OPERATIONS AND ACTIVITIES OF THE FORD MOTOR CO.

(Major George H. Robertson, AC-Res).

November 4, 1927.

To appreciate the absolute control of production the Company has, one must realize these important facts. The Ford industries are independent of strikes, price fluctuations, or shortages of raw materials such as coal, iron and timber, and every stage of transportation from the mines and the forest to the finished product is regulated. Raw materials, transportation, and manufacturing are entirely under the Company's control.

The Company's business has been so established that the purchase of Ford products is no longer seasonable and to the extent that Ford employees have steady jobs the year round. The manufacturing cycles have been worked out with such precision and the transportation element is so well in hand that the Company requires only small inventories (average inventory about forty million), thus releasing enormous sums of money for other purposes. Oil and limestone, however, are stored in large bulk, to carry plants through the winter when the Lakes are closed.

By reason of its policy of carrying a large cash reserve, approximately four hundred million, the Company is enabled to carry on experimental work on a hitherto unheard of scale. Few institutions could risk a million dollars on the manufacture of a single power unit, hitherto untried, or spend a quarter of a million in developing one single type of productive machine as the Ford Company has done.

Few institutions could take equal advantage of a policy whereby the manufacturing was done near the source of supply and the assembly near the point of distribution. This policy is, of course, followed by other manufacturers but nowhere else on such a large or efficient scale.

The Company operates thirty-five branches in the United States, of which thirty-one are assembly plants, and in addition there are also eleven manufacturing plants. Branches and assembly plants are also operated in every important country throughout the rest of the world.

The parent plant at Highland Park contains nearly two hundred and seventy-eight acres. It is at this plant that eighty-five hundred cars and trucks have been manufactured and assembled in one day of twenty-four hours.

At River Rouge, the Company has a plant area of eleven hundred acres, with blast furnaces, rolling mills, coke ovens, foundry, machine shops, body plant, sawmill, glass factory, cement plant, locomotive repair shop, paper mill, etc.

Storage bins with a combined capacity of two million tons have been provided for the iron ore, coke, coal and limestone.

By the recent dredging of the River Rouge the plant has become a Great Lakes port with about two miles of dock frontage. Completing the transportation system that joins the coal from the South with the iron from the North at the Rouge plant, the Company owns its own ore boats. These boats are Great Lake freighters, each with a capacity of twelve thousand, five hundred tons of iron ore and are operated by Diesel oil-burning engines. Smaller boats carry coal up the Lakes and bring back lumber. They also carry Ford products to foreign countries.

The Ford engineering laboratory, as well as the Airplane Manufacturing division with its Airport, is situated at Dearborn.

The Company has a glass plant at Glassmere, Pennsylvania, with an annual capacity of seven million, five hundred thousand square feet; one at Highland Park with a capacity of two million, five hundred thousand square feet; and a third at the Rouge Plant with a capacity of twelve million square feet - a total annual output of twenty-two million square feet.

The tractor plant, with a capacity of one thousand a day, is located at River Rouge.

A sawmill and body plant, producing wooden body parts, at Iron Mountain, are located on a four hundred and fifty-five thousand acre tract of timber and iron ore in the upper peninsula of Michigan.

Iron ore is mined at the Company mines at Michigamme, for the Rouge plant.

The Company owns and operates coal mines in Kentucky and West Virginia. It is estimated that these mines have a coal reserve of six hundred million tons.

The Detroit, Toledo and Ironton Railroad connects with practically every eastern trunk line, and affords unusual shipping facilities for the Company. A division known as the Detroit and Ironton, (thirteen and one-half miles long), forms a direct connection from the manufacturing unit at Flat Rock to the Rouge plant. This line is completely electrified.

The Lincoln Motor Company plant is situated in Detroit and has a capacity of fifty cars per day with its present equipment.

The Company, in 1928, secured the sole American rights to the famous Johansson gages, and put Mr. Johansson directly in charge of the engineering and the manufacture of these gages.

Highland Park Plant.

A quick glance at the Highland Park plant may prove of interest to you.

Highland Park is the headquarters of the Ford Motor Company. It is also the largest automobile factory in the world in production.

