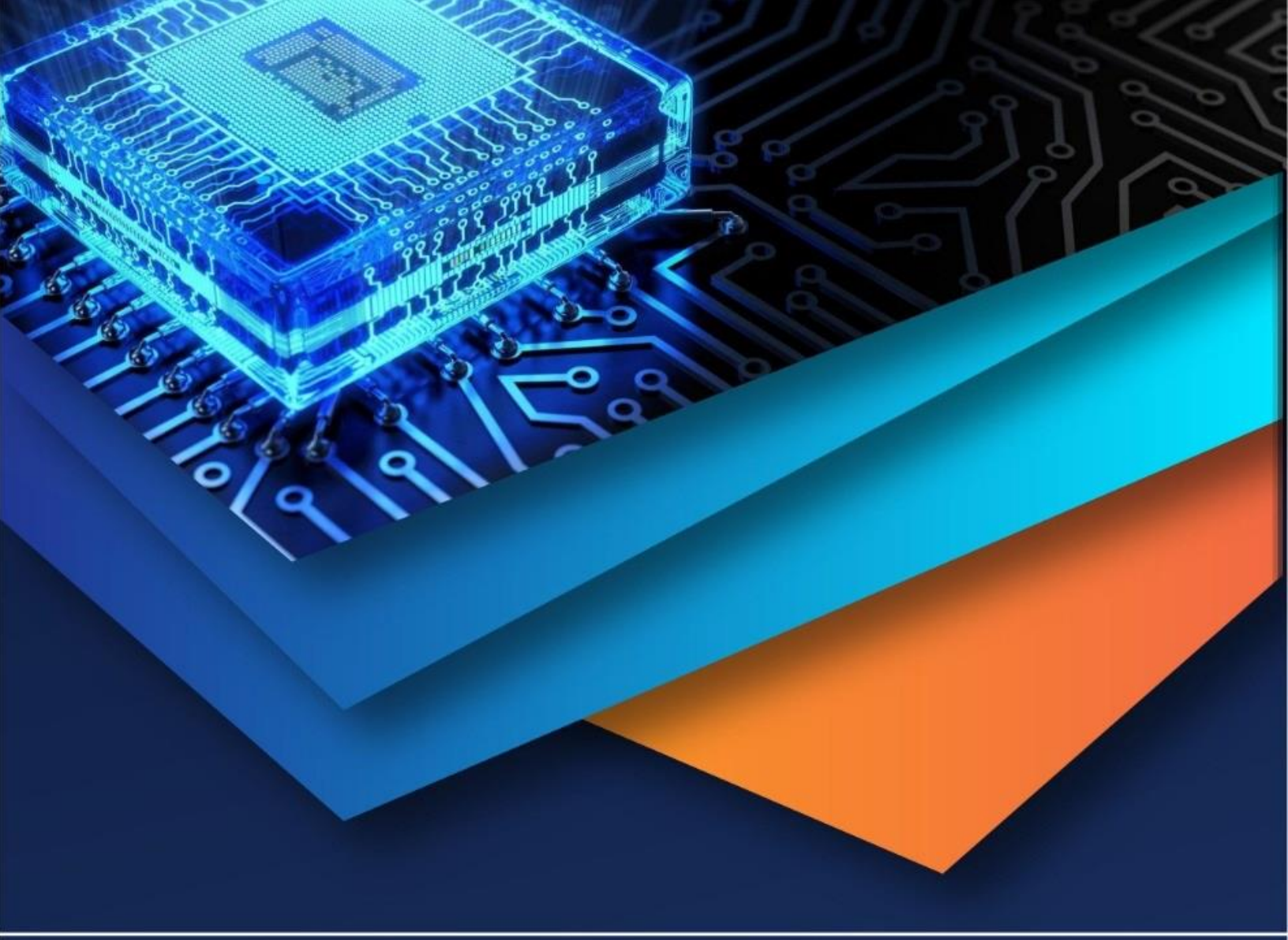

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