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(Research Article)

Fabrication of low-cost metal polishing machine for preparation of microstructure samples of lightweight alloy and composite material

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Abstract

A metallographic specimen should be performed to determine the microstructure of a material. One of the processes of preparation of metallographic specimen is polishing process. The designing and manufacturing a polishing machine will be very helpful in the process of polishing the metallographic specimen. This apparatus includes a motor, aluminum circular disc, switch and speed controller, and base plate. The polishing machine is constructed from these individual parts. This paper is proposed to design and fabrication a metal polishing machine for laboratory scale. In this paper, several stages of the process are performed, such as designing the model, preparing tools and materials used, making components, assembling and testing the polishing machine. The results obtained are polishing machine that works well and can be used for the metallographic test for students and researchers. It can be concluded that this polishing machine can produce the level of specimen preparation for a metallographic test.

Keywords: Aluminum circular disc; Emery Paper; Manufacturing; Cost effective

1. Introduction

This is the era of a customized market rather than a custom Market. In this era of customized markets, industries are preparing themselves to produce products according to the needs of customers to stay in this competitive market. Especially, Manufacturing sectors are facing a new challenge of customized demand fulfillment rapidly to provide outstanding services to their customers.

Due to “Mass Customization” along with the flexibility according to the changing environment of the market, the industries are adopting the trend of modern machinery. There has been much research on the characteristics and production methods of mechanically polished surfaces. All agreed that polishing is a cutting process that removes surface imperfections, leaving a smooth, grooved topography that gets smoother as the polishing medium gets finer and smoother, until a mirror-like, secularly reflective surface is achieved.

The field of research known as "metallography" focuses on the microscopic structure of metals and alloys, as well as the correlation between that structure and the material's chemical, physical, and mechanical characteristics. The internal structure can be determined in several ways, but microscopically investigations have consistently ranked high. Metallography analyses, for the most part, have been performed using an optical microscope, therefore a reliable polishing method is crucial for achieving accurate findings. There are three main Procedures involved in every optical microscopy investigation designed to disclose the atomic structure of metals:

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- Preparation of a sectioned surface
- Development of the structure on this prepared surface by a suitable etching process (Grinding and Polishing process)
- Actual microscopically examination of the surface.

It is necessary to have a successful conclusion of all three processes since they are intertwined and the overall process is constrained by the lowest quality achieved by any one of the three. The process of generating a smooth and glossy surface by rubbing it or applying a chemical action, leaving a surface that has a considerable and spectacular reflection, is referred to as polishing. When an unpolished surface is magnified by hundreds of times, it typically seems like a landscape with mountains and valleys. The specimens need to be carefully ground and polished by repeated abrasion that wears down "mountains" to flat or merely little "hills" to get a highly reflective surface that is free from scratches and distortion [1]. This is necessary to produce the desired result of a surface that is free from both scratches and deformation. When examined with a microscope, the findings are improved thanks to the use of this technique.

When using abrasives to polish, it is best to start with a coarser grit and work your way down to a finer one. Different techniques of grinding, polishing, and etching are used to prepare the surface of a metallographic specimen. Optical or electron microscopy are common methods of analysis after preparation. Rough polishing is done using emery sheets of varying grits on a wet grinding machine [2]. With speeds ranging from 500-1500 rpm, a feather touch control panel, and a detachable water coolant sprayer, polishing machines provide an affordable answer to the challenges of metallographic sample preparation. However, in a manufacturing setting, abrasive belts moving over metallic rollers accomplish the task of creating a finely polished surface, making use of extremely complex and automated surface polishing machinery.

It takes practice to master the technique of polishing metal specimens for microscopic analysis. Even with years of experience under their belts, metallographers often find themselves spending significant amounts of time correcting poor polishing results or experimenting with various, usually minor, adjustments to their polishing procedure. There seems to have been only minor shifts away from a standard since the polishing method used by the vast majority of metallographers today is quite similar to that used 10, 20, or 30 years ago. While concerns about polishing techniques have persisted since metallography's infancy, the topic has received surprisingly little systematic investigation. The Bureau of Standards recently conducted research to determine the advantages of the method, to recommend a method for metallagraphic polishing.