The numbers of men on the payroll, when in normal operation, runs between seventy to eighty thousand.

In order that public transportation facilities are not swamped when the working shifts change, the closing time of the various departments is set at different times and the complete change of shifts spread over the better part of an hour.

A parking space of seven and one-half acres is required for the cars of the men driving to and from work. A cooperative transportation scheme has been evolved to decrease the number of cars used.

There are dozens of departments which, if set apart by themselves, would be considered sizable industries. The radiator department is capable of providing more radiators than all other radiator manufacturers in this country combined.

The spring, axle, or steering gear departments, if freed from Ford production demands, could supply the balance of the automotive industry. Four hundred and forty carloads of raw material enter the factory every twelve hours and four hundred and eighty carloads of finished parts leave it in the same period.

In addition to the fabrication of parts, this factory houses several basic industries. Our artificial leather plant can produce eighty thousand yards of leather cloth per day. Every twenty-four hours, ten thousand square feet of windshield glass are turned out. One department makes Fordite, a rubber compound, and a textile department weaves cloth on its own looms. In addition, this plant manufactures many things usually supplied from outside sources, such as steel balls, copper wire, roller bearings, generators, magnetos, storage batteries, etc.

It has a fire department, hospital, drug store, auditorium, butcher shop, photograph gallery, shoe store, power plant, post office, telephone and telegraph division, grocery, and a motion picture studio. In addition, there is a boy's training school and two factory apprentice schools for older men.

Because of the original manufacturing methods originated and adopted by the Company, the price of the finished product has steadily dropped even while the quality has improved, despite the higher cost of labor, materials and transportation, plus the tax burden created by the war.

The methods of Ford production have been considered by the highest authorities as being near the peak of manufacturing efficiency and other manufacturers have not hesitated to follow this system of manufacture.

The conveyor system, which was developed at Highland Park, has been widely adopted in manufacturing circles.

There are two main types of conveyors; those on which work is done, and those which serve for the collection or distribution of stock.

At Highland Park there is a trunk line conveyor, probably the longest in the world, over a mile in length. It runs from the railroad tracks, through the forge shop, and main machine shop, gathering castings, forgings, and other parts which it distributes to various parts of the shop. Another conveyor picks up assembled or finished material, as engines or axles, and carries them back to the freight cars, for shipment to assembly plants.

The great length and the heavy loads these conveyors carry call for a well planned power application. Twelve motors move the conveyor, any alternate six of which can run the conveyor for a limited period during emergencies.

The day the first conveyor went into operation seventy men were released for other work.

Conveyors on which assembling work is done are carefully timed to insure an even output and thus act as a governor on the rate of production. The rate of speed at which they move is the result of a careful time study of each operation which determines the rate at which any piece of work should be done without crowding men or machines beyond their efficient capacity. A too slow a speed would be a waste while too great a speed would prove detrimental to the men and to the quality of production.

Correct timing conserves the energy of the men by holding them at a uniform pace. This results in a more uniform quality of work and also enables the Company to determine with accuracy the number of hours of labor that go into each car and into every part.

It also permits the factory to figure its production requirements months in advance and to regulate the flow of raw materials so that there is neither a shortage nor a surplus.

There are no peaks or valleys, but a steady flow of production.

There is no confusion, no waste motion, and the proverb "More haste, less speed" is borne constantly in mind. Order, cleanliness and system are insisted upon.

Another factor in reducing costs is the placing of consecutive operations adjacent to one another. All machines are placed in sequence so that each succeeding operation can be passed on to the next with little transportation or delay. At the Rouge plant, ore is smelted, cast, machined and assembled, without stopping, until it reaches the freight cars.

The inspection and testing in the plants are carried on to the extreme. Because of the light weight of the car, steels must be a combination of lightness and strength. Every "heat" of steel is given a metallurgical test by which it is checked. Vital parts such as axle, crankshaft, cam shaft, gears, steering knuckles, etc., are given a 100% inspection and test at every part of their manufacture. When anything wrong is discovered, further work is stopped immediately.

