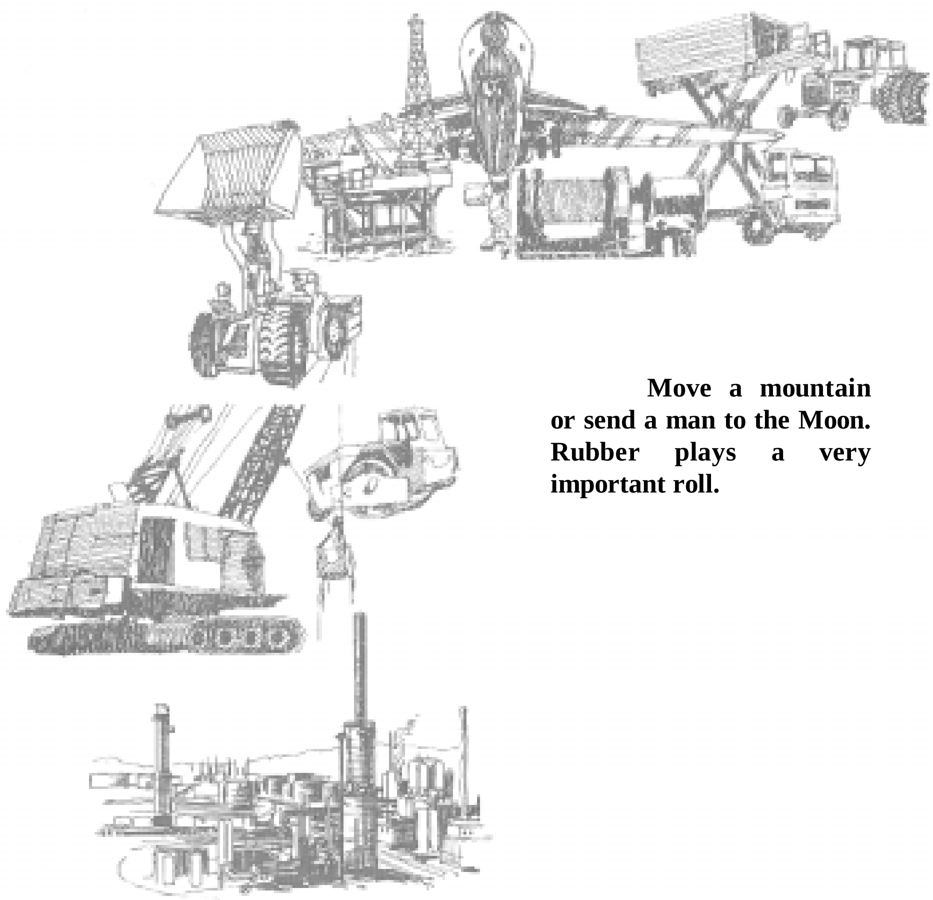
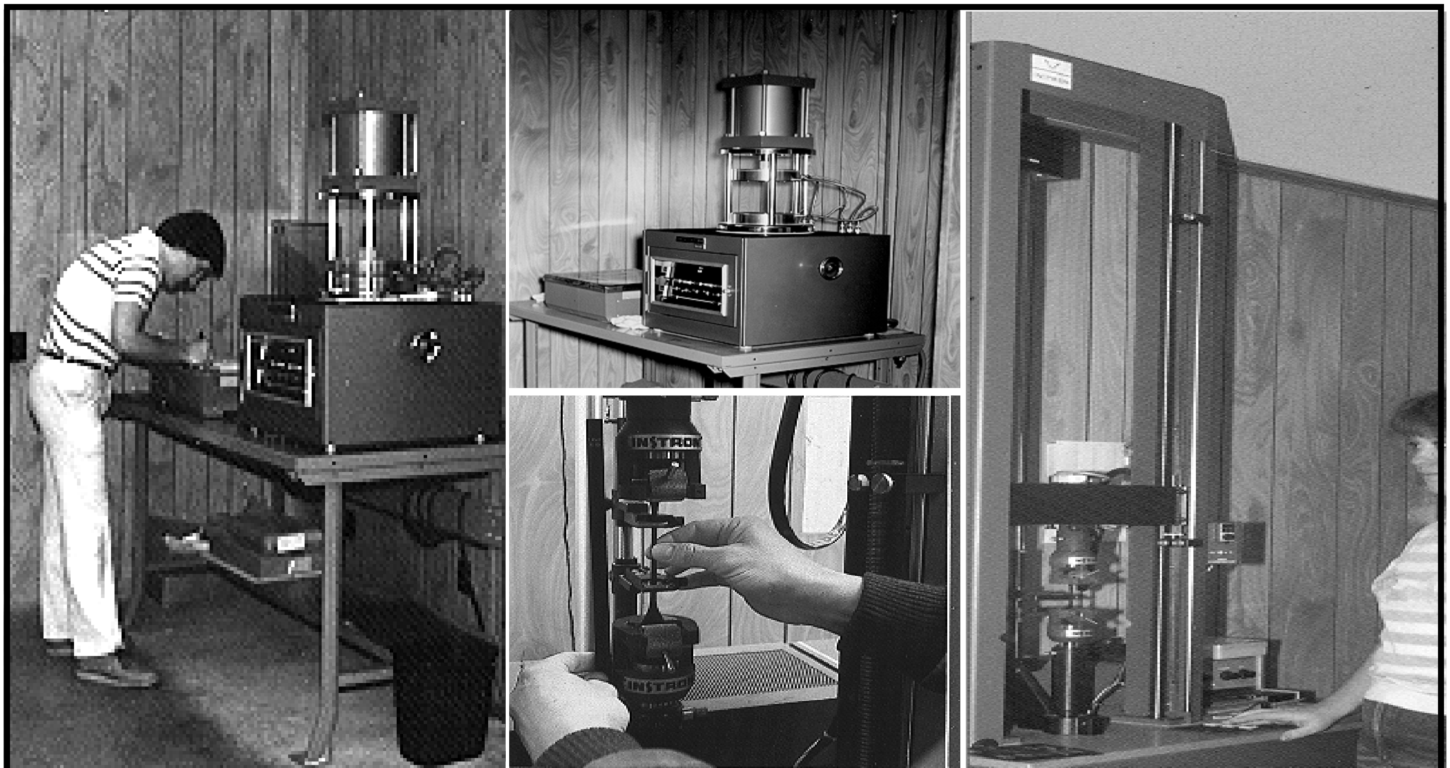
Chapter II.

