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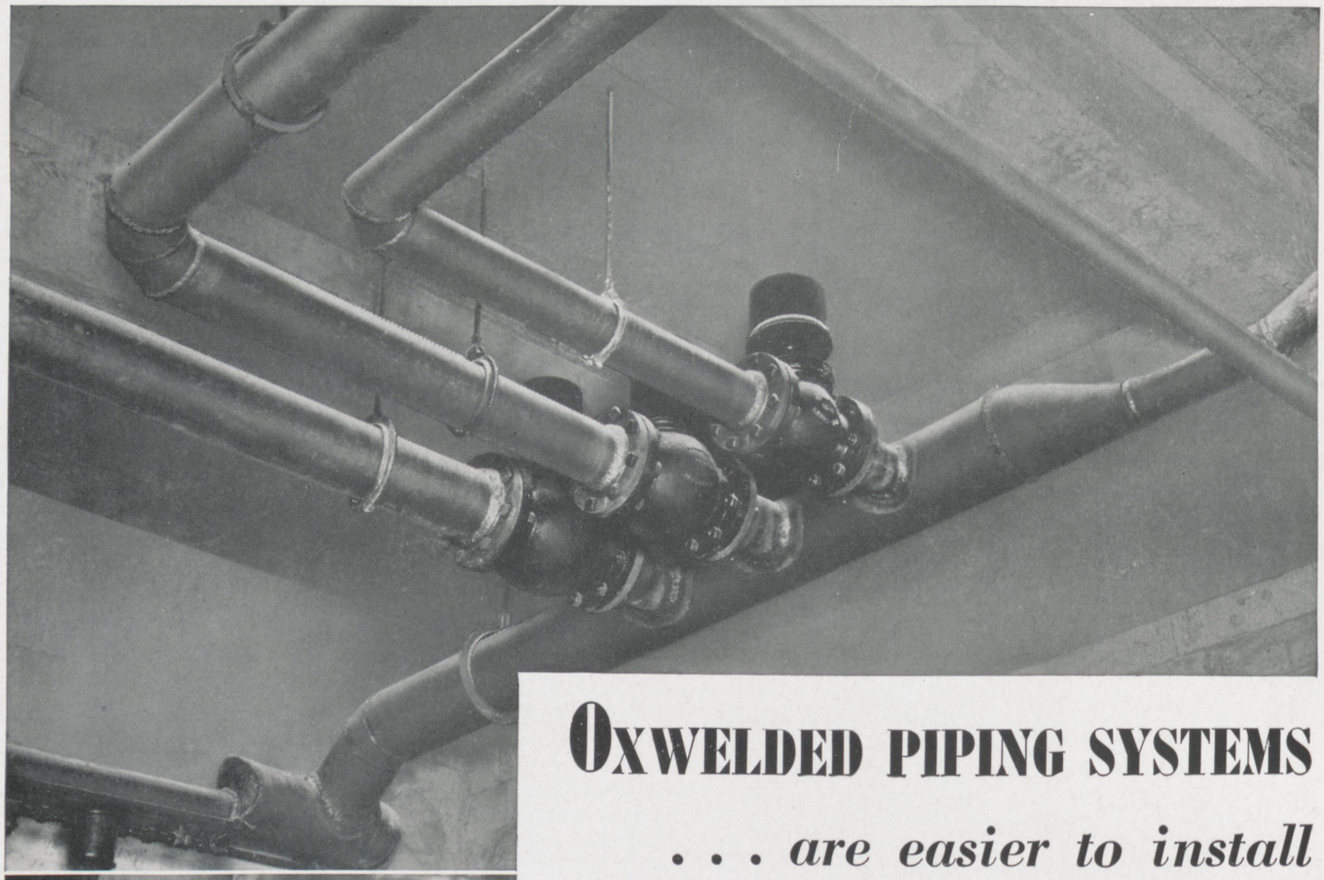
MARKS '35.

....SEASON'S GREETINGS....



On the installation shown above, the contractor fabricated by oxy-acetylene cutting and welding the bends, reducers, and other specials in his shop and installed them with tie-in welds on the job. The lines and bends were installed with a proximity which would have been impossible by other methods of joining. The insulation contractor estimated a 30 per cent saving on insulation labor because it was a welded installation.

