Thousands of Acres of Southern Farm Land Revitalized

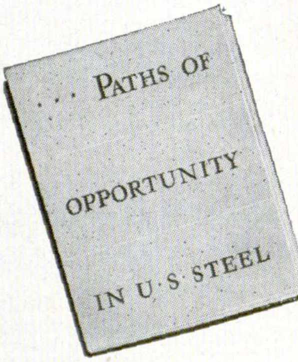
Tennessee Coal, Iron and Railroad Company

plays important role in task

FOR years, the devastating "one-crop system" robbed vast acreages of southern soil of the vital mineral elements which support plant growth. Cotton or tobacco raised in the same fields year after year had reduced the fertility of many southern farms to the point where the annual yield hardly paid for the seed and labor that went into production.

Among the things that agricultural leaders found in their efforts to build up southern agriculture was that Basic Slag—a by-product of open hearth steel, as manufactured at the Ensley (Alabama) Works of the Tennessee Coal, Iron and Railroad Company, a subsidiary of United States Steel Corporation—contained several important minerals, including phosphorus and lime. These elements are needed to grow bountiful crops and high beef and milk producing pastures.

Today, Basic Slag is in wide use as a convenient, economical soil builder. Together with the other soil-building programs of the agricultural agencies, it has helped the southern farmer to prosper.



Opportunities . . .

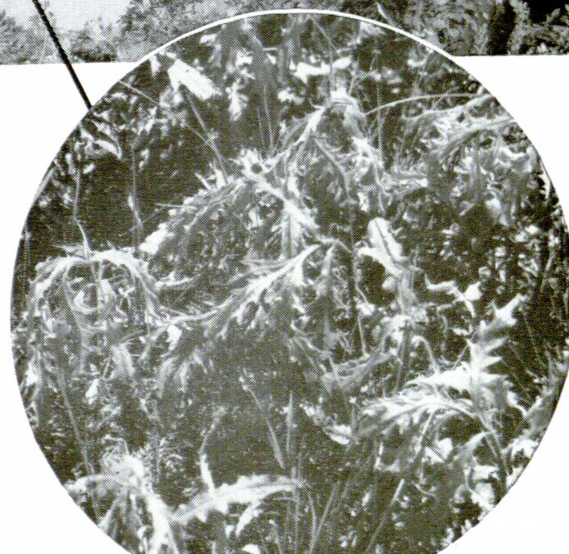
Here is another example of the important work being done by the United States Steel family. If you would like to take part in the widely-varied projects being conducted, why not see your Placement Officer for a copy of the book "Paths of Opportunity in U.S. Steel"?

AMERICAN BRIDGE COMPANY · AMERICAN STEEL & WIRE COMPANY · CARNEGIE-ILLINOIS STEEL CORPORATION · COLUMBIA STEEL COMPANY
H. C. FRICK COKE AND ASSOCIATED COMPANIES · GENEVA STEEL COMPANY · GERRARD STEEL STRAPPING COMPANY
MICHIGAN LIMESTONE & CHEMICAL COMPANY · NATIONAL TUBE COMPANY · OIL WELL SUPPLY COMPANY · OLIVER IRON MINING COMPANY
PITTSBURGH LIMESTONE CORPORATION · PITTSBURGH STEAMSHIP COMPANY · TENNESSEE COAL, IRON & RAILROAD COMPANY
UNITED STATES STEEL EXPORT COMPANY · UNITED STATES STEEL PRODUCTS COMPANY · UNITED STATES STEEL SUPPLY COMPANY
UNIVERSAL ATLAS CEMENT COMPANY · VIRGINIA BRIDGE COMPANY

USS

UNITED STATES STEEL

liquid death!



THAT'S WHAT ESTERON 245 IS to tough, stubborn weeds and woody growth.

Weed and brush control along highways, power lines and other utility right of ways is important. Esteron 245, a close cousin of 2,4-D, was developed for weeds found resistant to that well-known compound. It is particularly effective against woody growth, osage orange, gum, brambles, hickory and oak.

An unusual feature of this plant hormone-type weed killer is that it kills by chemical action which accelerates the normal growth processes, resulting in death of the plant.

The development of Esteron 245, following Esteron 44 and 2,4-D, is indicative of the unceasing effort to better things that is characteristic of Dow research.

Dow produces more than five hundred essential chemicals from plants located in Michigan, Texas, California and Ontario, Canada. These include agricultural chemicals, the Dowicides (including PENTAchlorophenol—the chemical that increases the life of wood many years) plastics, which is becoming a by-word in everyday living, as well as major industrial and pharmaceutical chemicals.

They Die!

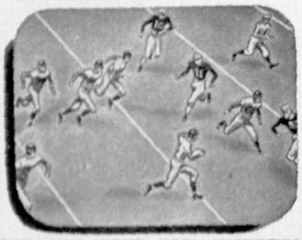
Esteron 245 destroys or inhibits herbaceous and woody growth, spares grass and allows the establishment of good sod.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago
St. Louis • Houston • San Francisco • Los Angeles • Seattle
Dow Chemical of Canada, Limited, Toronto, Canada

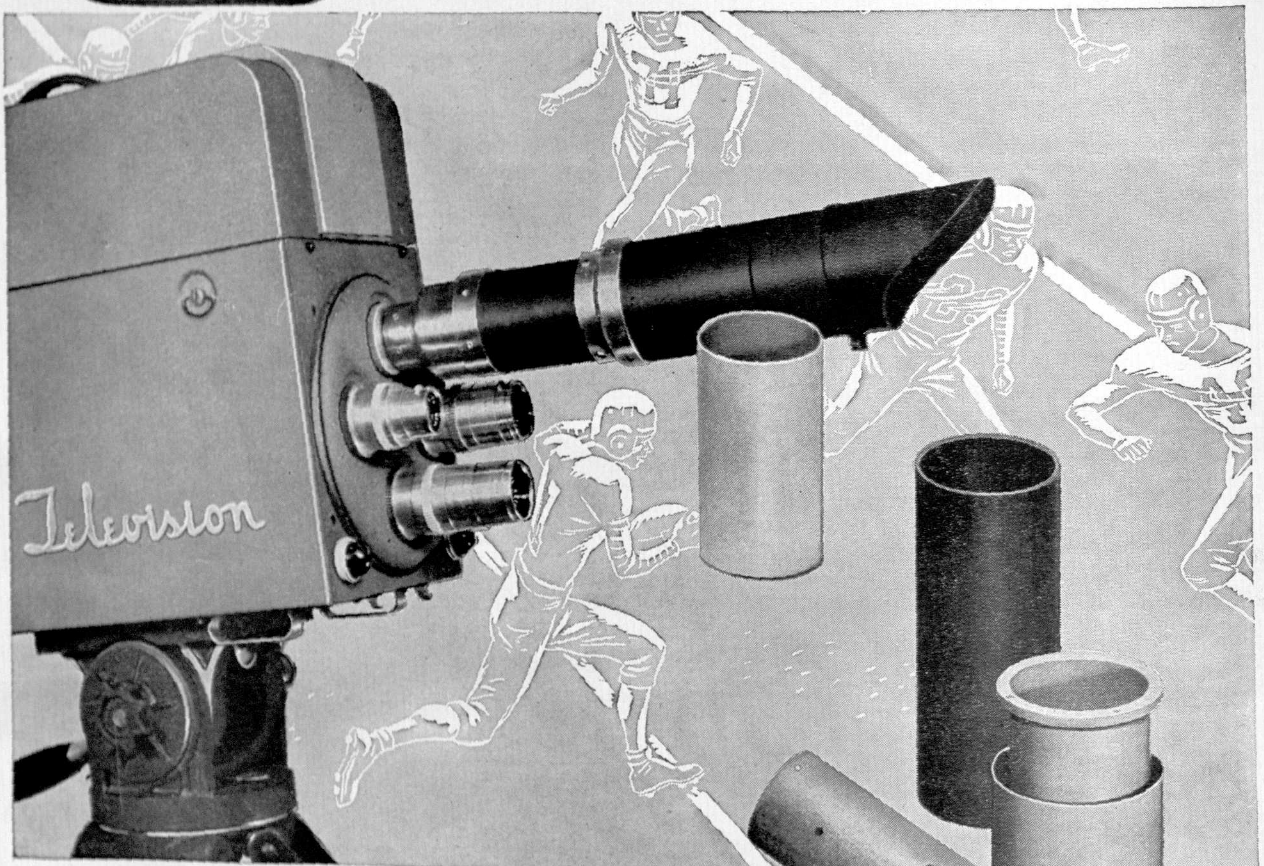
DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE



Plastics where plastics belong

for high dielectric and structural strength, light weight and ease of machining



In the RCA television camera, for example, Synthane was selected for coil forms, tubes, flanges and other components because of its electrical insulating properties, especially at high frequencies and high voltages. Its ease of machining, light weight and structural strength were other factors that led RCA's design engineers to select Synthane as the best possible material for this job.

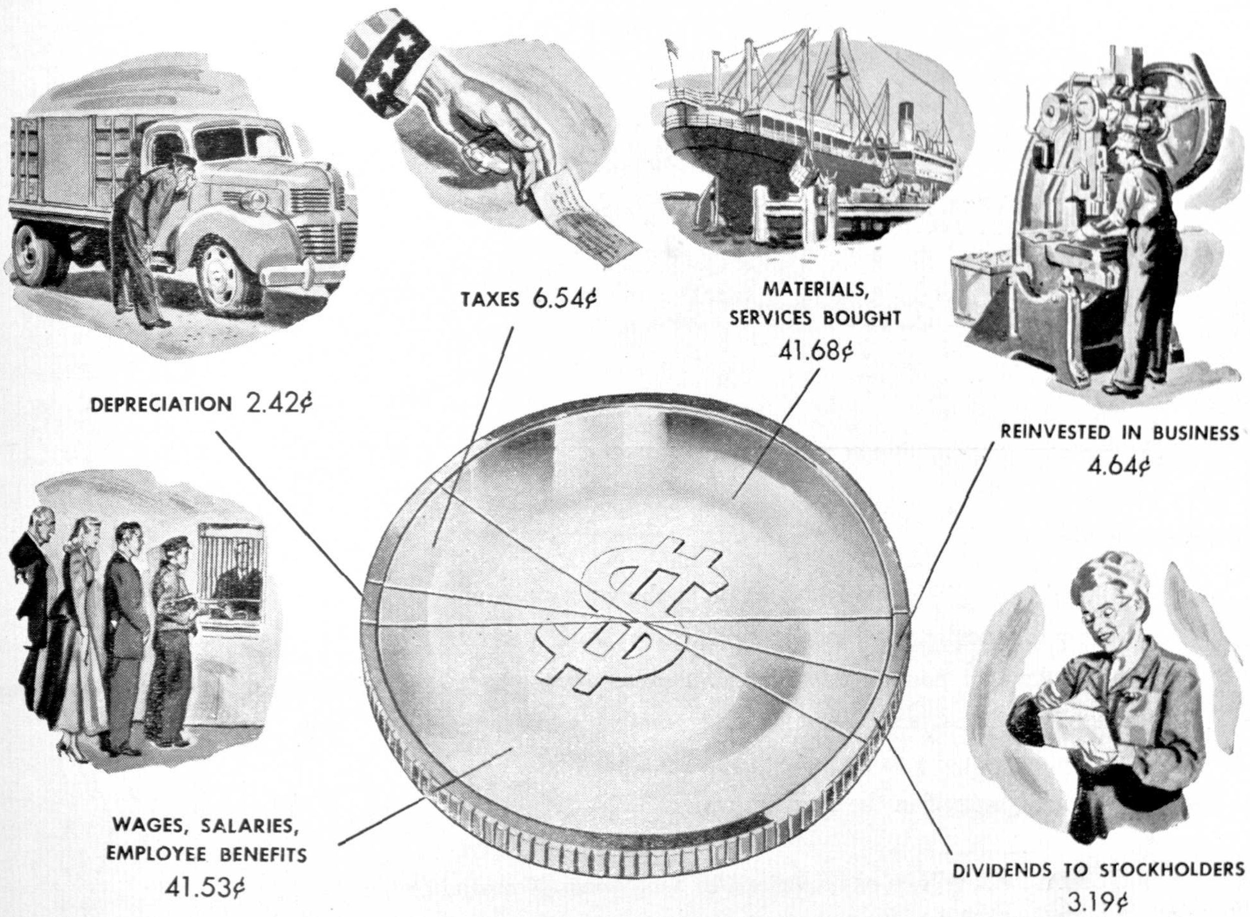
Synthane, laminated phenolic plastic, is at its best in applications requiring unusual *combinations* of characteristics. Its excellent electrical insulating ability, combined with ease of machining, light weight, rigidity and many other properties, such as moisture and corrosion resistance, make Synthane a valuable material for many industries.

Synthane Corporation, 1 River Road, Oaks, Pennsylvania

SYNTHANE S

where Synthane belongs

SHEETS • RODS • TUBES • FABRICATED PARTS • MOLDED-LAMINATED • MOLDED-MACERATED



HOW TO DIVIDE UP A DOLLAR

. . . the American Way

It may interest you to know the mistaken notions most folks have about the profits of American companies.

They tell interviewers that they *think* such companies are entitled to make 12 to 15 cents on every dollar of income, as a fair return. Yet, they add, it's their guess that manufacturers *actually do* make about 25 cents!

The facts are that in normal years American companies average about *nine cents* profit per income dollar.

Take Aluminum Company of America in 1947, for example. Out of each dollar received last year by Alcoa and its subsidiaries, the net profit amounted to *less than eight cents*. We show above where the rest of that dollar went. Nearly half of it in wages, salaries, and employee benefits, to Alcoans. Almost another half for materials and services we bought. Over six and a half cents for taxes.

The dollars-and-cents story of Aluminum Company of America represents the kind of facts you'll get from any typical American enterprise. Facts that show a fair return for a good product.

By dividing up a dollar, the American way, Alcoa has provided secure employment for 46,000 aluminum workers and has helped America to gain world leadership in aluminum production and research.

ALCOA ALUMINUM ®

Aluminum Company of America

Spartan ENGINEER

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Frontispiece: Courtesy of General Electric.