A bright, reflective surface may be achieved by the polishing process by rubbing or chemically treating the surface. Polishing is an iterative procedure. Emery paper of increasingly finer grades is used for each succeeding polishing step until the required sheen is obtained. At this point, the process of metal removal begins. The second process is called "Fine polishing," and it involves the removal of very small amounts of metal. Scratches on a specimen's surface may be removed using this tool [3-4]. Finally, etching is the process of selective chemical assault on the surface of the polished specimen that reveals microstructural characteristics (grain boundaries, phases, precipitates, and other micro-structure elements). Mirror-like sheen is often achieved by buffing, not polishing, despite popular belief to the contrary.

Polishing is often used to improve aesthetics, protect instruments from dirt and grime, eliminate oxidation, provide a reflecting surface, and even prevent corrosion. In metallography and metallurgy, a flat, defect-free surface is created by polishing to examine the microstructure of a metal. Polishing may be done using either silicon-based pads or a diamond solution. The antimicrobial properties of stainless steel may be improved by polishing.

1.1. Grinding and polishing process

Polishing is the last step in the precipitating section of a metallography test, and it involves utilizing a metallographic machine, which consists of revolving plates and in it uses force, to smooth out the surface. Polishing is often used to improve the look of a finished product, eliminate oxidation, disinfect medical equipment, and protect pipes from corrosion [5]. When inspecting the microstructures of metals with a microscope, a defect-free work surface is essential, and polishing is employed for this purpose in metallography and metallurgy.

The usage of a Manual grinder-polisher is suggested for optimal graphite retention. This apparatus allows for more precise regulation of the appropriate weight of the specimens and the duration of each preparation step. In addition, this apparatus guarantees that each specimen is aligned in the same way against the preparation surface, which affects the graphite retention. The specimen surface is prepared for metallographic examination by abrading it with progressively finer abrasive particles [6-7]. Different needs for preparation quality, quantity, and repeatability are fulfilled by the wide variety of metallographic preparation machines for grinding and polishing.

By rubbing or applying a chemical action, polishing may make a surface smooth and bright, resulting in a strong specular reflection. Polishing is an iterative procedure. Emery paper of increasingly finer grades is used for each succeeding polishing step until the required sheen is obtained. At this point, the process of metal removal begins. The second process is called "Fine polishing," and it involves the removal of very small amounts of metal. Scratches on a specimen's surface may be removed using this tool [8]. Metallography samples required for microscopic examination of different metal structures are polished using disc polishing machines. Machines' discs are polished until they are perfectly smooth, scratch-free, and mirror-like, allowing for precise metallographic analysis. The last step in creating a flat, smooth, scratch-free, mirror-like surface is polishing [9]. A suitable surface is required for later qualitative and quantitative metallographic interpretation. The Machine's drive comes from the motor spindle, which is held in place on the shaft by friction. Discs used for polishing are mounted on the shaft and secured with a nut. For quiet operation, two bearings on the shaft are mounted in a bearing holder. [10-11]

Etching is the process of disclosing the micro-structural characteristics of a polished specimen (such as grain boundaries, phases, precipitates, and other micro-structure elements) by the use of selective chemical assault on the surface. Etching is the last step in the process. There is a widespread misunderstanding that a polished surface will have a mirror-like shine; in reality, the majority of mirror-like shines are achieved by buffing [12].

The purpose of this paper is to fabricate a polishing machine that is capable of providing extremely fine polishing to the material. We hold two aluminum discs to get fast working and time-saving if multiple users want to work. A rod made of cast iron used for the construction of the frame, two-speed controllers, two motors used for rotating discs, and an emery paper hold circular ring are included. The cost of the approach that is being offered is lower than the cost of the way that is traditionally used. The newly created machine is easily transportable and does not take up much space. In the context of this paper, we had a brief discussion about the components that were employed in the development of the machine in the methodology section. The objectives of the paper is to design and construct a polishing machine that will polish metal for physical metallographic determination and also to design and construct a machine using waste available materials at a low cost as compared to the industrial polishing machine to produce a flat, smooth and mirror-like surface of any metallic materials to determine their physical structure using microscopy.

2. Literature review

This section presents an overview of a review of literature related to the present work. The literature survey is usually carried out to assess the past studies done on the subject. It covers previous studies related to research interest which involves the objectives of the studies, experimental details, outcomes, and conclusions related to the present work. Thus with the help of this literature, a direction can be obtained for completion of our work.

2.1. Current and Previous Studies

Current and previous studies are reviewed to analyze the gap between conventional technologies and current technologies. By in-depth analysis of these studies, it can be easily judged that how the technology is moving ahead and still what is the research gap that can be a step ahead towards future extension of that particular work. Thus, previous work and literature provide a path and guidance for future work so that objectives can be planned.

