Abstract— Spot facing provides a seat or flat surface at the entrance and surrounding area of a hole, it commonly done on casting where irregular surfaces are found. In spot facing, feed motion of the tool is parallel to axis of the work piece. It is followed by a mechanical drilling, or milling, process. After the initial hole is drilled, a larger well, or recess, is drilled into the material. This recess allows to easy fittings for tightening the stud nuts or fasteners.

The aim of this paper is to simplify the operation of spot facing in industrial valves. Different types of valves are available in different sizes, in this paper the area of focus is only on 2” 150# industrial valve. The efforts are done to reduce the operation time, reduce the cost of product and for increasing the productivity of the machine. Paper suggested the dedicated special purpose machine for back spot facing operation. It can able to perform back spot facing operation simultaneously on complete flange. In the same way it can reduce the human fatigue and minimize the problem of availability of skill labor.

Index Terms— Back Spot facing operation, Counter Boring, Spot facing, industrial valves.

I. INTRODUCTION

Current available facility for back spot facing

The shape and geometry of the valve body is very different than any other components. The shape of the side and top flanges are intricate and difficult to machine. It is difficult to machine the side and top flanges of the valves on turning machine. Back spot facing operation on the valve body is the last operation after all the other processes are completed.

The radial drilling machine is the only option on which the back spot facing operation can perform. There are so many aspects involved in the actual operation, but currently no any other options present so the process is going on the radial drilling machine. This is an unnatural type of operation on the Radial drilling machine, since the spindle moving towards upward direction means opposite to gravity. This results the load on the spindle due to which vibrations and spindle run out. It affects the efficiency of the machine. The clamping of component is also an issue since time required is much more & if clamping are not done properly the accident may occurred, since the spindle lift the body upwards. As shown in the attached photograph.

II. ADVANTAGES AND DISADVANTAGES OF CURRENT FACILITIES

Review Following are the advantages and disadvantages of the existing operation i.e. the back spot facing on the Radial drilling machine.

Advantages:-

- No need of body indexing during spot facing of each drilled hole
- Auto speed feed can be give to tool.
- Any size can be spot face up to the capacity of the machine.

Disadvantages:-

- Rigid clamping required for the work piece.
- Special type of tooling attachment is required like socket as per the machines Morse taper.
- Tool changing time is much higher.
- No judgment of dimensions to be maintained, since it is very difficult to see the actual operation going on by operator.
- Special types of clamping devices are required to clamp the work piece.
- Skilled operator requires performing the desired operation.
- Cost per piece is very high.
- Machine accuracy is affected very much due to this unconventional operation on this machine.
- Tool breakage is very high since operator cannot see the condition of tool visually every time during operation.
III. DEFINITION OF THE PROBLEM

Non-Conventional Operation on RD Machine

This operation is non-conventional on the Radial drilling machine. Normally in drilling the machine spindle is going in forward direction (backward direction). But in spot facing of valves it works in opposite.e.in upward direction which is reverse of the normal. So there is the extra cutting load generating on the machine spindle which reduces the life of the machine.

Time Consuming

This is a time consuming operation on the Radial drilling machine, since there are so many elements are involved, like job loading on machine table, clamping of the job, spindle positioning, tool adjustment, speed feed adjustment etc. which are very time consuming operations or activities.

High Maintenance

Since the Radial drilling machine is a outcome of various mechanisms so there are so many parts which may be affected during the operations, & due to this unnatural operation there are some critical maintenance issues are generating during the operation of spot facing like spindle vibrations, run out of spindle, gear backlash etc. these are very difficult issues for maintenance department to solve.

Difficulty in Holding Part

Parts or job holding or clamping is very difficult and time consuming. If it is not clamped properly the job can hit up from the machine & it may cause the serious accident. It may be machine can also be damaged.

Power Consuming

In Radial drilling machine there are so many mechanisms are working and to run these mechanisms, so many electrical parts or circuits are required which are consuming high electrical power, which is very costly for such a less important operation.

