Review on Development of Automated Fixture for Seam Welding Machine

[1]Deshpande Akshay Arunrao, [2]Dalvi Suraj Shivaji, [3]Mali Chandrakant Vana
[1]Student, [2] Student, [3]Student
[1, 2,3,] Department of Mechanical Engineering,
[1, 2,3]G.H Raisoni college of engineering and management, Chas, Ahmednagar, India

Abstract:
The Fixtures are work piece holding devices used for fix a part which support operations on different machines. Automation reduces efforts of workers, which means that they are able to stay operating for longer time and continue generating profit. Automated fixtures are widely used for reducing human efforts. We developed automated fixture for seam welding machine for reducing human effort and for greater stability of work piece. This paper presents an approach which allows automation of fixture for seam welding machine. The solution presented consist of a fixture design concept for seam welding machine.

Keywords: seam welding, fixtures, clamp, work piece, fixture design,etc.

1. INTRODUCTION

We are working on seam welding machine; this machine is used to weld the shell part of exhaust system of generator. This shell is basically of cylindrical shape. Initially this shell was worked on roll and spot welding machine where the ends of shell surface were spot welded. There are two roller of copper which are used as welding tool.
These rollers are operated by using an electrical system. This electric system supplies current to the rollers. These current then heat the rollers. These rollers are rotated in clockwise direction. An operator then put the shell on locating plate, which is place to hold the shell between hot rollers. As roller rotates, they guide the shell in forward motion. These hot rollers rolled out shell surface which is to be weld. Once the surface of shell is being weld completely, the rollers then moved away from the shell surface as pneumatic cylinder is been used for respective operation. Operator then takes the shell [art out of the locating plate. And put new shell part for same cycle. From above, it is clearly seen operator is also a main factor for the whole scenario. But what if the operator is unskilled? There are some chances of misalignment of shell while feeding to rollers. This may cause any problem to the welding quality. Automatic welding gives improved weld quality, increased productivity, high production rate, & decreased waste production. This will result in less reduction of ppm and hence sales value of industry will increase. Adding an active positioning adapting function increases the unit's degree of freedom, which further allows huge range of possible motions. Sometimes misalignment may occur while feeding the shell to the rollers. It may burn through the surface of shell, it may create noise and also it may be injurious for unskilled operator as the feeding is done manually.
Fixtures are work piece devices used to fix a part which support operations on different machining. Difficult work pieces are find through fixtures produced faster from standard parts and can then be separated when a production run is complete. Automated fixture application is mostly in manufacturing, can also utilized in assembly and analysis processes. Using automated fixtures, the flexibility and fast response capability of production systems can be raised. One of the major benefits of using automation in an assembly line is their capacity to perform a job over short period of time than that of a worker. Not only can automation perform at a high speed, they are also more accurate, which allows for less errors and wasted product, thus increasing efficiency. Automation also do not become fatigued like human effort, which means that they are able to stay operating for longer hours and continue producing profit.

Fig.1. Seam Welding Machine

1.2 Components of Seam Welding machine

Wheel Electrode: The rollers are operated using an electrical system. This electric system supplies current to these rollers. This current then heat the rollers. Out of these rollers, one is rotated in clockwise and vice versa.

Servo Motor: It controls the motion of the welding electrodes for Seam welding process. It also enables them to complete the circuit. Servo motor is controlled by electronic control unit.

Transformer: This unit is connected to the electronic unit. It also supplies current to wheel electrodes. It is water cooled of a high grade electrical steel. Primary and secondary coils of solid electrolytic copper of ample section, can withstand 140℃ and offers current in 50-200kVA.

Electronic Unit: Electronic unit is the main part of Seam welding machine. All the switches are controlled by the electronic unit system. This unit contains a display from which operator can give the require commands for operation.

Reservoir: It is storage tank for the fluid which is using for the operation of seam welding machine as a coolant. This fluid is used for cooling purpose on work piece for welding operation.

Coolant: It is a fluid used to reduce the temperature of hot work piece. Water is used as a coolant for this welding operation.

1.3 Components of Fixture

For the given Seam welding machine, our automated fixture is temporary designed on solid works software have following main assembly parts-

Guideways: We are planning to design the structure in such way that the structure will hold and guide the shell with help of linear motion guideway mechanism. While guiding the shell there will be no chance for misalignment. In this manner feeding operation of shell will have done automatically. The operator will work now only for loading and unloading of the object.

Supporting Blocks: Supporting blocks are generally used for holding purpose, we are going to use this for holding the job to be welded by using seam welding machine. These blocks are placed at near about end of holding plate. The gap between two plates are maintain for different sizes of work pieces.

Holding Plate: The holding plate is also a rectangular plate, made up of M.S. This plate is Allen bolted on the guide blocks, which can slide the plate with it. It is used for holding the L-block plate and block on it, for job holding purpose.

T-Slotted Plate: The T-slotted plate is a rectangular plate, made up of material M.S. These plate is fixed with the floor stand by the Allen bolts, which is used for placing guide ways on it. The guide ways are bolted on these fixture plate for rigid support.