2.1.1. Manufacturing and Polishing Technology

The “Manufacturing Segment” is a major sector in global economic market. Manufacturing is a key to development throughout the world. The economic prosperity of a nation is directly linked to the manufacturing capabilities of the nation. Manufacturing indeed has positive impact on GDP growth of the country [13].

The metallographic specimen polishing machine that was invented by Erinle and his colleagues has the capability to grind and polish any form of metal, is easy to use, and needs very little maintenance. In the material laboratory, the metallographic specimen polishing equipment may be used for grinding and polishing any kind of metallic material. Since the 16th century, polishing machines have undergone a variety of design and construction changes. Since that time, a number of innovators and scientists have worked on the machine's development using the resources that were accessible at the time [14-15].

Leonardo da Vinci was a pioneer in the fields of science and technology. He was responsible for the creation of machines that were used in the fabrication of optical instruments. In point of fact, he came up with the concept of grinding and polishing machinery for telescope mirrors, which at the time were made of bronze, between the years 1513 and 1517. Unfortunately, it would seem that Leonardo da Vinci did not really construct his idea during his lifetime, as he often did with other innovations that he developed [16].

After Galileo had brought it to widespread attention, the refractor went on to become the most popular kind of telescope used up until the end of the 19th century. The concept that Leonardo da Vinci should construct an astronomical instrument out of a mirror was disregarded for a long time until Jacques Grégory (1663) and subsequently Isaac Newton brought it back to life by implementing it in reflecting telescopes. These telescopes still carry their names even in modern times. The original mirrors for telescopes were hand-formed metal discs just a few millimetres in diameter. However, as soon as they reached bigger proportions, it quickly became necessary to make use of machinery in order to shape and polish them. In the course of this historical progression, the most well-known astronomers were first amateurs [17].

William Herschel (1738-1822) constructed a polishing machine as early as 1788, which enabled him to build a fifty foot mirror the next year in 1789. Unfortunately, no description of this gadget, which William Herschel guarded as a secret until the day he passed away, has been preserved. He merely asserts that the production of it was essential to replace the number of employees necessary to finish his bigger mirrors, a number that would sometimes equal to a dozen men. He claims that this number of workers was necessary in order to complete his larger mirrors. However, visitors to his museum in Bath, England may see a miniature polishing machine that he constructed there [18].

Following in the footsteps of William Herschel, Lord Rosse (1800-1867), a wealthy landowner and an amateur astronomer, began in 1843 the process of casting a 183-centimeter bronze mirror for his telescope, which he named the Parsonstown Leviathan and which may still be seen in Ireland. In order to do this, he made use of a polishing machine, which he first detailed in 1841 with the purpose of presenting it to the Royal Society.

Later on, still another amateur, this one a wealthy trader named William Lassell (1799-1880), utilised a polishing machine to create large-sized mirrors, the most notable of which was a 122-centimeter mirror that was installed in Malta in 1855. But all along this story, we also run across experts, such as Henry Draper (1837-1882) [19], who was one of the first people to cut mirrors using Leon Foucault's research. For this reason, in the year 1850, he constructed a machine that was inspired by the one built by Lord Rosse in the year 1840, which served as the standard for a considerable amount of time. His name lives on in perpetuity in association with this kind of equipment [20].

