MULTI-PURPOSE STEEL AND WOODWORKING MACHINE: A TECHNICAL FEASIBILITY STUDY

A Master's Thesis

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In Partial Fulfillment

Of the Requirements for the Degree

Master of Technician Education

ROLITO L. UNAY

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APPROVAL SHEET

In partial fulfillment of the requirements for the degree of Master of Technician Education (MTE), major in Civil Technology, this thesis entitled **"MULTI-PURPOSE STEEL AND WOODWORKING MACHINE: A TECHNICAL FEASIBILITY STUDY"** has been prepared and submitted by **Rolito L. Unay**, who having passed the comprehensive examination is hereby recommended for Oral Examination.

FELIPE F. CUNA, Ph.D.T.M.
Adviser

Approved by the Committee on Oral Examination on March 30, 2004 with a rating of **PASSED**.

SIMON P. BABALCON, JR., Ph. D.
Chairman

MARILYN D. CARDOSO, Ph.D.
Member

ROMULO O. ORALE, MTE
Member

ARMANDO L. PAGLIAWAN, Ph. D.
Member

- -

ACCEPTED AND APPROVED in partial fulfillment of the requirements for the degree **MASTER OF TECHNICIAN EDUCATION**, major in Civil Technology.

March 30, 2004
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MARILYN D. CARDOSO, Ph.D.
Dean, College of Graduate Studies

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D E D I C A T I O N

To my dearest Wife

Loida Lora-Unay

and

Children . . .

And to All Researchers in Samar,

this Humble Work is

Wholeheartedly

DEDICATED.

ABSTRACT

The main focus of the study entitled, "Multi-Purpose Steel and Woodworking Machine: A Technical Feasibility Study", is to design, construct, and demonstrate the functionality of the improvised equipment and revise the parts as a result of testing. It described several required parameters in order to develop a more realistic steel and woodworking machine, in terms of the various major functions and operations in crosscutting, rip sawing, metal cutting, grinding, and drilling. The multi-purpose machine was constructed and tried-out for possible defects. The identified defects were corrected and final try-out was made by performing all the suggested operations in the study. As a result of experimenting on the functionality of the multi-purpose machine, it was found out that the circular crosscut saw can cut across and circular ripsaw can cut along the grain of wood to a maximum of 5.0cm thickness. Likewise, the circular steel cutter can cut G.I. pipes and similar materials. The grinding stone can also grind rough metal surfaces to desired smoothness, and the drill press with properly selected bit can drill 8mm diameter holes to a maximum thickness of 6mm. The quality of the product produced shows that there are no test marks or burns on the finished piece of metal. Moreover, grinding operations on metal surfaces require careful feeding to prevent iron filings to cause possible eye injury. Wearing goggles is recommended. While drilling operations require careful and controlled feeding of bit to engage on metal materials with the application of lubricating oil necessary to avoid bit damages. Safety precautions, care and maintenance in the different uses and operations of the multi-purpose machine were instilled to prevent any possible injury to the operator.

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Chapter I

THE PROBLEM AND ITS SETTING

Introduction

One of the major problems in almost all schools in the country offering technology courses nowadays, is the lack of adequate equipment resources to support effective and efficient instruction. The problem of inadequacy and inavailability of handtools, machineries and equipment has perennially plagued school administrators, teachers and instructors which greatly hampered the efficiency of instruction.

Technology teachers and instructors should not only depend on the commercial and imported machineries all the time for the needed equipment in the shop.

Simpson (1972:2) as quoted by Cuna (1984:6) stressed the importance of improvization, said that: Improvization is feasible. Simple and locally made apparatus will enable the students to understand the basic principles more easily and make the students aware of these scientific principles applied to everyday things. He asserted that apparatuses need not be highly sophisticated in order to illustrate the concept of science.

In the absence of imported, modern and sophisticated machineries, it is a wise venture for the technology teachers, instructors and students to innovate, design and construct an improvised machine which can perform various operations similar to that of the commercial ones. This improvisation will serve as a substitute for commercial machineries which are not readily available, and in order for the technology and Livelihood Education programs to succeed.

Albaracin, as cited by Albos (1984:23), asserted that the teacher should have that initiative, imagination, and skill-know-how in the improvisation of the needed equipment in the laboratory shops. This idea underscores the idea of improvised gadget. The understanding and learning of the concepts and principles can be made effective with the actual performance of various technical skills.

In carpentry and construction technology, the circular rip and crosscut saw machines are two of the most important equipment to augment a broad range of activities in the laboratory shop. Likewise, the metal grinder, cutter, and drill press are three indispensable machineries in bench metal working.

Having this in mind, the researcher thought of designing an improvised machine that could be made out of locally available materials, as well as recyclable and discarded ones. The improvised equipment if properly designed and constructed, can perform almost as efficient as the modern and imported ones. The development of the multi-purpose steel and woodworking machine will contribute ways and means to better teaching of civil technology, furniture and cabinet making and bench metal work. It will unlock the difficulties of learning and facilitate better understanding of the basic theories and operating principles of the multi-purpose machine featuring five major functions and operations and is comprising of nine major assemblies.

In this context, there is a need to innovate an improvised instructional multi-purpose steel and woodworking machine for Civil Technology and other subjects relative to the demonstration and acquisition of operational skills. Hence, this study was conceptualized to improve technology instruction, manipulative skills and performance of the technology students. Hopefully, school administrators, teachers, students, future planners and researchers may benefit from the result of this study. It is also hoped that the output of this study will solve the

problem of inadequacy and inavailability of modern machineries, hence this study.

Objectives of the Study

Specifically, this study attempted to:

1. Design and construct a multi-purpose steel and woodworking machine out of locally available materials utilizing mostly metal parts and a minimum of wooden parts.

2. Demonstrate the functionality of the multi-purpose steel and woodworking machine.

3. Revise the parts of the machine as a result of testing.

Theoretical Framework

The study was anchored on the improvization theory of the Stanford University Team (1964) as a means of promoting the problem of inadequacy and inavailability of modern power tools in most vocational schools in the country. The team concluded that, the scarcity of the equipment, both in terms of machineries and handtools is a problem in the first magnitude in schools of developing countries. In most cases, these cannot be purchased. However, it is frequently possible to design and build simple tools and machineries which can be used to increase

production and to aid home industries and improve the shop programs.

Seymore (1966:xx) asserted that human skills and the capacity to acquire them have been fundamental through-out the progress of mankind. Skills are not innate, but acquired and one feature that characterizes living things as opposed to non-living ones in its capacity to learn. He concluded further that man is a tool-making animal. The manifestations of skills among primitive men were recorded in the products they left behind, and which were uncovered by Archeologists. Thus, the discovery of simple tools in burial places leads to the conclusion that those interred had the capacity to make and to use the tools which were found.

Wagner (1979:27), as cited by Pagliawan, stressed the importance of modern power tools, to wit:

> *A wide variety of skills of students depends upon the existence of modern power tools which greatly help an individual to acquire his versatility that qualifies him for a broad range of job opportunities. Modern power tools greatly reduce the time required to perform a certain task. Many of the operations can be accomplished with far less human energy, and when power tools*

are used in a proper way, high level of accuracy can be maintained.

Conceptual Framework

The Conceptual Framework that actually guide the researcher for this study is shown in Figure 1. The conceptual model follows the input-throughput-output model.

The first box contains the input variables which are the ideas, tools and equipment, supplies and materials needed and the labor for the development of the project.

The second box contains the throughput variables or the process of designing, constructing, demonstrating and revising. The steps as well as the operations are also included. The multi- purpose machine will be tested, and based on the result, revision or improvement would be made.

The third box contains the output variables of the study, which is the completed functional multi-purpose steel and woodworking machine.

Basically, the present study applied the concept on the improvization of multi-purpose steel and woodworking machine, out of low-cost and discarded materials locally available.

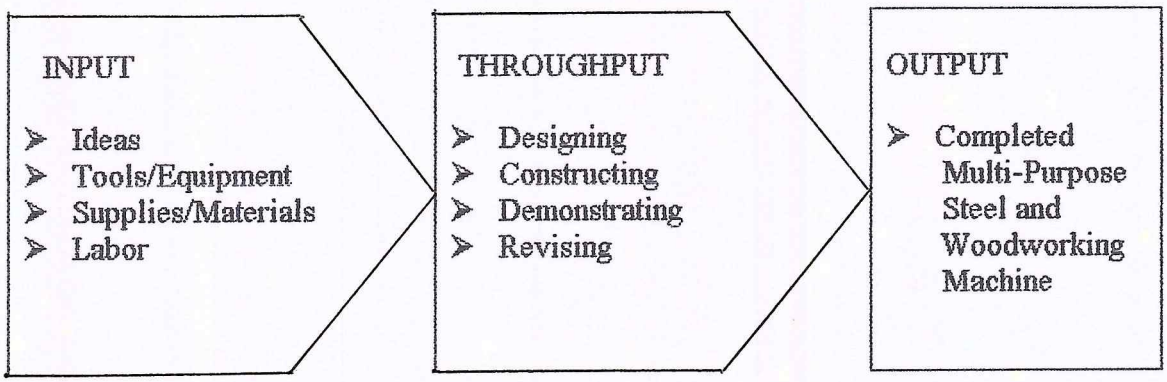


Figure 1. The Conceptual Model of the Study.

The procedure used was based on the readings of several books, magazines, journals, unpublished seminar papers and other valuable references.

A design was formulated/prepared for the multi-purpose steel and woodworking machine, electrically operated using a one-horse power 220-volt and 1740 rpm electric motor.

Statement of the Problem

The main purpose of the study is to design, construct and revise an improvised multi-purpose steel and woodworking machine during the school year 2003-2004 based on the existing problem of scarcity of instructional equipment.

The study sought to answer the following specific questions:

1. What multi-purpose machine can be constructed to cater/suit to the teaching learning needs in Civil Technology classes at Mondragon Agro-Industrial High School, Mondragon, Northern Samar, in terms of the following basic skills:

1.1 sawing along wood grain;

1.2 sawing across wood grain;

1.3 cutting metal;

1.4 grinding; and

1.5 drilling?

2. What are the construction procedures for appropriate functions of the different parts/assemblies of the machine?

3. What are the advantages that can be derived out of this multi-purpose machine?

Significance of the Study

The multi-purpose steel and woodworking machine if properly designed and constructed, will serve as substitute for modern machineries which are not readily available. Likewise, this improvised gadget will help unlock learning difficulties in teaching technology education in Mondragon Agro-Industrial High School and other technical schools in the country.

The result of this study will provide benefits and ideas to the students, teachers/instructors, vocational school administrators, planners/designers, and future researchers.

To the Students. The result of the study will directly benefit students in learning the various skills and encourage innovations in designing and creating improvised machines.

To the Teachers/Instructors. The result of the study will serve as the basis for replication and reproduction of the machines, usable for instructional purposes. And to encourage vocational teachers/instructors to innovate simple machineries, utilizing low-cost, recyclable materials which are locally available.

To the Vocational School Administrators. The result of the study will encourage them to support improvisation and in the fundings for reproduction and innovation of machineries.

To the Planners/Designers. The result of the study will serve as the basis for planning and designing other inexpensive improvised gadgets. The data obtained will serve as reference for future design and construction of the machine.

To the Future Researchers. The output of this study will serve as reference material for future researchers who intend to study further and improve the present study.

Scope and Delimitation of the Study

This feasibility study is limited to the design and construction of a multi-purpose steel and woodworking machine, utilizing mostly metal parts and a minimum of wooden parts and the use of low-cost, recyclable, and discarded materials which are locally available.

This study is also limited to the demonstration on the functionality and reliability of the multi-purpose machine based on the Five (5) major functions and standard quality of sawing, grinding, drilling and cutting metal/steel materials.

This study was conducted during the School Year 2003-2004.

Definition of Terms

The following terms are conceptually and operationally defined as well as used in this study.

Civil Technology. Refers to the systematic, scientific study of the techniques applied in the field of construction. As used in this study, it refers to one of

the major components of Technology and Livelihood Education (TLE) subject; where it also comprises the MAKABAYAN subject in high school curriculum.

Completed Multi-Purpose Steel and Woodworking Machine. Refers to an improvised machine consisting of several functions and operations in performing jobs. In this study, it is a combination workshop unit consisting five major functions and operations in sawing, cutting, grinding and drilling metal or steel and wooden materials which is electrically operated with 1HP Electric Motor.

Constructing. Refers to the act or process of putting something together systematically. In this study, it refers to fabricating, machining and assembling the major parts or assemblies of the multi-purpose machine.

Crosscutting. Refers to the process of cutting wood across the grain. In this study, the process is done by the use of circular crosscut saw which is electrically operated.

Demonstrating. Refers to the act, process or means of making evident or proving how something works or is used. In this study, it refers to the process of subjecting the machine to the actual operation intended to accomplish the various functions in terms of wood/steel cutting, grinding and drilling.

Designing. Refers to the derivation of data needed on the preparation of the master plan and the detailed drawing of the different parts of the machine. In this study, it refers to the act of planning and making the original sketches of different assemblies of the proposed multi-purpose machine.

Drilling. Refers to the operation of boring holes in solid materials by means of a cutting tool. In this study, it is the process of drilling holes in metal by means of the multi-purpose steel and woodworking machine, or drill press.

Grinding. Refers to the process of shaping, sharpening and smoothening metal surfaces by friction. In this study, it is the process of shaping metal with the use of an abrasive wheel directly driven by a shafting which is electrically operated.

Ideas. Refers to the technical information, knowledge and expertise in order to design a machine that can be used for construction.

Improvise. Refers to the fabrication of a device that is already found in the vicinity and modifying it for immediate use and economical purposes. In this study, it refers to the construction of an instructional machine that performs several operations.

Revising. Pertains to the possible adjustments of parts of the machines that are not properly secured. In this study, it refers to the modification of the part/s of the machine for better performance.

Ripsawing. Refers to the process of sawing or splitting along the grain of the wood. In this study, ripsawing is the process of cutting wood along its grain by means of a circular ripsaw which is electrically operated.

Technology and Livelihood Education. Refers to those educational or learning activities dealing with the development of technical skills, knowledge and attitude relative to production or service occupation for effective citizenship. In this study, it is one of the subjects that comprise the MAKABAYAN Curriculum.

Tools/Equipment. Refers to the hand instrument used to accomplish varied tasks needed to carry out a particular purpose or function. In this study, these are the implements used to construct the machine that bare hands cannot perform.

Supplies/Materials. Refer to the amount or quantity of goods available in the market to be purchased. In this study, these are the things that comprise the physical aspect of the machine.

Chapter II

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter presents the related literature on the problem of scarcity of instructional equipment. The researcher untiredly reviewed several books, journals, and other materials which have relevance to the study. It also presents some findings of related researches and studies undertaken in the Philippines.

Related Literature

The ideas, concepts, and principles cited in the review will give credence to the view that improvization of equipment is a viable alternative in solving the problem of scarcity of machineries.

Mendoza (1970:23) in one of the graduation addresses to the graduates of vocational-technical schools states: There is the possibility for you to improvise necessary handtools and machineries to lead the way to stimulating inventions, that would save labor and money. And again, there is the challenge for you to have active, assertive in discovering if we ensure for our country a fulfilling and inspiring future.

Doughtie (1981:15) concluded that design is a culmination of an engineering education. Without design, industries would cease in its production, basic information resulting from research would also stop. However, with the present trend of our educational programs, design is no longer limited to engineers. As ordinary shop teachers and instructors or even students may also do the job. Machine design is already integrated in some vocational courses and students are encouraged to make simple designs in their respective classes. This trend will result in the development of young engineers in their respective fields of specialization, especially if the program is augmented with sufficient exposure and practice.

Producing these new breed of people to cater to the new trends and demands of a fast accelerating technology and society would also necessitate a new kind of education. Technician teachers are aware of the inadequacy of equipment for instruction.

Weaver (1960:2) stressed that the primary problem in vocational education is the teaching of an occupation consisting of many manual skills. He further concluded that teachers are good in transferring concrete facts, theories and information, and that, if education is the

transfer of man's accumulated knowledge through the years from generation to generation, then it is the particular study of trade and the technical know-how.

Javier (1992:12), in his conference position paper on curriculum deserves our attention:

> *It is fortunate, however, that the Philippines as a developing country is simultaneously faced with the equally vital problem of accelerating economic progress which calls for the training of skilled manpower needed in the developing industries. This implies that vocational and technical education cannot be sacrificed to any appreciable degree without adversely affecting the government's efforts of improving the country's economy.*

Andres, et al (1989:117) concluded that:

> *Other leading educators and economists such as Dr. Sixto Roxas, an outstanding Filipino economist and at various times Chairman of the National Council and the Program Implementation Agency of the Republic of the Philippines and the Diokno Committee Report advocated vocational education. They believed that the training of more skilled manpower through a revitalization program of vocational education is the only salvation of Philippine economy.*

Angara (1988:1-2), on his keynote address during the Philippine Association for Technology Education-Technical Panel for Engineering Education (PATE-TPEE) Conference, pointed-out the importance of technology-oriented curricula by saying:

> *Why does the Philippines, despite its fairly high rank in educational attainment in Asia, lag behind in economic development?*
>
> *In a developing country such as ours, the crying need is economic growth. We could reverse the tide by having Science and Technology-Oriented Curriculum in schools, which can turn out scientists and competent technical workers.*
>
> *We should not profit from the experiences of other countries specifically in Latin America, that there is a preponderance of graduates in Philosophy, Humanities and Law. On the contrary, highly developed and industrialized countries veer toward the technological field. Blue-collar jobs are highly priced; labor is given due regard and attractive compensation.*

Cariño (1988:3-4), in his speech delivered during the PATE-TPEE Conference, stressed that:

We are known to be a highly educated people, if one judges from the number of students taking up courses in the colleges and universities. We have plenty of business graduates, lawyers, economists and engineers, yet, industry leaders complain of lack of needed manpower.

Of course, the government has to emphasize technological/technical education necessary in producing skilled workers that will be needed in the factories and plants.

Yap (1994:120), in his speech on the occasion of his conferment of the Doctor of Business Administration degree at the Pamantasan ng Lungsod ng Maynila on September 20, 1994, concluded that:

Our dream, which I know we share together is to see the Philippines self-sufficient in material resources, with a per capita income adequate for the needs of our people. We look forward to the day when we shall have enough jobs in our country. With such jobs available, our women need not have to go abroad to seek employment but to take care of their families here. Likewise, our men can obtain adequate employment here and stay home with their loved ones as a united and harmonious family.

In the meantime, the vision of the government even by the past administration, is the industrialization of the country at the turn of the 21st century. Business, shipping, mining, and other sectors in the society have been proven not enough to cope with the many necessities in the modernization and global competition.