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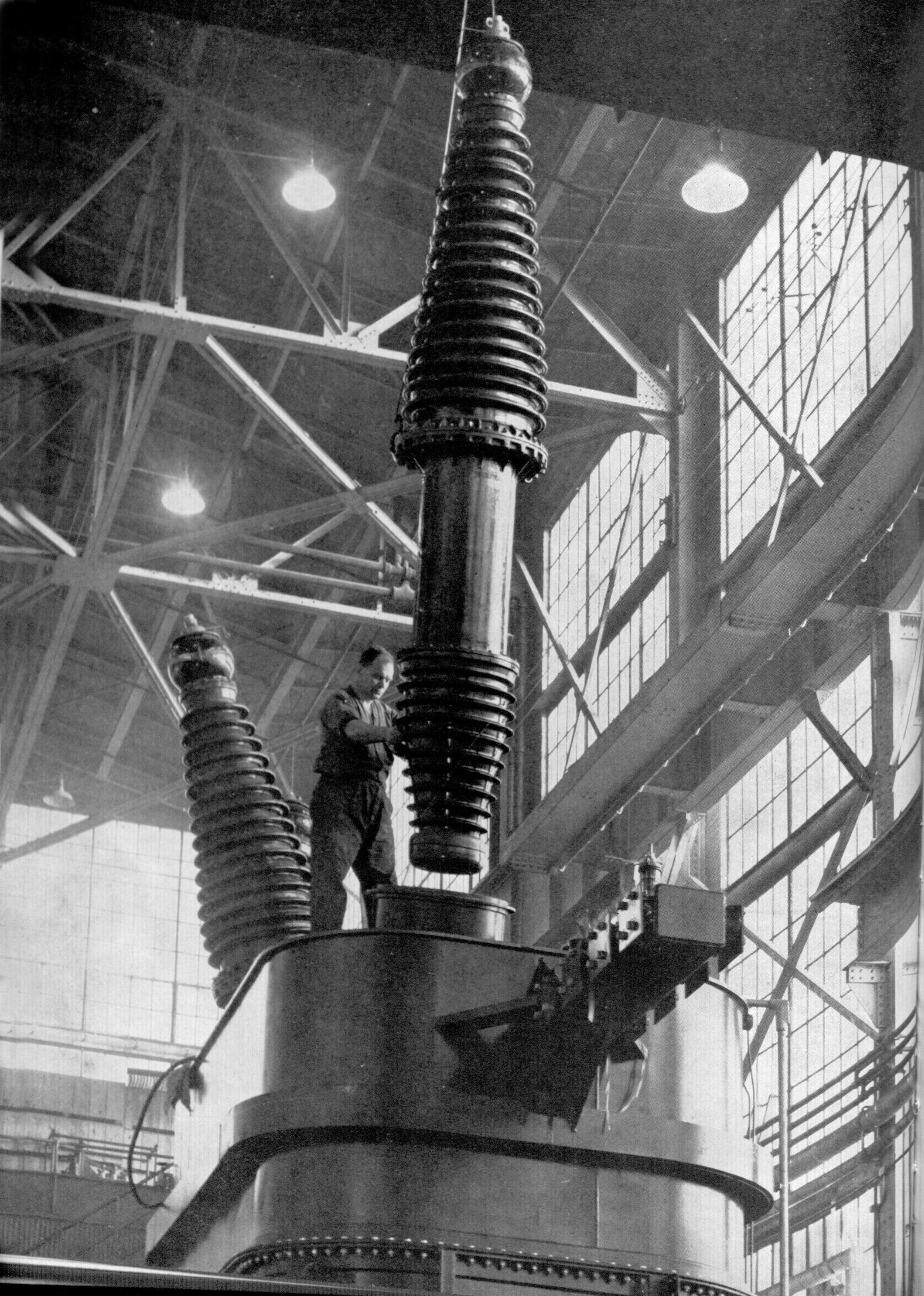

PROFESSOR L. C. PRICE

The MECHANICAL ENGINEER

PROFESSOR L. C. PRICE

A LIKING FOR MACHINERY is the distinguishing characteristic of the mechanical engineer. At least that is the starting point where his activities began. He may have wandered far from his home base, like a sheep which nibbles the grass farther and farther from home until it gets itself into strange pastures and may even end up in a strange fold, but I believe we will find in most cases that he became a mechanical engineer in the first place because he liked machinery.

All kinds of engineers have so much in common, and the field of mechanical engineering has become so wide that the work actually done by a mechanical engineer often has little direct connection with machinery. On this account there are mechanical engineers who do technical work, and others who do non-technical work; there are automotive engineers, design engineers, industrial engineers, power engineers, and many others, even some who are occasionally called human engineers.

All Junior students in mechanical engineering at M.S.C. have by this time of year become familiar with the four options because they must choose one of these to follow when they are Seniors. It seems pointless now to discuss these options at any length. Very briefly, then, the Aeronautical, Design, and Power options give training in technical work, and those who take them are supposed to be interested in the technical side of engineering. The Aeronautical Option includes studies of aircraft engines, fluid mechanics, and aerodynamics. Students who take the Design Option learn something of the finer points in the design of machines, a little about mechanical vibrations and stress analysis. Seniors in the Power Option have a course in power plants, another in refrigeration, and another in heating, ventilating, and air conditioning. Those who take the Industrial Option differ from the other three groups in that, while having an engineering background, their immediate interest is in the administrative side of engineering and manufacturing rather than the technical side. Thus, instead of studying about how a machine is made, the mechanics of its operation, the stresses in its parts, the metallurgy of its material, or the power that drives it, they are much more interested in the arrangement of machines in a factory, the organization of the people who run the factory, the handling of materials and products in it, and in studying the human problems of the operators.

Even this short list shows a wide field of opportunity for mechanical engineers. At one end is the man who loves engines, like the marine engineer in Kipling's poem, *McAndrew's Hymn*, who spoke of his engines as "yon orchestra sublime, Whaurto—uplifted like the Just—the tail-rods mark the time." At the other is the man who cares not a whoop about machines as design or construction problems, but who is primarily interested in seeing to it that they operate properly and that each contributes its share to the plant output. The field is steadily widening, and mechanical engineers are continually finding opportunities in activities which were simply non-existent twenty years ago or even less. They design, make, and supervise the making of boilers, locomotives, typewriters, nails, and the multitudes of other mechanical products, making of raw materials such as steel, the production and refining of petroleum. Even the radio manufacturers have mechanical engineers in their organizations to attend to layout, production, and other problems which are not strictly electrical.

In all these activities the engineer is under constant pressure to keep himself up to date, to improve quality, and to cut costs. For if his product lags behind the procession in any respect, some competitor is sure to get all the business, and the laggard will be out of a job. That means that advanced study and research are necessary now as never before. As manufactured products are steadily improved, further improvement becomes more and more difficult and, for some time now, the need for developing inven-

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DEVELOPMENT OF A SIMPLE TWO-BAY TURNSTILE ANTENNA

PROFESSOR W. M. NELLIS

THE TREND OF the popular F-M and amateur antennas for increased antenna gain seems to be the uni-directional type of beam antenna. The use of an essentially uni-directional antenna has the disadvantage that, unless some means for pointing the array in various directions is incorporated in its support, it can be peaked to give best results for only one station. Many antenna installations have a rather elaborate mechanical arrangement for the rotation of these uni-directional antennas. The object of this article is (1) to present the basic idea for an antenna that will have both gain and non-directional characteristics and (2) to develop this idea into a practical antenna design.

The solution to the problem at hand is partially given when one considers the type of antenna common to the F-M broadcast station—the turnstile antenna. The turnstile antenna system is shown in figure 1 with the feedlines attached to the elements. It has as its basic structure two half-wave dipoles mounted perpendicular to each other at centers. This is called a bay. The entire antenna array consists of stacking these bays one above the other. The more bays the more antenna gain.

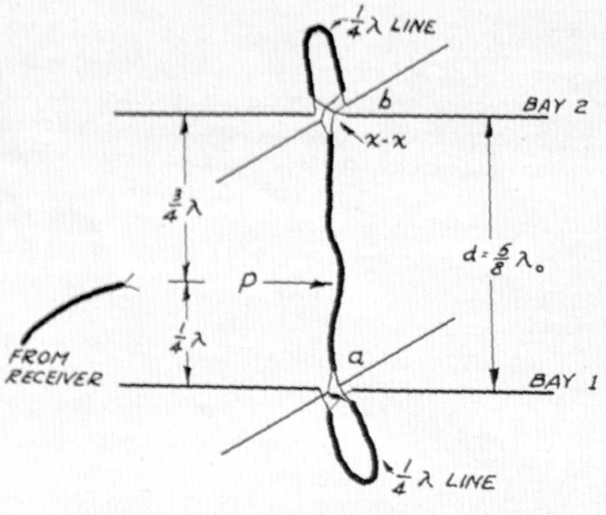
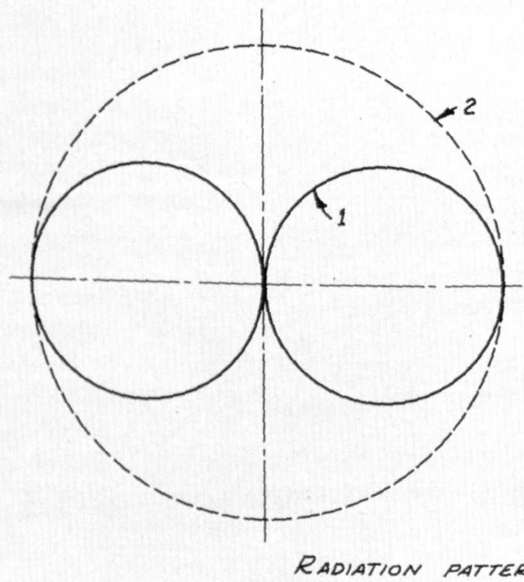


FIG. 1

The two dipoles of a bay which are 90° apart physically are also fed in such a manner that the current in one is 90° in time phase from the current in the other, thus they are also 90° apart electrically. This two-phase effect then would give a rotating field about the antenna when used in transmitting and therefore give the effect of a very rapidly rotating uni-directional beam. We are then rotating our antenna electrically rather than mechanically and it gives a neater and more economical system. The radiation pattern for a single half-wave dipole and the radiation from a bay of two perpendicular dipoles is shown in figure 2. The pattern for a single dipole is practically bi-directional while the pattern for the turnstile bay is good in all directions.



RADIATION PATTERN OF:
1. THE HALF WAVE DIPOLE
2. ONE BAY OF A TURNSTILE

FIG. 2

One of the dipoles of the lower bay has a parallel dipole in the upper bay. These two dipoles are fed electrically in phase. Since when these dipoles have maximum current on them, the others which are 90° out of phase have zero current. We might consider this action as separate broadside arrays working at different times and in different directions.

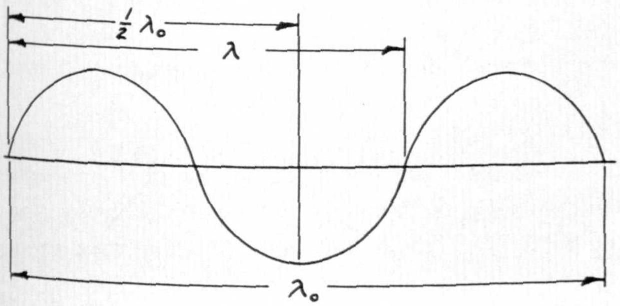
To design a practical working antenna of the type just described, some means of feeding the elements in the phase manner already described and means for matching the lines to the elements will have to be engineered.

It might be well to note that, although a system may be derived from the standpoint of a transmitting antenna, the principles are purely reciprocal so that an antenna which transmits a maximum in a given direction will also receive a maximum from that same direction.

In order to get the elements of one bay to be 90° apart electrically it is necessary to simply connect the two dipoles by a quarter wave-length of line as shown in figure 1.

The center of a half wave dipole presents an impedence of approximately 75 ohms so that if 75 ohm amphenol twin lead is used as the line in figure 1 a match from antenna to line will be secured and the impedance at x-x will be 37.5 ohms because there are two 75 ohm loads in parallel. Each bay connected in this manner will then be a 37.5 ohm load.

The spacing of the bays is the next consideration and it is noted that if ½ wave-length spacing is used for d in figure 1 a line stretched between the bays will not give a ½ wave phase shift but more than this because the radio waves travel slower on the line than in free space. Because the wave velocity is slowed up on a line, a piece of line will be shorter than a free space wave-length to support a full standing wave. The velocity factor of 75 ohm amphenol line is 67% which means that a wave-length of line will be 67% of a free space wave-lengths. These relationships are shown in figure 3.



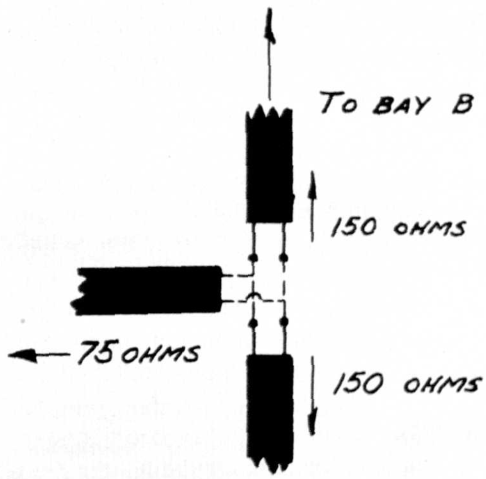
λ_o = FREE SPACE WAVELENGTH

λ = WAVELENGTH ON THE LINE

FIG. 3

From the relations shown in figure 3 it is seen that that ¾ of a wave-length on the line corresponds to ½ of a free space wave-length so that if the bays are spaced ½ wave-length in space the line needed to reach between bays will give a ¾ wave phase shift.

However, upon reference to curves of gain vs. spacing as shown in *The Radio Amateurs Handbook* it is noted that half wave spacing is not the maximum gain spacing for a two element broadside array. A spacing of about ⅝ wave-length gives maximum gain of almost 5 db over that of a simple dipole antenna. This would mean about 2 db gain for the two-bay turnstile because 3 db is lost in furnishing one-half the total power to each dipole. Maximum gain will then be secured by spacing the bays approximately ⅝ wave-lengths or 63% of a space wave-length. Reference to figure 3 shows that ⅔ or 67% of a space wave-length gives a full wave on the transmission line indicating that if a full wave of line were used it would slightly more than reach between the two bays. This realizes physical construction and allows the use of an even number of quarter waves of connecting line without too much excess line to blow in a breeze. An even number of quarter waves allows a connection such that the broadside antennas can be fed in phase. The proposed antenna as discussed thus far is shown in figure 1.



THE LINE JUNCTION AT P SHOWING IMPEDANCES LOOKING INTO EACH LINE.