How Rubber is put to Industrial Use



Move a mountain or send a man to the Moon. Rubber plays a very important roll.



LABORATORY FACILITIES ARE MAINTAINED AT MPI FOR QUALITY CONTROL AND COMPOUND DEVELOPMENT

HOW RUBBER IS PUT TO INDUSTRIAL USES

**WRITTEN AND ADAPTED BY
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Contrary to the popular impression that rubber products are made by pouring melted latex into molds and leaving it to cool and harden, the manufacture of these parts involves precise compounding followed by vulcanizing caused from exact control of temperature and pressure under molding. The merchandise turned out in the plant of M P INDUSTRIES, Inc. must meet rigid specifications, consequently from the laboratory through all phases of shop procedure, it must follow equally rigid procedure in manufacturing.

Before getting into the details of these requirements, it may be well to take a backward glance at the product we know as rubber.

In 1700, Joseph Priestly, an English clergyman, who engaged successfully in scientific pursuits, discovered that a mass of Caoutchouc would rub out pencil marks, so he dubbed the product rubber. In a strict sense rubber refers to a vegetable hydrocarbon of the chemical form $(C_5H_8)n$ and for practical purposes it may be defined as a material that is capable of being stretched or distorted to a considerable extent, then retracting quickly to nearly its original dimension upon release of tension. Technically, this quality is more correctly covered by the word, "Elastomer."

No Elastomer may be used to advantage in its native state. This fact was apparent to investigators as far back as 1800. The only Elastomer available at that time was tree rubber, and products made from it were very soft and tacky in hot weather and hard and brittle in cold weather. This temperature span was so short that the rubber articles were practically useless. Three investigators, Dr. James Anderson in Edinburgh, prior to 1800, Dr. Liedersforff in Berlin in 1832 and Dr. Jorrisen in Haarlem, Holland all worked toward improving the resistance to deterioration and workability over a large temperature range of the rubber products. Each in his own way learned that heat and sulfur combined with the Elastomer would cause a chemical change which reduced tackiness in hot weather and brittleness in cold, but it took Charles Goodyear in 1839

RUBBER MIXING MILL FOR COMMINGLING THE VARIOUS INGREDIENTS IN A RUBBER COMPOUND

to actually state the true, problem and realize what significance the answer played in the existence of a young floundering rubber industry. The first successful vulcanization was then performed in 1841 by Goodyear when he produced a few yards of rubber sheeting heated in a cast iron trough. In England a Thomas Hancock had also produced vulcanized rubber parts and by 1850 several stable rubber companies were in existence. Now rubber is one of our major industries.