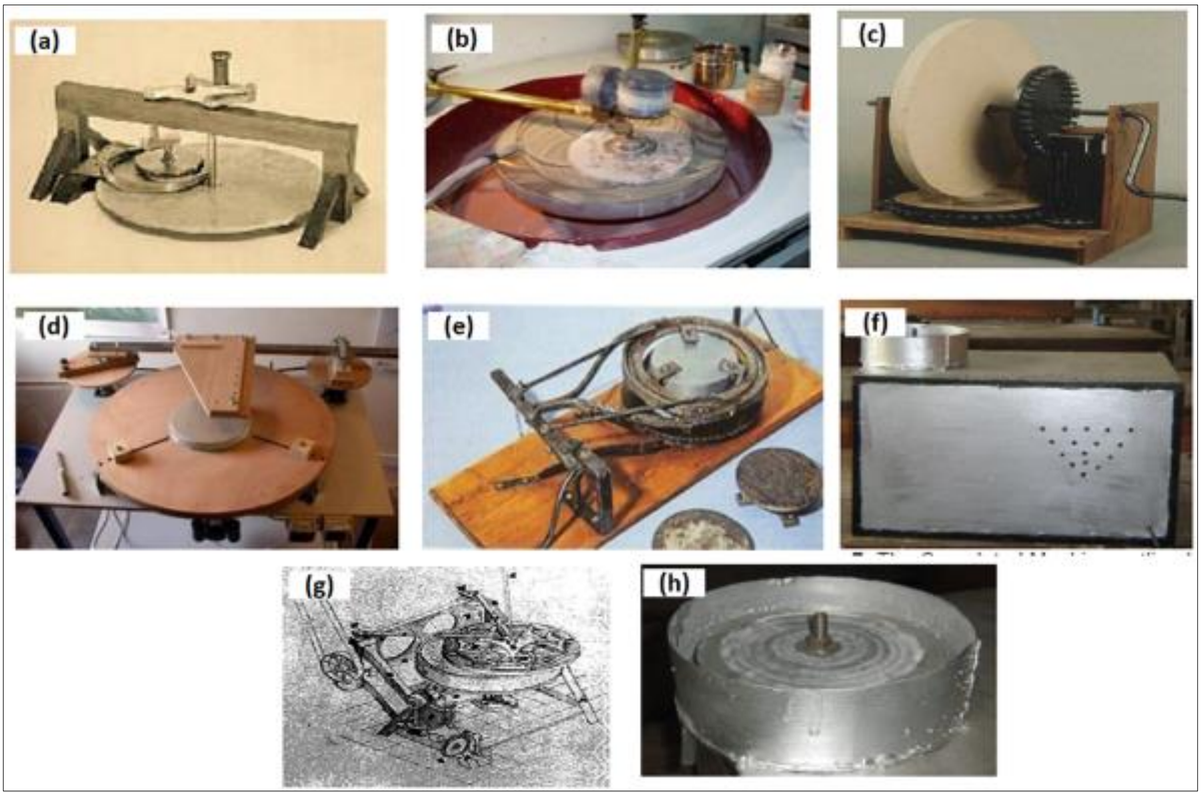

Figure 1 Model of polishing machines a) Leonardo da Vinci Polishing machine (Source : Cherubin D'orleans, 1670), b) Romano Zen's Polishing Machine (Source: Paul Vincart, 1922), c) Leonardo Vinci Polishing Machine (Source: Huygens, 1683), d) Jean-Marc Lecleire's Polishing Machine (Source: Jean Texereau, 1958), e) William Herschel's Polishing Machine (Source: Lord Rosse, 1841), f) The Completed Machine outlined in this Paper, g) William Lassel's Polishing Machine (Source: Henry Draper, 1850), h) The Machine showing the Polishing Surface. [21]

More recently, George Willis Ritchey, in his turn, improved and used the same type of machine, first in the United States (particularly for the making of the 2.5 metre mirror destined for the Mount Wilson Hooker telescope) and then in France at the optics laboratory of the Dina foundation at the Paris observatory. This was done in the order that the United States came first, followed by France. Following the conclusion of his time in France, he took with him two machines and the blueprints for a third machine with an 8-meter capacity that was never constructed [21-22]. The polishing machine (1890) owned by George Willis Ritchey and located in his workshop in the United States. Polishing machine for two metres that was created by G.W. Ritchey for use in the Dina laboratory at the Paris observatory (dating back to 1924). G.W. Ritchey's eight metres machine was the subject of his projection. Some polishing machines invented in past years are discussed in Fig 1.

2.1.2. Problem Identification

It is observed from literature review that lot of researchers put much efforts in design of polishing machine also tried to optimize the parameters so that obtain good surface finish. But there is still some limitation which is the fabrication of a polishing machine with waste material at a low cost as compared to an industrial polishing machine is missing and not more work has been done.

3. Material and method

3.1. Raw Materials

In this section, the specifics of the many components that make up the Specimen Polishing Machine, such as the Aluminum Disc incorporating Adapter, Emery Paper, and Motor, are broken down and described in further depth. The motor is coupled with an aluminum disc once the alternating current supply is changed to direct current at the suitable voltage. Following that, the aluminum disc that has the emery paper placed on it begins to revolve. The specimen that has to be polished (a drill bit, for example) is held by hand while the required polishing is completed. Because there is friction and the formation of heat, a manual water cooling system is used to cut down on the amount of heat generated.

3.2. Details of the components

3.2.1. Aluminum disc

Polishing head may be of Aluminum, Steel and allows us to separate the face plate from the adapter to minimize cost and inventory. The polishing head discs are made of high quality aluminum as shown in figure 2. The polishing head discs come with sponge pad and screws for fixing. It does not twist, easily withstand vibration and maintain firm stability.