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Surveying This Issue

OUR lead article this month is "Fuels." Mr. Averitt is starting a series of three articles which will treat individually solid, liquid, and gaseous fuels.

THE heavy traffic on our roads today calls for a balance of all forms of transportation. Mr. Harrod's article on "Land Transportation" concerns this problem.

IN this issue Mr. Denehie brings us interesting information concerning recent developments in "New All-Metal Radio Tubes."

WE have on our campus here at Rose some very interesting broadcasting apparatus. Mr. Mewhinney explains the two transmitters in "Broadcasting Equipment at Rose."

THE application of Diesel engines in all phases of industry today may not have been given our proper consideration. In any case you will enjoy reading "Diesel Engines in the World Today," by Mr. Carroll.

—*C. D. O.*

THE ROSE TECHNIC

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Lost Creek in Winter

Winter Scenes on the Campus

The Main Building

THE ROSE TECHNIC

THE TECHNICAL JOURNAL OF THE ROSE POLYTECHNIC INSTITUTE

Volume XLV DECEMBER, 1935 Number 3

FUELS

Robert A. Averitt, m., '37

Beginning With This Issue

ENGINEERS in all fields are interested in the production of power in some form or other. The phrase "production of power" is erroneous since what is actually meant is the transformation of some form of potential energy into kinetic energy. The most important source of potential energy which is used today is fuel. The chemical potential energy of the fuel is transformed into heat energy through combustion; the heat liberated acts upon some other medium, such as water, which in turn acts upon some mechanical device to produce kinetic energy. No power has been produced; the form of the energy has merely been transformed.

Classification of Fuels

Fuels may be divided into three distinct classes, namely, solid fuels, liquid fuels, and gaseous fuels. Let us now confine our discussion to solid fuels. A solid fuel, as the name implies, is solid in form and is a derivative of vegetable growth. Solid fuels may further be classified according to the method of preparation as natural fuels, prepared fuels, or refuse fuels.

Coal, A Natural Fuel

The most important of the natural solid fuels is coal. Coal is a rather general term embracing several distinct types. Anthracite coal, which is a hard glossy coal with a high volatile content, generally below five percent, is mined principally in the eastern coal fields of the United States. Anthracite is a clean coal, producing a relatively small amount of soot when burned. This coal is widely used as a domestic fuel. Its high initial cost prohibits its extensive use as an industrial fuel. Semi-Anthracite coal is a slightly softer coal, and contains a slightly higher volatile content. It is mined in the states of Colorado and Pennsylvania. Semi-Bituminous coal has a volatile content slightly higher than that of Semi-Anthracite and also has a higher moisture content. Bituminous coal is an abundant fuel, which is mined in most parts of the country, but principally in the midwest. Bituminous coal is consumed by the majority of industrial plants and by a large number of domestic plants throughout the midwest. This is largely due to the fact that the transportation cost is small compared to what it would be if anthracite coal from the eastern coal fields were shipped to the midwest states. Sub-Bituminous coal is higher in volatile matter and in moisture than Bituminous and has a lower heating value than any of the coals mentioned above. Lignite is a brownish-black, brittle sort of fuel which bears a marked resemblance to partly burned wood. It is comparatively low in heating value and high in volatile matter and moisture. All of the above-mentioned fuels are composed of carbon, hydrogen, oxygen, sulfur, and nitrogen, but each class has a different percentage range of each, which is responsible for the class characteristics of the coal. The heating values of the above-mentioned fuels vary approximately from seven thousand B.T.U. per pound for Lignite to fourteen thousand B.T.U. for Anthracite coal,

when based on the "as received" condition.

Storage of Coal

Industrial concerns which consume large amounts of coal are faced with the problem of coal storage. Storage difficulties may include effect of weather on heat value of coal, danger of spontaneous combustion, and disintegration of the coal itself. Anthracite coal may be stored without difficulty, but with those coals having a higher volatile content, more or less elaborate storing facilities must be provided. The two most prominent methods of storing coal are under-water storage and proper piling. When coal is piled, the fine aggregate must be thoroughly mixed with the coarse and then the mixture must be carefully compacted so as to eliminate any air pockets within the pile. Piles must not be too deep and must be repiled if dangerous internal heats develop.