Camarao (1998:191), pointed-out that the industrial sector has something to do with the country's development. He revealed further that:

> *Industrialization is a top priority in the country's scenario of development. The drive to industrialize is understandable in the light of a very successful experience of the new industrialized countries in Asia such as Singapore, Taiwan, and Republic of Korea, that followed this approach of development. The coming of industrialization marked the establishment of various types of manufacturing and service.*
>
> *Industries require various types of technical manpower. With this, industrial technologists, technicians and other skilled workers of various kinds are needed in the design, installation, operation and maintenance of various industrial*

machineries and in the production of various products.

On the other hand, Elevazo & Elevazo (1995:107), stated some sort of innovations, including the use of modern facilities which are necessary in order to be globally competitive. Elevazo stressed further, that:

> *The old term "technical-vocational education", has been given a new name, Technical Education and Skills Development (TESD). Both terms have the same meaning, referring to the same concern of producing middle-level manpower as perceived or assumed to be needed by an industrializing economy. The fundamental philosophy of TESD pertains to rationalizing the programs of technical, vocational and technological schools in line with the manpower needs of the industry, that all requiring a wide variety of equipment and facilities appropriate to the skills to be developed."*

Related Studies

The researcher reviewed related studies from the libraries in the Philippines.

Albos' (1985:19) study entitled: "A Multi-Purpose Grinder and Drill Press Machine: A Technical Feasibility

Study", was primarily concerned with the theory of improvization of a combination workshop unit which is a combination of a grinder and drill press machines. The grinder was designed to perform effectively and accurately in grinding metal, while the drill press can perform boring holes on metal surfaces.

The present study has similarities with that of the former, since both studies have considered grinding and drilling operations on metal or steel materials. However, it differs on scope; thus the present study is focused on the five major functions and operations as well as the drill press was designed in a horizontal position.

The study of Biñas (1984) entitled: "Improvised Power Hacksaw: A Technical Feasibility Study", was concerned with the design and construction of an improvised power hacksaw. The gadget is capable of cutting 12 to 14mm metal similar to a commercially made machine.

Comparatively, the present study has similarities with the former since it can perform cutting metal. However, the present study uses a circular metal-cutting disk. Both studies utilize locally available low-cost, recyclable and discarded materials.

Cuna (1984) in his study entitled: "An Instructional Saw-Sander Machine: A Technical Feasibility Study", was in

conformity with the concept of improvization of a combination workshop unit utilizing mostly wooden materials and a minimum of metal parts. The instructional machine can perform sawing operations by means of a circular saw blade and can perform sanding to the desired smoothness of wood surfaces.

The study has similarities with the present study, since both have considered wood working. Nevertheless, it differs in scope, thus the present study is a combination of wood and metal works, which include grinding, drilling and metal cutting.

Germones (1982) in his seminar paper entitled: "An Improvised Wood Lathe Machine", concluded that the improvised machine was effective as the commercially made one. The production cost amounted to P2,019.00 pesos only. The wood lathe machine can perform woodturning operations intended for table legs, balusters and other decorative millworks.

Theoretically, the similarities of the study to the present are the principles used in performing work is that both are driven by means of V-belt attached to the V-pulley of the motor to the V-pulley of main shafting. Wood turning is done in a horizontal position. The

similarity of the former study to the present, is that drilling operation is also done in a horizontal position.

Lara (1992) in his study entitled: "Improvised Swing Saw Machine: A Technical Feasibility Study", asserted that the machine can perform wood cutting operation by means of a swinging lever arm where the motor is secured. The circular saw blade was directly driven by the motor shafting.

The present study has similarities, where both machines can cut wood by means of a circular saw. It differs in scope and the method by which the circular saw is attached to the main shafting assembly and is driven indirectly by the use of V-belt attached to the V-pulley of the main shafting and the motor shafting.

The study conducted by Orale (1985) entitled: "Multi-Purpose Woodworking Machine: A Technical Feasibility Study", was designed and constructed to perform many of the operations in wood cutting, dovetailing and sanding. The machine was made with inexpensive wooden materials and a few of metal parts. The production cost amounted to P9,918.50 pesos which is much lower than a commercially made circular saw, dovetailing and sanding machine.

The present study also deals with cutting operations on wooden materials. The difference is that the former

study has its circular saw blade laid in horizontal position as well as the sanding disk. The blade is attached to a vertical shafting driven by v-belt using 1/2 HP electric motor while the present study uses a 1 HP, 1740 RPM speed.

Pagliawan (1991) conducted a study entitled: "An Improvised Multi-Purpose Mechanical Gadget: A Model". The gadget has a unique characteristic in the sense that in the absence of electric current, it can still be utilized by means of shifting the operation to a manual pedal-driving. This gadget is used in drilling or boring holes on metals, as well as blowing and sanding operations, which is driven by an electric motor.

This study has similarities with the present study, since both have considered drilling operations. However, they differ in operation/application; the former can be operated manually or electrically, while the present is electrically dependent.

Chapter III

DEVELOPMENT OF THE PROJECT

This chapter explains the entire life of the project which includes the bill of supplies and materials, tools and equipment needed in the construction, the construction procedure of the project and the production time and cost.

A. Supplies and Materials

Table 1 shows the quantity, unit, description as well as the cost of supplies and materials needed in the construction of the Multi-Purpose Steel and Woodworking Machine.

Table 1

Bill of Supplies and Materials

Quantity	Unit	DESCRIPTION	Unit Cost	Amount
1	unit	1-HP Electric Motor, 220V,1740rpm	P 2,300.00	P 2,300.00
1/2	pc.	20mm thk. Marine plywood	1,200.00	600.00
6	pcs.	2.54 cm hole Pillow Block Bearing	130.00	780.00
1	pc.	20mm hole Pillow Block Bearing	130.00	130.00
14	pcs.	12mmx38mm Bolt w/ nut & washer	6.00	84.00
2	pcs.	12mmx25mm Bolt w/ nut & washer	4.00	8.00
4	pcs.	10mmx62mm Bolt w/ nut & washer	6.00	24.00
5	pcs.	10mmx25mm Bolt w/ nut & washer	3.00	15.00
16	pcs.	6mmx25mm Bolt w/ nut & washer	3.00	48.00
1	pc.	16mmØ Drill chuck	240.00	240.00
10	ft.	2.54 cmØ Shafting	75.00	750.00
1/2	ft.	5.0 cmØ Shafting	250.00	125.00
2	pcs.	5cmx7.5x10cmØ Step/combination V-Pulley (machined)	450.00	900.00

1	pc.	V-belt (B-31)	100.00	100.00
3	pcs.	20mmx30cm Full Threaded Bolt (machined)	50.00	150.00
3	pairs	Bevel Gear (surplus)	150.00	450.00
1	pc.	6mm x 38mm Angular bar	450.00	450.00
1	pc.	6mm x 32mm Angular bar	400.00	400.00
1	pc.	6mm x 25mm Angular bar	350.00	350.00
1	pc.	10mm Ø Round plain bar	90.00	90.00
20	kgs.	8mm thk. Black iron plate (junk)	7.00	140.00
1	c.	2.54cm hole x 30cmØ Crosscut Saw Blade	770.00	770.00
1	pc.	2.54 cm hole x 30cmØ Ripsaw Blade	770.00	770.00
1	pc.	2.54cm hole x 35cmØ Steel cutter blade	300.00	300.00
1	pc.	16mm hole x 15cm Ø Grinder Stone	100.00	100.00
6	kgs.	Welding Electrodes (Wipweld)	50.00	300.00
5	pcs.	Hacksaw Blade (Eclipse)	40.00	200.00
5	pcs.	Grinder Stone 10cmØ	50.00	250.00
5	shts.	#120 Sandpaper	10.00	50.00
1	ltr.	Epoxy Primer w/ catalyst	110.00	110.00
1	ltr.	Easy Tite	110.00	110.00
1	ltr.	Quick Drying Enamel Paint (Nile Green)	110.00	110.00
1	pc.	Magnetic Switch	150.00	150.00
3	mts.	#16 Flat cord	15.00	45.00
GRAND TOTAL				P 11,399.00

As reflected in Table 1, the grand total cost of supplies and materials incurred in the production of one (1) unit Multi-Purpose Steel and Woodworking Machine amounted to Eleven Thousand Three Hundred Ninety-nine Pesos (P11,399.00) only.

B. Tools and Equipment

The tools and equipment listed in Table 2 are needed in the construction of the multi-purpose steel and

Table 2

Tools and Equipment and Their Uses

Tools and Equipment	U s e s
1. Adjustable Wrench	A tool used for tightening and loosening bolt nuts.
2. Bench Vise	Holds the stock for easy working.
3. C-Clamp	Adaptable to a wide range of assemblies where parts are needed to be held together while the metal fasteners are being applied.
4. Chuck Wrench	A tool used for tightening/loosening drill chuck for which a drill bit is fastened/attached.
5. Claw Hammer	A tool used to drive nails and to fasten parts together. It is best suited for pulling nails.
6. Cross Cut Saw	A saw used for cutting across the grain of the wood. It has 7-8 teeth/points per inch.
7. Drill Bit	Used to bore holes on metals and parts.
8. Grinding Machine	Used to remove unwanted and protruding welded parts of the machine.
9. Hacksaw	A special kind of saw intended for cutting steel. It has a fine-teeth blade.
10. Lathe Machine	Cuts, shapes and threads shafting to accommodate pulleys, gears and nuts.
11. Pull-Push Tape Rule	A measuring tool used to determine the size, thickness and length of the materials to be used.
12. Tinner Ship	Used to cut G.I. plates into shapes.
13. Try Square	This tool is used for testing if a surface squares with another, forming square corner.
14. Vernier Caliper	Used for delicate measuring operations.
15. Welding Machine	Cuts and joins metals firmly.

woodworking machine. The type and uses, specifications and capabilities of these tools and equipment are described in detail.

C. Construction Procedure

The multi-purpose steel and woodworking machine is composed of nine (9) major assemblies, namely: a) Working Table Assembly, b) Machines Column Assembly, c) Adjustable Beam Assembly, d) Vertical Adjuster Assembly, e) Electric Motor Assembly, f) Horizontal Adjuster Assembly, g) Main Shafting Assembly, h) Multi-Purpose Clamp Assembly, and i) Multi-Purpose Vise Assembly.

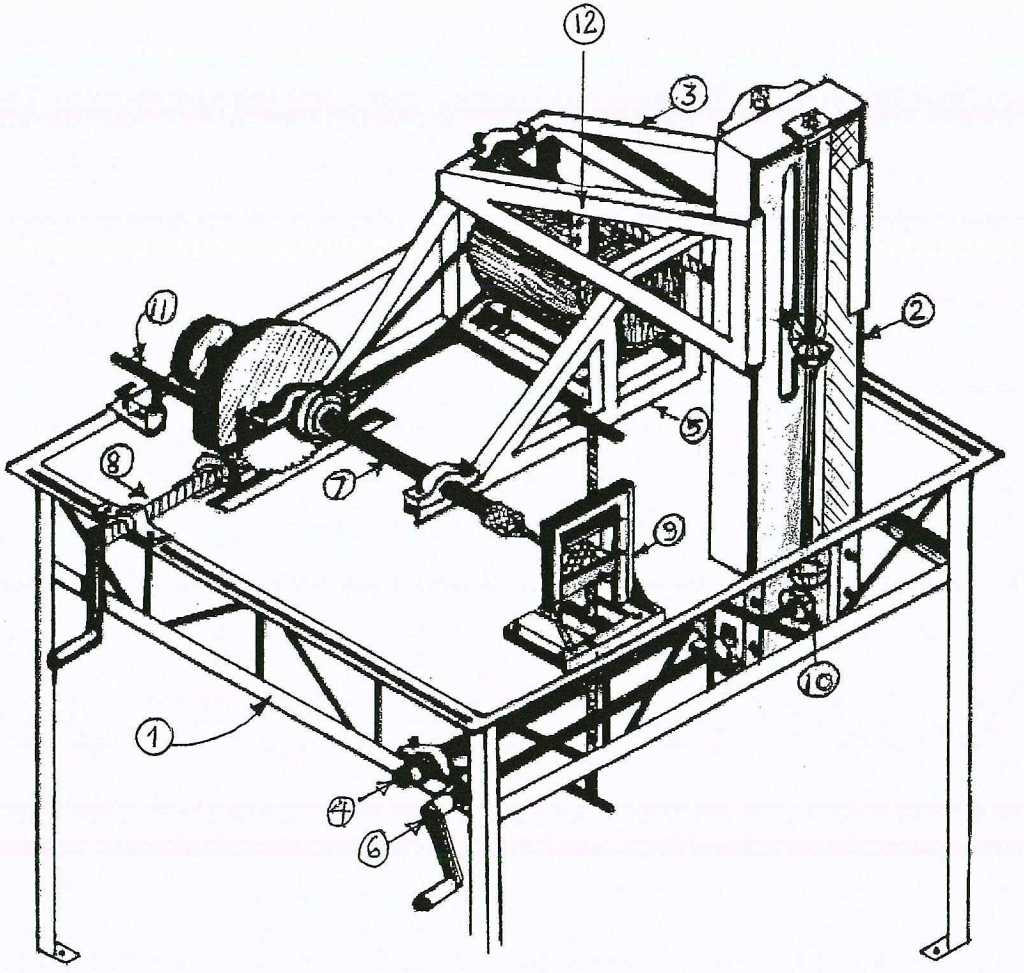
The Multi-Purpose Steel and Woodworking Machine that comprises the nine (9) major assemblies is shown in Figures 2, 3, 4, 5 & 6, respectively.

1. Working Table Assembly

a. Referring to the design of the machine, prepare a piece of 6mm thk. X 32 mm wide x 6.0m long Angular Bar.

b. Measure and cut four 80cm long for the legs of the table.

c. Measure and cut two pieces of the same material, 80cm long for its width, two pieces 90cm long for

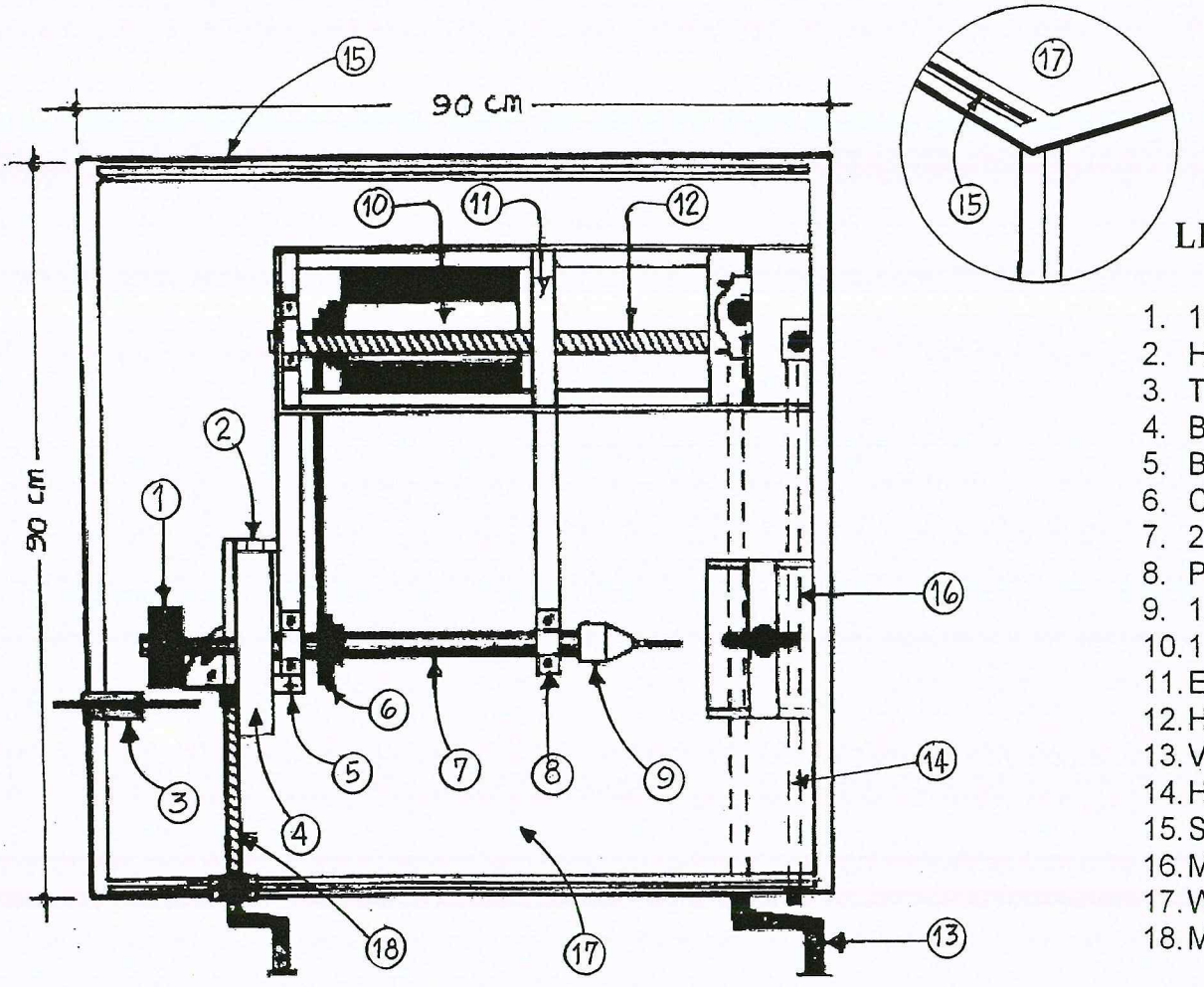


LEGEND :

1. TABLE ASSEMBLY (SEE FIG. 7)
2. COLUMN ASSEMBLY
3. ADJUSTABLE BEAM ASSEMBLY
4. VERTICAL ADJUSTER ASSEMBLY
5. ELECTRIC MOTOR ASSEMBLY
6. HORIZONTAL ADJUSTER ASSEMBLY
7. MAIN SHAFTING ASSEMBLY
8. MULTI – PURPOSE CLAMP ASSEMBLY
9. MULTI- PURPOSE VISE ASSEMBLY
10. MITER/ BEVEL GEAR
11. TOOL REST
12. MAGNETIC SWITCH