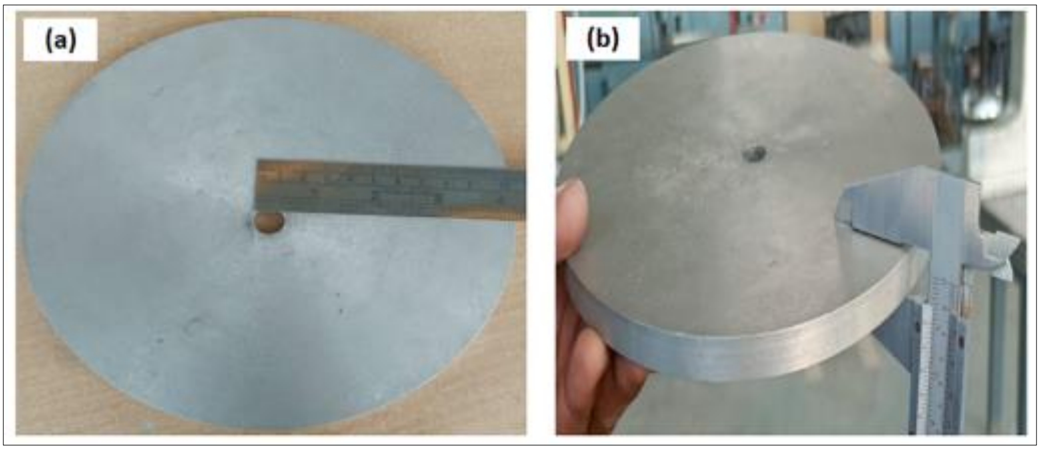

Figure 2 Aluminum circular disc, a) Disc with 100 mm radius, b) Disc with 20 mm thickness

3.2.2. Emery Paper

The process of abrasive finishing involves rubbing or moving a bonded or coated product over the surface of the workpiece while applying pressure. The abrasive mineral used in this process is harder than the workpiece itself. Products made of metals, composites, stone, glass, or wood may have either a visual or a mechanical finish applied to them via abrasive finishing. It is possible to complete the abrasive finishing operations by hand, with portable equipment, with manual or automated gear, or all four. Grinding, polishing, buffing, lapping, and honing are all processes that are performed.

3.2.3. Factors that affect Abrasive finishing are as follows:

- Abrasive minerals type, size, shape ad hardness
- Bonding types
- Cutting speed
- Machinery

3.2.4. Abrasive Technical Information

Most of the abrasives are of Mineral type and some of the common abrasives are given below:

- Aluminium Oxide
- Silicon Carbide
- Ceramic Abrasives
- Zirconia Alumina
- Diamond and CBN Abrasives
- Emery Abrasive
- Buffing Abrasive

The level of hardness of the mineral determines its use as an abrasive. The process of a harder substance chipping, abrading, or wearing away at a softer work piece material is the fundamental idea of abrasion. On the Mohs scale, the abrasive minerals typically have a value that falls between 7 and 10. The following is a chart that compares the different abrasive materials according to their Mohs hardness as shown in Table 1.

Table 1 Abrasive Material and Mohs Value

Sr. No.	Abrasive Material	Mohs Value
1	Aluminum Oxide	10.0
2	Silicon Oxide	9.5
3	Ceramic Abrasive	> 9.5
4	Zirconia	9.0
5	Aluminum Oxide	9.0
6	Emery	7.0 – 8.0
7	Garnet	7.0
8	Quartz	7.0
9	Sand	6.0

Emery paper is an example of an abrasive paper that is used for sanding and polishing metal. It has a surface that is coarsely textured, while the paper backing is smooth. It is important to keep in mind that items made of emery are intended for usage on metal, whilst sandpaper is often used with wood.

Emery paper is created when sheets of paper are coated in a particular adhesive and then abrasive mineral particles are glued to the paper. The mineral known as emery, which may also be found in nature, is sometimes referred to as iron spinel or hercynite. Emery cloths are significantly more frequent than conventional paper versions of this product and may be used in the same manner. The most fundamental versions of this product have a paper backing; however, more popular variants utilise emery cloths instead. Emery paper provides a higher degree of accuracy and consistency in its results than sandpaper does. This is because emery particles have a stable structure and a grain size that is uniform from particle to particle. Because of these properties, this paper is the superior choice for high-end metal work, and it also produces a more even finish or polish than competing options. When selecting Emery Products, abrasiveness, also known as grit, is a primary consideration. The grit number of very coarse versions often runs between 40 and 50, and they are used for sanding big areas or removing huge amounts of paint and rust. These versions are suited for use. Having a grit level that falls anywhere between 50 and 90, medium-grit paper is ideal for use in a variety of sanding applications. Paper with a grit rating of more than 90 is considered fine. This kind of paper is ideal for finishing work or polishing metal, since its coarseness level is the lowest. In actuality, the coarsest paper is used at the beginning of the process, followed by medium and then fine grit paper in order to get the results that are desired. Emery papers may be used either while dry or when wet, depending on the circumstances that are required. The emery papers are seen here in figure 3.