FIG. 4

The next problem is that of attaching a feedline from the transmitter or receiver to the antenna. Close consideration shows that, if the feed line from the receiver is connected at point p which is ¼ wave from one bay and ¾ wave from the other bay, a proper impedance match at the junction is obtained. The impedance match is obtained by transforming the 37.5 ohm bay to 150 ohms at p by the odd quarter wave section from each bay. The input, Z, to a quarter wave section terminated in an impedance, Z_2 is given by $Z^1 = Zo^2/Z_2$ where Zo is the characteristic impedance of the ¼ wave section. In the case presented, the termination is the 37.5 ohm bay and the line has Zo=75 so that the impedance looking either way if the line is opened at $P = 75^2/37.5$ or 150 ohms. Thus when the two 150 ohm terminals are jointed as at P, the impedance presented to a feed line tapped on will be 75 ohms and this gives a perfect match to a 75 ohm line from the receiver. The junction at p is illustrated in figure 4.

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FACTORY OF THE FUTURE

BILL THROOP, E.E. '51
CHUCK E. PAUL, E.E. '51

THE QUESTION HAS OFTEN been pondered in engineering circles whether it would be at all possible or even feasible to construct an automatic production line requiring a minimum amount of maintenance.

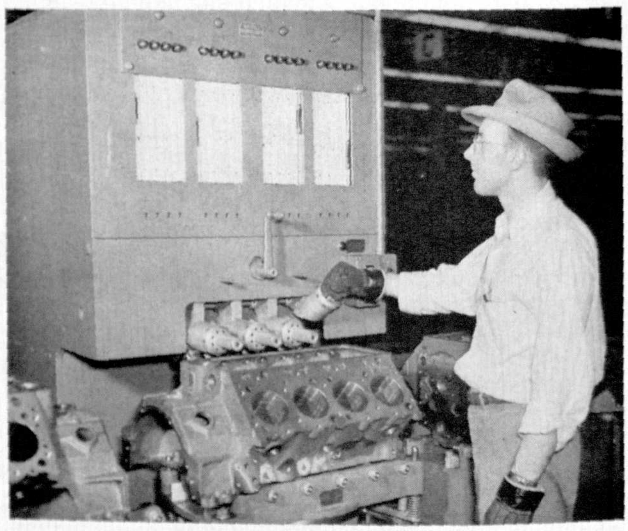
One of the nearest approaches to this concept of an automatic factory of the future is the new "Rocket" Engine Plant at the Lansing Oldsmobile Division of the General Motors Corporation. This plant produces the new "Rocket" Engine, an eight-cylinder V-type engine developed on an entirely new high-compression principle. Forty completely assembled engines can be produced every hour. Each engine is given a complete dynamometer performance test to make sure it meets specifications before it leaves the factory.

More than 169,000 square feet of floor space has been devoted to the assembly of this new "Rocket" Engine. Although the buildings housing this plant are not new, all of the machines, fixtures, and equipment are of the very latest design. The plant was planned to exact specifications worked out in three-dimensional detail by G. M. Engineers. Several months were required to build a complete model of the plant. The twelve by eight foot model layout, built at a scale of one-quarter inch to the foot, and containing 3,200 pieces, was of immeasurable assistance to the engineers and production men in planning the ideal location of overhead conveyors, air conditioning equipment, stock slides, compressed air lines, water lines, electrical conduits, lighting fixtures, machines, stock access aisles, and under floor chip conveyors which remove over three and one-half tons of scrap an hour. Every department having a part in the maintenance or operation of the new plant was invited to make any changes considered necessary in the location of machines or conveyors while the plant was still in the planning stage.

The air conditioning system in the new plant handles 164,000 cubic feet of air per minute. It provides an even flow of fresh air to the workers in every part of the plant, and at the same time carries dust particles in the air away from the final assembly line toward the machining areas. In this manner the assembly of the engine can be kept relatively free of foreign matter.

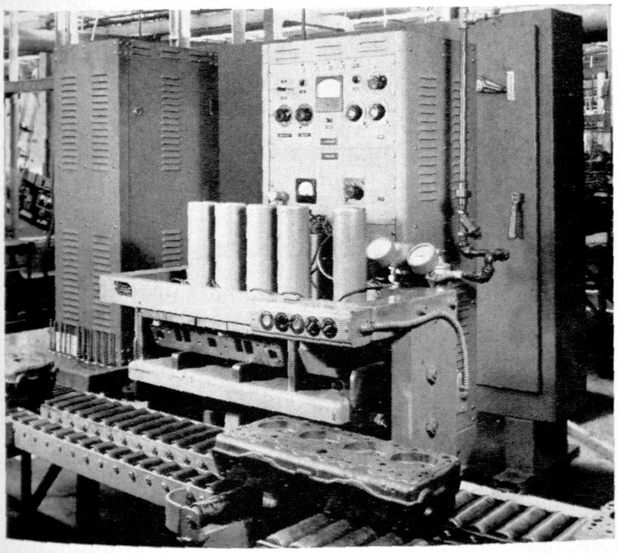
The very latest industrial fluorescent lighting equipment, designed to give the maximum amount of foot candles of light without creating a glare, has been installed in the plant. To eliminate heat and glare from the sun a special type of tinted glass has been employed.

The new engine plant is decorated with a specially-developed paint, selected to reduce eye strain and mental boredom due to physical fatigue. All of the new machines throughout the entire plant are finished with this special green paint.



This multiple air gage is used to classify cylinder bores into one of 8 classifications by .00025 step. There is a metal stamping arrangement enabling the operator to stamp the bore size designation adjacent to each cylinder. In addition, during this sizing operation, the inspector can observe the taper and out-of-round charactertistics of each bore by simultaneously measuring 4 points in each bore.

Several transfer-type machines, new to the automobile industry, are used in the milling, broaching, and drilling of the V-type engine blocks. One machine is 86 feet long and has 18 separate work stations which may be operated simultaneously by the operator. An electrically-controlled panel keeps the operator informed of the progress of the 18 engine blocks through this transfer machine. Any deviations from specifications or faulty operations are instantly called to the attention of the operator by the automatic electrical control system. There is approximately five miles of wiring in these intricate machines. During its passage through the machine the engine block is at one point rotated 180 degrees automatically, for the milling of both ends. At another point the block is again rotated to permit machining of the lower surfaces. Other transfer-type machines have as many as 90 different cutting tools in operation simultaneously at 17 different stations to automatically drill, ream, chamfer, and tap holes in the top, bottom, and sides of the engine block. One operator has control over the entire machine. Similar equipment is used for the machining of cylinder heads, bearing caps, intake and exhaust manifolds, and other parts of the engine.



This is an electronic gage using the principle of measurement of frequency of sound waves in combustion chambers of cylinder heads to determine their volume for the control of compression ratio. On an OK part, the head merely has to be loaded into the gage and the cycle started by pressing a button. The gage will then check each combustion chamber and return the head to the conveyor without attention by the operator. When an out of tolerance chamber is encountered, the cycle stops at that point, a light indicates the chamber in error, and a dial shows the extent of the error.

Besides the transfer-type machines, the plant contains the latest and most accurate inspection machines in the automobile industry. Specifications of machined parts are held down to very fine limits. Each cylinder bore in the block is checked at four different points and stamped with the proper classification for selective assembly with a matching piston. Diameter, roundness, taper, and bell-mouth of all the cylinder bores are checked and the bores classified in the matter of a few seconds. A total of eight different cylinder bore sizes result, cutting the number in half, compared with the present operations in the in-line engine plant. Another intricate machine accurately inspects pistons at the rate of 500 per hour. The pistons are automatically stamped in two places with the proper classification, based on the diameters of the piston pin-hole and skirt. At the same time a small red light indicates the proper slide conveyor nearby to which the operator transfers the checked piston for later assembly.

Power-driven overhead conveyors, gravity-feed roller conveyors and under-floor conveyors total more than 12,460 feet. These conveyors bring materials to the machine operators and carry them away to the next station of the line. All conveyors above the floor are designed to deliver parts and sub-assemblies to the worker at a uniform height of 38 inches. Double-handling of incoming and outgoing stock has been completely eliminated. All of the incoming stock is fed onto a conveyor system directly from the unloading docks and finished motors are trucked away from the engine test department as they come off the dynamometer test stands. The final assembly line is of the flush-floor type so that the worker can walk completely around the engine if necessary in order to accomplish his portion of the job. The conveyor moves forward a set distance at the end of each operation cycle. The engine is therefore stationary while the worker is completing his particular assembly task. The speed of the assembly line may be varied to accommodate the flow of the sub-assemblies to the line. The assembly line contains 360 feet of production line with 52 sub-assembly points.

Behind the "factory of the future" lies 50 years of Oldsmobile technical experience. The compression ratio of the new Oldsmobile "Rocket" engine is 7.25

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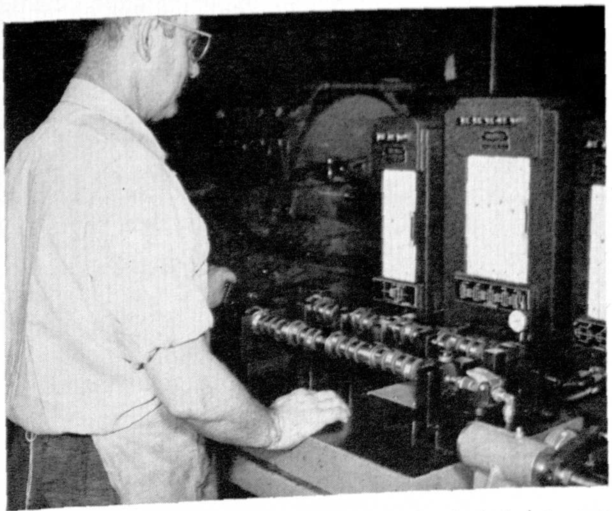


The Oldsmobile Rocket engine camshaft is checked into two different positions on this special testing device. In the first position, the shaft is checked for accuracy of the five main bearing diameters and for the proper flange thickness. The relationship of the contact face of the oil pump distributor gear to the flange is also determined.

While the camshaft is in the second position, the eccentricity of the oil pump distributor drive gear to the bearing is checked, and an air flow is used to make sure that an oil passage in the camshaft is open. The bearing spacer is checked in the second position also, and the camshaft is rotated manually for a visual inspection.

DYNAFLOW DRIVE

LOUIS E. DURKEE, Senior M.E.

THE HYDRAULIC TORQUE CONVERTER after a thorough wartime testing in Sherman tanks, has now been adapted to DYNAFLOW DRIVE used exclusively in the new Buick automobiles. Ordinary geared transmissions yield a limited number of predetermined gear ratios. Dynaflow drive offers a continuously variable range of torque ratio.

No longer is a clutch pedal necessary. The driver selects the desired driving range by means of a selector lever mounted on the steering column. There are five positions to which this selector lever may be moved: PARK, NEUTRAL, DRIVE, LOW, and REVERSE. For safety reasons the engine must be started with the selector at park or neutral. This prevents starting the motor while the power train is engaged.

There are two primary parts to Dynaflow Drive:

(1) the Hydraulic Torque Converter

(2) the planetary type gear train to provide for the low gear range and a reverse.

The low range is provided for heavy pulling for engine braking while descending steep hills. Shifts from low to drive may be made at any speed but shifts from drive to low are not advisable above 40 miles per hour.

"Rocking the car," to free it from mud or snow is possible from DYNAFLOW by simply applying a light throttle and moving the selector lever back and forth between low and reverse. However, it should not be necessary to "rock the car" to free it from mud or snow. It has been proven that a car can be freed more easily by applying a very low amount of torque to the wheels. This is possible with Dynaflow Drive due to the "SUPER LOW" provided by the low range.

A special gear is provided to prevent the car from being moved while parked. It consists of a heavy gear with square cut teeth mounted on the turbine output shaft and a wedge which is inserted between the teeth to prevent the gear and shaft from turning. When the selector is moved to the park position, the wedge is inserted between the gear teeth.

Torque Converter

The hydraulic torque converter is the principle part of DYNAFLOW. It transmits the total engine output under all conditions of operation.

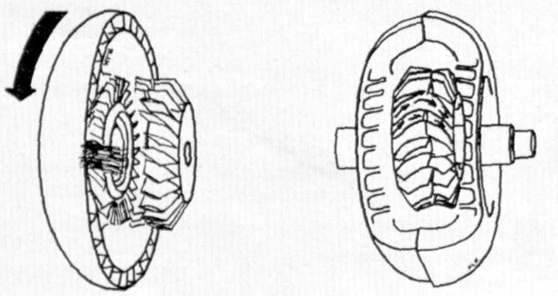
There are five principle sections in the converter unit:

1. The primary pump driven by the engine.
2. The secondary pump—mounted by means of a free-wheeling clutch upon the primary pump hub. The secondary pump may rotate about its axis faster than the primary pump but never slower.
3. The turbine which is fastened to the turbine shaft which actually drives the car.
4. The first stator.
5. The second stator.

The converter's function is best described by examining a normal sequence of power application.

Starting with the car motionless and the engine running at idle speed, the primary pump turns slowly with the engine since it is connected to the crankshaft. The turbine is not turning since it is connected to the drive shaft, therefore, the car is not moving. The oil in the pump is acted upon by a centrifugal force causing it to flow outward. The oil overcomes the resistance of the oil in the turbine and sets up a gentle circulation outward from the pump and inward through the turbine. The engine and the power train are now connected. But, due to the low circulation rate of the oil, no amount of torque is transmitted.

If the engine is idled too fast, the circulation rate of the oil may become sufficient to move the turbine. When this happens, the car will begin to move forward. This is known as "creep."



Figures 1 and 2—Here, in a cutaway view, are two parts of the supercharging assembly called stators which are uniquely vaned and placed between the pump and turbine. These stators can spin freely forward, but cannot turn backward. Thus, when oil speeding rearward from the turbine strikes them, they lock—and the oil is forced to turn around and enter the pump again. Traveling now in the same direction as the pump, this oil helps it pump harder.

Assuming the car not to be in motion, it is found that as the engine is accelerated it rapidly reaches its torque peak. The direction of flow of the oil projected from the pump at an increased velocity is changed causing a direct force to act on the turbine blades.