Other Natural Fuels

The second most important natural solid fuel is wood. Its use as a commercial fuel is confined to more or less isolated conditions. The desirability of wood as a fuel depends greatly on its moisture content, which in turn depends on the time of year at which the timber is cut. Timber cut in the spring has a comparatively high moisture content, about ten percent higher than when cut in the winter. The main constituent of all species of wood is cellulose, the chief differences in species being found in the density and composition of the sap. The heat values of the different species of wood range from about eight thousand to nine thousand B.T.U. per pound.

Another fuel in this class which is used in some parts of the world is peat. This fuel is composed of vegetable matter, generally mosses and aquatic plants. Peat is a spongy black substance found in swamp bogs. Its heating value when dried in air is about the same as that of wood. There seems to be no doubt that the formation of peat is merely one stage in the natural process by which vegetable fiber is converted into coal.

Prepared Fuels

In the class of solid prepared fuels, coke is undoubtedly the most important. This fuel is the residue from the destructive distillation of certain kinds of Bituminous coals or of petroleum oils. The physical and chemical properties of coke depend upon the nature of the coal or petroleum from which it is made, and upon the subsequent exposure. In general, coke is a gray-black, porous solid. Cokes have a high carbon content and a high heating value, posessing about fourteen or fifteen thousand B.T.U. per pound. Some coal cokes are slightly lower than this in heating value. Coke is a clean fuel, is easily stored, and has a comparatively low ash content. For these reasons it is extensively used as a domestic fuel in regions where Anthracite coal is costly.

Minnig Bituminous Coal

—Cut Courtesy Maumee Colleries Co.

A second solid prepared fuel which is becoming prominent in commercial usage is pulverized coal. Coal of almost any type can be pulverized. The raw coal is ground to powder fineness in a crusher. It is then burned in a hot furnace by means of a mixer which mixes the coal with a stream of air or steam and blows the mixture into the furnace. In this respect, pulverized coal has much in common with a gaseous fuel. Pulverized coal is advantageous in that the combustion is very complete and that the rate of combustion is easily controlled. Pulverizers have a high initial cost, however, and the storage problem is exceedingly complicated. Furthermore, ash disposal becomes a difficult problem because the ash has a tendency to go out the stack with the flue gases. Pulverized coal, however, is thought by many to be superior to any other type of coal fuel and is being installed in many large plants throughout the world.

Many plants in the wood working industries use refuse for fuel. Much of this refuse fuel is simply waste wood or sawdust. Other forms of solid refuse are fuelsare, tanbark, and bagasse. Tanbark is the remains of the oak or hemlock bark which is used in leather tanning. Bagasse is the crushed stalks of sugar cane, from which the juice has been extracted. Tanbark is finely divided in form and usually requires some other fuel for complete combustion. The moisture content is high, and the heating value will not exceed four thousand B.T.U. per pound as fired. The heating value of bagasse usually does not exceed four thousand B.T.U. per pound as fired. Refuse is not used for a fuel except under conditions where the refuse is a by-product of some other operation. Of all the solid fuels, coal is by far the most important.

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Land Transportation

By Raymond Harrod, m., '36

PERHAPS the title of this paper seems a bit inclusive, but when we stop to realize that one of the greatest physical and social problems of today is that of coordination and integration of the nation's internal distribution system, it sounds more reasonable.

Aside from the actual moving of freight and passengers, the prime requisite of transportation is speed. Time saved in transit means more effective use of capital and of human ability. Time is lost either at the terminal or on the road. The railroads have become very efficient in the utilization of time on the road but at a sacrifice of terminal efficiency due to investment in the wrong kind of capital goods, such as oversized locomotives. Highway transport is not so efficient on the road, but because of the small capacity of the units the terminal loss is practically negligible. So the problem is to combine the use of railroad right-of-way with the use of highway terminals and localized distribution facilities to yield a new and more efficient system.

Economy, of course, is another factor. The differential of actual cost of transportation must be balanced against a corresponding differential of the value of the time lost, that is, so much capital invested at a certain rate of interest or so many man-hours at so much per man-hour.

In passenger service, comfort, convenience, and safety also figure in the relative merit of any transportation system. The balancing of one point against another is that which makes competition interesting.