Figure 3 Emery Paper

3.2.5. DC Motor

Figure 4 discussed about direct current (DC) motors are relatively simple electric motors that create torque by combining the forces of energy and a magnetic field. This allows the motor to revolve in the desired direction. In its most basic configuration, it calls for two magnets with the opposite polarity of each other, in addition to an electric coil that functions as an electromagnet. Torque is what causes the motor to spin, and it comes from the electromagnetic forces of the magnets 10, which may either resist or attract one another. A DC motor must have at least one electromagnet in order to function properly. This electromagnet is responsible for switching the direction of the current flow when the motor rotates. It's possible that the other magnet or magnets are electromagnets, but they might also be permanent magnets. It is common practise to position the electromagnet in the middle of the motor, where it will rotate inside the permanent magnets; however, this configuration is not necessary.

3.2.6. DC Motor specifications:

- Power- 100 W
- Speed- 1400 rpm
- Voltage- 220 V
- Winding Material- Copper
- Phase- Single phase
- Frequency- 50 Hz
- Current- 1.5 A

Figure 4 Motor

3.2.7. Switch and regulator

Controlling the functioning of a double disc metal polishing machine requires the employment of significant electrical components such as a switch and a regulator are shown in figure 5. These components are found in the machine. The machine may be turned on and off using the switch on the panel. The switch is often a straightforward on/off toggle that may be found on the control panel of the machine. The electrical system of the device is energised as well as the motors and electronics when the switch is switched on. On the other hand, it is the job of the regulator to keep the polishing discs moving at the appropriate pace. The operator is often provided with a variable speed regulator that enables them to alter the speed of the machine in order to get the required finish on the metal surface.

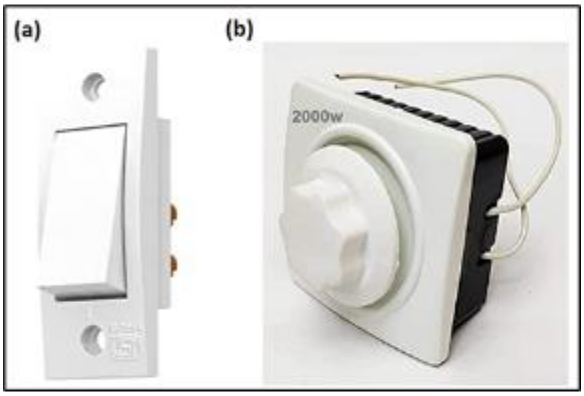

Figure 5 a) Electric switch, b) Regulator for speed control

3.3. Manufacturing Method

Following the completion of the design phase, the next step is to move on to the production phase. When making polishing machines, it is necessary to pay careful attention to the sequence or technique of either the design being created or the design to be manufactured. The process of manufacturing was carried out in line with the work that needed to be done in groups for each component, which made the process of assembly much simpler later on. The production technique for polishing machines consists of various components, including the following:

- Main components, such as a frame, polishing discs, and machine cover.
- Sub-components, such as electric motor, switch.

After the manufacturing stage, the next step was the assembly stage. The term "assembly process" refers to the act of assembling or merging each component into a form that is mutually supportive in order to build a tool in line with the intended specifications. In the Advanced Composite Material Lab of the Department of Mechanical Engineering at

Suresh Gyan Vihar University in Jaipur, Rajasthan, India, the polishing machine is put through its paces for testing. When polishing, Steel is the material of choice for the materials. The effect of polishing may be achieved by experimenting with different grades of emery paper and keeping the amount of time spent polishing to a minimum. At each point in time when the polishing process was brought to a close, its data-gathering result was recorded. If the results of the polishing process have a glossy appearance, the polishing process is done. Next, the microstructures of the work piece are examined using a microscope, and images are taken of the final product.