The oil leaves the turbine in a direction opposite to the rotation of the turbine and the pump. When the turbine is stationary the oil leaving the turbine has

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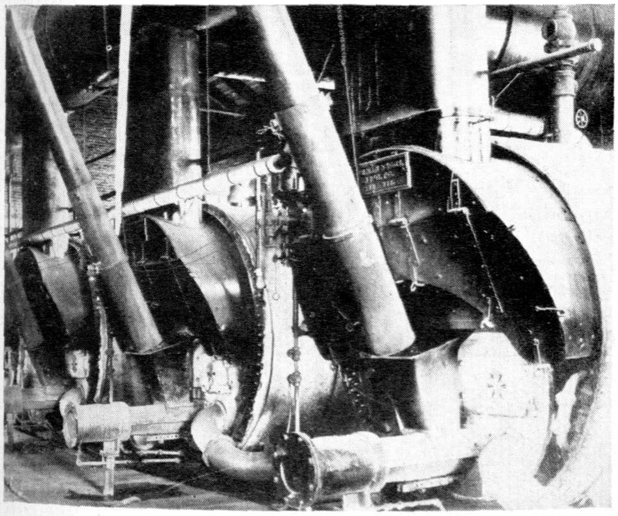
"MORE POWER" TO MSC POWER PLANT

H. W. FRITZ, Senior M.E.



1904 Boilers at M.S.C.—Four 150-H.P. Scotch Marine Boilers with Jones Under-fed Stokers.

FEW OF US TODAY realize the full extent our Alma Mater's growing pains of the past decade. True, we see the piling of brick and mortar, but some of the less obvious feats go unnoticed until such time as they are brought to our attention. To be sure, the new steam generating plant can hardly go unnoticed standing 85 feet high on the south campus. The operation and maintenance of the power system is a severe responsibility and its recognition brings to the front a few such personalities as: Messrs. E. E. Kinney, Buildings and Utilities Superintendent; C. F. Filter, Mechanical Engineer; R. F. Noonan, Electrical Engineer; J. M. Campbell, Power Plant Superintendent; and J. Slater (OK Pops), as Power Plant Engineer. As these men will tell you, the MSC power picture is much different today than that which they viewed a few years ago.

Let us go back beyond these men. In 1894 the first boiler was installed on the campus. In 1895 a few lights were suspended from trees on the campus and those installed in the library were powered by a small generator of lost description. In 1896, Mr. E. P. Kinney, still physically active but retired, and father of our B & U Superintendent, wired the remainder of the buildings for electricity. Power was purchased from Piatte Dam, the present site of Lansing's Moores Power Plant. In 1904 the college installed a new power plant of 4-150 H.P. Scotch Marine boilers equipped with Jones underfed stokers. Also placed in operation were 2-660 KW, D.C. generators and 1-190 KW generator. These were driven by 3 Corliss type engines. In 1920 the building which is now called the "old power plant" was erected and 4 Wickes Vertical Boilers (400 H.P.) with "V" Type Detroit Stokers were installed. Four men have vivid recollections of this power era. They are: Frank Mitchell, now retired B & U Electrical Engineer; E. P. Kinney, mentioned earlier; Homer Hewes, operator in the present engine room; and J. Slater, our Power Plant Engineer.

In 1923 the change-over from DC to AC was made. Two 500 KVA, A.C. (100 psi) generators were placed in operation. Additional heating load warranted another 800 H.P. Wickes Sterling type boiler with Detroit underfed stoker in 1936. At this time the first large building expansion was begun with Jenison Field House, the Auditorium, and men's and women's dormitories. The college, being tied in with the city of Lansing for emergency purposes and peak loads, began paying $2,000 monthly for electric power, and the heating load was critical. Therefor, between 1939 and 1941 two additional

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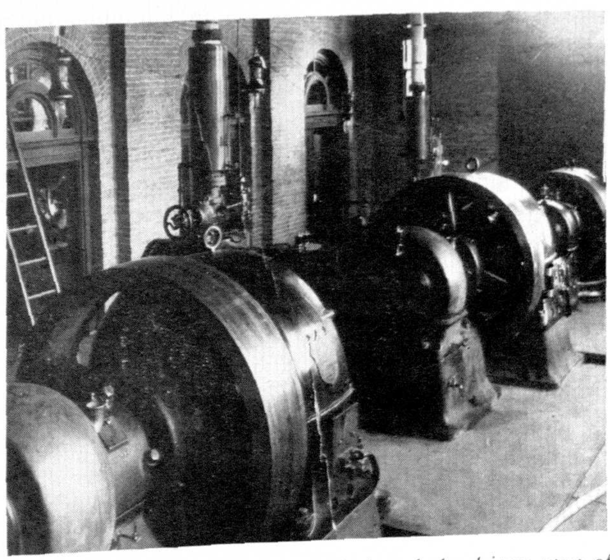


These generators were built by Bullock and the drivers were of the Corliss type engine made by Albany. Two generators were 660 KW D.C. and one was 190 KW, sufficient to carry a daylight load.

"MORE POWER" TO MSC POWER PLANT *(continued)*

Wickes boilers were installed and the stokers were changed over to automatic Taylors with boiler horsepowers of 1171 each. In addition, an Allis-Chalmers turbo-generator of 3000 KW at 2300 volts (now called #3) was placed on the line. The Wickes Verticals were considered obsolete at this time. They have been removed and the old power plant is essentially the same at this date.

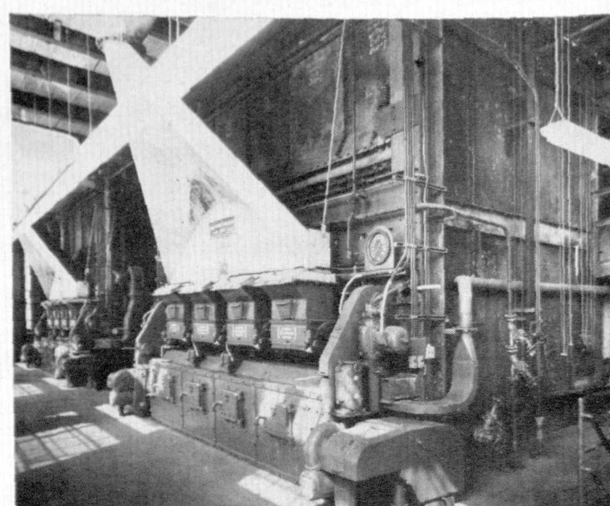
Everything was fine. This last building program, however, (1945 to 1949) was 10 times as great as the "37"-"41". This program, as it developed, made very obvious the fact that additional electric and steam sources were needed. As frequently happens, however, power expansion was not concurrent with the demand, and such was the case at this time. Finally, the great load on the boilers (which were operating 24 hours a day at full load) and the electric bill of $6000 a month with the City of Lansing Power and Light led to another expansion plan for the power facilities at MSC. If the plans at that time were not sufficient it can be laid to the fact that expediency at the moment was essential. Those plans were completed and at this writing it is found that further expansion is necessary to carry the load that the yet unfinished campus building program will demand in Steam and Electric power.

Let us look at the power expansion just completed. The necessities included were a steam pressure of 100 psi for South Campus heating and other processing. The old plant was already producing 150 psi which furnished design pressure for #1 and #2 (500 KW) generators and also 150 psi for a design pressure of 250 for the 3,000 KW (#3) with single extraction at 15 psi for heating. So, as the old boilers were of retirement age, it was decided to replace the three with two new ones of 350 psi generating pressure to furnish steam pressure at 250 psi for by-product electric power. As one generator was already installed at this design pressure, a second 3,000 KW General Electric 2,400 volt generator was set in to furnish an expected demand of 6,000 KW hr. This new 3,000 KW generator was of double extraction, 100 psi and 15 psi with 14 stages. This extraction at 100 psi would be used for South Campus heating and general medium class processes.

The equipment as installed was excellent. A student test group of 50 students under the direction of Mr. Campbell ran test loads on boiler #2 using ASME Power Test Code and they determined that the efficiency varied from 80 to 90%, agreeing with specifications and depending on the load. The generator has proven itself by operation.

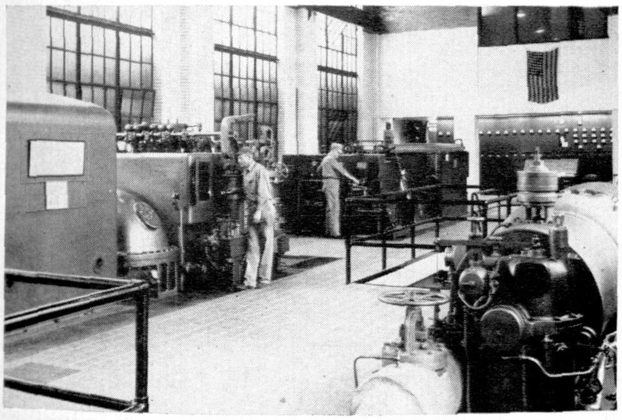
Despite the equipment, failures in the program began to appear. There is still insufficient electric power for the finished building program. In plans for the steam lines to South Campus, no returns were provided. Make-up water was in the order of 25%. The Building and Utilities department reduced these losses by the installation of condensate returns. No plans were made for pumping of condensate water, however, B. & U. is slowly making the necessary corrections. Another unhealthy situation is the fact that many spare parts were not made immediately available for the boilers and auxiliaries in the new power plant. In case of breakdown quick emergency repairs are almost impossible. An effort is being made to acquire these parts as quickly as possible, but it is a slow process although many parts were on the original materials order. In the overall picture it can be seen that the power expansion was very necessary—but it didn't go far enough. The five men now responsible for the power on the campus are concentrating all efforts on correcting the present situation and are making plans for further expansion.

If there has been criticism, some of it has been unjust. There should never be excuses in engineering, but there were some circumstances during the last expansion that couldn't be helped. One B. & U. superintendent quit for a better job. One power plant superintendent died suddenly of a heart attack. There was a difficult period when it was nearly impossible to train and keep good operators. During the building program a great amount of steam was used in preventing fresh concrete from freezing. This led to the use of huge amounts of make-up water and caused overloads on softeners, boilers, auxiliaries—and men.



The two new 1250 H.P. Wickes Boilers, Detroit Roto Grate Stokers. Boilers are 3 drum, bent tube with a Foster-Wheeler super heater to produce 100,000# steam per hour at 300 psi and 550° F.

Having reviewed the development of the MSC Campus Electric and Steam power let us look now at the current results. With two power plants in use, the plant engineer is working under very unusual circumstances. He must communicate by phone in order to coordinate one bank of boilers in the old plant at 150 psi with a second set in the new power plant at 350 psi. If the equipment driven by these were of the same pressure some 450,000 #/hr. of steam could be utilized. As it is, two generators (#3 and #4) are driven at 250 psi and the other two (#1 and #2) are driven at 150 psi. In order to balance the heating and lighting load against the most satisfactory steam generating conditions it is necessary to use great ingenuity.



Engine Room as it appears today looking North. Left to right, the new General Electric, 3000 KW, the Allis Chalmers 3000 KW, and 2-500 KVA Allis Chalmers (Parsons type) generators.

To give an idea of the operating load that must be met, consider two extreme daily mean temperatures at which there would be maximum and minimum loads.

	Tons Coal 24 Hours	Steam #/24 Hrs.	Electric KW/24 Hrs.
August 8, 1948	66	1,269,861	44,000
January 11, 1949	214	4,220,805	108,200
Steam and electricity that can be produced with present equipment		11,436,200	144,000
Loads to be expected 1952		5,000,000	160,000

At present, when the load on the boilers is of low order, 100,000 to 200,000 lbs./hr., the new boilers are operated at about 50,000 to 60,000 lbs./ hr. each. At these loads the draft fans can be operated at low speeds. When the load on a new boiler reaches the 75,000 #/hr. point a bucking point is reached. Here it is difficult to control the new boilers as the fans will be continually kicking from high to low speeds (only two speeds available) which makes for difficult operation. If the new boilers can be carried at 60,000 #/hr. there will be sufficient demand left to maintain the old boilers at firing condition. In case of breakdown on one of the new boilers the old set can pick up the load with no delay, as one of the new boilers is unable to carry the full load by itself in the winter months.

In addition to the fact that the new boilers are not independent to support a winter-time load, there is the fact that the by-product, electricity, of these boilers is limited to the two present turbines. There is no reason, then, that the new boilers should operate at maximum output.

At present we see that the college can well furnish enough steam and electricity with plenty of steam to spare, but being on the margin in regards to electric power. The method of present operation is not the most efficient nor the most economical. It calls for double crews and operation of boilers at below maximum efficiencies. Messrs. Kinney, Campbell and Slater are making many plans for further expansion of power equipment to bring about correction of existing evils and to handle the expected loads of the future. Included in these plans are:

1. A third 350 psi boiler in the new boiler room of the same capacity as the present ones (1250 H.P.-100,000 # steam/hr.) At such a time the old power house will be torn down and parking space probably made available.
2. An additional generator, probably of 3,000 KW.
3. Condensate and feed water pumping facilities whereby water can be de-aerated and preheated properly. Some work is being done on this already. On February 2, 1948, make-up water was 19.58%. On February 2, 1949, make-up water was 18.20%, and Mr. Slater plans to have that reduced to 9.8%
4. An additional air compressor for the controls in the new power plant. There have been three breakdowns of the present compressor and it has been necessary to use a portable compressor used on pneumatic construction work.
5. Spare parts for conveyors, crushers, auxiliaries, grates and pumps in the new plant.
6. A "House Generator" in the new plant to be steam driven and of probably 800 KVA capacity to handle the electric auxiliaries in case of failure from the campus and city sources.

It is argued, and logically so, that these additions to the campus power compliment will pay for themselves in short order when the cost is compared to the present losses, methods, and cost of operation.

FACTORY OF THE FUTURE

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to 1. As compared to the old in-line type engine, there is an increase of from 115 H.P. to 135 H.P. in power rating and an increase in fuel economy of about one mile per gallon. Performance of the new "Rocket" engine is spectacular and outstanding. The modern, well-equipped manufacturing plant that produces this engine is certainly a far cry from the small work shop that produced the first one-cylinder, four H.P. gasoline engine for the first Oldsmobile way back in 1897.

Pi Mu Epsilon

Two MSC mathematics students received scholarships at the annual banquet of Pi Mu Epsilon held in Hunt's Food Shop this winter term. Edwin J. Crosby received $50.00 for the first L. C. Plant award. A $40.00 second award went to Ronald K. Engel. Dr. J. S. Frame of the Math department made the awards. Speaker for the banquet was Prof. R. V. Churchill, University of Michigan Math Prof., whose topic was "Applications of Differential Equations."

Sigma Pi Sigma

The Alpha Epsilon Chapter of the Sigma Pi Sigma, Physics Honorary, held its annual winter term banquet at Hunt's Food Shop February 19th. Head of Department, Dr. T. H. Osgood spoke on "Sizes and Shapes."