Increase Cost per Unit of Production

Due to high machine cost, tooling cost, power cost, clamping cost, maintenance cost and all other direct and indirect costs involved in this operation, the cost per piece is very much increased.

Human Fatigue

This is creating human fatigue during operation since the operator cannot work in natural condition. During operation he will bend to see the cut and measurement. Also he bends to see the proper condition of tool time to time, so he is not working in natural condition. Safety of operator is also on very high risk.

Due to reverse machining direction and job clamping poor visibility to operator during running condition. This highly increases the risk of job rejection and tool broken.

Difficult To Spot Face on Intricate Shapes

On Radial drilling machine it is very difficult to spot face the intricate shapes and surfaces since there are limitations to see and adjust the spindle position and cutter adjustment according to work space.

IV. FUNDAMENTALS OF SPM TECHNOLOGY

Groover (2008) has defined the term “automation in production” is need for rapid and quality production in large volumes. Automated production techniques are widely used in manufacturing industries for dealing with issues such as high cost of labour, shortage of skilled people, low interest of labour to work in production firms, safety, high cost of raw materials, improved quality, uniformity in the quality of products, low inventory, customers satisfaction, and performing difficult operations.

Generally SPMs lack the high rigidity found in conventional and Computerize Numerical Control machines. Consequently, majority of these machines are used for performing drilling and drilling-related operations such as tapping, reaming, counter boring, spot facing and countersinking on machinable materials where the magnitude of machining forces is relatively low. However, it should be noted that SPMs are also capable of performing milling and some other machining operations that would result in high cutting forces. In such cases there is a need of special accessories for reducing the setup time and improving the productivity of the firm.

V. INTRODUCTION TO SPECIAL PURPOSE MACHINE

Drilling and drilling-related operations like spot facing or counter boring constitutes more than 60% of all machining processes in manufacturing industries. Consequently, it is important to know how to perform these operations properly. With availability of many machining processes capable of performing spot facing operation sometimes it is difficult to decide which process would result in a higher profit or a lower unit cost for a given task. Due to increasing global competition, manufacturing industries are now more concerned with their productivity and are more sensitive than ever to their investments with respect to flexibility and efficiency of production equipment (Boothroyd and Knight, 2005, Wecka and Staimer, 2002). Researchers (Koert al., 2005) believe that increasing the quality of production and reducing cost and time of production are very important factors in achieving higher productivity. Achieving this goal requires reconsidering current production methods that could lead to introduction of new production techniques and more advanced technologies.
In traditional manufacturing systems, spot face is performed by a vertical drilling machine. It uses a sharp cutting tool with multiple edges to cut a recess around a hole in the workpiece material. Generally, non-traditional processes incorporate high capital and operating costs. Therefore, when machining economy is a concern, manufacturing companies focus on advanced technologies or special purpose machines. Groover (2008) stated that when the quality of product and limited variety is crucial, universal machines give the best results. In case of flexibility of the components, computer numerical control machines are the best option. For high production quantity with low variety, special purpose machines give the highest productivity and are considered the most economic production method.

According to Tolouei-Rad and Zolfaghari (2009), special purpose machines (SPMs) are superior to computer numerical control machines for producing large quantities of similar parts. Special purpose machines are more productive and less flexible. When the demand of the product is no longer due to fluctuation in the market, special purpose machines are not economical. Spot face is a machined feature in which a certain region around the hole is faced for providing the recess for fasteners. This is especially for cast or forged workpieces where the geometry is irregular. The most common application of spot facing is the area around a bolt hole where the bolt head will sit. It is often followed by cutting a counterbore just deep enough (in wrought cast metal, generally we are taking 3 mm) to remove the material and make the surface flat. Other common applications of spot facing involve facing a pad onto a boss, creating planar surfaces in known locations that can orient a casting or forging into position in the assembly; allow part marking such as stamping or nameplate riveting; or offer machine-finish visual appeal in spots, without the need for finishing all over (FAO).