FIGURE -2 **PICTORIAL VIEW OF THE MULTI – PURPOSE STEEL AND WOOD WORKING MACHINE**

Note:
NOT DRAWN TO SCALE

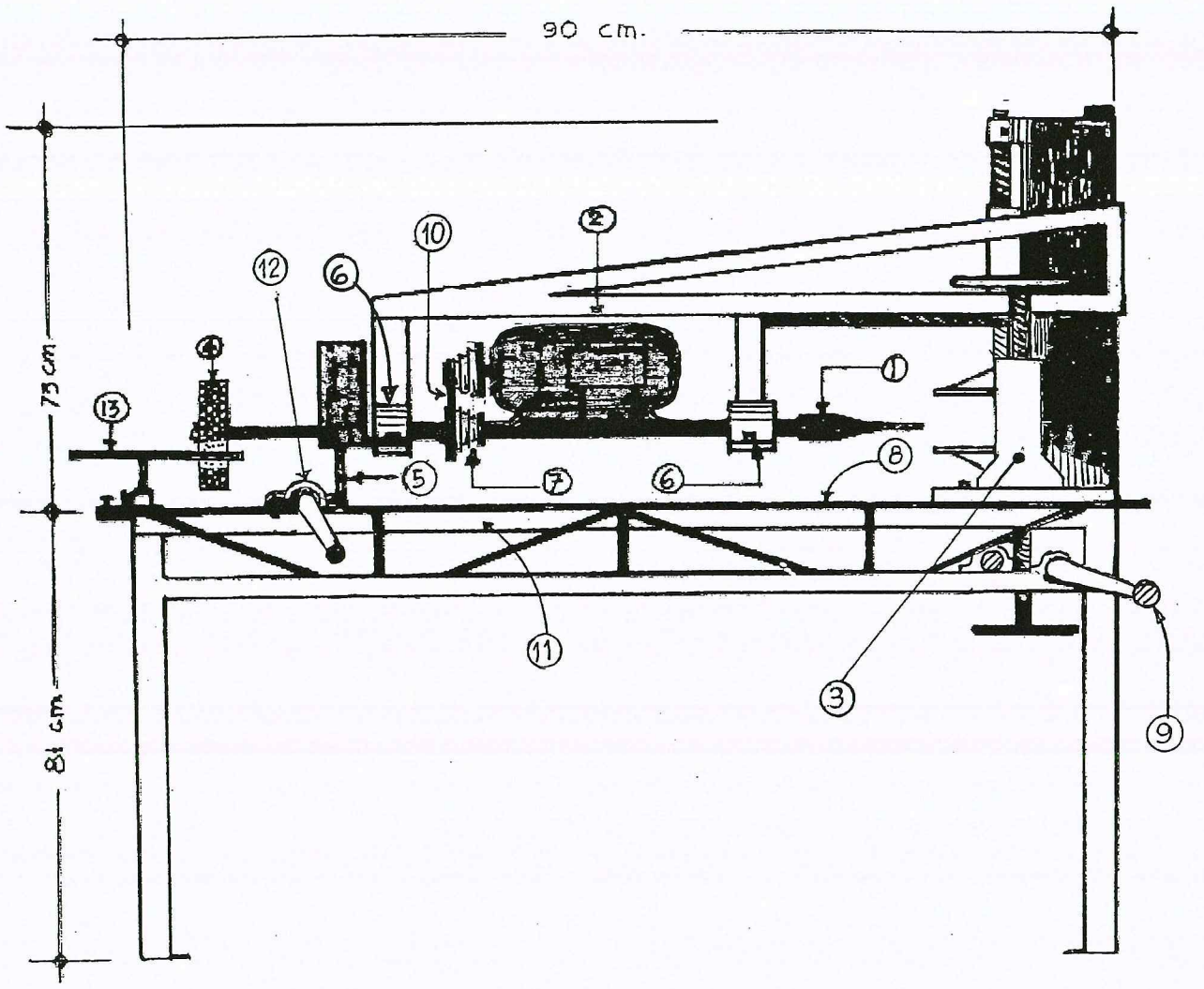


LEGEND:

1. 10 cm ø GRINDER STONE
2. HINGE
3. TOOL REST
4. BLADE COVER
5. BLADECOVER LOCK
6. COMBINED V- PULLEY
7. 2.54 CM SHAFTING
8. PILLOW BLOCK BEARING
9. 1.6 cm ø DRILL CHUCK
10. 1 – H. P. ELECTRIC MOTOR
11. ELECTRIC MOTOR ASSY.
12. HORIZONTAL ADJUSTER
13. VERTICAL ADJUSTER
14. HORIZONTAL ADJUSTER
15. SLOTTED EDGE
16. MULTI – PURPOSE VISE
17. WORKING TABLE
18. MULTI – PURPOSE CLAMP

FIGURE -3 **TOP VIEW**

Note:
NOT DRAWN TO SCALE



LEGEND

1. 16 mm Ø DRILL CHUCK
2. 1 HP ELECTRIC MOTOR
3. MULTI PURPOSE VISE
4. 10 cm Ø GRINDER STONE
5. CIRCULAR SAW BLADE
6. PILLOW BLOCK BEARING
7. COMBINED V- PULLEY
8. WORKING TABLE
9. HORIZONTAL ADJUSTER
10. V – BELT (B-31)
11. 6 X 3.7 cm. ANGLE BAR TABLE FRAME
12. MULTI - PURPOSE CLAMP
13. TOOL REST

Figure -4 **FRONT VIEW**

Note:

NOT DRAWN TO SCALE

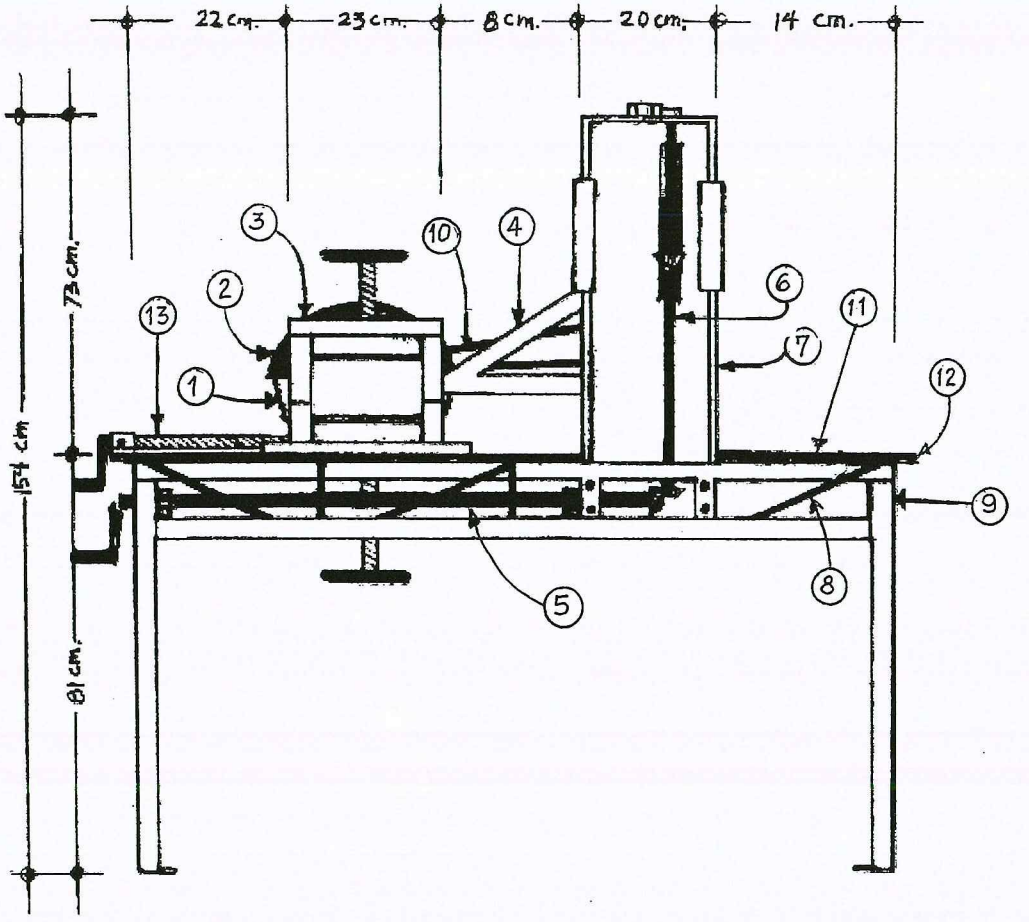
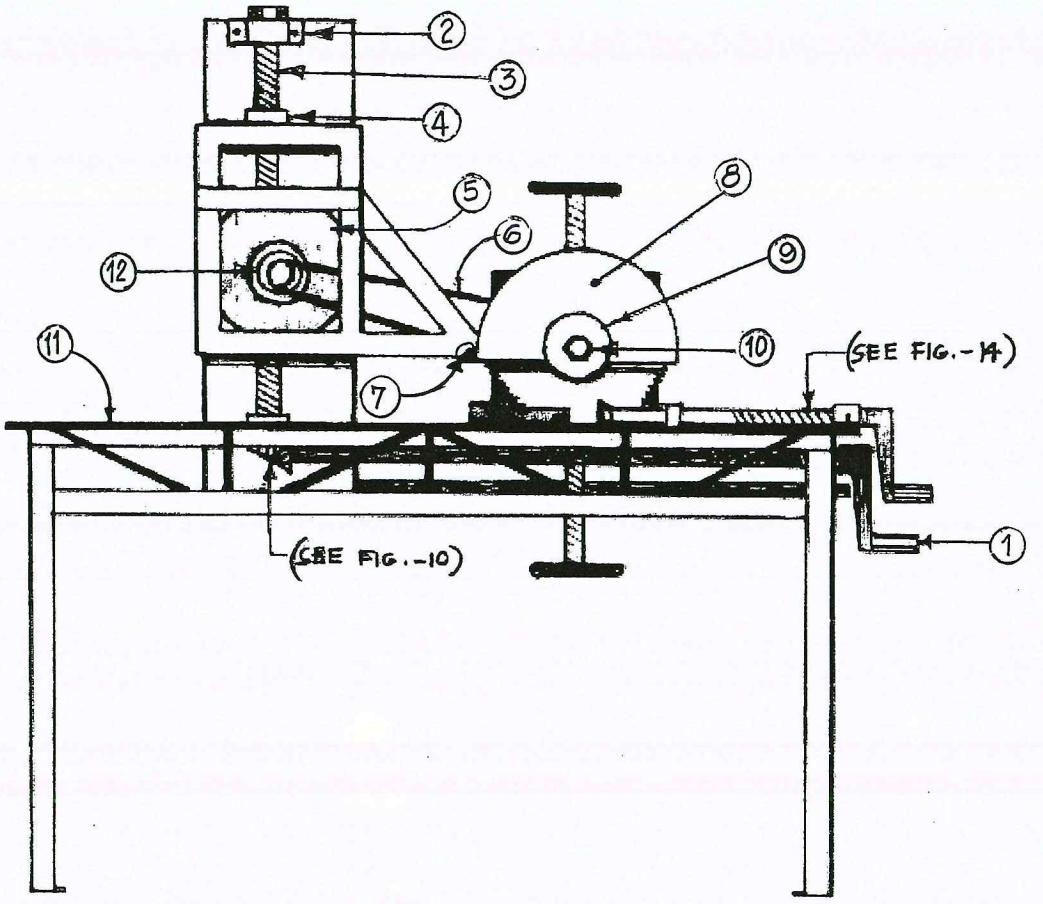


FIGURE -5 **RIGHT SIDE VIEW**

LEGEND:

1. CIRC. SAW BLADE
2. BLADE COVER
3. MULTI – PURPOSE VISE
4. MACHINE'S FRAME
5. VERTICAL ADJUSTER
6. HORIZONTAL ADJUSTER
7. MACHINE'S COLUMN
8. 10 mm ø ROUND PLN/ BAR
9. WORKING TABLE
10. V – BELT (B-31)
11. 2- CM THK . MARINE PLY WOOD
12. TABLE EDGE PROVIDED WITH SLOT
13. MULTI – PURPOSE CLAMP

Note:
NOT DRAWN TO SCALE



LEGEND

1. VERTICAL ADJUSTER
2. BOLT HOLDER/ BUSHING
3. THREADED VERTICAL ADJUSTER
4. SPECIAL NUT
5. 1-H.P. ELECTRIC MOTOR
6. V-BELT
7. BLADE COVER HINGE
8. CIRC. SAW COVER
9. 10cm ø GRINDING STONE
10. LOCK NUT WITH PIN
11. 2cm thk. MARINE PLYWOOD
12. COMBINATION V-PULLEY

FIGURE -6 **LEFT SIDE VIEW**

Note:
NOT DRAWN TO SCALE

its height for top rail.

d. Weld the legs and top rails temporarily.

e. Check the squareness in every intersection with the use of a Framing Square, and provide bracing before doing the full welding.

f. Prepare slots for the Circular Rip and Crosscut Saw, and Steel Cutter blades beside the Multi-Purpose Bar Clamp, and a slot for the Machine's Column as shown in Figure 7.

g. Prepare and attach the table top measuring 2cm thk. x 80cm wide and 90cm long marine plywood.

h. Fasten the table top with bolts and nuts directly to the angular bars or top rail underneath.

2. Machine's Column Assembly

a. Looking into the design, prepare a piece of 6mm thk black iron (B.I) plate and the gas welding set (oxygen & acetylene), then cut it based on the dimension in Figure 8.

b. Measure and cut two pieces of eight (8) cm wide x 82cm long, and two pieces of 20cm wide and 82cm long black iron plate.

c. Assemble and weld the column assembly as shown in Figure 8.

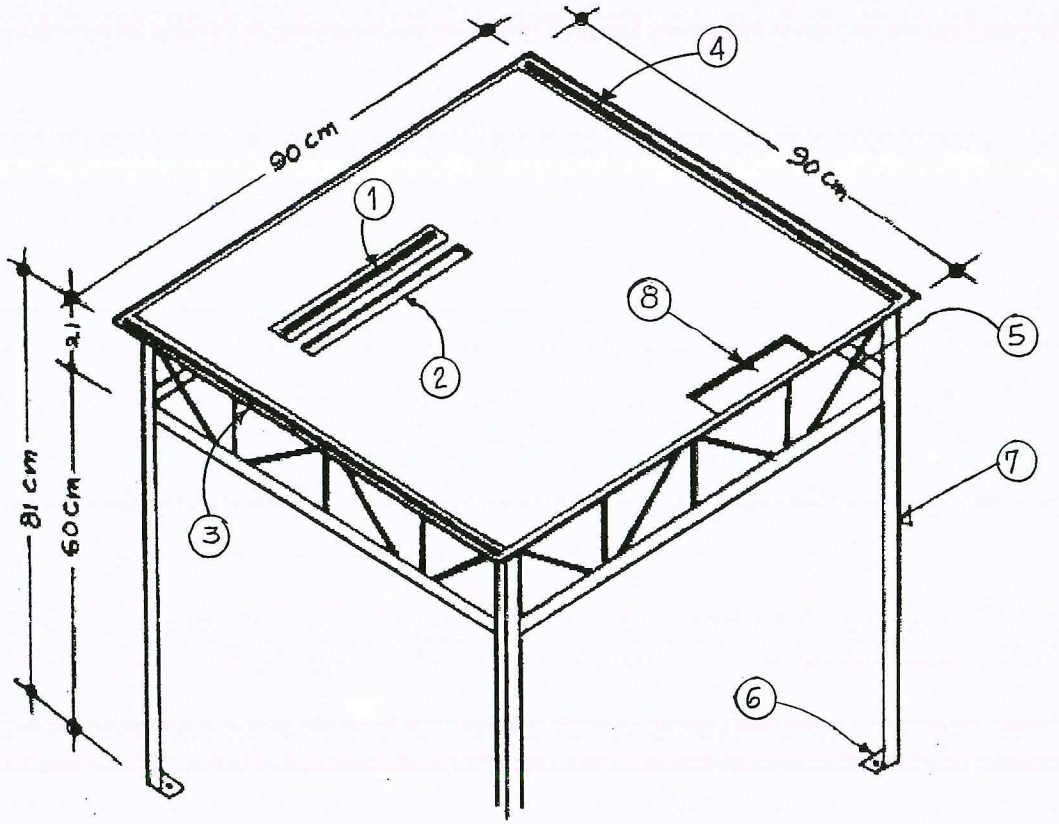
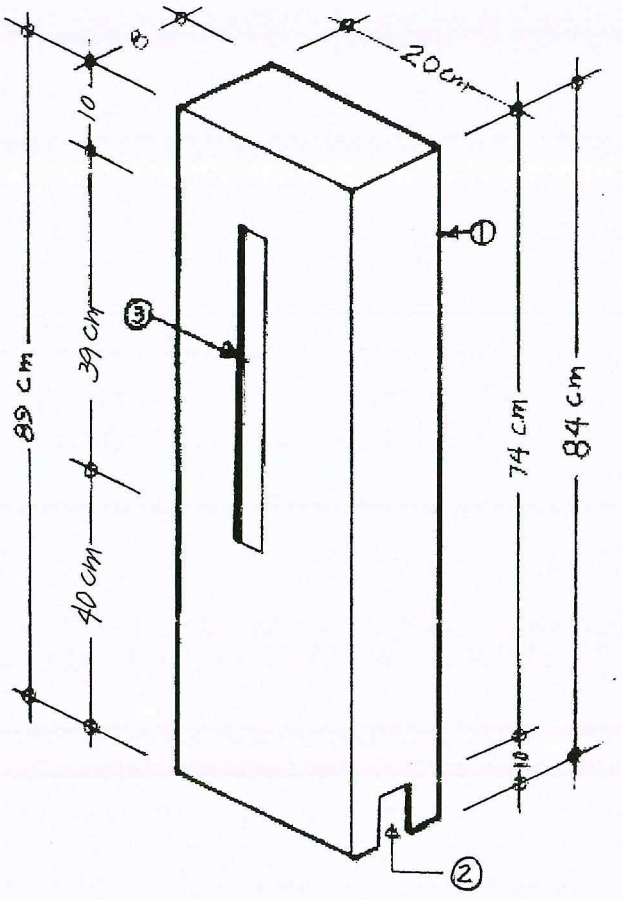


FIGURE -7 **TABLE ASSEMBLY**

LEGEND:

1. SLOT FOR BAR CLAMPBUSHING / STOPPER (SLIDING)
2. SLOT FOR CIRC. SAW BLADE
3. SLOT FOR BAR CLAMP END STOPPER
4. SLOT FOR RIP SAWING GUIDE
5. 2 – cm ǿ ROUND BAR
6. FOOT BRACKET
7. 6 MM X 38 MM ANGLE BARS
8. SLOT FOR MACHINE'S COLUMN

Note:
NOT DRAWN TO SCALE



LEGEND:

1. 10 mm thk. BLACK IRON (B.I.) PLATE
2. SLOT FOR HORIZONTAL ADJUSTER DRIVER SHAFT
3. SLOT FOR HORIZONTAL ADJUSTER DRIVEN SHAFT

FIGURE -8 **MACHINE 'S COLUMN ASSEMBLY**

Note:
NOT DRAWN TO SCALE

d. Trace the precise location of the slots provided for the vertical and horizontal adjusters on both sides.

e. Weld it steadfast on the right side of the working table, taking into consideration of its verticalness to the working table.