Stand: Floor stand made up of material M.S. The height of the stand is about 800mm. There is a tray mounted on it for connecting the fixture holding plate. The stand has great strength for withstanding the overall load of the system on it.

2. RESEARCH WORK OF DIFFERENT LITERATURES

Yuguang Wu et.al (2008)[(1)] has derived that this paper presents Automated modular fixture planning based on linkage mechanism theory. We studied from this paper, Modular fixture is a kind of very promising flexible fixture device in manufacturing. It is also used in assembly and verification process. The modular fixture is able to deal to with the work piece with irregular shape by combining modular fixture elements. Therefore, the flexibility and response capability of manufacturing system can be improved. However, modular fixture planning is a very difficult problem, especially for the modular fixture with the dowel pin system as the locators of such modular fixtures can only be inserted into the fixed doweled holes. That is why modular fixture planning is still performed by fixture designers in industries up to now, relying on designer's experiences and trial and error method. The main problem with manual planning

of modular fixtures lies in that it is almost impossible for a designer to enumerate all the alternative fixture plans, which makes it extremely hard to find out the optimal fixture plan. Obviously it hinders the use of modular fixtures with dowel-pin system in industries. One way to solve the above problems is to use computer to assist designers in performing modular fixture planning. In general, the current achievements on computer-aided modular fixture design still have a certain distance from what industries expect. The main limitations of the current works include: (1) because the assembly relationships between locators and the work piece are not described in an analytic way, the current methods of determining location plans are enumerative in nature and thus very time consuming; (2) the current approaches to determination of the side clamping positions are relatively complex; (3) the existing quality metrics about fixture design do not consider the geometry structure of the work piece and the assembly relationship between the work piece and locators which also affect the quality of location plans.

In this paper, they present a new approach to automated planning of modular fixtures with dowel-pin. The approach identifies all the alternative location plans of a work piece comprising both planar and cylindrical faces in a general and efficient way by using four-bar mechanism theory, and performs accessibility and fixture ability analysis and generates feasible clamp positions of a fixture plan in an effective manner based on several new concepts. In the approach, the assembly relationship between locators, side clamping points and work piece are described in an analytic way.

Yu Zheng et.al. (2010) [2] We referred that, fixture is familiar tool in manufacturing, which is use to hold objects for machining, assembly, inspection, etc. As a fundamental topic in fixture research, fixture lay out design is to find the locations of fixturing elements, including locators and clamps, on an object surface such that the object has a deterministic position and it is completely immobilized. The total immobility is also known as form-closure. Beside the two essential properties, some other performance qualities of fixture layout are often expected to be enhanced, such as localization accuracy and immobilization capability or force balance capability. Many valuable results on fixture layout design can be found in the existing literature.

Following some work on fixture layout design, we make the following assumptions, on which this paper is based:

(1) The accessible areas on the object surface for fixturing have been determined and represented with sufficient discrete points. In practice, the location of a fixel (fixturing element) on the object surface must be subject to geometrical or physical conditions and task demands.

(2) Locators and clamps are not distinguished from each other and treated uniformly as fixels. When a fixtured object is machined, a machine tool often exerts a large external load on the object, resulting in high reaction forces on both locators and clamps. If locators in fixture layout design are supposed only to uniquely locate an object without considering a proper distribution of reaction forces on them and clamps, then for certain external loads in machining, the reaction forces could concentrate on minority locators and clamps and cause high stresses and deformations at these contacts. This is harmful to the localization accuracy and the object safety. Moreover, in some fixturing machines [7,12], fixels have functions in both locating and clamping an object. It is hard and unnecessary to say which one should be handled as a locator or a clamp.

(3) Contacts between fixers and the object are frictionless. Although friction is beneficial for a fixture to hold an object, it is unreliable and liable to diminish or even vanish in vibration or with water or oil on the object surface. Such situations are common in manufacturing. For reliability, we prefer ignoring the effect of friction in fixture layout design.

(4) Each contact is a regular point, where the normal vector is good defined. At sharp or singular points, the local stresses could be extremely high even if small forces are applied there; hence such points are unsuitable for locating fixels, especially in the case of large external loads on the object that need to be resisted by the fixels.

Manjushree D. Sutar et.al.(2013) We studied from this paper that, the linear guides consist of a mechanism in which steel balls are circulated infinitely to enable an infinite stroke of ball slides theoretically. Balls roll along the ball groove formed on a rail and a ball slide and there, they are scooped at the point A by the tip of an end cap. There, they are forced to change their circulating direction by a return guide of the end cap and guided to a circulating hole provided inside of the ball slide. The balls continue to pass through the hole to the other end of the ball slide and go through the circulation circuit to the tip of the end cap of the other and then, return to the ball grooves of rail and ball slide. Thus, the balls continue their never ending circulation motion.