Twenty-two new candidates were received into membership. They are: Eugene R. Aten, Keith M. Baldwin, Robert G. Cunningham, Richard N. Dexter, Harold Friedman, Robert N. Habermehl, Wm. F. Heckert, Rudolph A. Jacobs, Ralph D. Johnson, Jeremiah J. Kenny, Noah Kramer, Glen G. Lorch, Robert C. McBryde, Stelice Mastorakis, Samuel Mercer, Jr., Richard E. Michel, Frederick Miller, Jr., Robert Nelson, Jack W. Osgood, John B. Porter, Nico H. Roos, Theodore P. Rykala.

American Institute of Electrical Engineers and The Institute of Radio Engineers

At their monthly meeting held Wednesday, February 23, the student branches of the A.I.E.E. and I.R.E. had the opportunity of hearing Walter Lawrence of R.C.A. Mr. Lawrence spoke on "Television and Microwave." The talk was well received by the audience.

The M.S.C. Radio Club

The M.S.C. Amateur Radio Club is now making a concerted effort to aid and assist junior members and others interested in obtaining their amateur radio license. Our weekly meetings are now arranged so that the first and third Thursday of each month is to be used as an organized work program, the second Thursday for a lecture or demonstration, and an open business meeting on the last Thursday.

A good portion of the membership enjoyed the recent "Hamfest" held in the Morton Hotel at Grand Rapids.

Mr. Frank Pelton has recently presented an interesting lecture on electronics in irrigation control. We have also had the pleasure of hearing Mr. Bob Hogle of WKAR speaking on the principle and application of the Dougherty circuit, and also on the new FM transmitter now in use at WKAR.

Mr. Mert Nellis has recently presented another lecture on antenna, dealing with the complete development and practical applications of the now popular turnstile antenna.

Owing to continued responses, the club is maintaining its code classes on Tuesday from 2 to 3 p.m., and on Wednesday from 4 to 5 p.m. Both are being held in the club room in the tower of the E. E. Building.

The club wishes to announce the continuance of its free message relay service. Those desiring to send a radiogram should come up to the "shack" late in the afternoon or early in the evening.

American Society of Mechanical Engineers

At the January 12 meeting Thomas S. McKewan of the Wolf Management Engineering Company was the principal speaker. Mr. McKewan talked about problems of management. He referred to such problems as the old front versus the younger generation. Mr. McKewan concluded his talk with a question and answer period during which he answered many questions of interest to everyone.

At the business meeting which followed, President Ross Christian asked for suggestions pertaining to spending the excess money in the Treasury.

Arthur F. Underwood, of General Motors Research, was the evening speaker at the January 26 meeting. Mr. Underwood explained a slide film on metals and their properties in bearings. He also showed a colored motion picture concerning lubrication.

Dr. Micholas Kulik, Assoc. Prof. at the New York University, spoke before the ASME's February 25. Thirty faculty members and fifty students listened to "The Theory and Practical Uses of the Heat Pump." Dr. Kulik explained that the Heat Pump can be used for both heating and cooling, simultaneously or at separate times. He also stated that installation of the heat pump warrants consideration if both heating and cooling effects are the aim. The heat pump is not the most economical or efficient unit under the following conditions: 1—where extreme hot and cold climatic conditions exist, 2—where power costs are over one or two cents per KW.

It was also announced at this meeting that engineering students interested in competing for the National ASME award this year should contact Mr. Ip or Mr. Price.

The annual Regional Student Conference will be held this year at Ohio State University April 25 through 27. Expenses for the trip will be paid to the winner of the local contest to be held tentatively April 13 at M.S.C. Other students wishing to attend the regional conference will also receive mileage and hotel expenses upon the approval of the local student officers. The conference prizes are $50.00, $25.00, and $10.00, and will be judged by chairmen of engineering departments of schools having local chapters. One student from each local student branch will be accepted to compete in the regional and the paper must be of a technical nature in the field of engineering.

M.S.C. Metallurgy Society

On January 20, Mr. Zanetti, Chief Contact Metallurgist of Great Lakes Steel Company, spoke to the group. His topic was "Low Alloy Tensile Steel."

At the business meeting that followed, John Richards was elected to the Student Engineering Society Council and Ted Bourdon was appointed chairman of the club.

Met. E.'s have big future. Left to right are: Council Members John E. Milne and John Richards, Prof. Sweet, Chairman Ted Borden, Secretary and Treasurer William S. Fiscus and John Disantis.

Prof. R. Sweet, of the Chemical and Metallurgical Engineering Department here at M.S.C., gave a talk to the society at the February 17 meeting. Prof. Sweet's talk was entitled, "Jobs in Metallurgy," in which he discussed the different types of jobs and training plans offered by industry to young graduate engineers.

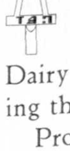
Engineer's Association

With the successful Engineer's Ball under their belts, the Engineer's Association devoted the last meeting to the discussion of plans for the rest of the school year. The increased interest shown by the Engineers in supporting the dance renewed optimism and gave rise to new ideas. The majority of the plans are intended to increase the prestige of Engineers on campus.

One of the more important topics discussed was the possibility of an Engineer's Exposition and Open House to be held sometime during spring term. Exhibits prepared by student organizations as well as industrial displays would be featured. A program of speakers and films would round out the day. Tours of the Engineering facilities would be conducted for guests.

The value of a successful exposition would be increased recognition in industrial and educational circles. Such an exhibit would also bring the students of the different groups together in friendly competition and stimulate the students' interests in the various branches of engineering other than their own. The suggestion was made that the exposition be held at the same time the new Electrical Engineering Building is dedicated.

Tau Beta Pi



Tau Beta Pi, national engineering honorary, initiated thirty-six students and three members of the faculty into the organization on February 10. A banquet was held in the Home Dairy dining room in Lansing immediately following the ceremony.

Prof. Robert L. Sweet of the Chemical Engineering department was the toastmaster and Ted Abrams of the Abrams Aerial Survey corporation was the main speaker. Mr. Abrams gave a very interesting talk on his recent trip around the world; or rather, as Mr. Abrams pointed out, around Russia.

The members of the faculty initiated were: Prof. Ira B. Baccus, head of the electrical engineering department, who was initiated for the chapter at Texas A & M; Prof. Alfred H. Leigh of the civil engineer-

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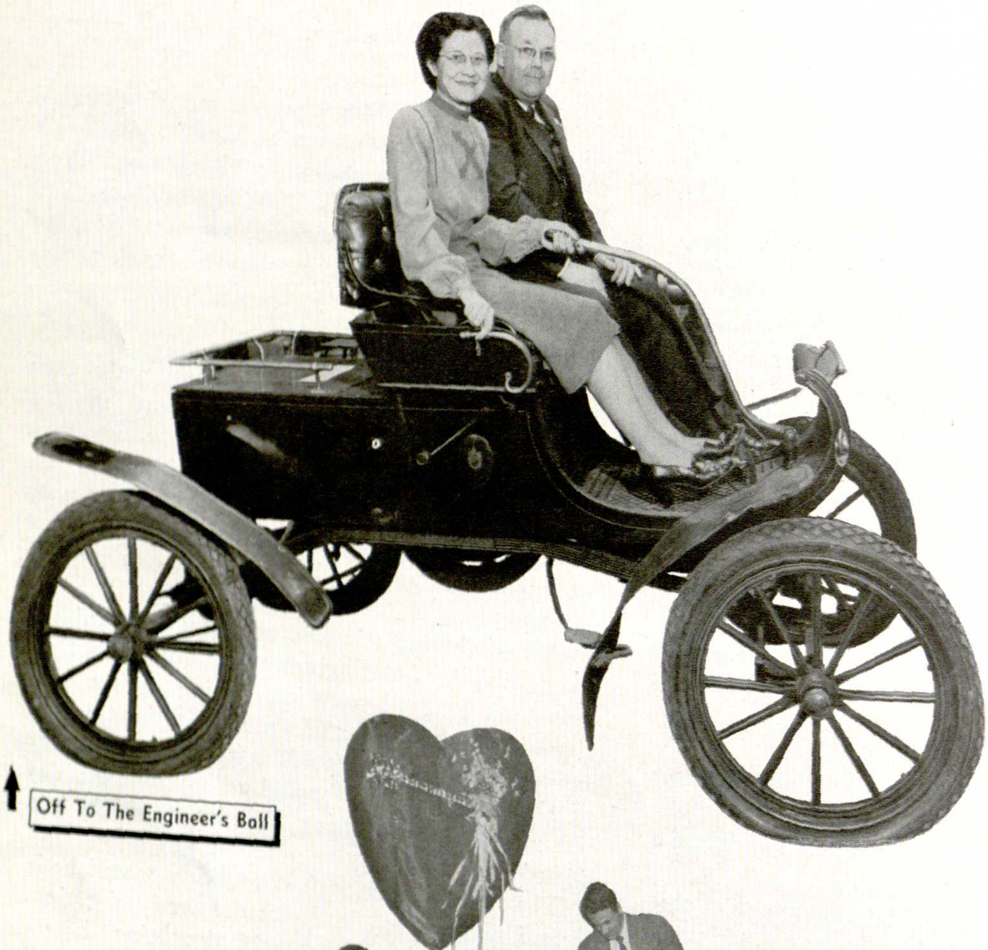


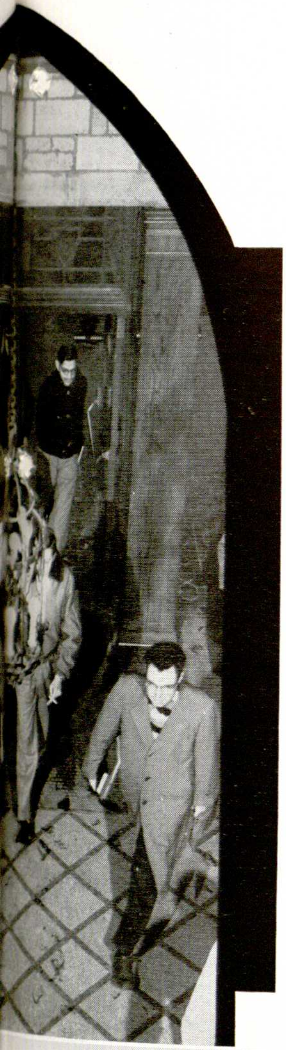
Off To The Engineer's Ball

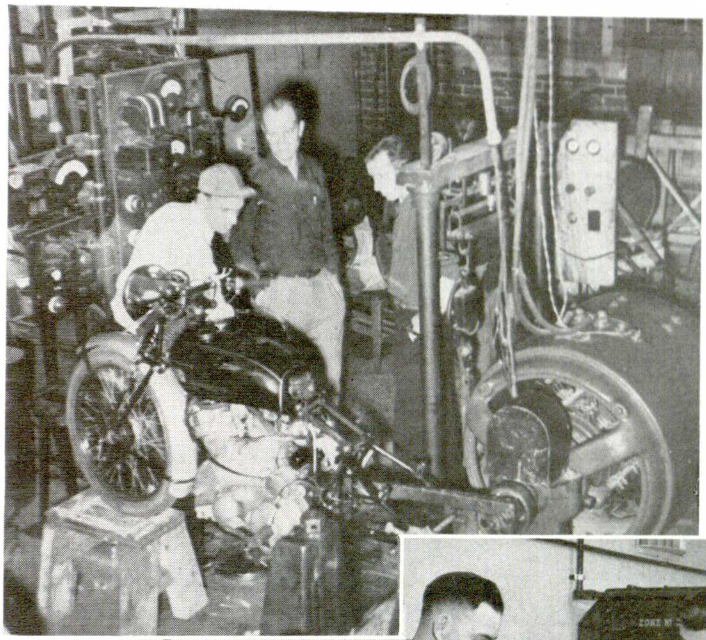
Wheels At The Tua Beta Pi Winter Term Dinner Ignore The Camera

Comparing Notes In Busting Lab.

Sparks In

Jack Osgood St
Prof. Price At





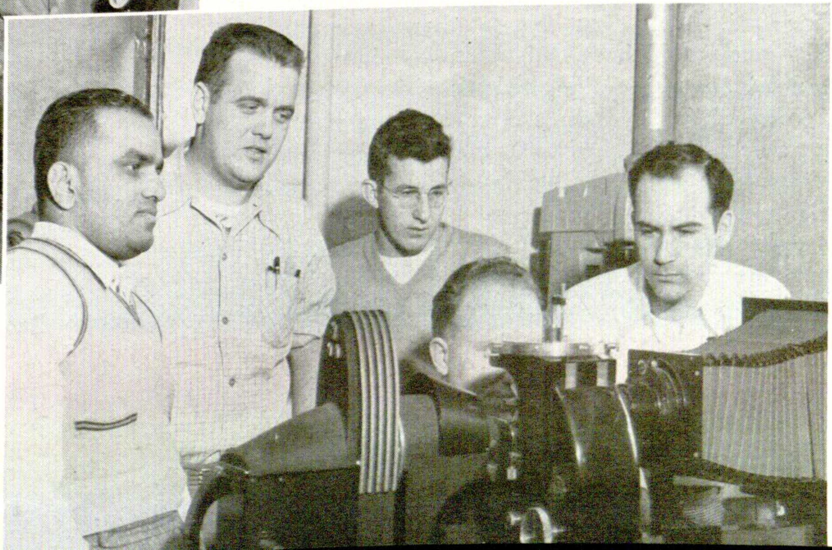
Karber's Bike On The Dynamometer

Headin' For Trouble In Kedzie

Lots of Production In The Pyrometry Laboratory

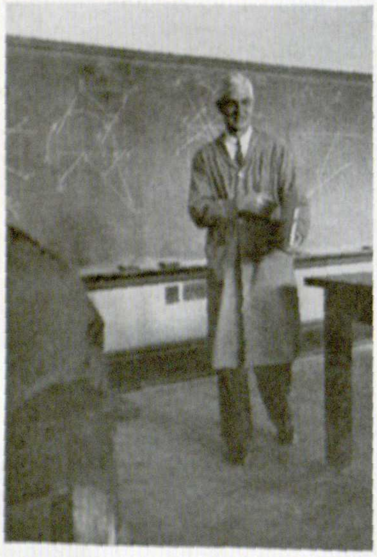
C-DC Circuit Laboratory

A Scene From Engineer's Ball



The Boys Show Off A New Piece of Equipment In The Metalurgy Laboratory

WE PRESENT



PROFESSOR O. W. FAIRBANKS

There is hardly an engineering student on the campus of M.S.C. who does not know Associate Professor O. W. Fairbanks of the engineering drawing department. They have all seen him, as shown above, explaining where some given line intersects the Z axis.

Professor Fairbanks is very well acquainted with M.S.C., having watched its growth since 1904, when he enrolled in M.A.C. In those days, many of the students, who, like himself, had not attended high school were enrolled in the "prep school" for one year to make up for the years of high school missed.