Two types of Elastomers exist which are used by the rubber industry, natural coming from trees and synthetic from chemicals. Both types are handled similarly in all stages of compounding and through vulcanization. The difference in choice is determined by the difference in the physical and chemical requirements of the finished product.

At this point the rubber chemist and the rubber testing laboratory take their most important place in the scope of fitting the proper compound to the requirements of each product. Actually, the rubber laboratory is the pilot plant for the overall plant operation. Small quantities of the Elastomers are taken through production and testing stages and the suitability of each is determined. After passing rigid physical and chemical procedures set out by the ASTM, the compound is sent to the plant for actual production runs.

In compounding, the chemist must first decide what Elastomer to use. For excellent overall physical properties and low oil resistance, They may choose natural rubber. For superior overall physical properties and good Oil resistance, they may choose the polychloroprene type (Neoprene). For good physical properties and excellent oil resistance, they may choose the butadiene acrylonitrile (Hycar). For good low temperature and high temperature physical properties and for good chemical resistance, they may choose the fluorinated type (Viton). For excellent low and high temperature requirements and fair chemical resistance, they may choose the silicones (Silastic). Keeping this in mind, they will study the working conditions of the product to be made and determine the properties necessary for compounding to allow proper operation in the known environment.

After the Elastomer has been selected and the desired physical properties determined, the chemist may then set out on the formula design. They may utilize published data, laboratory data, a small amount of trial and error, and most of all, experience. Actually, each compound designed is a compromise in that some chemical resistance must be sacrificed for better physical properties or vice versa. The rubber chemist has many chemicals at hand to use in their work and a thorough knowledge of the action each takes in the several Elastomers is necessary. The choice here may mean the difference in a product working or failing, or a loss or profit for the

Another basic consideration in proper product design and production is the type and shape mold that must be used to produce the rubber parts. Many things other than shape must be considered in order that parts may be run with a minimum amount of rejections and a maximum amount of quality. How will the prepared stock be loaded, what durometer is the stock, what is the shrinkage factor of the stock, in what size press will the mold be run, how fast will the stock flow, what is the viscosity of the stock, what is the heat history of the stock and what is the method of getting the finished part from the mold? These are only a few considerations, but it can be seen that each product produced from rubber is a compromise of many things. In some instances it is necessary for us to lower our sights a little on product requirements in order to obtain good processing compounds and other times it is necessary to improve our processing means to meet higher product requirements. At best, mold design is a practiced art at which the designer must be proficient and experienced.

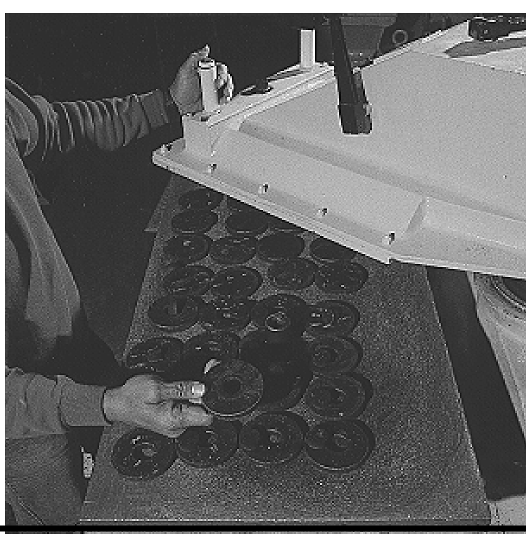
After the final design for the compound and proper mold design have been established, the next step is to proceed to the mixing process in the plant. This entails the mixing of the compound ingredients on what is commonly known as a rubber mixing mill. The mill consists of two large water cooled steel rolls that have their axis parallel and in the horizontal plane. On the mixing mill the Elastomer is broken down and banded around the front roll to form a smooth surface. This is accomplished by a kneading action caused by the back roll running approximately 1.2 times as fast as the front roll. Next, the dry ingredients of the formulation are all has been added to the Elastomer, the whole is thoroughly mixed on the mill and then sheeted off for future use.

The next step is that of stock preparation. Each person engaged in it must have a working knowledge of the shape of the mold in which the stock is to be inserted and the weight of the finished product. They must also know if there is to be any metal or fabric inserts included in the finished part. These facts govern the size, shape and weight required for each molding problem. Stock properly prepared will enable products to be produced with a minimum amount of rejections.