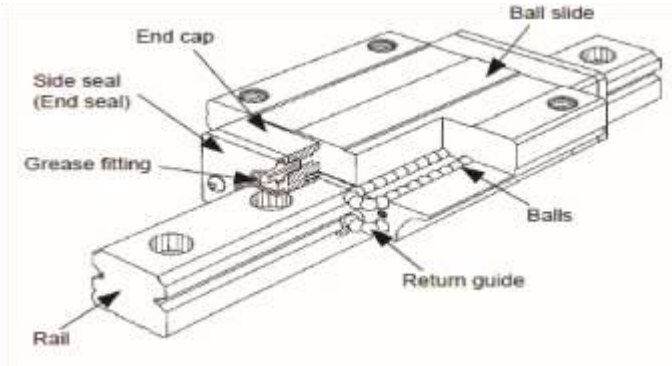

Fig.2. Guideways

J. Saleem et.al. (2013)[3] From this paper, we referred that, Resistance seam welding is a mostly used process for combining metal sheets in the automobile industries. It is also used in the manufacturing of steel roofs in relation to water tightness. Overall in these applications leakage isn't allowed and therefore it is necessary for reliable welding procedures which is to be used. The required factors for maintaining unchanging and a better seam weld nugget formation are, the welding force, current ,magnitude, welding speed, electrode shape and the mode of the current being supplied.

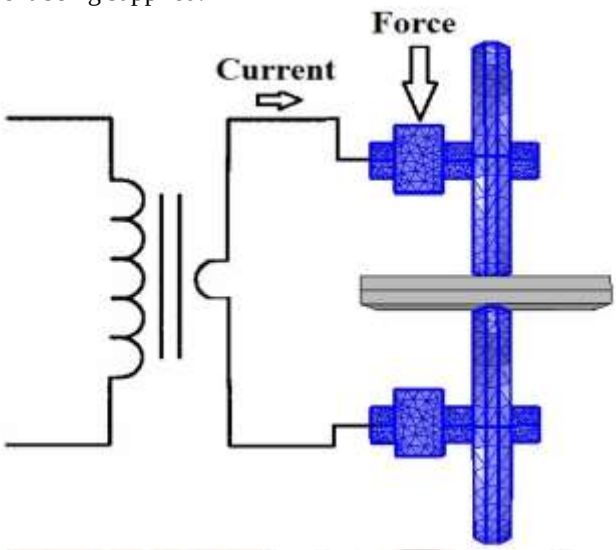

Fig.3.Working Principle of Seam welding

Saigopal Nelaturi et. al. (2014)[4] we referred from this paper that, . A base plate is designed to be mounted on a machine and provides the standard interface for other modular fixture elements. Locators are cylindrical or spherical elements that are attached to the base plate to provide repeatable point contact for locating the part.

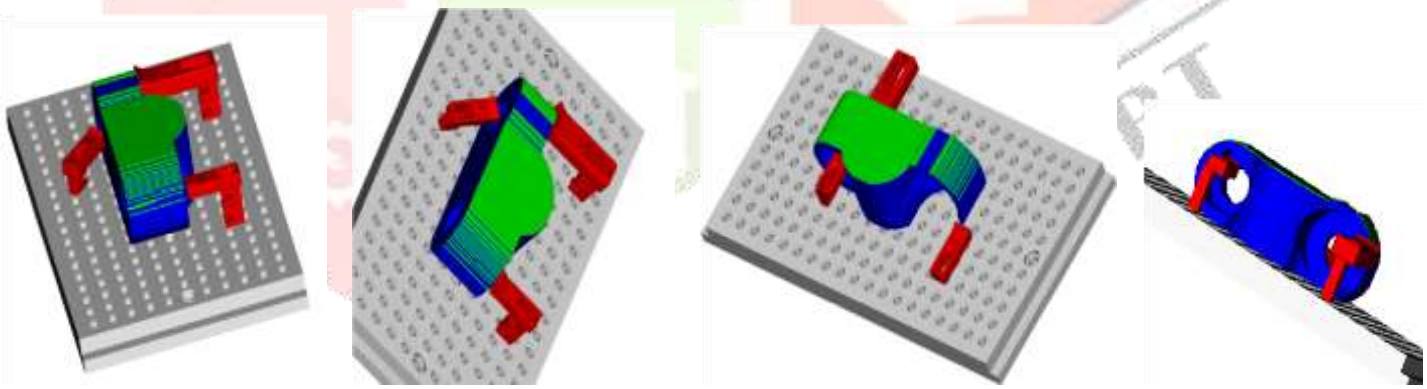

Fig.4.Locating Device model

Attila Rétfalvi et.al. (2015)[5] In this paper, the review of the articles published in this field and the smaller introduction of the system of support and clamp is shown. Constructing a good fixture that assures the given accuracy and stability is often a difficult and time-consuming task. That is the reason why many efforts have been made to develop a system that is able to automatically determine the number and the order of the setups for a given work piece, and construct acceptable fixtures for each setup. That type of system could save respective time spent on fixture planning and design.

3. Conclusion

As we examined our finding, we drew conclusion based on the information collected about each aspect of our project. This conclusion led us to recommendations that we believe will, if applied, create an even better machine than we have designed.

In today's market all large manufacturers ate automating as much of their production line as possible. Automated processes have been in high demand. Seam welding fixture minimizes the gap between engineering of automated featuring mechanism. In spite of all the

obstacles and difficulties we faced, we created very realistic final design concepts. The design of fixture fulfils all the demands and design criteria which were shown at the start of the project.

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