The college in those days, recalls Professor Fairbanks, didn't look much like it does today. Olds Hall and the string of old buildings, starting with Agricultural Hall, made up the greater part of the campus.

Lansing was reached by means of a muddy-one-lane road. In the event that two buggies should have met, one would have had to pull off into the sand and mire until the other had passed.

Mr. Fairbanks reminds us that, contrary to popular belief, students had to struggle even in those days to complete school. In his class of 119 students, only 19 graduated on schedule.

After graduation in 1909, Fairbanks and his two brothers decided to go into the ice-making business. At that time the manufacturing of ice was a new field. The three brothers pooled their funds and an inheritance they received to buy a steam engine, refrigeration equipment and a building. The method of manufacture they set up was quite ingenious.

After choosing a location beside a lake the steam engine and other equipment were installed. Water was pumped from the lake into the boiler of the steam engine. Upon heating, the steam operated the engine, which was the prime mover of all the plant machinery. At the exhaust port, lake water flowing over the pipes condensed the used steam thus increasing the thermodynamic efficiency. As the vaporization of the boiler water had removed the mineral impurities as well as sterilizing it, this exhaust steam was the ideal material to be made into ice.

Thus the same water which supplied the motive power was purified and used to make the ice, free of charge, so to speak.

The newly formed ice company struggled along as has many a young enterprise until a lucky break occurred. One winter, soon after the formation of the company, the weather was exceptionally mild. This created a serious shortage for the local competition. They formerly secured their summer supply by sawing chunks of ice out of the lake. Naturally, the Fairbanks Company jumped at the opportunity presented and, thereafter, began to prosper.

In another case, the opposite extreme in weather also gave the Fairbanks Company an edge over the competition. One of the neighboring lakes used as a source of commercial ice was so shallow that when extremely cold weather arrived the whole lake froze solid, which made it impossible to cut the ice loose.

The brothers, with their crew of six men, could produce ten tons of ice a day and with their economical method of manufacture could sell it to the housewives for as little as forty cents per hundred pounds. Present day companies charge half again as much even though they used a method of manufacture which does not remove the hardness from the water, Fairbanks observes.

Neither Fairbanks nor his brothers are connected with the ice plant any longer, having sold it a few years ago after building the business up to its present production of sixty tons of ice per day.

Whatever time Professor Fairbanks has free from his duties as Descriptive Geometry lecturer, he spends fishing at his cottage, near Holland, Michigan.

THE SOCIETIES

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ing department; Prof. John W. Donnel, head of the chemical engineering department.

Seniors initiated include: Herbert D. Bartels, Lansing; Frank J. DeDecker, Detroit; Warren T. Edinborough, Benton Harbor; James W. Federhart, Saginaw; Isidor T. Flaum, New York; William J. Mac-

Creery, Battle Creek; Taher Mojtehedi, Tehran, Iran; Joseph P. Nixon, Alma; Jack W. Osgood, E. Lansing; William E. Pearson, Lansing; Edward B. Pepke, Grosse Ile; Lee J. Seymour, Franklin.

Juniors initiated were: George S. Ammon, Grand Rapids; Orville R. Bakeman, White Pigeon; Jack M. Baldwin, Lansing; Marvin D. Bicknell, St. Joseph; Robert F. Bogan, Kearny, N. J.; Edwin B. Bozian, Birmingham; Donald R. Brundage, Kalamazoo; Max C. Christensen, Trufant; Leroy R. Genaw, Port Huron; Paul A. Holt, E. Lansing; Harry J. B. Horn, Jr., Lansing; Kenneth M. Johnson, Grand Rapids; Richard L. Keinath, Frankenmuth; Jack R. Nothstine, Mancelona; Ezra G. Ogletree, Jr., Lansing; James B. Post, Evergreen Park, Ill.; Lewis W. Post, Evergreen Park, Ill.; Bruce G. Rook, Lansing; Richard G. Sayers, Jackson; Howard A. Scheetz, Sturgis; Edward F. Schlee, Jr., Detroit; Charles B. Sunris, Manistee; Donald J. Waalkes, Muskegon; Loris D. Whipple, Mason.

American Institute of Chemical Engineering

Mr. C. J. Kirchgessner, of the Portland Cement Association, spoke to the Chem. E.'s at their regular meeting, held January 25. He discussed special problems and applications of concrete of interest to Chemical Engineers.

Mr. Kirchgessner, a civil engineer, has had construction experience with the State Highway Department, Commonwealth and Southern Corp., and the Dow Chemical Co. before becoming affiliated with the Portland Cement Association. The next meeting is scheduled for March 2, at which time the registration of engineers will be discussed.

American Society of Civil Engineers

At the first meeting of winter term, held January 18, the C.E.'s had 40 members present.

Several members volunteered to accept the invitation of the downtown Engineers Club and attended meetings. Six members expressed intentions of attending the North Central Conference meeting of the A.S.C.E. in Cleveland April 8 and 9.

On February 22, at a regular meeting, President Spelman outlined forthcoming meetings and activities.

Here is the program:

Tuesday, March 8, Mr. Berriman, of the Grand Valley Chapter of the A.S.C.E., and Prof. Blomquist will discuss a timely topic, in view of the fact that professional registration exams for engineers are to be held at M.S.C. next spring. Their topic will be "Registration of Professional Engineers."

On April 5, A.S.C.E. will have a movie from the Dow Chemical Company.

Election of officers will take place April 19.

The A.S.C.E. dance will be held on April 29 at

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Field Mapping Instrument

The invisible field of force surrounding electrically-charged pieces of metal can automatically be represented on a drawing board with a new instrument developed by the General Electric Corporation. The instrument can be used to solve problems in magnetics, fluid streamlining, heat conduction, and propeller blade torsion.

This instrument draws lines on a drawing board which represents the electric voltage surrounding the tested specimen. For experiments, metal boundaries are connected to a power supply and submerged in water. The water conducts current and the voltage in the water, which varies from place to place, is picked up by the instrument and recorded on the drawing board. This same principle applies equally well to heat or torsion problems; however, here the lines of equal temperature or strain in the metal equal the constant voltage lines.

Previous "field mapping" was a tedious process of calculation and plotting of curves. In some cases it took weeks to complete the mapping of complex shapes. With this new instrument "field mapping" of any two-dimensional and many three-dimensional shapes can be done in a matter of hours.

Electron Diffraction Instrument

An instrument, that will assist in developing longer-wearing metals, has been built by General Electric. The "Electron Diffraction Instrument" either shoots a beam of electrons through an extremely thin piece of metal, or diverts the beam at an angle to the surface of a block of metal. These tests enable engineers to determine a variety of surface conditions, including corrosion and crystal structure of the molecules.

In operation of the instrument, a beam of electrons is emitted from a white hot tungsten filament, and focused by means of a magnetic lens, in much the same manner as a beam of light is focused with a glass lens. For one type of work, this beam then is passed through a two-millionths-inch thick piece of metal and produces an image on a fluorescent screen. In other applications, the beam is directed at a metal surface at an angle, passes through tiny surface projections which bend the beam and is directed at the screen. A piece of ordinary photographic film can be substituted for the fluorescent screen to obtain a permanent record of the image. The image produced is a series of concentric circles, which differs for each type of crystal structure.

Electricity at 30,000 cycles per second is used to power the tungsten-filament tube. The equipment to convert 60 cycles per second current to this high frequency, the vacuum system and the vacuum chamber are enclosed in a cabinet about the size of an office desk. (See photo.)

Krypton Increases Fluorescent Efficiency

Fifty years ago one of natures rarest elements, krypton, was found to be present in air. Since its discovery it has been used to give added light efficiency in various occupations, two of which are miners' cap-type incandescent lamps and recently in the All-Weather Approach Landing System for planes. Ten years ago krypton-fluorescent lamps were experimentally produced but their use was limited because of the small quantity and high cost of the rare gas. Only recently have these factors been brought within the range of large scale production.

The ability of krypton to increase efficiency is now being utilized in a new standard 85-watt fluorescent lamp. This output is equal to that of a 100-watt non-krypton lamp. The increase in efficiency of this new lamp is approximately 17 percent.

THE MECHANICAL ENGINEER

continued from page 7

tiveness in engineering students has been emphasized by industrialists and engineering teachers alike.

The need for always "digging deeper" can be illustrated by a simple example from the field of design. It used to be that a machine part could be designed by dividing the ultimate strength of the material by a factor of safety and then using the resulting stress to calculate the size of the part. The choice of a factor of safety was just a guess, based on experience, and the term might better have been called "factor of ignorance" since it covered those things which were unknown. Treatment of such matters is rapidly becoming more scientific. We no longer need such large allowances for non-homogeneous material. The steel-maker and the foundryman are making more homogeneous products, and are under constant pressure to improve them further. By more refined calculations and the use of experimental stress analysis, a redistribution of material is often possible which makes a part both lighter and stronger. Sometimes it is possible to improve the shock resistance of a part by actually removing material in some places. And when the engineer can predict the variation of load on a part, he can apply rational methods to his calculations and design with a very small factor of safety. The "factor of ignorance" has been almost eliminated by exact knowledge of the loads, the properties of the material, and the behavior of the material under different types of loading. The metallurgist and the stress analysist have done great things, and are still doing them.

The same kind of illustration could be applied to the field of thermodynamics and to other places where the engineer is active.

This process of constantly "digging deeper" means that the general level of education among engineers is rising higher and higher. The man who, without formal technical education, could pick up enough engineering to get along has become rare and seems well on the road to virtual extinction. Not only that, but study beyond the usual four-year college course is becoming increasingly necessary for the more capable students, just as a man digging a well needs better tools as the well gets deeper and deeper. Dean H. P. Hammond of Penn State pointed out recently that of the total number of degrees granted in all branches of engineering in 1947-48, all advanced degrees amounted to only 17 percent of the number of first degrees, and the number of doctor's degrees was only 0.7 percent of the number of first degrees. Too many good students who are perfectly capable of doing advanced work are taking no formal education beyond the first degree. Some companies have

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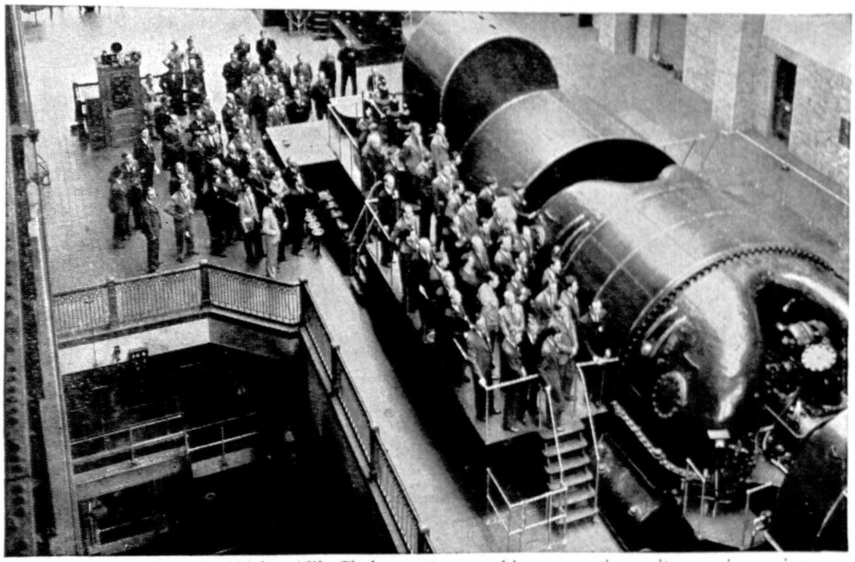
Change Your Mind...

Most of us have, at one time or another

by J. L. SINGLETON
Vice-Pres. and Director of Sales,
General Machinery Division
ALLIS-CHALMERS MANUFACTURING CO.
(Graduate Training Course 1928)



One of the three 80,000 kw Allis-Chalmers steam turbine generating units now in service in a big mid-western power plant. A fourth unit is being built, and a fifth is on order.

You may be one of those men who knows exactly the sort of work he wants to do when he finishes engineering school. I did. I was going into straight engineering work. But I became a salesman.

J. L. SINGLETON

I've noticed since that it's not unusual for Graduate Training Course students at Allis-Chalmers to change their minds. Here, opportunities have a way of seeking out a man according to his ability. Sometimes these opportunities are in fields that he had not fully understood or considered before. There are so many kinds of work to do here that a man is almost sure to end up in work that will bring him the most in personal satisfaction and advancement.

Opportunities in Selling

For example—sales. Not every engineer is a salesman, but at Allis-Chalmers every salesman is an engineer. Engineering plays a vital part in the sale of a big steam turbine, a cement plant—or even a multiple V-belt drive.

There's a thrill in landing orders—really big ones, such as two 115,000 HP generators for Hoover Dam—all of the rolls and purifiers for the world's newest and most modern flour mill—the world's largest axial compressor for use in a supersonic wind tunnel, or volume sales of small motors, pumps and drives. Orders like these come through teamwork of engineering, manufacturing skill, high-level salesmanship and merchandising. It's good to be a member of such a team.

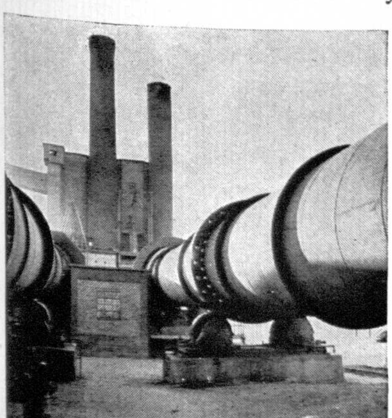
If you have ability and a leaning toward sales work, you'll have plenty of chance to test and develop it at Allis-Chalmers during your Graduate Training Course. Then you take your place in a Coast-to-Coast sales organization—perhaps even in a foreign office.

Many Fields Are Open

Or, maybe you'll change your mind. Research and development—or manufacturing—or design engineering may prove your field. The point I want to make is, all of these things are open to you at Allis-Chalmers. This company is in intimate touch with every basic industry: mining and ore processing, electric power, pulp and wood products, flour milling, steel, agriculture, public works.

The Graduate Training Course here doesn't hold you down. You help plan it yourself, and are free to change as you go along. You work with engineers of national reputation—divide your time between shops and offices—can earn advanced degrees in engineering at the same time.

Those are some of the things that appealed to me 23 years ago. They're still good.



Rotary Kilns are the most gigantic of all machines. Allis-Chalmers has designed and built kilns up to 475 feet in length, 12 feet in diameter—supplies all basic machinery for complete cement mills and processing plants.

