

## Welding Slag Removal Machine

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**Abstract** - The project work aimed to design and manufacture the "WELDING SLAG REMOVAL MACHINE". Removal of slag is important and needs to be done it can be done manually using a chipping hammer but the process is laborious and time consuming sometimes needs a dedicated works men specially for slag removal in assembly line. Hence there is need for a special purpose machine to remove slag from welded components. Also to reduce operator's fatigue and rejections of component. Hence during the design of machine various functional parameters and ergonomic considerations are to be considered. The machine is designed using suitable material and equipment's in low cost that increase production rate. Slag is great for protecting the weld while it cools, but once it has done its job, it has to be removed before the next pass. There are many conventional methods for removal of slag from work piece but some of them are time consuming and some gives more fatigue to worker so find optimum way for removal of slag by welding Slag Removal Machine .which consist following parts.

1. Wire brush rotational head
2. Brush feeder linkage
3. Work-piece indexing mechanism
4. Slide arrangement

### 1. INTRODUCTION

Welding is a joining that uses heat, pressure, and/or chemicals to fuse two materials to fuse two materials together permanently. But while joining two components with welding unnecessary slag is form on the components. There are many methods available to remove this slag but they are time consuming and laborious, it is not desirable since it decreases productivity hence there is need of simple and time saving technique in production process for removal of slag from component.

Important Terminology in Welding Process Welding:

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing fusion, which is distinct from lower temperature metal joining techniques.. Welder: Either the person who performs a weld task or the power source that provides the electricity needed to perform an arc weld. Printed materials may use both meanings of the term. Electric Arc: The current through a normally nonconductive medium such as air produces plasma. The high temperatures generated by the

arc melts the base metals get melted. Electrode: A device used to make contact with a nonmetallic part of a circuit. In welding, the electrode also can act as the filler metal Flux: A non-metallic material used to protect the weld puddle and solid metal from atmospheric contamination. Fluxes may have more than one function at a time. Flux-Cored Arc Welding: It is a semi-automatic or automatic arc welding process. The process is widely used in construction because of its high welding speed and portability. Slag: Cooled flux that forms on top of the bead. Slag protects cooling metal and is then chipped off. Arc welding is a one of type of welding that uses a welding power supply to create an enough heat to melt metal, and the melted metals when cool result in a binding of the metals. They can use either direct (DC) or alternating (AC) current and consumable or non-consumable electrodes. The welding region is usually protected by some type of shielding gas, vapor or slag. Arc welding processes may be manual, semiautomatic or fully automated. C. Main Function of Weld Slag o it shields the hot metal from atmospheric contaminants that may weaken the weld joint. Slag can also be globules (drop) of molten metal that are expelled from the joint and then resolidify on the metal surface. It protects the weld (in form molten metal) from oxidation and slows down the rate at which the weld cools. It also helps to prevents brittleness of the metal. In either case, they are usually chipped away with a slag hammer.

Why It Is Removed?

Slag does not help to cause strength or protection of metals after the welding process; it is waste material. Removal of the slag is necessary for four reasons: Ability to inspect the quality of the weld area, Aesthetics, or ergonomically appearance. If a second layer or pass of welding is to be made on top of the first to clean and clear the unpleasant surface for coatings such as paint or oil.

### 1.1 Manual Metal Arc Welding

Manual metal arc welding (MMAW) or shielded metal arc welding (SMAW) is the oldest and most widely used process being used for fabrication. The arc is struck between a flux covered stick electrode and the work pieces. The work pieces are made part of an electric circuit, known as welding circuit. It includes welding power source, welding cables, electrode holder, earth clamp and the consumable coated electrode

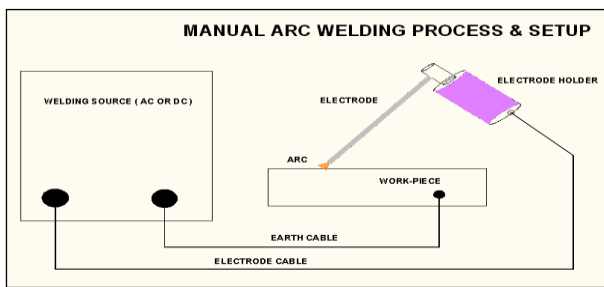


Figure 1 Shows details of welding circuit.

### Shielded metal arc welding

Shielded metal arc welding (SMAW), also known as manual metal arc welding (MMA or MMAW), flux shielded arc welding or informally as stick welding, is a manual arc welding process that uses a consumable electrode coated in flux to lay the weld. An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form an electric arc between the electrode and the metals to be joined. As the weld is laid, the flux coating of the electrode disintegrates, giving off vapors that serve as a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination. Because of the versatility of the process and the simplicity of its equipment and operation, shielded metal arc welding is one of the world's most popular welding processes. It dominates other welding processes in the maintenance and repair industry, and though flux-cored arc welding is growing in popularity, SMAW continues to be used extensively in the construction of steel structures and in industrial fabrication.

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Function of Slag for Welding

Slag is the leftover of weld process that is result of flux having done its job. Slag is formed from the flux,

decomposing in to either a shielding gas or deoxidizers, which form molten compounds that cover weld while it cool to prevent oxidation of freshly formed weld. The slag in the welding process protects the weld from oxidation and slows down the rate at which the weld cools. It also prevents brittleness of the metal.