Electric gages using colored lights and Johansson gages are used extensively. The Brinnel test for hardness is made on every part as it passes through the inspection. While modern machinery insures very accurate work, it is still necessary that a thorough inspection be given each part, as assemblies are made in every part of the world and every part must be up to specifications to insure proper assembly.

As a check on our production cycle, a test was made some time ago to follow the movement of the materials; and it was found that ore delivered at the Rouge docks on Monday was cast, machined, and assembled as a unit, then shipped to a Branch three hundred miles distant to be assembled into a finished car, and was delivered to a dealer on Thursday night of the same week.

It took thirty hours and forty minutes from ore to finished tractor.

It is no trick to design a good automobile nowadays, but to build the machinery with which to manufacture it is a different story. It has been a tremendous undertaking to work out methods and machines by which our products are made on a production basis.

A saving of a fraction of a cent per part runs into big figures when multiplied by millions, and by reason of the Company's enormous production a new time-saving machine soon pays for itself. The Company never hesitates to invest in new equipment, regardless of the expense involved. Orders for a million dollars' worth of new machinery are not uncommon, and for this reason the best known machinery manufacturers devote a good deal of attention to Ford manufacturing problems, especially when Ford engineers help them in the development of new machinery.

About 90% of the machine tool equipment is standard and can be bought in the open market, also many of these tools have been adopted for Ford production.

The Company has made no effort to maintain a monopoly on its new ideas in machine tool equipment.

-oOo-

(Notes)

Each blast furnace has a capacity of 600 tons high silicon iron per day; 400,000 tons of iron per year being required for Ford production.

Coal which costs the Company $5.00 per ton is converted into $13.50 worth of coke and by-products.

The average daily production from the high temperature ovens is 1,600 tons of coke; 24,000,000 cu.ft. of gas; 22,000 gals. benzol; 56,000 lbs. ammonium sulphate; 17,000 gals. tar; and 6,200 gals. refined light oil.

The Rouge foundry is the largest in the world. It covers 30 acres; pours 3,000 tons castings every 24 hours. It leads the world in size, equipment and number of men employed; also in the production of small castings. All are handled by overhead conveyors. Suction pipes, ventilators and dust collectors keep place clean and cool. The floors are paved - no dust thereon.

2,000 barrels of cement are made daily from blast furnace slag (125 tons) - by the wet process.

Cargoes are removed at rate of 500 tons per hour by two

Hulett unloaders - which lift from 12 to 17 tons at a dip.

There are fifty miles of railroad in Rouge plant.

Glass:

Batch of 35 tons daily melted at temperature of 2500°, and refining heat of 2300°. Furnaces charged every 15 minutes with sand, soda ash and other chemicals. Flows on revolving drum, rolled for thickness, then enters the lehr, moving at 30 to 34 inches per minute. Lehr is 42 ft. long, and is great feat to cool sheet from 1440° to nothing. Gas flames help control reduction temperature. The glass is then ground, washed, smoothed and polished.

Lincoln - Precision on Inspections:

						Portion of thickness
Over 5,000	Inspections at		1/1000	inch	- 1/3	human hair
2,000	"	"	1/2/1000	"	- 1/6	
1,500	"	"	1/4/1000	"	- 1/12	
150	"	"	1/10/1000	"	- 1/30	

A human hair is 3/1000 inch.

Transmissions are tested for quietness in a "quiet room" for a period of an hour and those not passing the inspection tests are rejected for dis-assembling and re-assembly. Speedometers and clocks are also tested in the same manner.

The finished motor is tested on a 8 consecutive hour plan, at varying speeds from 1200 to 4500 per minute; these motors are then turned over, the bottom half of the crankcase removed and each bearing and part checked for clearances. The chassis is assembled; given one hour's test on the track; reinspected and the body then mounted and the entire car painted. The car is then placed on an agitator for one hour, which throws each wheel in a different position at all times at varying speeds. This will produce whatever looseness or rattles which may be found to exist after such a test. The finished car is then given an half-hour's test for quietness, body weakness, etc., and placed on the loading dock for final inspection of all details.

Seventy-five men inspect these cars in every particular, body as well as mechanical details, but they are again inspected at the docks before being loaded into freight cars which are fully lined with heavy paper to prevent dust entering the cars.