The points to be considered in freight service are speed, through billing, pick up and delivery, service, and reliability of the carrier.

With the above points in mind let us look into the different phases of the transportation of freight and passengers by land over a considerable distance.

Since the private automobile is the most popular, it should be considered first. It provides several advantages. Personal choice of routing, timing, and quality of service demanded; the economy and convenience of using one's own car at the destination; and the ability to take along one's friends at little or no extra cost are special points to be considered. It has comfort except when night operation is necessary. Automobile speeds are comparable to those of medium fast trains. However, at fast speeds the automobile lacks safety, but this important factor is often neglected. In recent years much has been done to increase the comfort, speed, safety, and economy of automotive travel. The modern house trailer has much promise even for the commercial traveler. In fact, it has been predicted that soon a large portion of the population of the United States will be more or less permanently housed in them. While solving the age-old problem of the immobility of labor, it will create many new problems.

Although de luxe railway service (sleepers, parlor cars, etc.) is more important than coach service from the financial standpoint, it is considerably less important when the passenger-mile is the standard. The railroads have been reluctant to greatly improve coach service, because they feared it would detract from the de luxe service. In other words, they are confronted with the problem of catering to two classes of demands. And now that air competition is effectively cutting into the de luxe class, the problem becomes acute. In the future the railroad's best market will be overnight service for trips of the order of six hundred miles, requiring about twelve hours of time. However, the entire field of coach service is still open. In both fields lower fares and service charges are the most important requisites. Competing forms of transportation and six years of depression have taught the traveler not to pay premiums for food, supplies, etc. In many parts of the country the railways have lowered their rates with satisfactory results, and much is being done to improve coach service. Better seats, more space per passenger, sanitary head rests, larger lavatories, cheaper food, air conditioning, and even stewardess service are some of the features to be found in the south and west for less than two cents per mile.

In regard to new ideas in passenger car engineering, the three or four car Diesel powered train seems to be the most popular. The Chicago-Twin Cities run on the various railroads is being used as a proving ground. The Burlington is using Diesel powered, extra light, articulated, high speed trains on schedules between these cities; The C. & N. W. is using standard steam trains; and the Milwaukee is using steam trains of a semi-light weight design. The Chicago-St. Louis run also promises to be such a test ground for high speed service; the running time has already been cut more than fifteen percent.

Some roads in the southwest are making attempts to get local traffic by the use of rail busses. One company recently converted its busses for rail use; another is using a rubber tired coach pulled by a self-propelled express-mail car. The promoters of the rail-bus idea contend that a bus is able to operate

with greater speed, comfort, and safety on rails than by highway and that by combining a bus load of passengers with one or two truck loads of mail and express, great economy can be realized, as well.

One important point that is overlooked by the layman in regard to rail cars is that a low center of gravity is not desirable. For a car with a low center of gravity the impact between the flange and the rail is greater than for a car with a high center of gravity, because with a high center of gravity impacts are partially absorbed by the rocking of the car on the springs.

The entire field of commercial highway transportation is governed by the recently passed law which places the industry partially under the jurisdiction of the Interstate Commerce Commission; therefore, there will probably be considerable change within the next few years.

At the present time interstate bus lines are making quite an effort to increase speed. This is being done by cutting down the length of rest stops and by running non-stop express schedules. On some runs, notably in the west where highway traffic is comparatively light, bus speeds approach train speeds. On the Chicago-New York run the time is twenty-seven hours as compared to sixteen and one-half or more by train.

Bus lines attempt to keep their fares at less than two-thirds of rail fares. Rates are less than one cent per mile in the south.

The introduction of sleeper busses on transcontinental service is perhaps the most significant of the recent developments.

Many modern busses have the engine in the rear or under the floor. They have low centers of gravity and low floors.

Of interest especially to the private motorist is the development of the small capacity bus. Its advantages are: greater speed, frequent service, through service, greater safety, greater ease of operation, greater popularity with the general public, and lower capital investment. Almost all manufacturers have seventeen to twenty-one passenger inter-city busses on the market. The FitzJohn Body Company has a "thoroughly engineered and proven conversion of the 1935 Chevrolet Master sedan into a vehicle with a capacity of eleven persons, including the driver". The conversion has a wheelbase of one hundred eighty-five inches, weighs four thousand three hundred pounds, and is equipped with seats of thirty-nine inch spacing. In the event of actual coordinated transportation the small bus will probably become predominant. Increasingly keen competition will eventually require the use of the small bus. Since lower fares are more or less independent of costs, this may be considered a desirable trend.