4. Results and Discussion

4.1. Testing

The machine were tested by using the two polishing discs simultaneously and also by disengaging on of the polishing disc for the other one. The machine was also tested by polishing a rust metal coupon on a 150 to 600 grade emery paper fixed on the polisher disc as shown in figure 6.

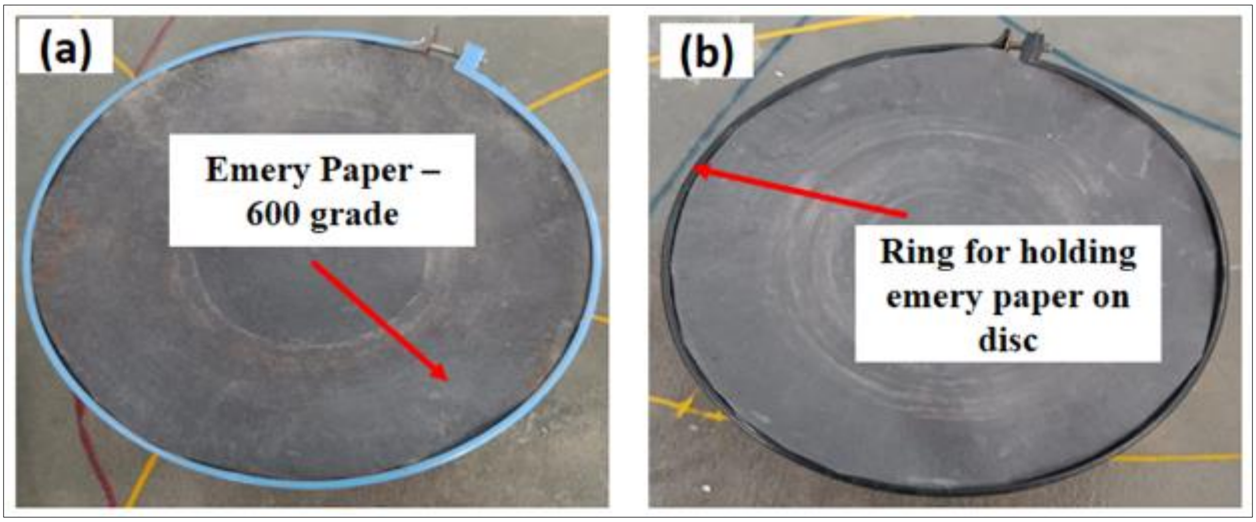

Figure 6 a) Covering of 600 grade emery paper on disc, b) Circular ring for holding and fixing of emery paper on disc

4.2. Working principle of polishing machine

Figure 7 discussed about the process of generating a smooth and shining surface by rubbing it or applying a chemical action, leaving a surface that has a large specular reflection, is referred to as polishing. The process of polishing consists of many steps. In the initial step, a rough polishing is performed, and in each succeeding step, progressively finer emery paper of varying grades is used. This process continues until the required finish is obtained. At this point in the process, the metal is being removed. The next step is the fine polishing, which removes very little or even almost none of the metal from the surface of the object being polished. The primary purpose of this tool is to eliminate scratches from the specimen's surface. Etching is the process of disclosing the micro-structural characteristics of a polished specimen (such as grain boundaries, phases, precipitates, and other micro-structure elements) by the use of selective chemical assault on the surface. Etching is the last step in the process. Before the specimens can be looked at under a microscope, they have to go through a process of being thoroughly ground and polished so that they have a surface that is highly reflective and is free from any scratches or other forms of distortion. The Emery paper that we use is attached to an aluminum disc, and that disc is then attached to the motor. The speed of rotation ranges from 100 to 1400 revolutions per minute (rpm). This has the effect of polishing the specimen, which ultimately leads to the achievement of the desired outcomes. The double disc polishing machine fabrication cost in the present work is discussed in Table 2.

Figure 7 Experimental Setup of double disc polishing machine

4.3. Surface quality of Material after polishing

A polished machine will be tested for magnesium (AZ 61) alloy by using different types of emery paper and polishing time. The result of the polishing test on steel can be seen in the figure 8.