3. Adjustable Beam Assembly

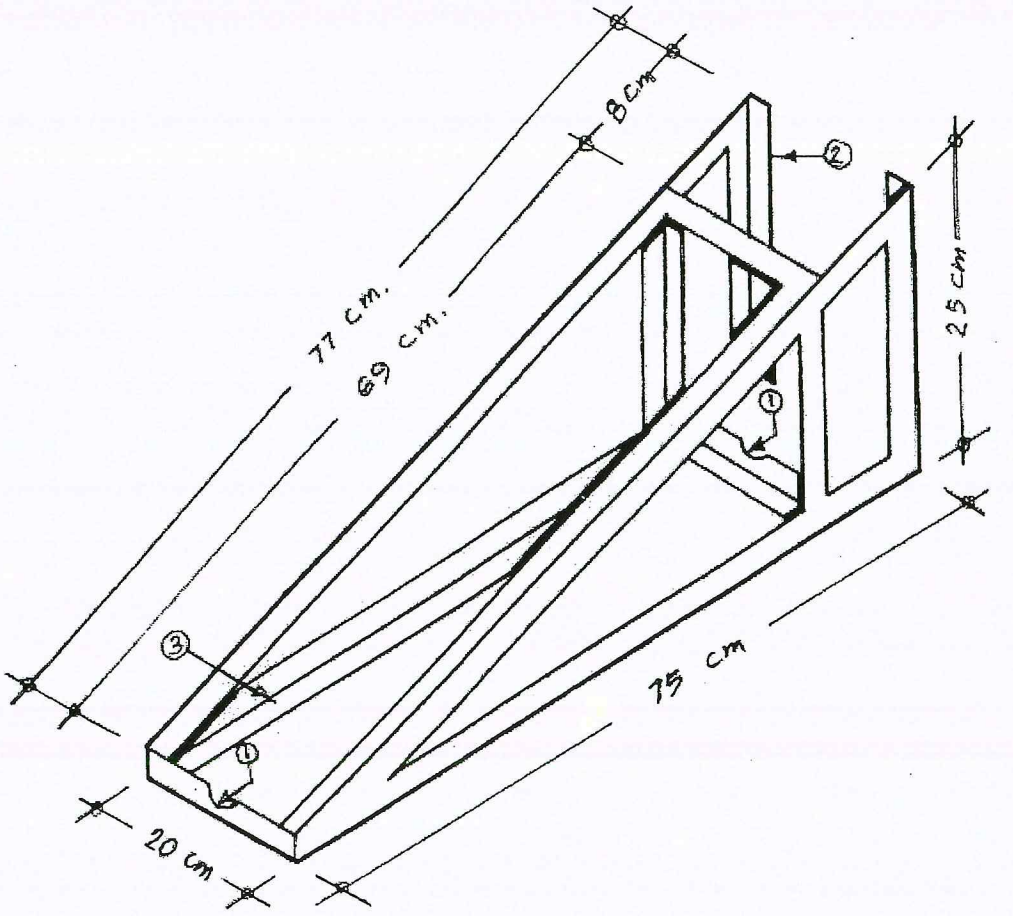
a. Prepare one (1) piece of a 6mm thk x 4cm wide x 6.0 meter long angular bar.

b. Refer to the design for its measurement. Cut two pieces 65cm long and two pieces 68cm long considering the clearance for their inclination based on the dimension on the design.

c. Cut four pieces 20cm long and two pieces 25cm long. Again, consider their inclination, basing also from the design.

d. Check measurement with precision, especially at the bottom, where the motor assembly framing has to slide either of the sides.

e. Provide bracing in every intersection or joints for squareness and desired inclination based on the design in Figure 9.



LEGEND:

1. SLOT FOR HORIZONTAL ADJUSTER
2. MACHINE COLUMN STOPPER
3. PORTION WHERE ELECTRIC MOTOR ASSEMBLY SLIDES

Figure -9

ADJUSTABLE BEAM ASSEMBLY

Note :
NOT DRAWN TO SCALE

f. Mount first on the assembly the special nut provided for the vertical adjuster before mounting it to the Machine's column. Use the four pieces 16mm x 32mm long bolts that will be tightened during drilling operations, and loosened during sawing and steel cutting operations.

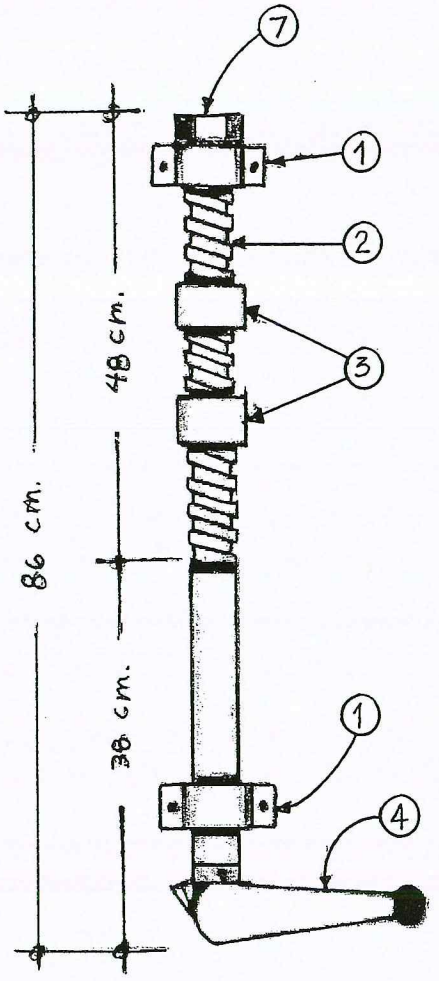
4. Vertical Adjuster Assembly

a. Prepare one piece of a 32mmØ x 78cm long shafting for the vertical member of the assembly. At one end, measure 40cm to be machined of a square thread (ideal thread when power is to be transmitted).

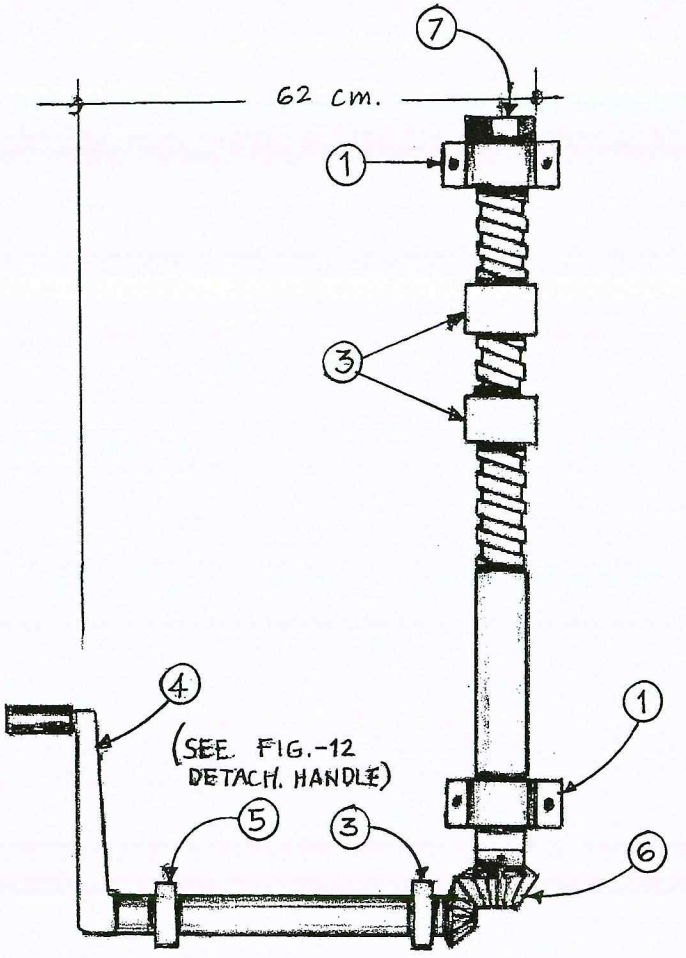
b. Fit-in the two pieces 5cmØ x 7.5cm long machined special nuts, and the bigger size bevel/miter gear at the non-threaded end.

c. Get another piece of a 2.54cm x 65cm long shafting. Attach at the first end the smaller pair of the bevel/miter gear (as shown in Figure 10). Fit-in the stopper for the handle.

d. Fit-in two pieces of a 2.54cm hole Pillow Block Bearings to fasten the assembly at the Machine's Column.



FRONT VIEW



RIGHT SIDE VIEW

LEGEND:

1. PILLOW BLOCK BEARING
2. SQUARE THREADED
3. SPECIAL NUT
4. DETACHABLE HANLDE
5. PILLOW BLOCK BEARING
6. MESHED BEVEL GEARS
7. LOCK NUT

Figure -10

VERTICAL ADJUSTER ASSEMBLY

Note :
NOT DRAWN TO SCALE

5. Electric Motor Assembly

   a. Measure and cut the 6mm thk x 32mm wide angular bar, two pieces 50cm long at 45°, four pieces 40cm at 45° and five pieces 35cm for the framing of the assembly. (See Figure 11)

   b. Assemble the parts as specified on the plan, then weld temporarily after checking the squareness of every intersecting points.

   c. Be sure that the assembly could slide either of the sides on the Adjustable Beam Assembly.

   d. Follow the fabrication of the base of the sliding motor, measuring with precision the exact location of the bolts.

   e. Weld it fully to insure rigidity during operations.

6. Horizontal Adjuster Assembly

   a. Fit-in at one end of the machined 2.54cm x 65cm top horizontal member of the assembly. Attach it from the left side the Pillow Block Bearing, the special nut, going to the right, the bushing and the bevel/miter gear at its end. Weld it temporarily. Make sure that it is aligned to the vertical member.

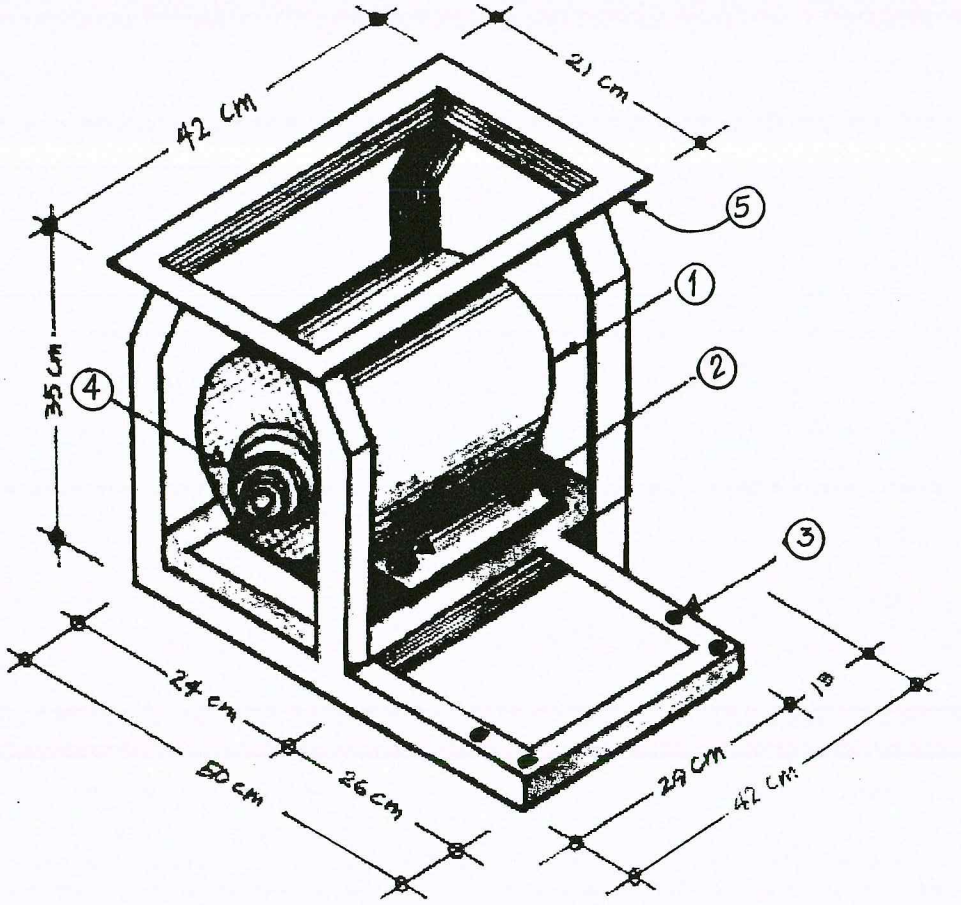


FIGURE -11 **ELECTRIC MOTOR ASSEMBLY**

LEGEND:

1. ONE – HORSE POWER 220 VOLT A.C. ELECTRIC MOTOR
2. 12 mm ǿ x 40 mm BOLT
3. HOLE FOR PILLOW BLOCK BEARING
4. COMBINATION V - PULLEY
5. SLIDING PORTION @ THE ADJUSTABLE BEAM ASSEMBLY

Note:
NOT DRAWN TO SCALE

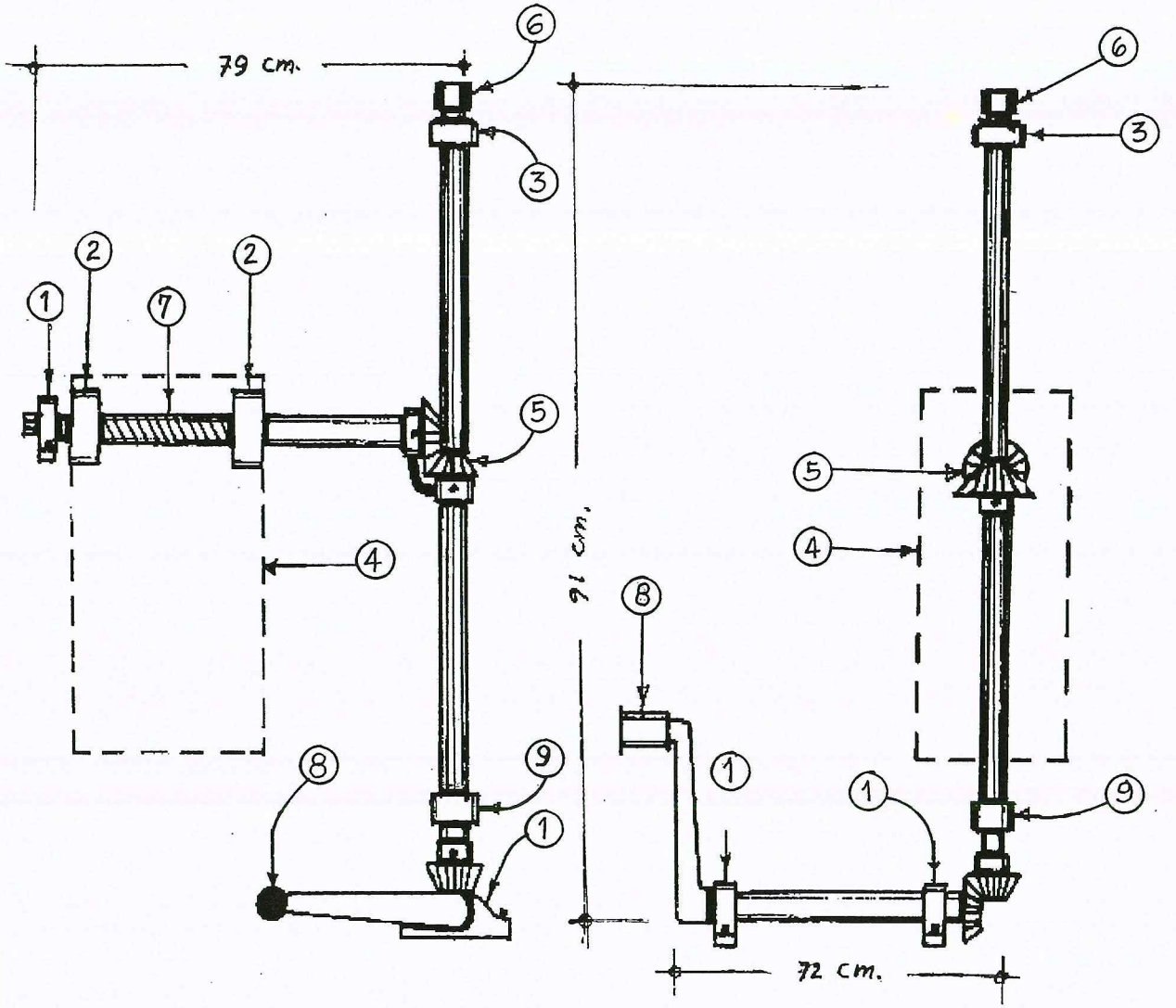
b. Before mounting the vertical member, a 2.54cm x 82cm machined shafting, see to it that the bearing at its upper part, the bevel/miter gear at the center is properly meshed with the one at the end of the top horizontal member, and at its end below are the bushing and the smaller bevel/miter gear for the horizontal member of the assembly at the bottom. Align it with the first one, then weld it temporarily.

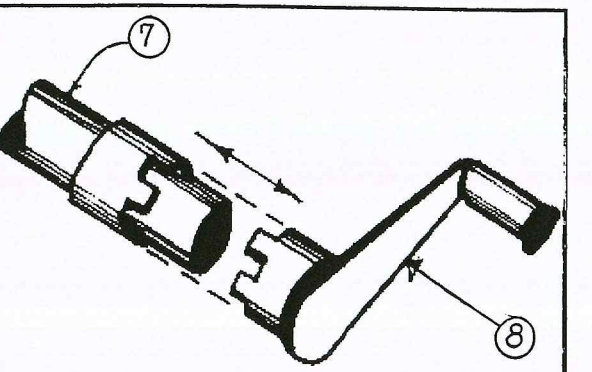
c. Follow the attachment of the last part of the assembly at the bottom of the table. Make sure that the bevel/miter gear has been properly attached at its end, properly fitted with the other one on the vertical member. Align it with the vertical member, then weld it temporarily.

d. Check first the functionality of this assembly, see Figure 12, before welding it firmly.

7. Main Shafting Assembly

a. Assemble the parts as specified on the plan, see Figure 14. Attach the combination/step pulley to the main shafting, followed by the two 2.54 cm hole Pillow Block Bearings.





DETAIL OF DETACHABLE HANDLE

LEGEND:

1. PILOW BLOCK BEARING
2. SPECIAL NUT
3. BEARING
4. ELECTRIC MOTOR ASSEMBLY
5. MESHED BEVEL GEARS
6. LOCK NUT
7. HORIZONTAL ADJUSTER SHAFT
8. DETACHABLE HANDLE
9. BUSHING

FIGURE -12 **HORIZONTAL ADJUSTER ASSEMBLY**

Note:

NOT DRAWN TO SCALE

b. Install the Pillow Block Bearings to the motor assembly by four pieces 12mmØ x 32mm bolts with nuts and washers.

c. Align the combination/stepped pulley on the shafting to the V-pulley directly attached to the motor shafting with a V-belt.

d. At one end of the main shafting right side, attach the drill chuck. At its left side, choose either the circular rip or crosscut saw blade, or the steel cutter blade. At its very end is the grinder stone as shown in Figure 13.