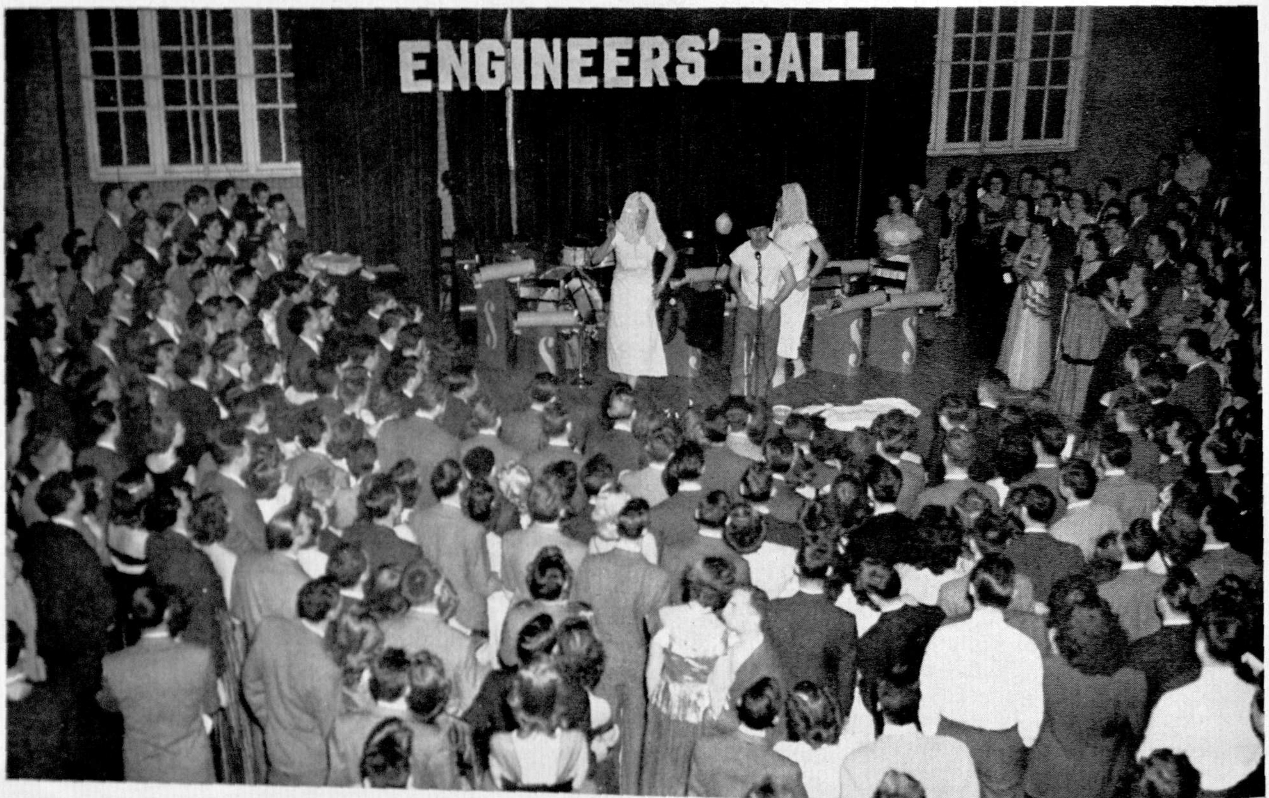
Front-line man on the A-C team that designs, builds and sells basic machinery to all industry.

Write for details of the Allis-Chalmers Graduate Training Course — requirements, salary, advantages. Representatives may visit your school. Watch for date.

ALLIS-CHALMERS MFG. CO.
Milwaukee 1, Wisconsin

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment—Biggest of All in Range of Industrial Products



The Student Engineering Council Scores With the Engineer's Ball

The Engineer's Ball for 1949 was a complete success socially, financially, and entertainingly. Dispite the cold, three hundred couples found the evening thoroughly enjoyable. The dance floor was full, but not crowded at any one time. The music of Bob Shinberg was well accepted by the dancers. With the antics of the "Gay Deceivers" this was the most successful Engineering social for several years.

Financially the ball made possible the clearing of the debts of the Student Engineering Council and left a modest reserve for future events.

The Student Engineering Council's success with the Activities Carnival and the Engineer's Ball has proven that it could function socially. What, however, has it done for the student engineer? Little is known on the campus by the student engineer at this time as to what extent other Engineering Councils assume responsibilities.

At our neighboring U. of M. a most complete and active organization is serving the student engineer. Its activities are felt in every phase of the engineering curriculum. Not only does it interest itself in social activities, but it also has set up and enforces an Honor System. It successfully and effectively represents the student engineer before the administration, the deans, and the faculty. It advises the individual student, and intercedes upon request. This in some cases rectifies a frequent gripe, that of being utterly alone in regard to occasional injustices or pleas for consideration. It is felt that the Engineering Council is missing a bet if it doesn't investigate and assume more responsibilities for the benefit of the student engineer.

State Registration Exams For Engineers To Be Given at M.S.C. in June

Senior Engineering students and faculty of M.S.C. will have an opportunity to take the State of Michigan Engineering Registration examinations here at M.S.C. some time in June. Mr. Miller announced that if the date set for these exams conflicts with senior classes, arrangements will be made to allow seniors to take the examinations.

For the convenience of the student, these exams were held annually at M.S.C. until 1942. Since then the exams have been given only in Detroit. Permission to give the tests came from Watts Shelly, executive secretary for the Board of Engineering Registration in Detroit.

The C.E. Department of M.S.C. is furnishing all the instructors for refresher groups now being held.

Mr. C. L. Allen, Chairman of the department of C.E. instructs law, Prof. Gail Blomquist instructs other branches. These two men instruct Monday and Wednesday at the Eastern High School, Lansing. This group is sponsored by the Grand Valley Chapter for Registered Engineers. In addition, Profs. Allen and Blomquist instruct Tuesday and Thursday nights at M.S.C. for the benefit of the faculty. In addition, assisting instructors are: Prof. A. H. Leigh, Prof. Leo Nothstine, and Mr. K. A. Campbell. Mr. Nothstine also instructs weekly at Bay City.

To Mr. Blomquist, the *Spartan Engineer* presents roses for his efforts in assisting the Engineering student in becoming registered. Application blanks are now available in his office. In addition to laying the ground work for the present program, Mr. Blomquist plans to appear before senior seminars to present information and answer questions on the subject.

Look in the next issue of the *Spartan Engineer* for a feature article on more facts in regard to Professional Registered Engineers.

Dean Emeritus H. B. Dirks to Return To East Lansing in June

This editor recently received a letter from H. B. Dirks expressing his approval of the recently installed *Spartan Engineer* and his wishes for its continued success.

After spending the summer at their Vermont home, Mr. and Mrs. Dirks set off for California via East Lansing. On the various legs of their journey they found time to look up many friends and relatives. Now temporarily residing at 924 Church Street, Redlands, California, they are leisurely enjoying the mild California weather while taking in many concerts and lectures, and visiting points of interest.

Dean Dirks has become very "water conscious" during these travels, and spoke particularily of the current water problem in California. An interesting item that had his attention was the misinterpretation and dispute that resulted from specifications of the Hoover and Parker Dams. The difficulty arises out of the question of the amounts of water Arizona and California were to be allotted. The conclusion he made is that "we should never be too careful in our specifications, making certain that there can be but only one meaning," and also stressing "the need for English foundations for the Engineer."

After visiting their daughter in San Antonio, Texas, the Dirks plan to return to East Lansing to observe graduation exercises in June.

DYNAFLOW DRIVE

continued from page 12

a greater velocity than when it was projected from the pump. This is explained by the fact that the oil is deflected by the stationary turbine blades without removal of energy. When oil is deflected by the physical confines of the turbines back towards its axis, it is deflected into passages of reduced sectional area. Since the amount of oil leaving the turbine must equal the amount entering it, the velocity of the oil must be increased.

Although the velocity of the oil leaving the turbine is negative in relation to the rotation of the pumps, it is converted into positive velocity by means of a static member. The static member is placed in the turbine and, having curved blades, redirects the oil streams so that it has the same direction as the rotation of the pump. If the oil is supplied to the pump with a positive rotation, the pump output is directly increased and is now the sum of the input velocity and the output velocity due to the engine torque alone.

The static members extract no work from the oil because they are not permitted to move from reaction forces. It is the function of the curvature of the stator blades to redirect the oil into the pump at the proper angle. The effective speed of the oil redirected into the pump is 1.25 times the pump output rate due to engine torque alone. Thus, the torque on the turbine is one plus 1.25, or 2.25.

Upon opening the throttle, the forces acting on the turbine become great enough to place the turbine in motion. Since the turbine is connected to the turbine and drive shaft the car begins to move. The pump picks up speed and so does the turbine. But, the pump rotates much faster than the turbine.

As the turbine speed increases the oil discharged from it has a reduced negative velocity. When this velocity has been reduced to a minimum the force of the oil begins to act upon the rear sides of the stator blades. This causes the first stator to free wheel and offer no obstruction to the flow of oil. At this time the second stator is still being entered effectively. Acceleration still being demanded, the speed of the turbine continues to increase. Torque multiplication is still present since the second stator is still redirecting a small amount of oil back into the pump. As the turbine speed increases to a point where the oil is discharged with less negative velocity than the forward speed of the turbine, the second stator free wheels. When this occurs, oil is no longer being redirected into the pump and torque multiplication ceases.

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DYNAFLOW DRIVE

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The circulation rate has now become less than that which the pump can produce through engine torque alone. At this time the secondary pump locks to the primary pump.

With the stator free wheeling, and the primary pump and the secondary pump turning as a unit, the convertor now functions as a fluid coupling transmitting torque at a one to one ratio.

The planetary gear train furnishes the low range and reverse. In low range and in reverse, the gear reduction is 1.82 to 1. With maximum torque multiplication by the converter, this is changed to 4.09 to 1.

The DYNAFLOW DRIVE shows about the same overall efficiency as a conventional gear drive. It is more efficient at low speeds than other fluid couplings, and has fewer parts. There is no motion lag as is characteristic of other automatic transmissions and fluid couplings. And of great importance is the fact that in driving range where 95% of ordinary driving is done, there are no gears engaged and hence there is nothing to wear out.

Mechanics report that DYNAFLOW, after some fifteen months of being installed, has been trouble-free and very few have required service.

THE MECHANICAL ENGINEER

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their own post-graduate schools and some graduate students never get their degrees, so that the number who do some advanced work is really somewhat larger than the number of degrees granted.

This is no cause for complacency, however. Mr. E. G. Bailey, recently retired president of the A.S.M.E., said recently, "The most dangerous period in any cycle of active development is at the time when a great deal has already been accomplished and one takes time out to brag about it."

The education of the mechanical engineer cannot stop with his graduation from college any more than he can say that his field of opportunity will not grow any more. In both breadth and depth, his opportunities and the necessity for more knowledge and the ability to use it are increasing. His education is a thing that can never stop. Even after getting all the formal schooling up to the limit of his capabilities, he cannot stop. He must continue on his own initiative by private study and observation. Always, but especially after graduation, he cannot be content with learning only what is taught him, but must go further and deeper "on his own." A phonograph repeats only what somebody has told it. The phonograph is a great invention, but it is not an engineer.

THE SOCIETIES

Continued from page 21

the Forestry Cabin.

On May 5 the M.S.C. Chapter will have a joint meeting and banquet with the Michigan Station in the Union Building. They will hold their annual field day and picnic on May 28.

Members Schwabbe and Klein of the Engineering Council reported that the Engineers' Ball was a success and an all Engineer Field Day has been planned for May.

American Society of Engineering Education

The American Society for Engineering Education at Michigan State College is a branch of a large national organization interested in improving Engineering Education.

The local chapter, which meets on the average of twice a term, has outlined a program of improvement both for themselves and the engineering school as a whole.

At present the officers of the organization are: President H. P. Skamser, Vice President D. S. Pearson, Treasurer Charles A. Miller, and Secretary D. J. Renwick.

Protecting and advancing the Engineering Profession at M.S.C. for ASEE are (left to right): Secretary D. J. Renwick, President H. P. Skamser, Vice President D. S. Pearson, and Treasurer C. A. Miller.

During the fall term two meetings were held. The first on November fourth had as its subject, "The History and Development of State Registration of Professional Engineers." At the December second meeting Prof. A. W. Farrel, Head of the Department of Agricultural Engineering, reviewed his paper about Agricultural Engineering which was published in the April 1948 issue of *Journal of Engineering Education.*

The first meeting of the new year was of a social nature to acquaint new members with the society. At the next meeting held March third an improvement program for the school was discussed.

Meetings for the Spring term will include a discussion of the Relation of the School of Engineering and Small Industry. On May seventh Michigan State College will be hosts to the State Convention of A.S.E.E. The state president of the A.S.E.E. is Prof. C. L. Brattin, Head of the Department of Engineering Drawing here at Michigan State College.

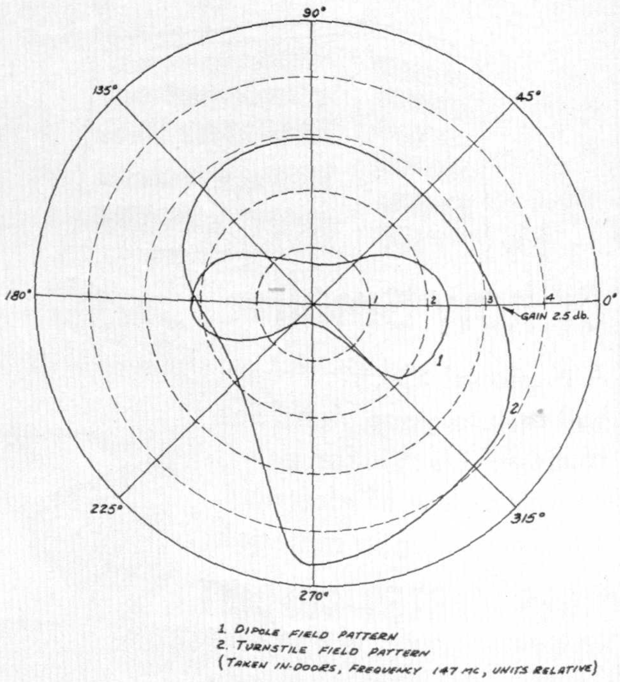
Other activities of the group include a training program for engineering faculty with J. M. Apple as director.