VI. NECESSITY OF THE BACK SPOT FACING IN VALVES

The back spot facing is much needed in all flanges of the valves and pumps for tightening of fasteners and nuts in pipe fitting. It avoids the leakage in testing and online application of the valve. Back spot facing is equally important to other operations to avoid the condition of accident during tightening of the valves.

The shape and geometry of the valve body is different & it is not easy to machine the back face on the turning machine just like front face of the side and top flanges of the valve body. Here are some pictures which showing the requirement & importance of the back spot facing.

VII. FINALIZED MECHANISM

This mechanism uses four spindles to perform a spot facing operation on side and top flanges of the valves. Wing tools of high-speed steel (HSS) are mounted on each individual spindle. The wing tools are open and closed at desired rpm which can easily control by variable frequency drive. In this finalized mechanism all the drill holes of flanges are easily spot faced in a single attempt. In suggested mechanism, once the work piece is mounting on the holding devices both the flanges are faced with same setup.

Fig 3 Schematic representation of suggested mechanism
Advantages
- It reduces the setup time.
- It reduces the operating time.
- It reduces cost per unit of production.
- Increase the productivity
- Reduce human fatigue.
- Excellent job accuracy.

Disadvantages
- High initial investment is required.
- Less Flexible as compared to CNC machines.
- Rigid setup required for big size components.
- Job indexing is little difficult.

Precautions
- Proper Alignment of drill hole and spindle should be required.
- Regular maintenance is required.

VIII. CONCLUSION
Production quality and low production cost are crucial for the success of manufacturers in today’s competitive market. SPMs are very useful for producing large quantities of high-quality products at lower costs. These machines can also be altered to produce similar components when necessary. High accuracy, uniform quality, and large production quantities are important characteristics of SPMs. However, the inadequate knowledge of machining specialists with this technology has resulted in its low utilization in manufacturing firms. In this project a detailed discussion on need of SPM, designing procedure with all possible calculations, development procedure with all detailed drawings, fabricated model with their capabilities and accessories have been described. It also explained the available facilities and other possible mechanism with their advantages and disadvantages. An analysis was made on the basis of technical and economical considerations. After a detailed discussion and extensive computations it has been concluded that for the given production task SPM would result in a significant reduction of costs.

Generally SPMs lack the high rigidity found in conventional and CNC machines. Consequently, majority of these machines are used for performing drilling and drilling-related operations such as tapping, reaming, counter boring and countersinking on machinable materials where the magnitude of machining forces is relatively low. SPMs are dedicated machines it gives the higher productivity but less flexible as compared to CNCs and other conventional machines. SPM describe in this project reduced the human efforts and operational time. In addition, the system developed minimizes the level of expertise required to perform the analysis and eliminates possible human errors.

REFERENCES

First Author- Ms. Hansini S. Rahate
B.E. (Mechanical) M.Tech (CAD/CAM),
Paper Publication:
One paper published in International Journal,
One paper presented in national conference &
Two papers published in International Conference.

Second Author Mrs. SeemaS.Rewatkar
B.E.(Mechanical) M.Tech (MED),
Paper Publications:
Three papers presented in International Journal.

Third Author Ms. Prajakta H. Dahake
B.E.(Mechanical) M.Tech (CAD/CAM),
Paper Publication:
One paper presented in International Journal &
Two papers presented in national conference.

Manuscript received October 15, 2013.
Ms. Hansini S. Rahate, Mechanical, RTMNU/DBACER/DBACER Nagpur, (e-mail: rahatehansini@gamil.com), Nagpur, India, 9096958582
Mrs. SeemaS.Rewatkar, Mechanical, RTMNU/DBACER/DBACER Nagpur 9822408935., (e-mail: seema_rewatkar@rediffmail.com).
Ms. Prajakta H. Dahake Mechanical, RTMNU/DBACER/DBACER Nagpur 9764445317., (e-mail: praju_dahake1@yahoo.co.in).