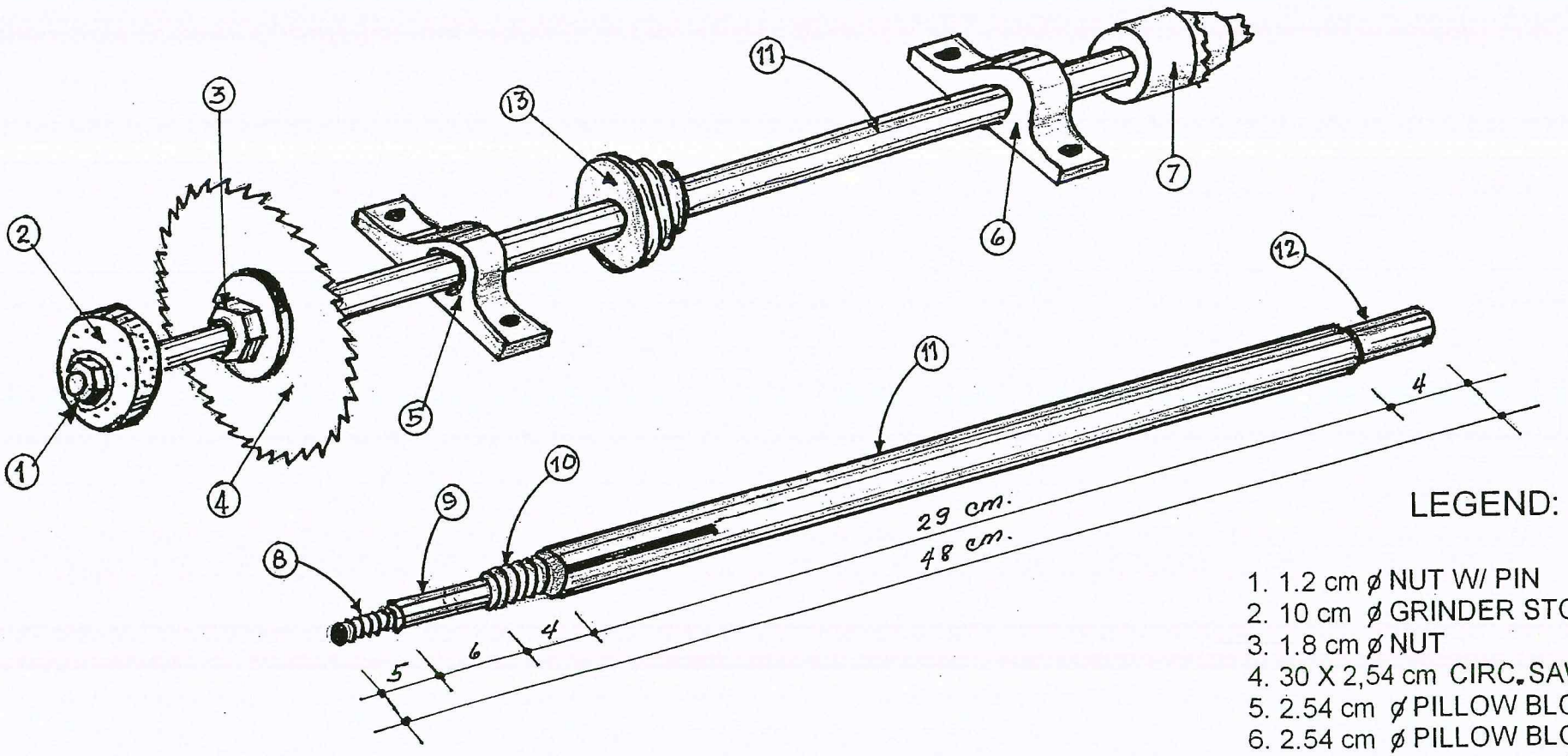
8. Multi-Purpose Clamp Assembly

a. Machine 40cm long 2cmØ shafting for the adjuster forward or backward.

b. Mount it at the slot provided at the end of the table infront.

c. See to it that the mounted circular blade won't strike nor cut it during operation.

d. Move it a little at the left side of the mounted circular blade, specifically near the slot provided for.



LEGEND:

1. 1.2 cm ø NUT W/ PIN
2. 10 cm ø GRINDER STONE
3. 1.8 cm ø NUT
4. 30 X 2,54 cm CIRC. SAW
5. 2.54 cm ø PILLOW BLOCK
6. 2.54 cm ø PILLOW BLOCK
7. 1.6 cm ø DRILL CHUCK
8. 1.2 cm THREADED
9. 1.6 cm ø PLAIN
10. 1.8 cm ø THREADED
11. 2.54 cm ø SHAFTING
12. 1.6 cm ø PLAIN
13. COMBINED V-PULLEY

FIGURE -13 **MAIN SHAFTING ASSEMBLY**

NOT DRAWN TO SCALE

e. Measure, cut then shape the turning stopper provided, for cutting 45°, 90°, and any angle desired during operation (See Figure 14).

9. Multi-Purpose Vise Assembly

a. Machine two pieces 30cm long 2cmØ shafting for the top and bottom adjuster coupled with a two inches nuts each.

b. Measure then cut into specifications .6cm x 3.8cm Angular Bar for the base and body of the vise.

c. Refer to the design how they are being assembled, including the other parts as expected. (Figure 15)

10. Wiring Installation

a. Install the Magnetic Switch on the Adjustable Beam Assembly.

b. Follow the installation of the #16 Flat cord to the motor, starting and tapping it from the Magnetic Switch. Look some ways and means that it is hidden so as not to interrupt nor interfere during the operations.

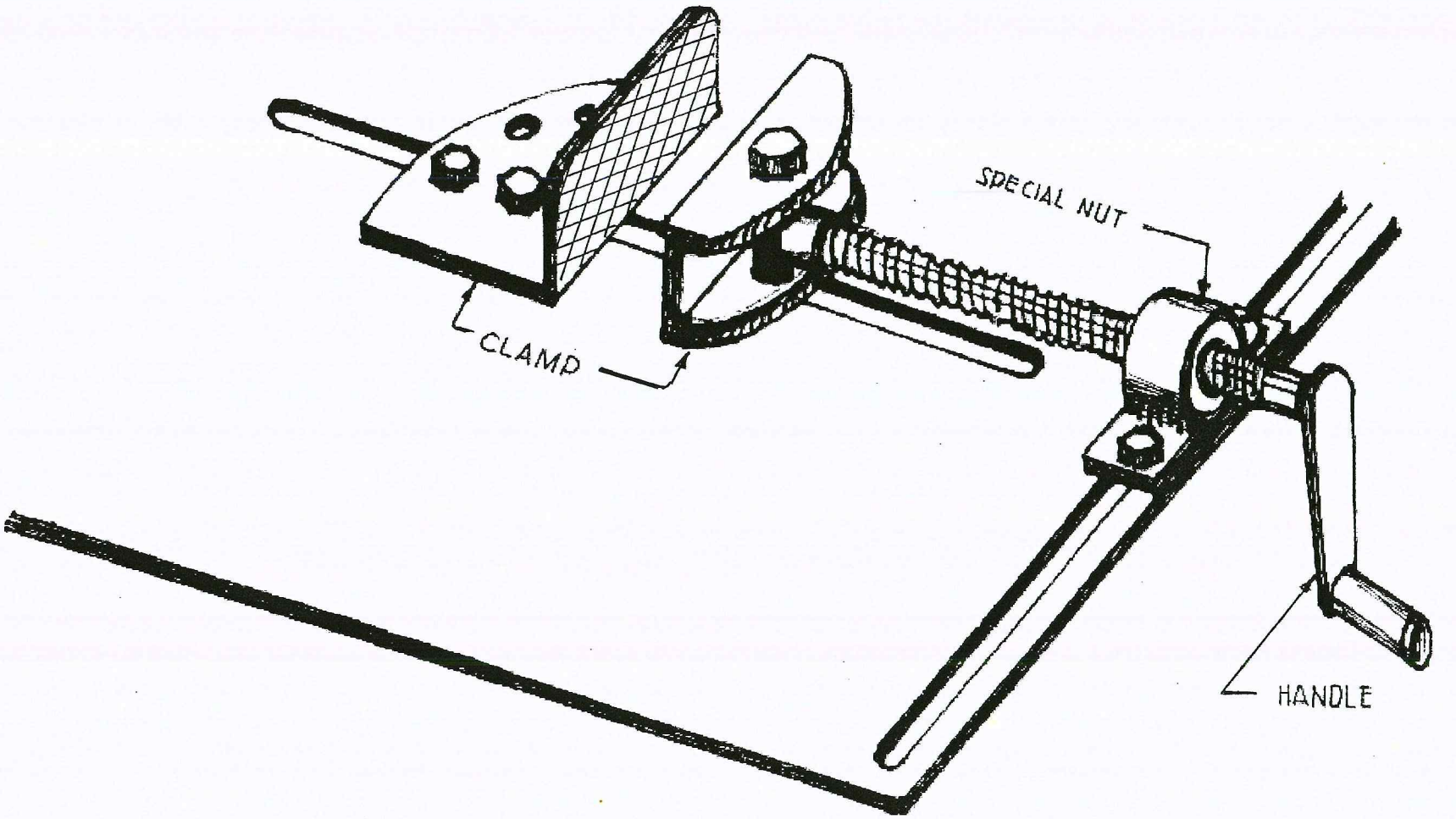


FIGURE - 14 **MULTI – PURPOSE CLAMP ASSEMBLY**

Note:

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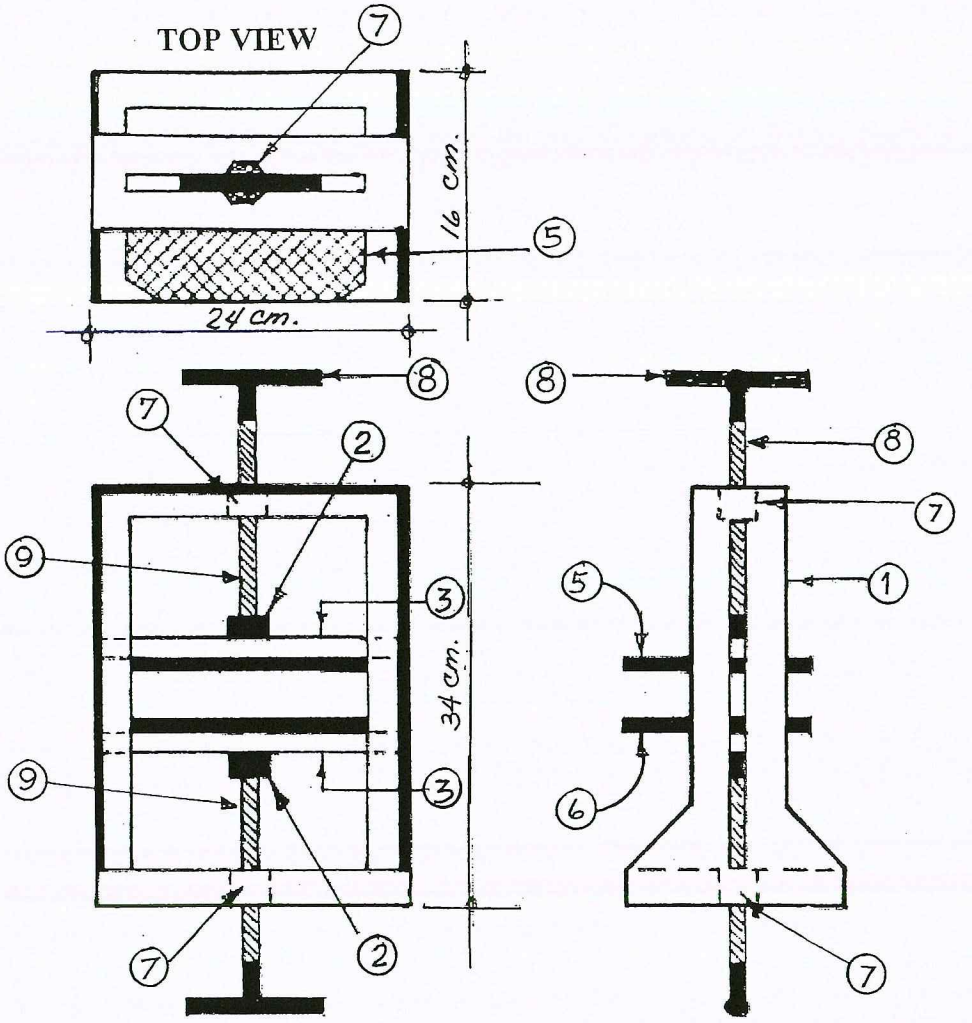

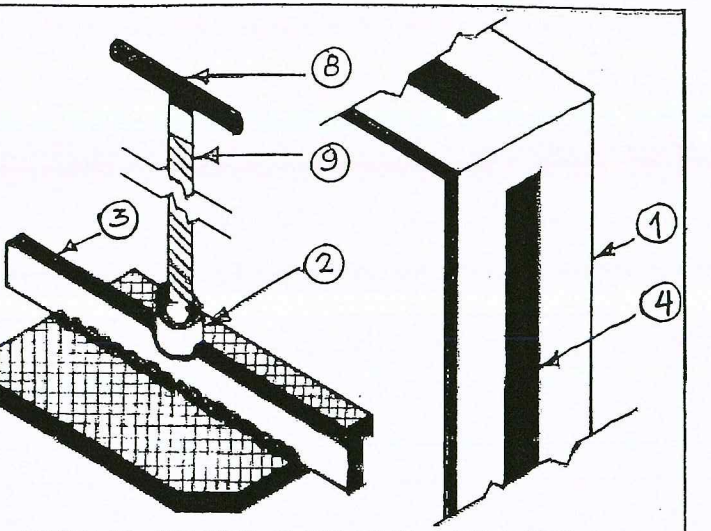

DETAIL OF TIE-ROD END ATTACHMENT

LEGEND:

1. VISE'S FRAME
2. TIE ROD END
3. SLIDING PLATE
4. SLIDING GUIDE
5. UPPER JAW
6. LOWER JAW
7. SPECIAL NUT
8. ADJUSTER HANDLE
9. ADJUSTER (THREADED)

FIGURE -15 **MULTI –PURPOSE VISE ASSEMBLY**

Note:
NOT DRAWN TO SCALE

c. Tap again another wire of the same kind and size on the switch which would serve as extension during testing and/or operation.

11. Finishing Touches

a. Grind all of the welded parts of the machine to smoothen it, and cut all protruding bolts and other hazardous objects.

b. Do some welding jobs if necessary or if there are still any.

c. Clean all surfaces to be coated with a clean damp cloth.

d. Apply rust converter for all metal parts, then keep it dry for 24 hours.

e. Apply epoxy primer for all metal parts and flat wall enamel for wooden parts.

f. Allow 24 hours drying time, then apply second coat using three (3) parts of epoxy paint and one (1) part epoxy catalyst. Use epoxy reducer for thinning purposes.

D. Production Time and Cost

A. Production Time - The production time involved in the construction of the different major assemblies of the Multi-Purpose Steel and Woodworking Machine

is indicated in Table 3.

Table 3

Estimated Number of Days Required in the Production of the Multi-Purpose Steel and Woodworking Machine

Code	Activity	Duration (Days)
A	Table Assembly	1
B	Machine's Column Assembly	1
C	Adjustable Beam Assembly	2
D	Vertical Adjuster Assembly	2
E	Electric Motor Assembly	3
F	Horizontal Adjuster Assembly	3
G	Main Shafting Assembly	2
H	Multi-Purpose Clamp Assembly	3
I	Multi-Purpose Vise Assembly	2
J	Wiring Installation	1
K	Finishing Touches	2
	Total	21 days

B. Production Cost - There are several factors to consider in determining the production cost of any industrial machinery based on the standard criteria such as the quality of the product, capacity of the machine, construction process, model design of the machine and manpower.

To fabricate or innovate a multi-purpose machine which features five (5) major functions, like the present study, requires enough amount of time as much as twenty-one (21) days.

Table 4 reveals that the project can be completed in 21 days, employing one machinist for a period of nine (9) days in an eight-working hours per day, and one welder for twelve (12) days in an eight-working hours per day. Labor cost in the Province of Northern Samar is Two Hundred Pesos (P200.00) per day for machinist and welder. Therefore, the labor cost for a machinist is One Thousand Eight Hundred Pesos (P1,800.00), and Two Thousand Four Hundred Pesos (P2,400.00) for a welder.

The total labor cost in the production of the multi-purpose machine amounted to Four Thousand Two Hundred Pesos (P4,200.00) only.

The cost of supplies/materials amounted to Eleven Thousand Three Hundred Ninety-nine Pesos (P11,399.00). A ten (10) percent additional was included for overhead cost, based on the Total Cost of Labor and Materials which amounted to One Thousand Five Hundred Fifty-nine Pesos(P1,559.00).

The Operating Cost of Twenty-five percent (25%) of the Labor Cost is added to compensate for the wear-and-tear, maintenance and repair and energy consumed in the production of the machine amounted to One Thousand Fifty Pesos (P1,050.00) only.

The Cost Analysis is shown in Table 4. It can be noted from this table that the production cost amounted to Eighteen Thousand Two Hundred eight Pesos and Ninety Centavos (P18,208.90).

Table 4

Cost Analysis in the Production of Multi-Purpose Steel and Woodworking Machine

SOURCES	No%	Rate/day	Estimated No. of days	Total Cost
Supplies/Materials				P 11,399.00
Labor:				
Machinist	1	P200.00	9	1,800.00
Welder	1	P200.00	12	2,400.00
Overhead Cost	10% (Labor & materials)			1,559.90
Operating Cost	25% (Labor)			1,050.00
Production Cost				P 18,208.90

Chapter IV

DESCRIPTION OF THE COMPLETED PROJECT

This chapter describes the completed project in terms of its structure, process, and tryout and revision.

A. Structure

1. Characteristics of the Main Feature of the Machine

The features of the Multi-Purpose Steel and Woodworking Machine are enumerated and briefly discussed below:

Multi-Purpose Machine. This combination workshop unit can perform several functions and operations in working with wooden and steel materials. The Circular Saw can cut across and along the grain of wood. The Circular Steel Cutter and Grinder can perform metal working operations and the drill press can perform drilling operations on metal or steel materials.