The organization is also sponsoring a refresher course for the faculty concerned with the Engineers Registration Examination to be held here next spring. C. E. Dennis is in charge of the refresher course.

TWO-BAY TURNSTILE ANTENNA

continued from page 9

The antenna was set up and a field strength check was run. The first results without any adjustment of the phasing from that of calculated values gave an elliptical pattern. The turnstile did not show a circular pattern as predicted because of improper length of phasing stubs, but it did show more gain in all directions.



1. DIPOLE FIELD PATTERN
2. TURNSTILE FIELD PATTERN
(TAKEN IN-DOORS, FREQUENCY 147 MC, UNITS RELATIVE)

FIG. 5

The data for patterns plotted in figure 5 was taken indoors and, although the turnstile has been adjusted for better directivity, both patterns show distortion from the theoretical values of figure 2. This is to be expected, however, for when measurements are made in confined spaces the reflections from near-by objects tend to distort the pattern.

The experimental data shows approximately a 2.5 db gain over that of the dipole in the zero degree direction and plus or minus that amount in other directions. The phasing stub adjustments are fairly critical when attempting to obtain a perfectly circular turnstile pattern. With care in phasing adjustments a good circular pattern of about 2 db gain can be predicted.

The little boy looked at the girls in their midriff bathing suits and asked: "Papa, why do the good-looking girls wear their water wings all the time?"

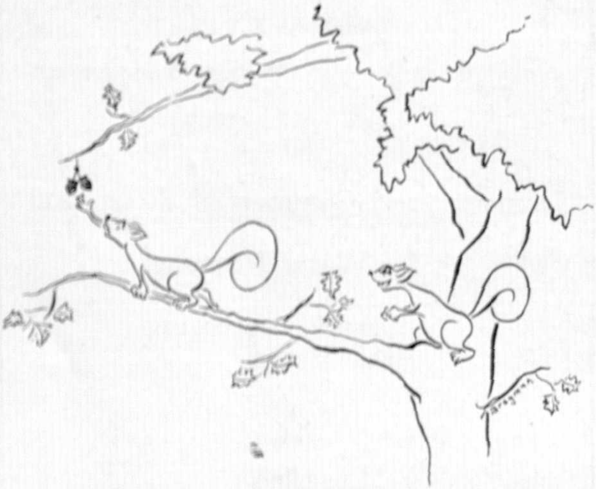
* * *

They were dancing. He held her tight, his eyes closed, and danced as though floating on a cloud. Then the music stopped. "Let's go outside," he said.

Outside he took her in his arms and whispered in her ear, "Darling, I love you very much. I may not be rich like Joe Doaks, I may not have a car like Joe Doaks or spend money like he does, but I love you so much I'd do anything in the world for you."

Two soft white arms reached around his neck, and two ruby red lips whispered in his ear, "Darling, introduce me to Joe Doaks."

SIDE TRACKED



"Cough."

— Harvard Lampoon

Always remember, fellow engineers, that the difference between a model woman and a woman model is that the former is a bare possibility and the other is a naked fact.

★ ★ ★

Here I sit and fuss and fret
While my seat is getting wet,
It's enough to make me fume,
Teacher, can't I leave the room?
Why delay me when you know
That I simply have to go.
Honest, teacher, I'm not feigning—
My car top's down and it's raining.

★ ★ ★

Short dresses make one look longer.

★ ★ ★

He—"Do you pet with the lights on or off?"
She—"Yes."

★ ★ ★

"F-e-e-t," the teacher exclaimed, "what does that spell, Mary?"
"I dunno."
"Well, what is it that a cow has four of and I have only two?"
So Mary told her.

★ ★ ★

Prof: "Are you cheating on this exam?"
Engineer: "No, sir, I was only telling him his nose was dripping on my paper."

★ ★ ★

Civil Engineers a few years from now:
"But chief, it wasn't my fault the bridge collapsed. I thought that fly speck was a decimal point."

They decided not to buy twin beds because she heard they induced people to walk in their sleep.

★ ★ ★

"I don't like your boy friend at all."
"Why?"
"He whistles dirty songs."

★ ★ ★

"Pardon me, young lady, in the matter of your dress, don't you think you could show a little more discretion?"
"My gosh! Some of you fellows are never satisfied!"

★ ★ ★

"Are all men fools?" inquired the wife after a dispute with her husband.
"No, dear," he replied, "some are bachelors."

★ ★ ★

Pappy says a lazy man is a guy who marries a widow with five children.

★ ★ ★

Soft, the new love tells his lies,
And ah, he tells them well;
Demurely, I turn down my eyes—
Alone, I laugh like hell.

★ ★ ★

Customer—"Won't you take something off for cash?"
Salesgirl—"Sir."

★ ★ ★

"Oh, look at the funny little bug; what kind of a bug is it?" exclaimed a young lady on whose lap the bug had just lit!
"That's a lady bug," replied her escort.
"My, but you have good eyesight."

★ ★ ★

Last night I held a little hand,
So dainty and so sweet,
I thought my heart would surely break
So wildly did it beat
No other hand in all this world
Can greater solace bring,
Than that sweet hand I held last night—
Four aces and a king.

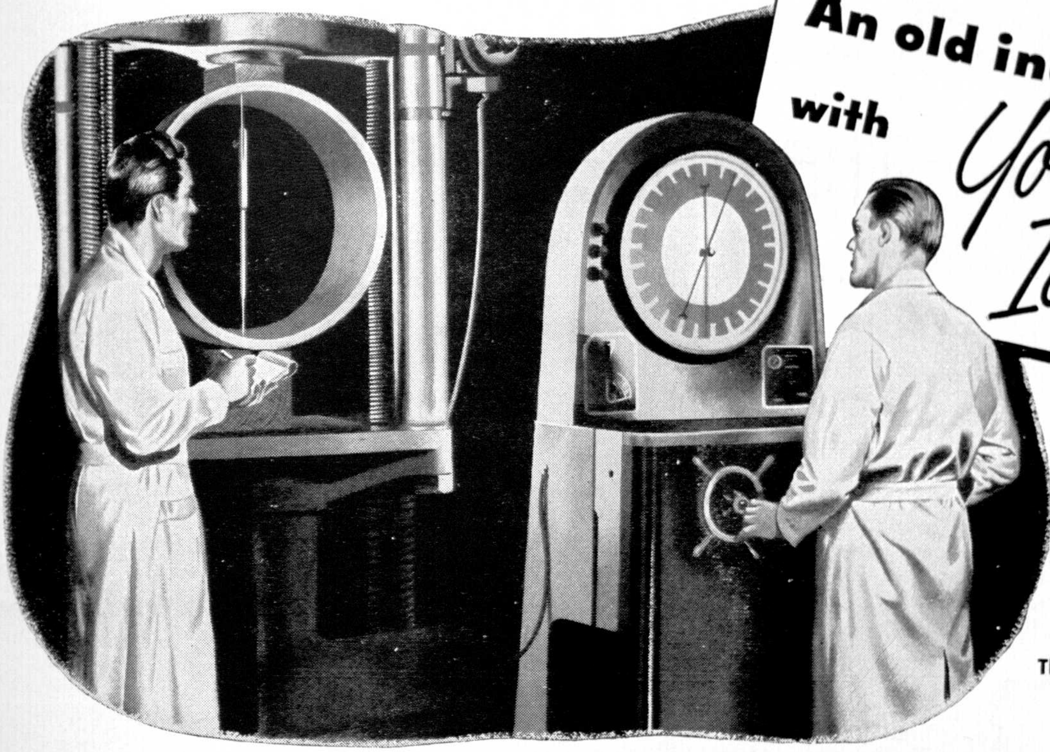
★ ★ ★

May I take you home? I like to take experienced girls home.
I'm not experienced.
You're not home yet.

★ ★ ★

Lady (at almond counter): "Who attends to the nuts?"
Clerk: "I'll be with you in just a minute."

An old industry with *Young Ideas*

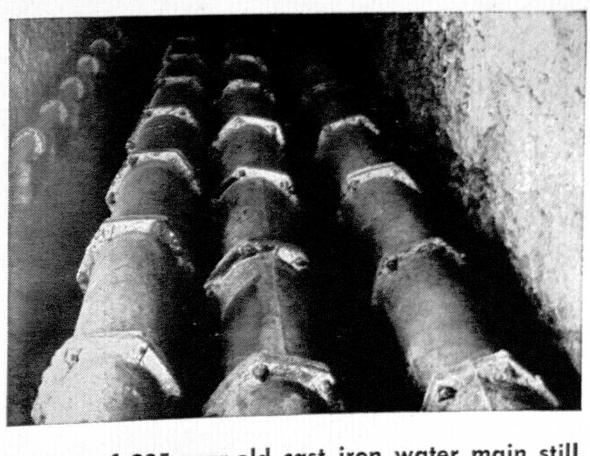


The Ring Test

The ring test, shown above, is a scientific method for determining the modulus of rupture of pipe. It is not a required acceptance test but one of the additional tests made by cast iron pipe manufacturers to ensure that the quality of the pipe meets or exceeds standard specifications.

A ring, cut from random pipe, is subjected to progressively increased crushing load until failure occurs. Standard 6-inch cast iron pipe, for example, withstands a crushing weight of more than 14,000 lbs. *per foot.* Such pipe meets severe service requirements with an ample margin of safety.

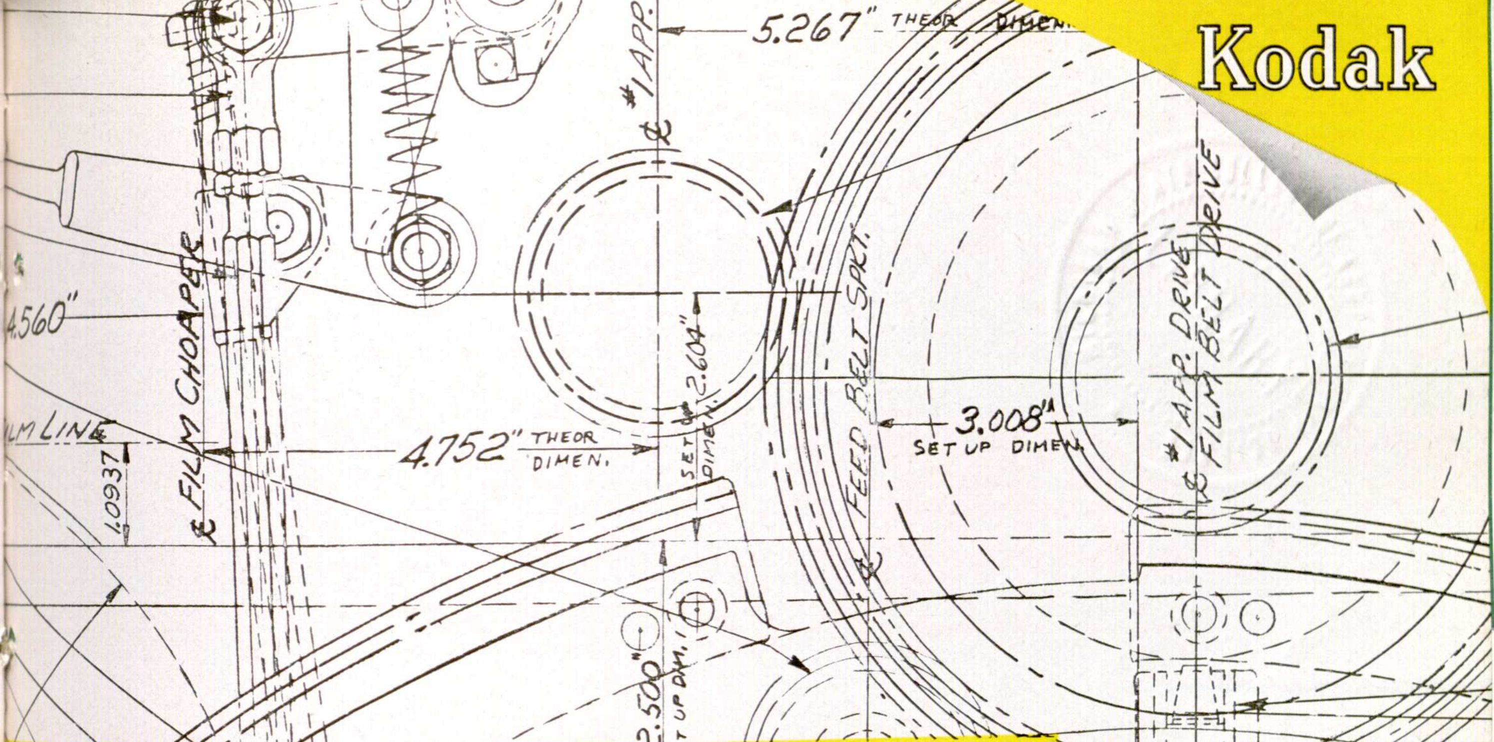
Scientific progress in the laboratories of our members has resulted in higher attainable standards of quality in the production processes. By metallurgical controls and tests of materials, cast iron pipe is produced today with precise knowledge of the physical characteristics of the iron before it is poured into the mold. Constant control of cupola operation is maintained by metal analysis. Rigid tests of the finished product, both acceptance tests and routine tests, complete the quality control cycle. But with all the remarkable improvements in cast iron pipe production, we do not forget the achievements of the early pipe founders as evidenced by the photograph below of cast iron pipe installed in 1664 to supply the town and fountains of Versailles, France and still in service. Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.



Section of 285-year-old cast iron water main still serving the town and fountains of Versailles, France.

CAST IRON PIPE SERVES FOR CENTURIES

Kodak



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The magic of photography turns hours of costly drafting room time into a minute-quick job of utmost accuracy.

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Using the new Kodagraph Autopositive Paper, you can get sharp positive prints directly from originals of every type, even from worn or weak tracings—get them with regular blueprint or direct process equipment—in ordinary room light, without negatives.

Using the new Kodagraph Contact Paper (with conventional photo-copying equipment and negative step) you can produce sharp, clear, legible photographic prints of letters, specification sheets, forms, drawings.

Using the new Kodagraph Projection Papers, you can enlarge small-scale negatives of drawings and documents to original size or larger . . . get high contrast reproductions.

With Kodagraph or Recordak Micro-File Equipment, you can reproduce the most detailed drawings, charts, etc.—"de-bulk" them 98% . . . and protect your valuable originals.

This same ability to reproduce detail exactly, completely, lastingly . . . even to improve its quality . . . gives photography a multitude of uses in your plant. It can help make your designs faster, your production methods smoother, and get your product to the dealer's sooner.

Eastman Kodak Co., Rochester 4, N. Y.

Advancing industrial technics—Functional Photography