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Fabrication of Waste Cable Stripping Machine for Recycling Copper Material

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Abstract: *With the rapid growth of civilization and the constant expansion of electrical cables, there has been an increase in the amount of used cable in recent years. But for recycling used cables, the local recyclers have not yet been reached the machine. They were mostly using open burn technology. It ended up with lot of health issues, environmental pollution, poor quality copper and others. By aiming for this, a copper cable recycling machine was built in this project to achieve a pollution-free environment for the copper recycling process, resulting in a significant increase in the creation of a healthy environment for waste copper cable recyclers at the lowest possible cost. Using AUTOCAD 2020, the conceptual design of the machine was done. The machine consists of frame, motor with adjuster, rotary V-shaped rod and rotary tool with adjuster. All the parts of the machine were collected and/or fabricated, and they were also assembled together with the help of a metal arc welding process to form the rigid structure. The result declared that the machine used stripping technology to separate the plastic and copper from the used cables.*
Keyword: *Copper Wire , Cable Stripping Machine , Recycling , Electric Motor*

I. INTRODUCTION

The cable is crucial parts of any electrical and electronic machine/equipments, houses and industries to pass information, command and electricity. There is growing need for ideal separation of valuable copper metal from waste cable. Resource utilization of cable waste is key area of research work. Copper is one of the prime raw materials of the Indian economy. However, relatively very few resources are available for copper material in India.

In 21st century, the used copper cable recycling is an environmental and human health issues for the entire world. To solve these practical problems, peoples are keenly looking into the suitable and best technique of recycling copper from used cables. All over the world, the West Africa is the main point for recycling the used cables. Waste copper cable recyclers are using mechanical shredding and open burning techniques to separate the copper from the plastic insulation materials in West Africa. The burning of copper cables, highly reliable chemical containing toxic gases is exposed to the atmosphere which creates potential environmental and health problems. To overcome the above said problems, the mechanical stripping is suitable alternative solution according to the Blacksmith Institute (USA).

Xiao et al (2016) discussed different treatment techniques (stripping machine technology, mechanical crushing sorting technology, high-pressure water jet recovery technology, chemical processing technology, cryogenic technology, heat recovery technology and ultrasonic separation technology) available for recycling scrap wire and cable according to China's national conditions. From the above mentioned the stripping machine technology is selected for recycling the copper from the used cables due to its simple construction, low cost and flexibility. However, it has the disadvantages of noisy operation, parts wear and energy consumption. Moreover, it also creates dust during processing.

Asante et al (2016) documented electrical and electronic waste (e-waste) intrusion processes in Ghana. This paper addressed the mechanical shredding and open burning as primitive technology used in Ghana for recycling the metal from plastics. Yang et al (2010) simulated copper recycling process by cable granulator method by finite element method. Stress and strain distribution in the cutting tool and copper wire in cable granulator method was studied. It is revealed that the different region different stress distributions occur. Yokayama et al (2011) performed metallic copper from polymer-insulated copper wire by mechanical means. It is ascertained that the recovery of copper was progressed with increasing the number of rolling times. Li et al (2017) collected the literature papers in the area of waste copper cable recycling and treatment technologies. It is learnt that waste copper cables-the important "urban mineral"- should be effectively exploited to improve waste cable recycling industry. Bigum et al (2017) performed investigated analysis on misplaced special waste to environmental impact through life cycle assessment modelling. It is concluded that the recovering rare metal would it be possible to reduce the loss of abiotic resource from the system. The presence of the rare metal in special waste is on special focus currently.

Hence, this mini-project work deals on improving the efficiency of recycling copper from used cables by its unique design and robust fabrication under very low cost. Upon completion of this work recycler will grasp this technique for recovering pure copper metal from the used cables.

II. PARTS OF WASTE CABLE STRIPPING MACHINE

The design of waste cable stripping machine was drawn using Schematic diagram. The waste cable stripper machine mainly consists of electrical motor, drive shaft, tool with adjuster and frame. The parts are fabricated as per the proposed design by field study. The manual metal arc welding process is enabled for joining all the parts rigidly. The parts of the waste cable stripper machine is detailed in the following sections 3.1-3.4.



Fig. 1 Schematic diagram of waste cable stripper machine

A. Electrical Motor

The specification of motor is shown in Table 1. The electrical motor employed during the fabrication of waste cable stripper machine is shown in figure 2.

Table 1 Specification of motor

Model	Merritt- Singer India Pvt. Ltd.
Control	Semi-Automatic/ Manual
Mode of operation	1/12 HP
Maximum speed	6500 rpm
Frequency	50 Hz
Current	0.6 A

The electrical motor was utilized as sewing machine motor for strip the waste cable with high torque. The motor is suitably controlled according to the required speed by foot step controller.

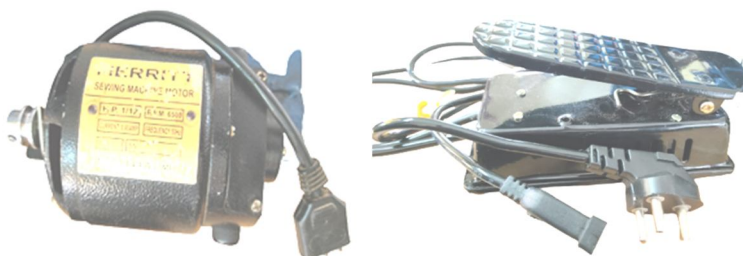


Fig. 2 Electrical motor and controller

B. Rotary Taper Shaft

The rotary taper shaft is employed in the machine as drive shaft which is rotated when the motor runs and is captured in figure 3. Because of the taper in the drive shaft, the different diameters of waste cables are seated on the driver shaft perfect during the cable stripping process.