Electrically Operated. The multi-purpose machine is operated with a 1HP, 1740 RPM electric motor. A stepped or combination V-pulleys consisting of 10, 7.5, and 5 centimeter diameter are attached to the motor shafting and main shafting of the machine, respectively, as shown in Figure 16. As the motor

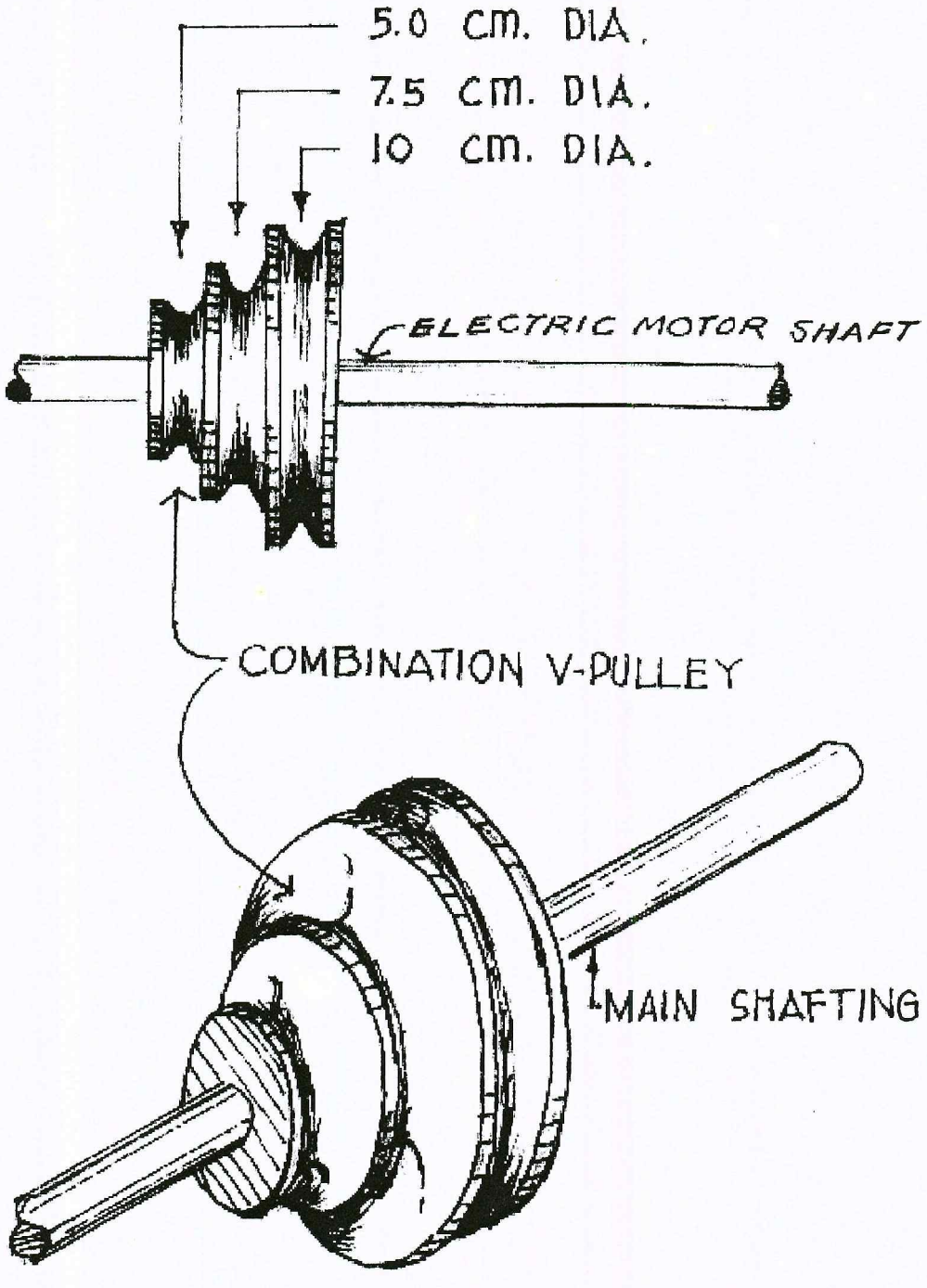

FIGURE - 16 **COMBINATION V- PULLEY**

NOTE :
NOT DRAWN TO SCALE

operates, the V-pulley of the motor drives the V-pulley of the main shafting assembly by means of V-belt. In cutting along and across the grain of wood, the V-belt is shifted to the 10 cm. diameter of the main shafting which require high speed or 3480 RPM, enough to cut lumber and metal. In grinding operations the required speed is 1740 rpm using the 7.5 cm. (3") on both shafting. Table 5 shows the required speed (RPM) conversion for the various cutting operations.

Table 5

Speed (RPM Conversion)

Operations	V-Belt Linkages		Required RPM (Speed)	Remarks
	Motor Pulley	Main Shaft Pulley		
Crosscutting (Wood)	4"Ø	2"Ø	3480	High Speed
Rip Sawing (Wood)	4"Ø	2"Ø	3480	High Speed
Metal Cutting	4"Ø	2"Ø	3480	High Speed
Grinding (Metal)	3"Ø	3"Ø	1740	Standard
Drilling (Metal)	2"Ø	4"Ø	870	Low Speed

As reflected in Table 5, the required speed in drilling operation is 870 RPM thus the V-belt is shifted to a 5cm v-pulley in the motor shaft and 10cm v-pulley in the main shafting producing low speed. Familiarization in the various operations of the machine is necessary.

Functional. The machine is functional, similar to those found in industry in five (5) operations: 1) Cutting along the grain of wood to a maximum thickness of 5.0 cm., 2) cutting across the grain of wood with 45° grinding metal surfaces, 4) cutting metal to a maximum thickness of 6mm, 5) drilling holes to a maximum diameter not to exceed 8mm and a minimum thickness of 6mm.

Economical. The multi-purpose machine is economical for instructional use in the schools offering technology courses for the following reasons:

1) It is economical in terms of labor and materials.

2) The 1hp motor consumes less energy to operate the multi-purpose machine, compared to a 3 or 5hp motor.

3) The parts are replaceable with less expensive, low cost, recyclable, and discarded materials found in the shop/locality.

4) The production of this combination workshop unit can serve as an instructional materials for the students in civil technology.

5) The machine is a multi-purpose gadget of sawing, metal cutting, grinding and drilling and is operated with one electric motor.

Educationally Valuable. The production of the multi-purpose steel and woodworking machine has an educational value on the part of the designer's ingenuity to innovate this combination workshop unit which combines steel and woodworking device into a single unit. The basic theories, concepts, techniques and operating procedures can be attained by the students by the use of this machine.

Can Be Produced Locally. With the existing materials and machineries in the locality particularly in Mondragon, Northern Samar, and its simplicity in design of the machine, there is the possibility to produce the machine. Metal parts can be fabricated in the lathe machine and the wooden parts can be done with the use of woodworking handtools.

2. Parts and Functions of the Machine

Stand. Composed of four legs of angular bars, supporting the parts or assemblies of the machine.

Working Table. Made of 20mm thick marine plywood, supporting the multi-purpose clamp assembly,

vise assembly, toolrest for grinding, rip fence, and the machine's column assembly. It holds work during cutting operations.

Machine's Column. The main or major structure of the machine provides a movable beam which travels vertically along the column with the use of a continuous threaded bolt or adjuster as the handwheel is turned/rotated.

Vertical Adjuster. At the machine's column, a vertical shafting assembly is installed/secured with a lock nut at the upper end and a pillow block bearing at the lower. The operation of lowering and raising the adjustable beam assembly done by means of two (2) bevel/miter gears attached to both vertical and horizontal shafting.

Adjustable Beam. Composed of angular bar framing, where sliding motor assembly travel horizontally left and right as they are adjusted.

Sliding Motor Assembly. A framework of angular bars where a 1hp electric motor is attached. This assembly is directly installed on the adjustable beam assembly where it slides either of the sides during drilling operations.

Horizontal Adjuster. Composed of vertical

shafting which is driven by the horizontal shafting handwheel to adjust the horizontal beam left or right. It consist of special nuts, two sets of bevel gears, bushings, bearings and Pillow Block Bearing.

Main Shafting Assembly. Made of mild steel composed of pillow block bearings attached to the motor assembly. The main shafting holds the drill chuck on one end, combination V-pulley, Circular Saw and Grinding Disk on the other end. The main shafting operates by means of a v-belt driven by the motor.

Multi-Purpose Clamp. Composed of steel adjuster, movable clamp stopper, movable bolt end and sliding clamp. The multi-purpose clamp is directly attached to the working table by means of bolts and nuts to fasten it firmly. It is used to hold steel/wooden materials to be cut.

Multi-Purpose Vise. Composed of machined milled steel consisting of upper and lower jaws used to hold the stock firmly during drilling operations.

Standard Pillow Block Bearing. A factory-made device which contains bearing to support the moving parts of the main shafting which drives the circular saw, drill chuck, grinding stone, circular metal cutter, and the handwheels. (See Figure 17)

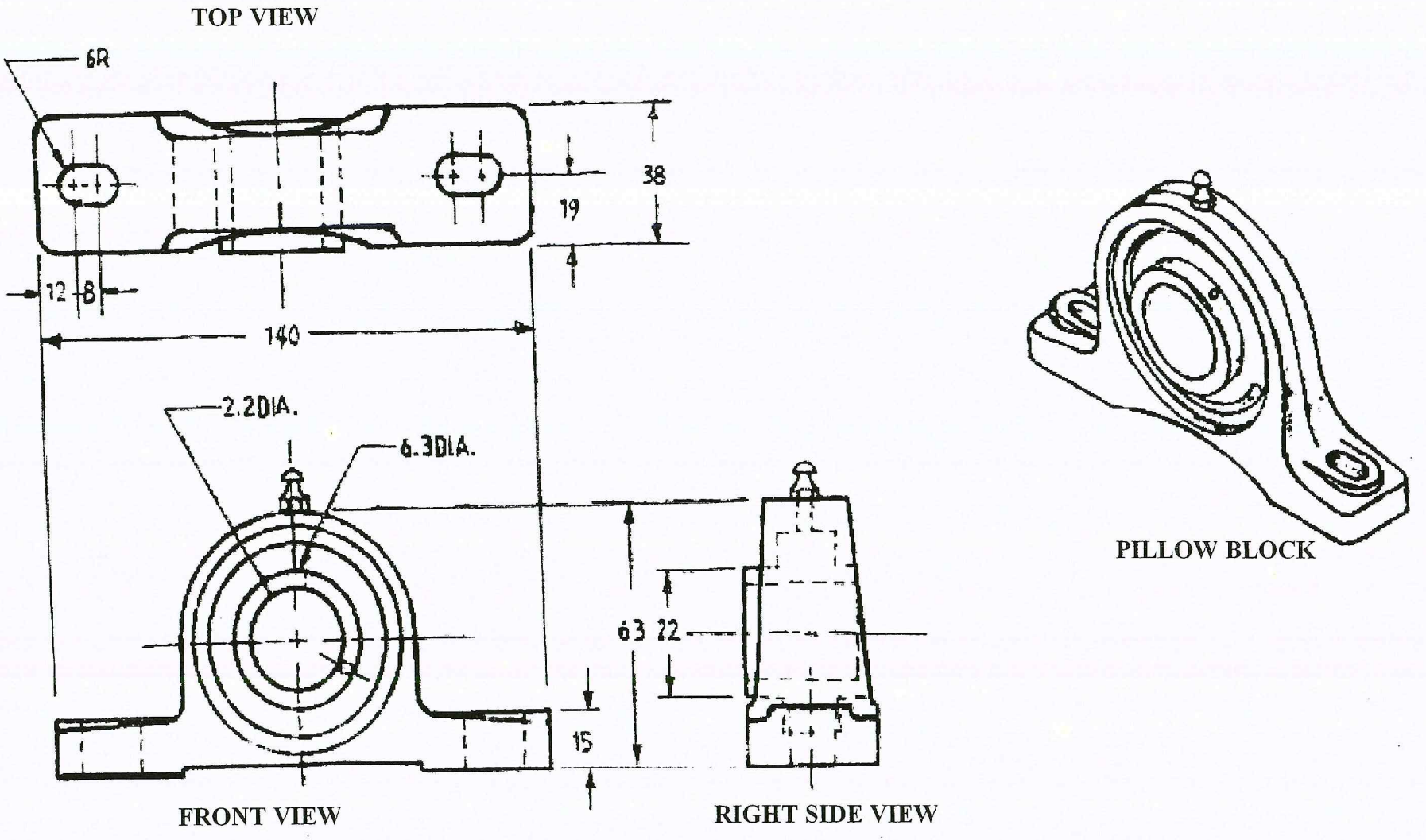

FIGURE -17 **THE PILLOW BLOCK BEARING**

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V-Pulley. A factory-made device usually cast-iron with v-groove. It is used to transmit the rotary motion of the motor to the v-pulley of the main shafting.

V-Belt. An imported belt usually used to drive both pulley of the motor and the main shafting.

Electric Motor. Provides power to operate the multi-purpose machine by means of v-pulley and v-belt.

Miter or Bevel Gear. A recycled device from a differential of an automobile which is designed to transmit the turning action of the handwheel through the horizontal and vertical shafting. (See Figure 18)

Handwheel. A device made of mild steel which contains an arm and a handle to rotate the horizontal shafting when adjusting the horizontal beam assembly.

Switch. A magnetic type of switch used to control the power supply of the machine.

Circular Saw Blade. Saw blades are specified according to the type and number of teeth, gauge, thickness of the blade, arbor hole, size and grade of steel. It is used for cutting wooden materials.

Grinding Stone. An imported circular grinding stone with a 12mmØ arbor hole, used for grinding rough

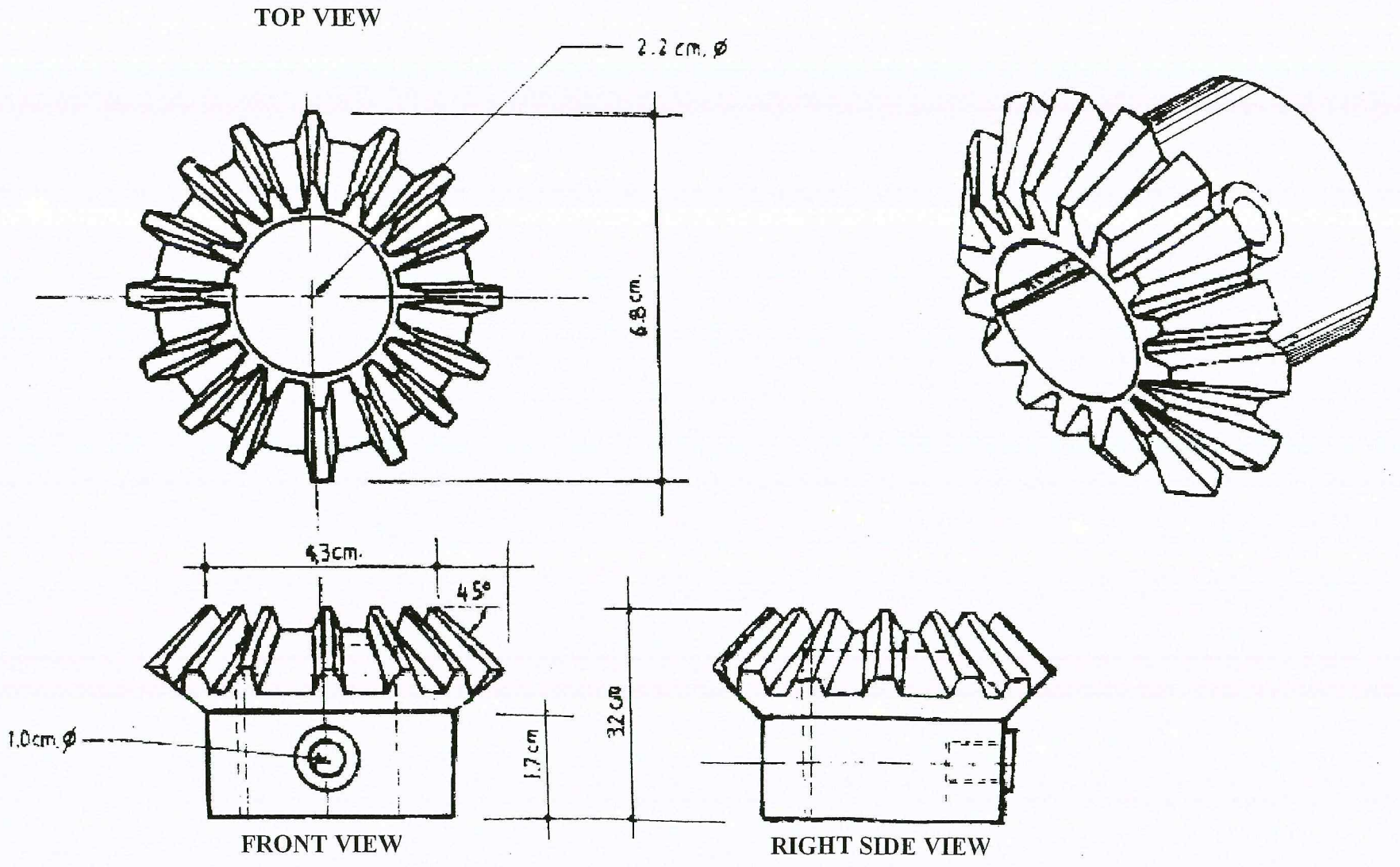

FIGURE -18 **THE MITER / BEVEL GEAR**

Note:

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surfaces of steel/metal materials and for sharpening edge-cutting tools.

Circular Steel Cutter. A factory-made steel cutting device made of high-grade 3mm thick stone. It is used for cutting metals.

Drill Press Bit. A factory-made machine tool used for drilling holes in metals and in wood which is held on a drill chuck. (See Figure 19)

3. Interrelationship

The multi-purpose steel and woodworking machine composed of nine (9) major assemblies is shown in Figure 2, 3, 4, 5 and 6, respectively. It has a working table that measures 90cm long, 70cm wide and 80cm high, made of a 2cm thick marine plywood framed with a 6mm thick x 32mm wide angle bars. To avoid it from vibration during operations, it has been provided with a horizontal member of the same kind of material as stated, directly beneath the table and braced continuously with a 10mmØ round plain bar.