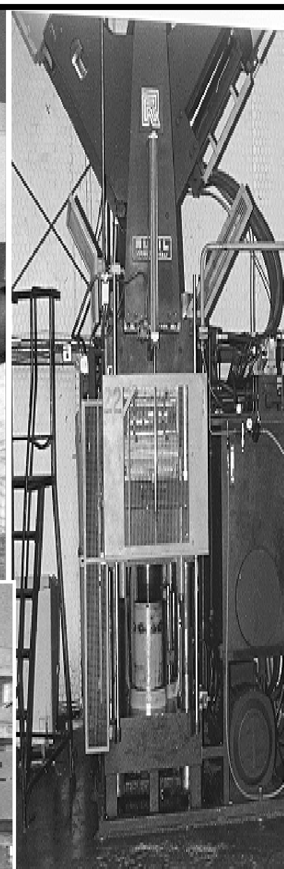
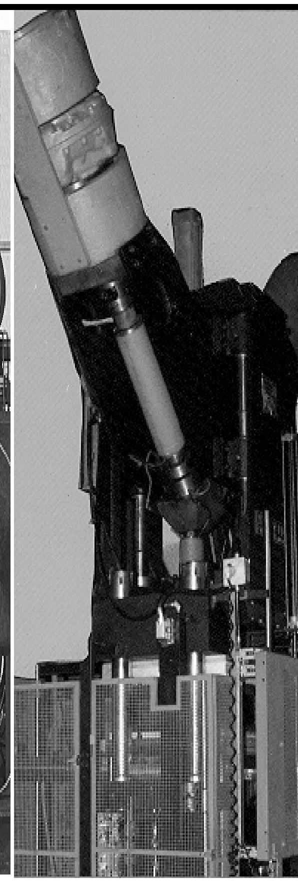
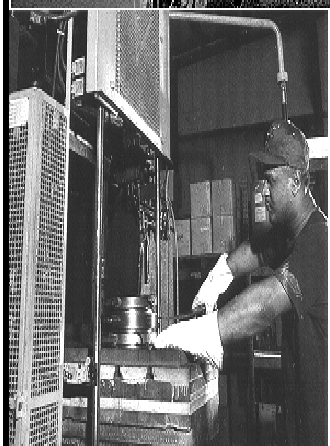
After stock preparation, the prepared loads are taken to the press line and inserted into their respective molds for forming and vulcanization. Vulcanization is a chemical phenomenon by which the unsaturation of the long chain molecules of the Elastomer is taken up causing what is known as crosslinking to form a strong interlocked mass of long chain molecules. This is affected by the proper control of heat and pressure and acceleration of the rubber compound. It changes the uncured compound from one of low strength to high strength, low recovery to high recovery when stretched, high plasticity to low plasticity, high solubility in solvents to low solubility and from a low softening to high softening point.

Rubber, natural and synthetic, is a material which is thermoplastic at the start of vulcanization and thermosetting at the finish. When heated before vulcanization in the mold under pressure, the rubber acts similar to water in that it is non-compressible fluid. This allows it to be forced into the shape of the mold and to be held there until the thermosetting phase is complete and the finished part removed from the mold.

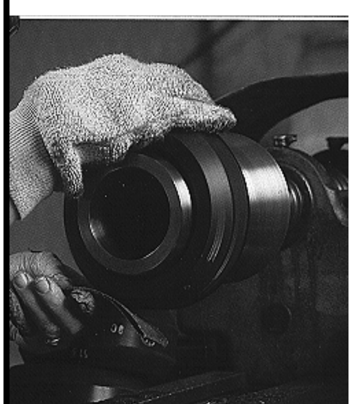
Stock preparation department where the exact amount and shape of stock required for each mold is set up for molding.






Various molding operations employed in 26 presses varying in pressure from 30 tons to 450 tons.



At left spinning of finished part to remove excess flash.

Below trimming and final inspection of molded seals prior to packaging and shipment .

The finished parts are taken into the trimming and inspection department. Here excess rubber from the molding operation is removed and the parts inspected. The trimming must be performed by persons with great skill with their hands in order to maintain a high quality appearance. Inspection checks at this point include dimensional accuracy and correct compound usage and vulcanization. Quality control starts with the trimming and inspection people and defect problems are quickly brought to the attention of the production department for rectification.

The acceptable parts are sent to the shipping room to be packaged and shipped to the customer to meet a definite delivery date. Here is a constant flow of many different types, shapes and sizes of parts that must be handled, packaged properly and shipped properly to the purchaser. This department is a veritable bee-hive of activity during the course of a complete working day.

LEAD FOLLOW OR GET OUT OF THE WAY !!!

: TED TURNER