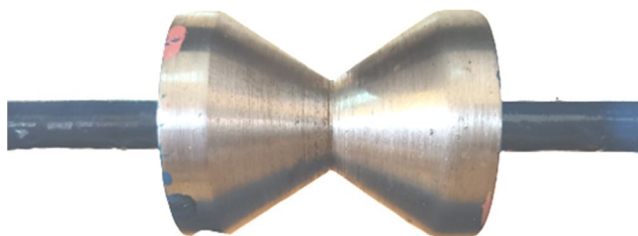


Fig. 3 Rotary taper shaft

C. Tool and Adjuster

The rotary tool and adjuster adopted in waste cable stripper machine is presented in figure 4. Depending on the diameter the height of the rotary tool is adjusted for stripping with the help of adjuster.



Fig. 4 Tool and adjuster

D. Frame

Frame of the machine is in the form of rectangular shape. In order to arrest the vibration, structure is made up of cast iron material. Figure 5 realizes the structure of waste cable stripper machine.



Fig. 5 Frame

III. WASTE CABLE STRIPPING MACHINE AND ITS WORKING

The assembly of waste cable stripping machine is shown in Figure 6. It has dimensions of 40 mm length, 10 mm breadth and 40 mm height. The total weight of the machine is 12 kg. The waste cable is stripped into the pure copper and plastic with the help of waste cable stripper machine and it is schematically illustrated in Figure 7. The rotary taper rod is rotated when the motor is switched on. The gap between the rotary tool and taper rotary rod is maintained by adjusting the head according to the diameter of the waste cable. Under the circumstances, the waste cable is inserted into the gap to strip the pure copper. Finally, the stripped cables are separated from the waste plastics and are packaged for futuristic purposes.



Fig. 6 Assembly of waste cable stripper machine

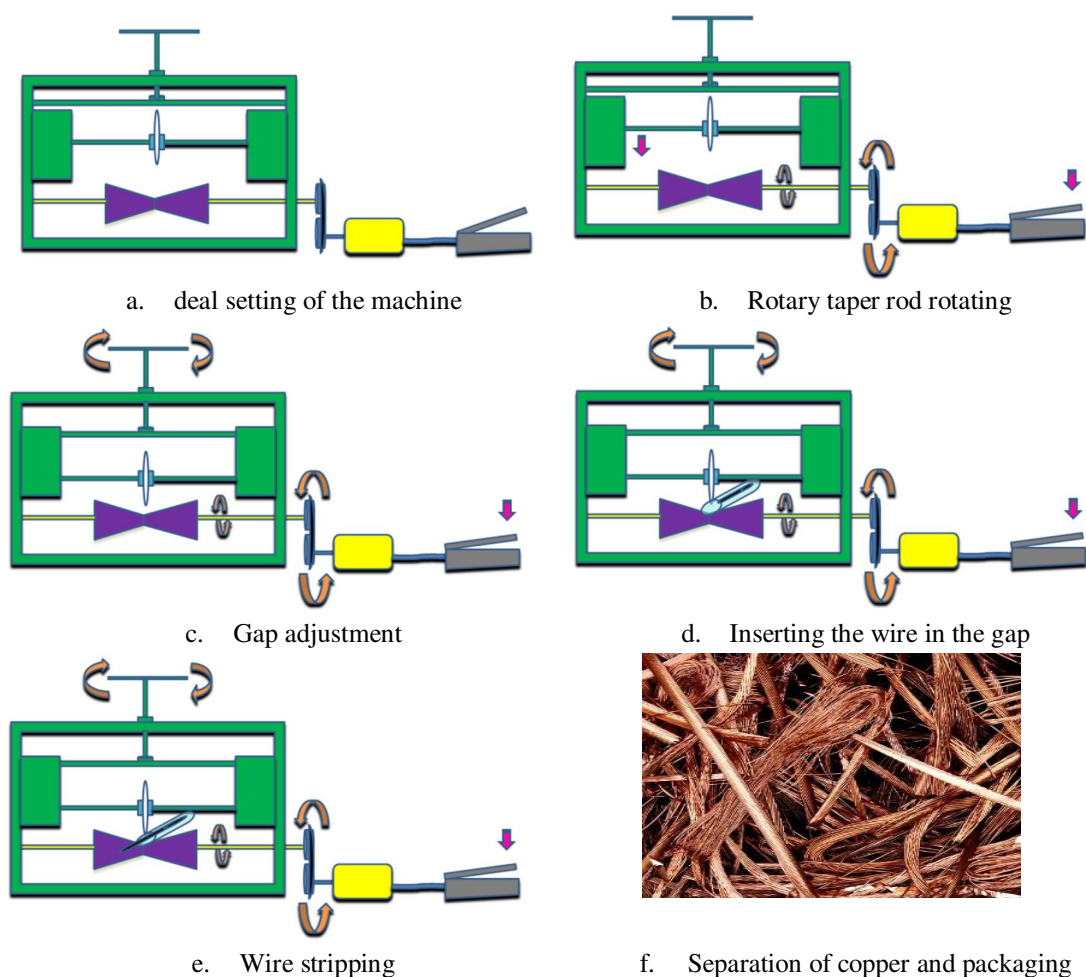


Figure 7. Working of waste cable stripping machine

IV. CONCLUSION

This paper discusses the waste cable recycling machine based on the stripping principle. AutoCAD 2000 was used to configure the structure of the proposed machine; the following conclusions can be drawn from the research work.

- 1) The parts of the waste copper cable recycling machine were fabricated rigidly as per the design.
- 2) During the assembly process, metal arc welding was utilized and robust structure was constructed for recycling the waste copper cables.
- 3) The fabricated machine can yield highest pure form of copper from the waste cable without any sort of practical issues in an easy, economic and eco-friendly manner.



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