### WHY WE ARE USING WIRE BRUSH?

A wire brush attaches to your drill. The bristles are made of stiff wire and as the drill spins, these bristles clean rust and paint off of metallic objects. A wire brush works moderately quickly, a wire brush will work on surfaces that aren't flat (unpleasant) and can be best when you have to clean areas of intricate metal work. This is because a wire brush can be forced into nooks and crannies that a needle gun wouldn't be able reach. The size of the wheel also makes it more flexible for small areas. Depending on what you're stripping, a wire brush can be an excellent complement to a needle gun. The chipping hammer is great for general purpose welding when combined with a wire brush, results are generally good. Hence there is need of a special purpose machine to remove slag from welded components.

A wire brush is a tool, consisting of a handle, usually wood or plastic, occasionally bone, and a brush. The brush is usually made from a large number of steel wire bristles. The steel used is generally a high carbon variety and very hard. Other wire brushes feature bristles made from brass or stainless steel, depending on application. Wires in a wire brush can be held together by epoxy, staples, or in some cases one continuous wire. Some types of wire brushes can also be used on an angle grinder or electric drill.



Wire brush

### What Is To Be Developed?

The machine comprises of basically five sub-assemblies, namely; 1. Wire Brush Rotational Head: It comprises of a variable speed motor of 100 watt, 0 to 4000 rpm, connected to a single stage gearbox to get required torque amplification. This is a single unit assembly and it is mounted on the brush feeder mechanism. 2. Brush Feeder: Brush feeder makes the rotating brush to move to and fro with respect to the work-piece. The assembly comprises of a linear guide at the bottom, wire brush feeder bar. The wire brush rotational head is mounted on to the brush

feeder bar.3. Slide Arrangement: The slide is provided with the view to center the job, to accommodate various sizes and shape of work-piece. When the hand wheel rotated, it will rotate the screw and nut will

1. Slide to move the work-table thereby adjusting the work-gap between the wire brush and work-piece

2. Work-piece Indexing: The work-piece indexing mechanism is an innovative concept for indexing various shapes and sizes of work-piece for slag removal applications. It comprises of the top work table that primarily holds work-piece – fix Turing can be done using single bolt at center. Table is mounted on the spindle that carries the four bar linkage output at its lower end. The four bar linkage is used to index the work-piece to the required angle. This mechanism takes into account the fact that in a four bars linkage if we change the crank length the degree of oscillation of the output link changes. Hence the crank is slotted in the above mechanism to vary the crank length. Mechanism is operated using a pneumatic cylinder. This makes indexing fast and accurate. This linkage mechanism replaces the servo DC motors with encoder and de-coder arrangement used in the automatic machines to carry out the same indexing activity. Thus makes a considerable saving in budget for machine.

**ADVANTAGES**

- I] Quick action clamping.
- II] Precise indexing.
- III] Polygonal indexer makes all range of size and shape jobs cleaning possible
- IV] Fast action cleaning due sequential operation of the brush head and indexer.
- V] Low cost automation.
- VI] Flexibility of circuit design / can be converted into fully automatic mode with minimal circuit components.
- VII] Low cost automation process
- VIII] Saves labor cost and monotony of operation.

Hence we have designed and manufactured a Welding slag removal machine. We have considered all the design aspects and the safety of machine and the product. The design is very economical. The mechanical parts that have been fabricated are extremely simple. The machine helps in minimizing the time of slag removal providing additional safety.

**FUTURE SCOPE**

- 1. Welding slag removal machines can be made more productive using electromagnetic base for holding and upholding the job, this would further reduce the time for clamping and need for fixtures
- 2. Welding slag removal machine can be used for surface finish if the grinding tool is used instead of wire brush.

**TESTING AND RESULT**

Trials are necessary to check performance of the machine. For that we take some observations by comparing welding slag removal machine with existing conventional method these are following,

| Sr. No. | Conventional Method   | Welding slag removal machine   |
|---------|---|--|
| 1.      | Tool used for slag removal are frequently break and more wear of tool.                  | Tool doesn't break, less wear of tool compare to tool used in conventional method.                   |
| 2.      | It removes more material from weld joint therefore it weakens the weld joint.           | It removes only slag therefore it doesn't weaken the weld joint.                                     |
| 3.      | It forms more marks or chatter on the surface of work-piece, hence poor surface finish. | It forms compare to less marks or chatter on the surface of work-piece, hence better surface finish. |
| 4.      | More time required for slag removal.  | Less time required for slag removal.   |
| 5.      | More chances of injury to worker.   | Less chances of injury to worker.  |
| 6.      | Process involves more fatigue to worker.  | Process involves less fatigue to worker.   |
| 7.      | Machine used for removal of slag have very complex configuration.                       | Simple in construction.  |

**3. CONCLUSIONS**

The linkage mechanism replaces the servo DC motors with encoder and de-coder arrangement used in the automatic machines to carry out the same indexing activity. This makes a considerable saving in budget for machine. A wire brush will work on surfaces that aren't flat and can be best when you have to clean areas of intricate metal work. This is because a wire brush can be forced into nooks and crannies that a needle gun wouldn't be able reach. The size of the wheel also makes it more flexible for small areas. Depending on what you're stripping, a wire brush can be an excellent complement to a needle gun. A wire brush works fairly quickly. This machine requires less space, hence most suitable for small industries. It is semi-automatic machine giving more

accurate results. It requires less skilled persons and provides more safety to human when comparing chipping hammer.

The main aim of our project to reduce time for slag removal. Conventional methods are time consuming and Laborious. Welding Slag removal Machine reduces the time for slag removal. Trial was conducted. To compare the time and extent of slag removal using conventional methods and Slag removal machine. Welds were made on a circular disc of diameter 50mm and thickness 3.5 mm.

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