Although many lines use a two man crew, the tractor semi-trailer type bus is not in common usage. Nevertheless, it merits consideration because of certain advantages. It is easier to handle, has a lower center of gravity, is safer, costs less per unit, and has less wheel load. A disadvantage is that this type has slightly reduced acceleration and hill climbing ability because of the weight on, and the position of, the driving axle or axles. The flexibility, economy (where two men are employed anyway), and safety present possibilities which may well be considered.

In the trucking industry the application of Diesel power is outstanding among recent developments. Commercial motor vehicles are continually being subjected more and more to the restriction of State and Federal regulations. Some states have a mileage tax; Indiana has a weight tax on commercial vehicles. There are restrictions and prohibitions on certain roads. Most states require special lights and emergency equipment. One distinct failure of the states has been concerned with the personnel and labor regulations of trucking companies. The hazard of sleepy truck drivers has of necessity been left to the Federal Government. If the tramp truck is to remain (under Federal regulations), safety considerations will necessitate the use of three drivers for long trips.

Just why there has been no tax on the size of vehicles is rather a mystery. Highways are designed for use primarily by the private automobile, which is about six feet wide and fifteen feet long. A transport truck or bus is eight feet wide and thirty or thirty-five long and has an area three times that of an ordinary car. A progressive tax, say on vehicles over eighty inches wide and over twenty feet long, which is just steep enough to be felt, with a rate of about two dollars a foot length and inch width thus amounting to fifty or sixty dollars on large transport trucks, would be both effective, penetrating, simple, and just, and also a highly flexible method of making the highways safer. If correctly administered, it would not prove a detriment to the motor transport industry, because it (the industry) would tend toward a more efficient use of the highways. In fact, many operators and manufacturers would welcome some such control by the Federal Government in order to ward off varied and perhaps aggressive measures passed by the states to appease the motorist. From an engineering standpoint, such a tax would encourage the development of such features as cab-over-engine design, transverse motor, horizontal cylinders, multiple axles, and the like.

There is considerable interest shown in the idea of building trucks to run on both rails and highways. Certain advantages which are apparent include less handling, more safety, greater popularity with the general public, better service to towns not on railroads, less congestion at terminals, and smaller crews possible

with multiple unit combinations. The Evans Products Company is producing units similar to the Twin Coach system (Rose Technic, November, 1933). These units are equipped with retractable guide wheels. The General Transportation Company together with the B. F. Goodrich Company has patented a "combination wheel" which is an ordinary railway wheel with a penumatic tire mounted beside it. If the tire is deflated, the wheel is ready for railway use; when inflated, the wheel is used on the highway. With trucks using air brakes this scheme presents no large problem. Since an ordinary eighty horse-power tractor could easily handle three or four regular trailers by rail, the labor cost compares favorably with that of highway operation, namely, one-half to one man per load unit as compared to one or two per unit as required by most states for transport trucks. Many engineers feel that the rail truck is the answer to the railroads' problem.

Standardization of the container car system has progressed considerably since 1933. The length and width of such units are definitely limited by the width of railroad car and of trucks respectively. There is still some question as to the method of handling; cranes and skids have been used. The crane is perhaps the best, but it requires a considerable outlay of capital. Skids are cheaper but more cumbersome to handle. Both systems are used on the same containers. Open containers can be used for transporting domestic coal and stone for roads. Agreement and subsequent legislation are expected soon on the container system.

At the present time an organization which is operating considerable mileage of ferry trucks in Illinois is expanding into a nation-wide enterprise under the federal regulation of motor carriers. The ferry truck system of coordination has a marked advantage over the others in that it involves a minimum of new capital and reorganization. This is a quick, cheap, and easy method of coordinating transportation.

Many railroads are now engaged in pick-up and delivery service either directly, or through a subsidiary, or by local contract on certain classes of freight.