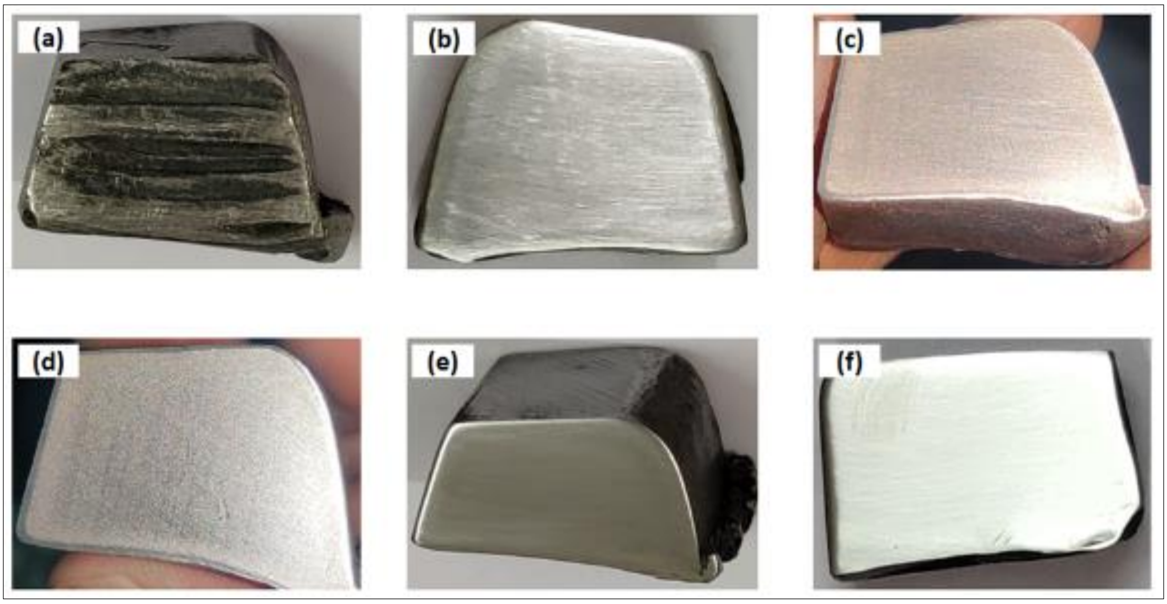

Figure 8 Surface finishing of material after polishing a) As cast material, b) Polishing with 350-grade emery paper for 20 minutes, c) Polishing with 450-grade emery paper for 20 minutes, d) Polishing with 600-grade emery paper for 20 minutes, e) Polishing with 800-grade emery paper for 20 minutes, f) Polishing with 1000-grade emery paper for 20 minutes

The polishing results as shown in figure 8, show that the ability of the polishing machine has been reliable for use as a means of preparing a metallographic specimen.

Table 2 Fabrication cost of metal polishing machine

Sr. No.	Item Name	Quantity	Price (INR)
1.	Aluminum Disc	2	300
2.	DC Motor	2	4000
3.	Switch	2	80
4.	Regulator	2	400
5.	Emery Paper	5	450
6.	Fiber Casing	5	1200
7.	Nuts and Bolts	20	100
Total Cost = 6,530/-			

5. Conclusion

In conclusion, the double disc polishing machine has been conceived, built, and examined for its functionality. The fact that the metallographic specimen polishing equipment carried out its duties to a sufficient level provided evidence that the paper goals and aims had been accomplished. During the course of the experiment, it was found out that every degree of speed has a significant part to play in producing nice, smooth results, including fine grinding and polishing. At each successively faster speed setting, the machine operates more effectively. The machine can grind and polish any sort of metal, it is easy to use, and it needs very little maintenance. Testing results prove that the length of time polishing and rotation speed of the disk will affect the level of fineness of the test specimen. While the level of coarse emery paper roughness is directly proportional to the level of fineness of the test object polish. We have created a machine that is both cost-effective and productive in its operation. The whole cost of the project is 6,530 rupees, which is far cheaper than the price of the equipment if it were to be purchased elsewhere (which would be 70,000 rupees). The apparatus is easy to use, does not need a lot of maintenance, and can grind and polish any sort of metal.

Suggestions for Future Work

Through the results and conclusions obtained from experimental work, numerous suggestions can be recommended which will be fruitful for future work related to improving the quality of surface polishing and less time-consuming process.

Double disc polishing machine should be modified by automatic operating in the present work person required to operate the polishing machine and sometimes human errors are observed while operating the machine such as vibrating of hands.

"Over-polishing" is the main issue that arises throughout the polishing process, which implies that the quality of the mould surface degrades as polishing time increases. "Orange peel" and "pitting" are two types of phenomena that result in excessive polishing. The majority of excessive polishing happens during mechanical polishing. Such type of issues will be eliminated by automatic operating machine by setting the time period of operation after it will automatically stop.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Data and materials availability

All data associated with this study are present in the paper.

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