At the right side of the working table, there stands the machine's column assembly which has a height of 70cm from the table top and 12cm below. The machine's column is provided with a slot infront and

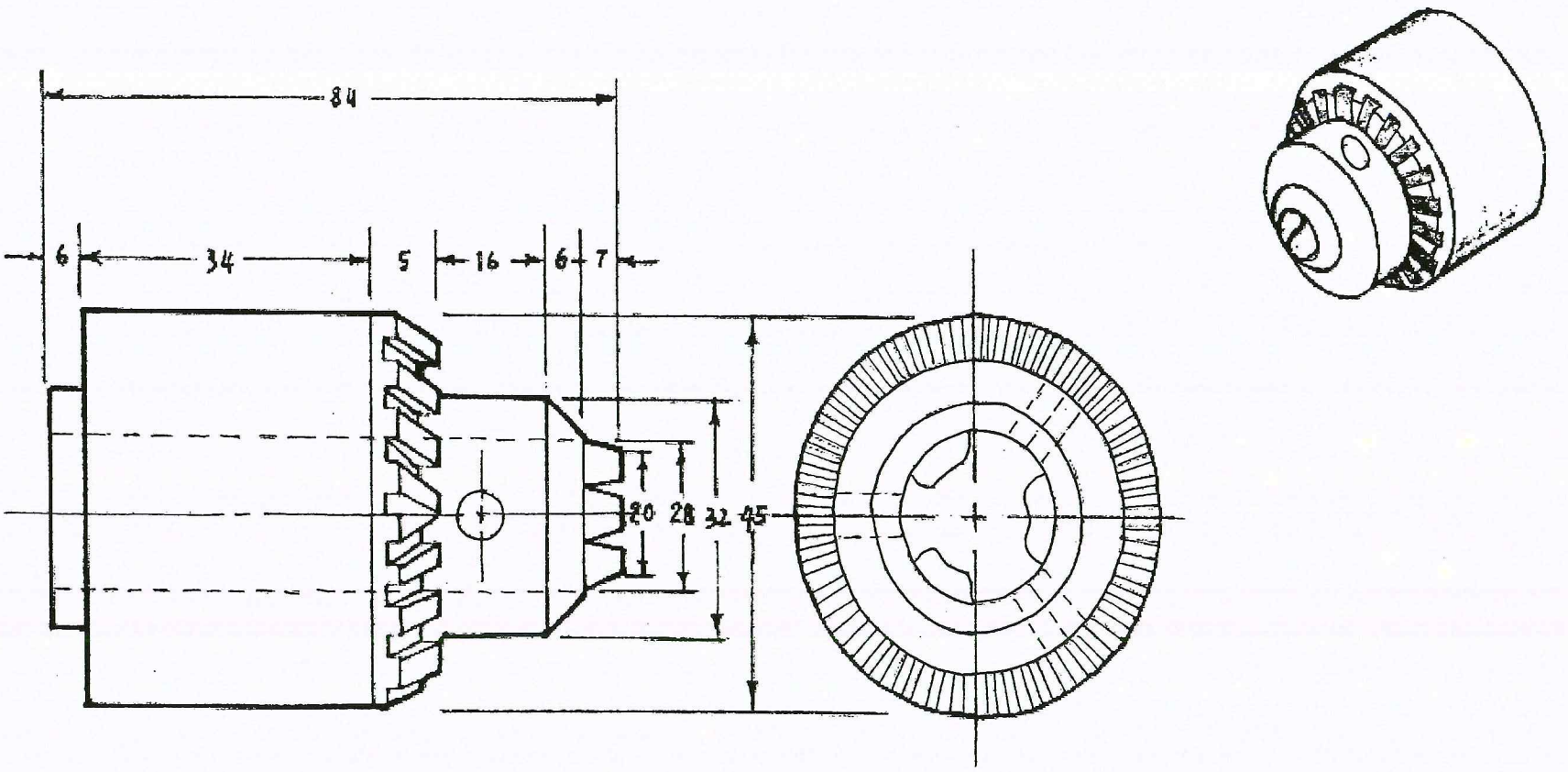

FIGURE -19 **THE DRILL CHUCK STRUCTURE**

Note:

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either of the sides. In this column, attached is the movable/adjustable beam which travels vertically (up and down), with the use of a continuously threaded bolt or adjuster. Attached at its end below the table is a larger bevel/miter gear meshed to a smaller gear going infront of the table, which has an adjuster handwheel to adjust the assembly upward or downward.

On the adjustable beam, attached is the sliding motor assembly where the one-horse power electric motor, 220V, A.C. 1,740 rpm is firmly attached. The end shafting of said motor attached also is a combination/stepped V-pulley where it is connected to the main shafting assembly by means of a V-belt and another inverted stepped V-pulley that determines the speed of the driven implement during operations.

Attached to the main shafting assembly are: from right to left, the drill chuck, for horizontal drilling, Pillow Block Bearing, combined/stepped V-pulley, another Pillow Block, either of the Circular Rip Saw blade, Circular Crosscut Saw blade and the Steel/metal cutter blade, which is provided with cover for safety purposes. From here follows the Grinder Stone at the end of the shafting that has been provided with a tool rest for a comfortable grinding

operation.

Infront of the Drill Chuck and beside the Machine's Column Assembly is a specially designed and fabricated multi-purpose vise to hold firmly the stock during drilling operations.

On the table directly under, and little bit parallel to the blade, is either the Rip fence or guide for ripsawing which is made of 6mm thick x 2.54cm wide angle bar bolted to the slot provided at the edge of the table for the said purpose, and the movable multi-purpose clamp for crosscutting, miter cutting both for wooden and steel materials.

Before the electric motor is operated the operator should be well-oriented with the different functionalities and capabilities of the machine for a more accurate and safety task. See the suggested setting of V-belt posted on the Adjustable Beam Assembly in every operation to perform. Anyway, when the V-belt has been properly set, there are only two adjusters to use in adjusting the implements used. In drilling for instance, the horizontal adjusting wheel/lever at the right side, and at its left side under the table adjusters is used in setting the implements up and down as in cutting wood and metal.

Magnetic switch is provided at the upper portion of the motor for an easy switching of the machine.

Lastly, to avoid the machine from vibration, it is provided with a foot bracket to fasten it to the floor using 12mmØ x 10cm machine bolt for a stationary position.

4. Capabilities

The minimum capacity of the multi-purpose machine is to cut thin pieces of wooden materials such as plywood, plyboard, lumbers and the like to a maximum thickness of 5.0cm. It can also cut metals to a maximum of 6mm thick, and GI pipes. The grinding disk/stone can grind metal surfaces which is also attached to one end of the main shafting. A drill bit attached to the drill chuck can drill holes to a minimum thickness of 6mm and a minimum of 6mm to 8mm diameter, with the application of coalant or lubricating oil to avoid damages on the bit.

A 1 H.P., 220 volts, 1740 RPM motor provides power to operate the multi-purpose machine. The rotary motion of the motor on the main shafting assembly can be adjusted to the desired/required r.p.m. necessary to perform cutting wood and metal, grinding and

drilling operations, by means of a combination v-pulley for which it is intended for. The machine can be used as a saw, metal cutter, grinder and drill press in a given period of time.

The machine can cut wood across and along the grain, can cut miter, groove, and rabbet parallel to the edge of the board.

5. Limitations

The machine is limited to perform on the following operations:

Sawing Operation

1. Cut across the grain of wood.
2. Cut along the grain of the wood.
3. Cut 45 degrees angle.

Metal Cutting Operations

1. Cut flat bars, square bars, and round bars.
2. Cut G.I. pipes to maximum of 5cm diameter.

Grinding Operations

1. Grind rough surfaces and edges of metal.
2. Grind round edges of pipes.
3. Grind bevel or chamfer cut on ends of pipes.
4. Sharpen chisels and plane iron blades.

Drilling Operations

1. Drill holes on flat metal surfaces.

2. Drill holes on round pipe surfaces.

3. Drill holes on wooden materials.

B. Process

This section describes briefly the various operations required on the efficient and effective utilization of the multi-purpose machine.

1. Operating Procedures

a. Crosscutting of wood

1. Use circular crosscut saw blade, fastened firmly with the use of adjustable wrench and provide safe locking pins to the main shafting assembly.

2. Adjust the saw blade at least 6mm. below the surface of the table, to cut stock completely.

3. Set the miter gauge with graduate scale to determine squareness or 90 degree position or check with a try-square.

4. Be sure that the straight edge of the stock should be in contact with the miter gauge before cutting.

5. Secure or hold the stock firmly against the face of the miter gauge with the use of the multi-purpose clamp. (See Figure 20)

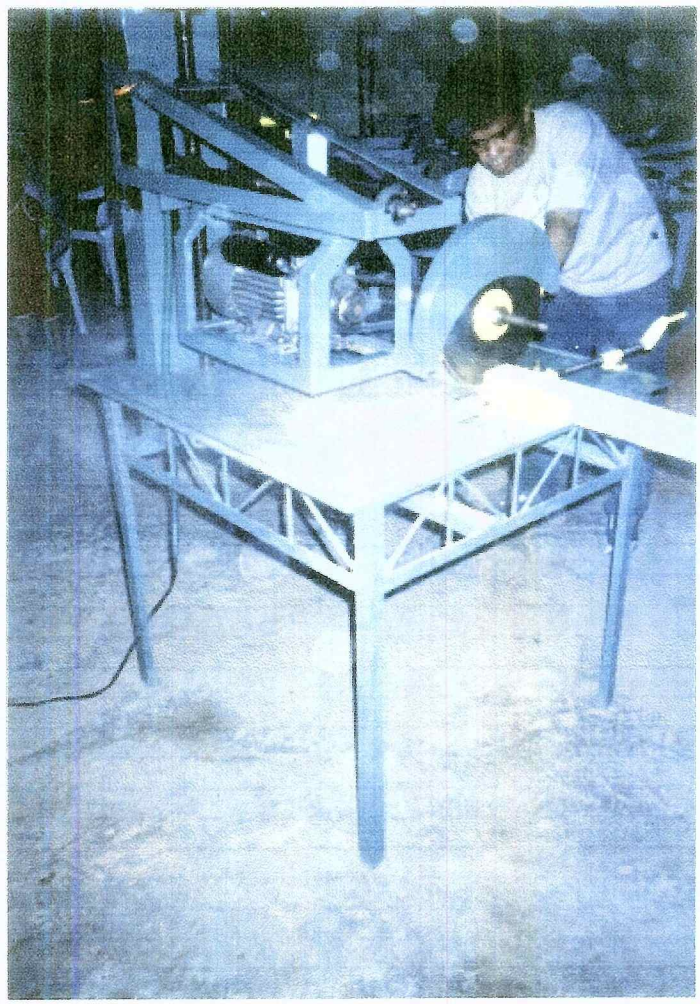


FIGURE 20 **CROSSCUTTING WOOD OPERATION**

6. Start the machine and allow it to reach full speed. Make a test cut on the stock before feeding through.

7. Make necessary adjustment of the stock. Hold stock firmly with both hands, feed steadily through the saw.

8. Remove the stock to prevent obstruction before returning the guide to the starting position.

b. Cutting along the grain of stock

1. A circular ripsaw blade is adjusted to the desired depth of cut.

2. Fasten the rip fence on the table edge provided with slot firmly to the required distance at the right side of the saw, which maybe checked with a rule by measuring between the teeth of the saw to the rip fence.

3. One edge of the stock to be cut must be straight, and must be held against the rip fence.

4. Stand on the left side of the saw. Start the machine and push the board with an even and firm motion to make the required cut. (See Figure 21)

5. If the cut is made close to the saw blade, use a "push stick" to move the board. Do not reach over the blade to remove the stock.

FIGURE 21 **RIPSAWING OPERATION**

6. Long pieces of board should be supported with a stand of the same level with the saw table.

c. Cutting Steel/Metal

1. A circular steel cutter is fastened and adjusted to a required deep of cut.

2. Move away the rip fence to prevent obstructions.

3. Set the stock firmly on the multi-purpose clamp, by tightening the adjuster and other parts of the clamp. (See Figure 22)

4. Determine the required r.p.m. speed required in cutting steel materials. Make adjustment by shifting the v-belt to the right v-groove of the pulley.

5. Secure the stock firmly on the multi-purpose clamp assembly.

6. Stand on the right side of the circular steel/metal cutter. Start the machine to its fullest speed before feeding or adjusting the blade downward to cut the stock.

7. Always wear goggles to prevent eye injury.

d. Grinding Steel

1. A circular grinding wheel is fastened and adjusted and provided with safe locking device or pin.

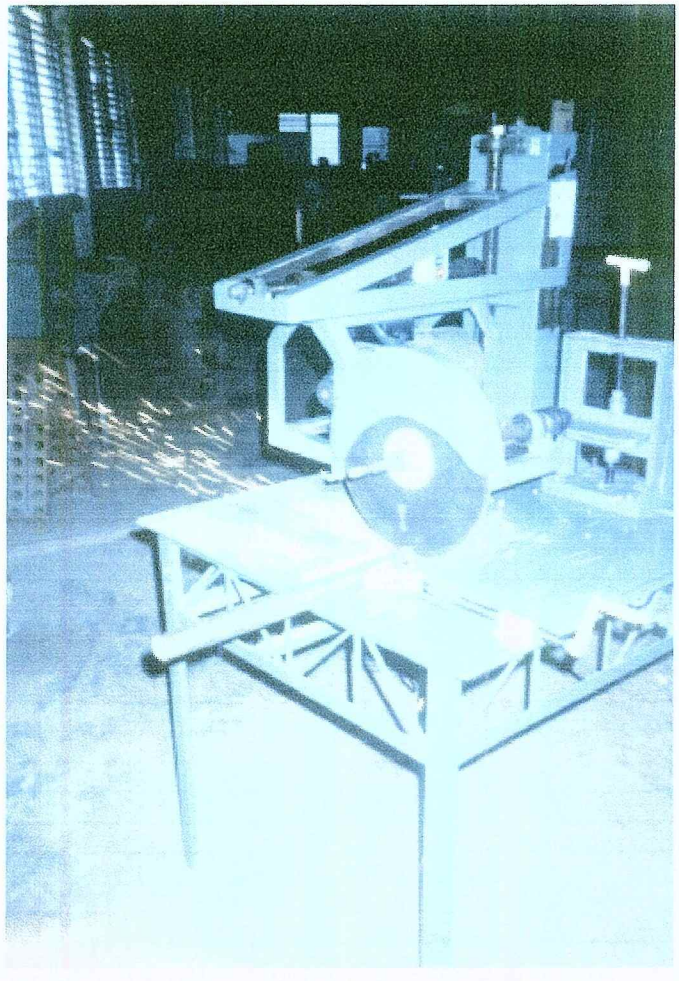


FIGURE 22 **CUTTING METAL OPERATION**

2. Adjust the required level necessary for ease of operation.

3. Set the safety transparent cover to prevent flying iron filings against possible eye injury.

4. Provide or set tool or stock rest firmly to avoid waggling of stock to be grounded and to maintain feeding and precise quality of cut. (See Figure 23)

5. Stand to a distance from the grinding wheel. Start the machine and allow it to reach its full speed.

6. Hold the stock firmly with both hands and feed steadily with care against the rotating wheel.

7. Turn "off" the machine and wait until it stops fully. Clean the table free of iron filings for the next operation.

e. Drilling on Metal/Wood

1. Remove all cutting blades which are attached to the main shafting to prevent unwanted serious injury.

2. On the drill chuck, fasten the required size/diameter of drill bit for the job, with a chuck wrench.

3. Clamp the stock to be bored on the multi-purpose vise firmly. Make adjustment for possible

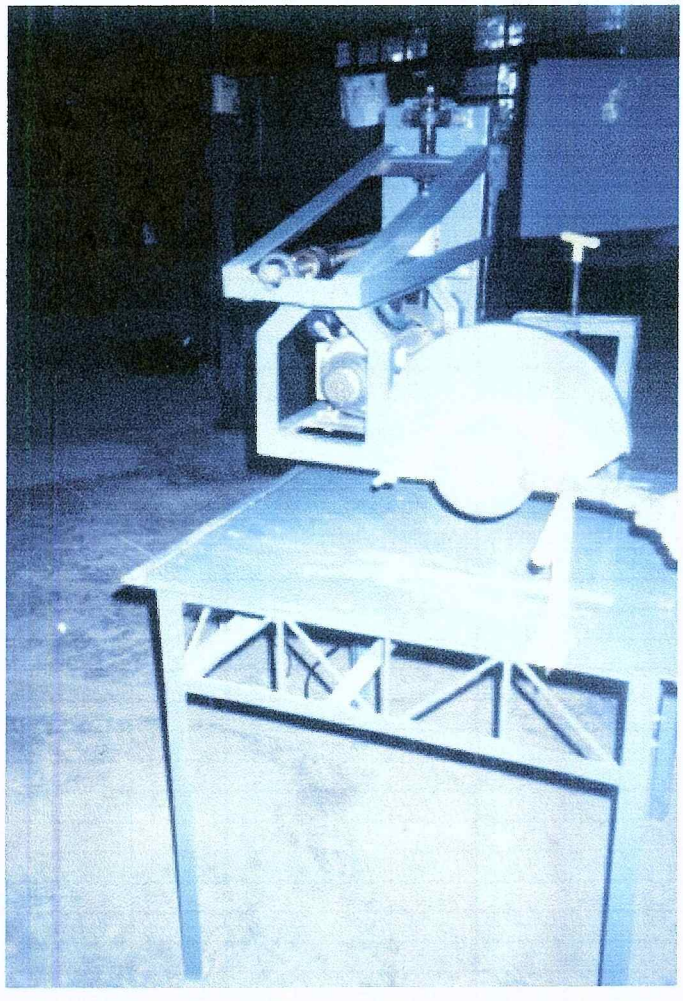


FIGURE 23 **GRINDING METAL OPERATION**

vibration or waggling during the operation. (See Figure 24)

4. Adjust the vertical and horizontal adjuster assemblies to the desired drilling point or hole.

5. Start the machine and allow it to reach full speed. Check the required r.p.m. speed for drilling operation.

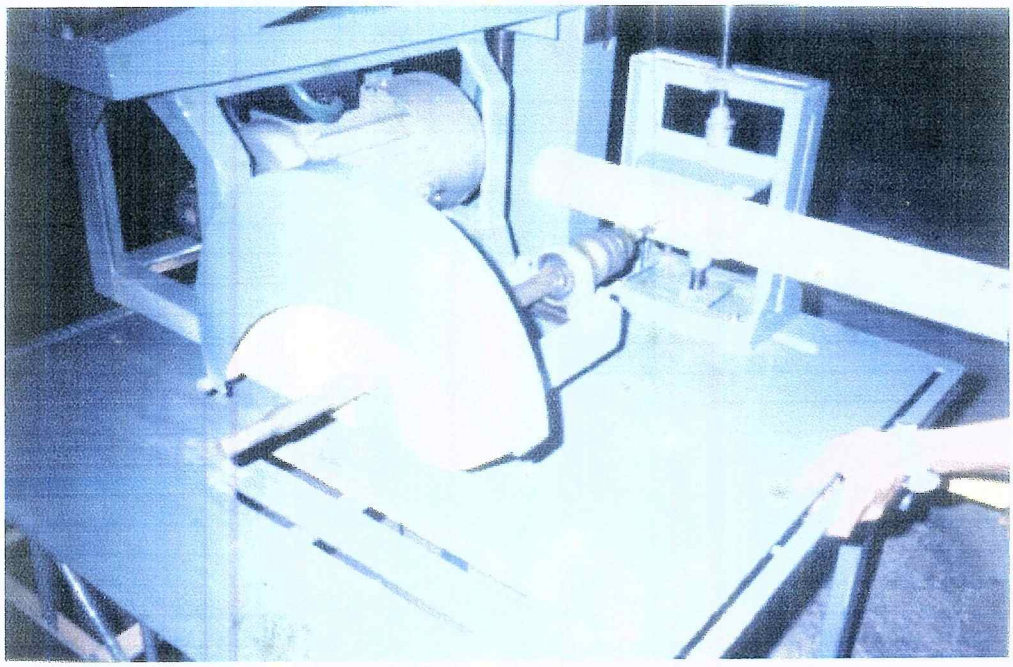
6. Holding the horizontal adjuster handwheel, turn the wheel clockwise or counterclockwise to feed and withdraw the drill bit from the stock being drilled. Apply lubricating oil to prevent overheating and damages on the drill bit.

7. Engage the drilling machine with a steady and controlled motion into the stock to be drilled/bored.

8. Always remove the cutting bit when not in use. And clean the area from iron filings and other waste materials.

Selecting Blades for the Circular Saw

Circular Saws are specified according to the type, number of teeth, gauge, thickness of blades, arbor hole size (in diameter) and grade of steel from which they are made. In selecting blade, one must consider that the more teeth in contact with the wood, the more power is needed



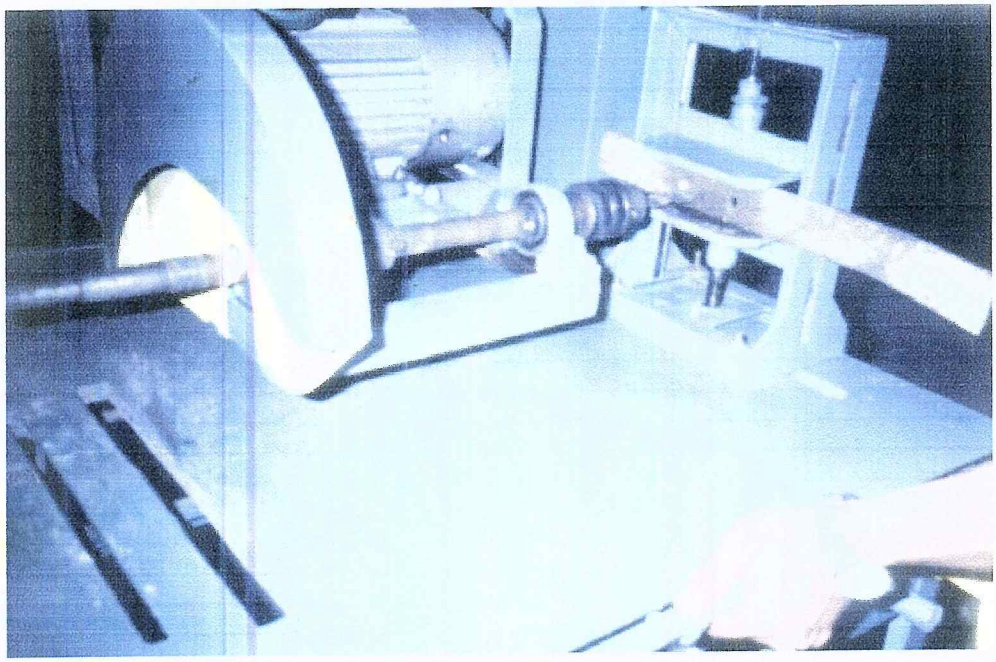


FIGURE - 24 **DRILLING METAL OPERATION**

or required to drive the saw at its power revolution per minute (rpm).

Circular Crosscut Saw. This type of saw is designed to cut across the grain of wood. It has a finer teeth than the circular ripsaw. Overheating the teeth or rim of the saw will tend the blade to warp that will not make accurate cut.

Circular Rip Saw. The circular rip saw is designed to cut along the length or grain of wood. It has a coarser chisel-shaped teeth which remove series of chips to make the cut.

Maintenance

a. Circular Saw

1. Be certain that the blade is sharp and is the right one for the job at hand.

2. All moving parts of the machine must be checked regularly to maintain functionality and reliability.

3. All moving parts of the machine require periodic greasing.

4. Saw dust should be blown from the blade cover from the major assemblies of the machine.

5. Check alignment of the miter gauge and rip fence to the front and rear teeth of the circular saw.

6. Check the required speed to 3,480 RPM.

Circular Steel Cutter

A circular steel cutter is an imported device with a very hard, heat-resistant, tenacious stone. This is designed to cut mild steel plates, angular, square, round, flat bars and steel pipes.

Maintenance

1. Steel bars must be held firmly on the multi-purpose clamp to avoid waggling.

2. Do not overload the machine. This will absolutely damage the cutting blade.

3. Heated blade should not be flashed with water. It will probably weaken its temper and quality of the blade.

4. Check required speed of 3480 RPM.

Grinding Disk/Stone

The grinding disk is a device designed to rub-away, sharpen, shape or smooth by friction metal surfaces. Similarly with other circular blade, the grinding disk/stone is fastened to the main shafting assembly of the machine. It is made of fine and coarse particles of millstone into a revolving stone disk for sharpening bladed tools or shaping and polishing things.

Maintenance

1. Grinding disk must be installed in the main shafting assembly with two 10cm. diameter x 6mm thk. flanges and must be secured with a left-threaded nuts.

2. Feed your work steadily with slight pressure to the rotating disk.

3. When sharpening, soak the blade to water or oil to avoid heating or burning your work.

4. Never overload the machine to avoid damages on the grinding stone and your work.

5. Check the required speed in grinding operation to 1740 RPM.

Drill Press

The drill press is designed to bore holes on metal in a horizontal position. The drill chuck is attached to the main shafting assembly. The bit is a drilling or boring tool for use in a drill press.

Maintenance

1. Always check the required power (RPM) speed for drilling or boring holes on metal from the speed conversion table.

2. Select the right bit for the job at hand. Fasten tightly the bit with a chuck wrench on the drill chuck.

3. The use of substitute fastening device is not advisable, hence it will damage the gear of the chuck.

4. Hold firmly the stock on the multi-purpose vise properly positioned and adjusted, to avoid waggling.

5. Use coalant or lubricating oil to prevent overheating the bit, which results to breakage and damages on the working tip of the bit.

6. Check the required speed of 870 RPM.

Safety and Control Measures

Before operating any power tool or machine, you must be thoroughly familiar with the way it works and the correct procedures to follow. In general, when you learn to use the equipment the correct way, you also learn to use it in the same way.

While operating a power tool or machine, do not allow your attention to be distracted. Keep all safety guards in position and wear safety glasses. Feed the work carefully and only as fast as the tool will cut it easily. Overloading is hazardous to the operator and will likely damage the tool or work.

When operating is complete, turn off the power and wait until the moving parts have stopped before leaving the machine. Always make sure that the source of electric

power is in the correct voltage and that the tool switch is in the "off" position before it is plugged in. Electric shock is one of the potential hazard in operating power tools or machines.

TRY-OUT AND REVISION

Based on the results of testing the various functions and mechanical operations of the multi-purpose machine, by performing the different cutting, grinding, and drilling operations as suggested in this study, the following observations revealed that: Circular crosscutting and ripsawing can cut 5.0cm thick wooden materials which requires a revolution per minute (RPM) speed of 3480 or high speed which can be derived from a 10cm.(4") diameter v-pulley in the motor shafting to drive a 5.0cm.(2") diameter v-pulley in the main shafting. The 10cm. diameter v-pulley generates 1740 rpm while the 5.0cm diameter v-pulley exerts 3480 RPM enough to cut a 5.0cm(2") thick wood.

Likewise, circular metal cutting also requires high speed to a maximum of 3480 RPM, similar to wood cutting operations enough to cut metal or GI pipes. In grinding metal surfaces, it was found out that the required speed to drive a grinding stone 2.0cm thick by 15cm. diameter

was 1740 RPM enough to grind metal surfaces. This is done by shifting the v-belt to 7.5 cm. dia, v-pulleys both in the motor shafting and main shafting assembly.

On the otherhand, drilling operation requires low speed at a minimum of 870 RPM which is done by shifting the v-belt to a 5.0 cm. diameter v-pulley in the motor shaft to drive a 10cm. dia. v-pulley in the main shafting assembly enough to drill 8mm diameter holes on a 6mm thick steel plate. This problem was resolved with the use of the diagram shown in Figure 25.

Difficulty was met in shifting the v-belt to the required speed. It was found out that the v-belt could hardly be shifted to another pulley. To remedy this problem, a bolt slot was provided at the base of the motor where it can be moved to and from and providing two bolts with nuts, where nuts were welded to the motor frame assembly. In adjusting, the bolts supporting the motor are loosen while the bolts held on the motor frame assembly is being turned to, loosen or tighten as the v-belt is adjusted to the right v-pulleys.

The circular saw and the metal cutting disk/blades waggled causing a larger cut and danger to the operator. To solve the waggling problem, a pair of loose collar or recessed washers with nut was provided to fasten the saw

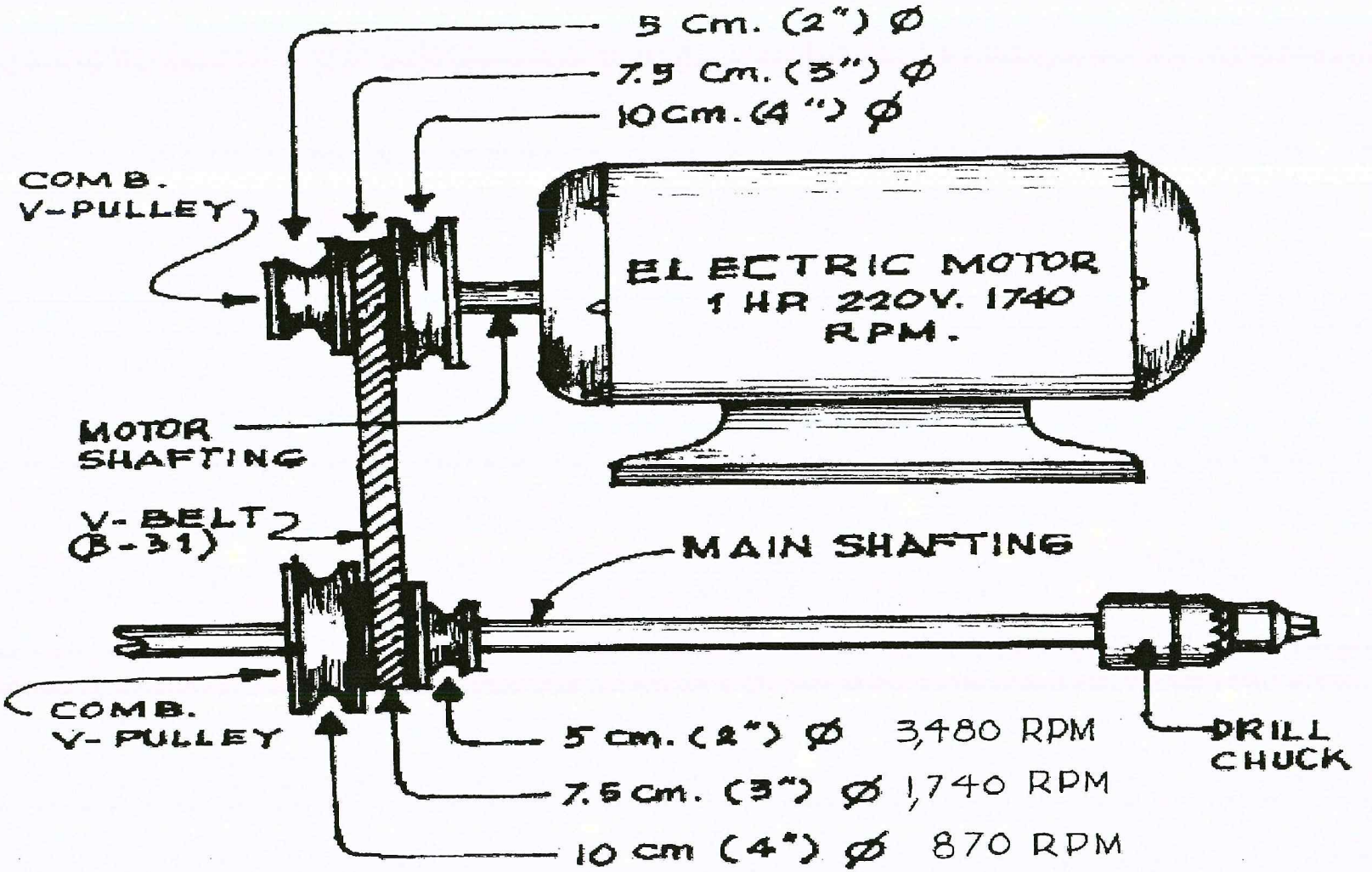


FIGURE -25 V – BELT LINKAGES

Note:

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blade and the cutting disk firmly to the main shafting assembly.

Moreover, the drill chuck has also a waggling problem. To check this, the end of the main shafting where the chuck is mounted was grounded with precision enough to force fit the drill chuck and was tackwelded to prevent it from waggling during the drilling operation.

As to the vertical shafting used to drive the horizontal shafting, it was found out that there was difficulty in adjusting and turning the hand wheel, because of the tendency of the vertical shafting to drop causing a considerable pressure to the miter/bevel gears in contact without tolerable clearance. To remedy this problem, two (2) interlocking nuts were provided to hold the vertical shafting from dropping and by the application of grease within the contacting bevel gears.

Chapter V

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusions, and recommendations of the study.

Summary of Findings

The findings of the study revealed that the multi-purpose steel and woodworking machine can perform five (5) major operations in a single combination workshop unit similar to those performed by an imported and commercially made machineries found in industries. It can be designed and constructed by the civil technology and mechanical technology instructors and students using the basic machineries such as: lathe machine, milling machine, welding machine, portable power tools/handtools and other equipment found in the shop.

The production time spent in the construction of the machine lasted for twenty one (21) days and with a reasonable production cost amounted to Eighteen Thousand Two Hundred Eight Pesos and 90/100 (P18,208.90) as of March 2004, which is much lower or inexpensive compared to the commercially-made machineries.

Conclusions

The result of this study conclusively showed that the multi-purpose machine is effective in performing sawing, metal cutting, grinding and drilling operations. It can be mass-produced on commercial basis because the mechanism is very simple and workable with the use of mechanical equipment. It can be reproduced by the students with the proper supervision of the instructor. It is cost-saving in the sense that materials, facilities and manpower needed are locally available.

Moreover, this multi-purpose machine ensures savings of government funds allocated for the procurement of school machineries, handtools and other equipment intended for shop instructions.

Recommendations

As a result of this study, the researcher recommends the following:

1. Vocational School Administrators should encourage teachers and instructors to innovate or construct simple improvised gadget or instructional machine as a substitute for the inavailability of the imported ones.

2. Vocational schools with problems of scarcity of equipment and machineries can use this study as a basis

for design and construction of a multi-purpose machine which can perform various functions and operations for their own use.

3. The materials used in constructing the machine in this study may be changed to ensure rigidity and longer serviceability (life span) of the machine and to improve its functionality.

4. The result of this study can be used as reference for future researchers, planners and designers who intend to study further and improve this study.

5. Further study should be conducted similar to this study that can cut wooden materials thicker than 5.0 cm., drill holes thicker than 6.0mm, and cut metal thicker than 6.0mm.

6. The table top made of 20mm thick marine plywood can be replaced with 6.0mm thick steel plate for longer serviceability and reliability of the machine.

7. The multi-purpose machine can also be used as disk sander machine utilizing 20mm thick plywood, 30cm diameter as well as steel brushing machine employing a factory-made circular steel brush.

8. The multi-purpose machine should be patented by the school or researcher for its mass production on commercial basis.

9. A saw dust or iron filing protector shall be installed at the hinge of the Circular Cutting Blade Guard to prevent eye-injury to the operator and other workmen.

10. Provide additional braces on the table legs/stand for rigidity.

11. Install the machine permanently to the floor where it is intended with four 12mmØ x 10cm anchor bolts to prevent vibration or movement during the operation.

12. To replicate the machine for improvement, it is necessary to replace or provide a smaller driving bevel gear to drive a bigger gear to cause the horizontal adjuster easy to adjust and to improve its lateral movement.

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APPENDICES

APPENDIX "A"

Republic of the Philippines
Commission on Higher Education
SAMAR STATE UNIVERSITY
Catbalogan, Samar

Dr. Marilyn D. Cardoso
Dean, Graduate Studies
Samar State University
Main Campus, Catbalogan, Samar

Madam:

I have the honor to submit herewith my proposed seminar paper entitled "Multi-Purpose Steel and Woodworking Machine: A Technical Feasibility Study", for your approval.

This proposed feasibility study was already referred to Dr. Felipe F. Cuna, Civil Technology Professor, Samar State University, Main Campus, Catbalogan, Samar, for comments, suggestions and recommendations regarding its feasibility to design and construct this project.

In this connection, I am anticipating for your favorable action/approval on this regard.

Very truly yours,

(Sgd.) ROLITO L. UNAY
MTE Student

APPROVED:

(Sgd.) MARILYN D. CARDOSO, Ph. D.
Dean, Graduate Studies

APPENDIX "B"

Republic of the Philippines
SAMAR STATE UNIVERSITY
Main Campus, Catbalogan, Samar

THESIS/SEMINAR PAPER APPROVAL SHEET

This proposed thesis/seminar paper entitled: "MULTI-PURPOSE STEEL AND WOODWORKING MACHINE: A TECHNICAL FEASIBILITY STUDY"

in partial fulfillment of the requirements for the degree of Master in Technician Education (MTE), is hereby submitted for approval.

(Sgd.) ROLITO L. UNAY
MTE Student

(Sgd.) FELIPE F. CUNA, Ph.D.T.M.
Adviser

(Sgd.) MARILYN D. CARDOSO, Ph. D.
Dean, Graduate Studies

CURRICULUM VITAE

CURRICULUM VITAE

Name	:	**ROLITO LAYAN UNAY**
Address	:	Brgy. Eco, Mondragon, N.Samar
Date of Birth	:	June 27, 1970
Place of Birth	:	Brgy. Roxas, Mondragon, N. Samar
Civil Status	:	Married
Spouse	:	Loida Lora-Unay
Parents: (father)	:	Rodolfo Ramirez Unay
(mother)	:	Galilea Amador Layan-Unay

Educational Attainment

Elementary Education	:	Roxas Elementary School (1977-1983)
Secondary Education	:	Mondragon Agro-Industrial High School (1983-1987)
Technical/Vocational	:	National Manpower & Youth Council (NMYC now TESDA)
College	:	University of Eastern Phils. (1987-1996)
Graduate Studies	:	Samar State University March, 2004

Civil Service Eligibility

Career Sub-Professional Examination (CSC)	1994
Licensure Examination for Teachers (LET)	1996

Awards and Distinctions

Certificate of College Proficiency/Award	:	March 28, 1996
Certificate of Appreciation (Speaker)	:	Roxas Elementary School (March 25, 1999)
Certificate of Appreciation (Speaker)	:	Mondragon Agro-Industrial High School (March 30, 1999

Trainings and Seminars/Workshops

Four-Month Training on General Building Construction	:	NMYC now TESDA April 28, 1989
One-Month Training on Silkscreen Printing	:	NMYC now TESDA May 2, 1990
Barangay Administration Training Program	:	LGU Mondragon, N.Samar October 10-12, 1994
Seminar-workshop on the Different Approaches and Strategies in Teaching-Focusing on the Integration of Values	:	December 14-16, 1995

Annual Orientation Seminar For Teacher Education Senior Students (PAFTE)	:	Leyte Normal University Tacloban City February 28, 1996
Leadership Training Seminar Future Farmers of the Philippines Collegiate Chapter	:	SSPC, Catbalogan, Samar September 10-11, 1999
Basic Computer Training Compaq Computer Phils., Inc.	:	April 29-30, 2002
Values Orientation Workshop	:	CSC, Catarman, N. Samar July 24-26, 2002

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