Economy is being introduced by the reduction of tare weight and by the development of all purpose cars. Materials such as aluminum and "Cor ten" play an important part in this economy drive. Some new cars have doors in the sides, top, and bottom. These cars are economical in that they may be loaded with a crane and unloaded by dumping, besides being used as regular box cars. Another design is the covered hopper car, similar to the above mentioned box car but without side openings.

A much needed balance of all forms of transportation is expected from the Federal Government's regulation. The heavy and long distance traffic will surely revert to the rails, while local, light weight traffic will remain on the highways. If a well planned program, extending over a period of several years, is adopted, obsolescence and general expansion of traffic will overcome most difficulties.

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New All-Metal Radio Tubes

Edward B. Denehie, e., '36

ALTHOUGH metal tubes have been on the market in Europe for some time, they are quite new to us in the United States. Improved American made tubes are now available, and within a short time they will be used in most of our modern radio receivers. The metal tube is considered to be one of the outstanding achievements in the recent improvement of radio receiving equipment. For over two years the metal radio tube, a General Electric product, has been in the course of development in their laboratories.

It is interesting to note that the glass type tube began as a development of Edison's original incandescent lamp, which was necessarily made of glass in order to transmit the light that was given off by the white hot filament. In adapting the incandescent lamp principle to the requirements of radio, the glass was retained merely because it was already there; in other words, the line of least resistance was followed. Since the enclosure by glass seemed quite satisfactory, tube manufacturers continued to use it. The fact that the tube filament can be seen when glowing, the only apparent advantage of the glass, is actually of no intrinsic value, because the tube has lost its efficiency long before the element ceases to glow. Therefore, it can be seen that transparency in the tube element, which requires the use of glass, is quite unnecessary.

Among the numerous advantages

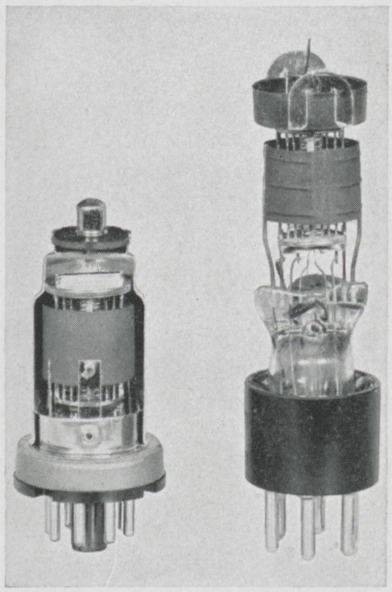
of the new metal tubes over those of glass are the following: (1) they are smaller and sturdier, (2) they provide their own shielding, and in addition the metal shield excels glass as a heat conductor and radiator, (3) they are of particular advantage in the field of short-wave reception, because the shorter leads which are used permit greater amplification at the higher frequencies, while the more effective shielding insures greater stability.

Cylindrical in form, some of the tubes have a smaller diameter at the top. Others, like the glass-type tubes, have a terminal at the top. The metal shell is assembled to a steel and plate or "header," on which the inner parts of the tube have first been assembled. Each lead-in wire passes through a tiny bead of special glass that is fused securely within an alloy eyelet, which in turn is welded to the metal end plate. This insures a lifelong vacuum so far as any leakage at these points is concerned. Especially developed for the purpose is Fernico, the alloy used for the eyelet. Fernico is a combination of iron, nickel, and cobalt and has substantially the same coefficient of expansion as glass, thereby giving assurance that extremes of heat and cold will not cause strain on either the metal eyelet or the glass bead. The use of Fernico eyelets and glass bead seals permits of many advantageous innovations in tube assembly. Some of these are: (1) elimination of need for the usual glass-stem structure, (2) reduction in overall length without reducing size of electrode structure, (3) small distance between mount and base with resultant rigidity of the mount, and (4) short and direct connection of each electrode to its pin terminal.

The "pinch seal" in which all leads and supports are concentrated in the glass-type tubes has been eliminated in the metal tubes, thus allowing the leads to enter the header of the metal tube at the proper points for short, direct paths. This is an important advantage in short-wave reception particularly.

The familiar metal shield, or "can", which is necessary with the glass tube in radio-frequency stages of a circuit, is no longer required with the new tube. The metal envelope itself serves as the shield. The shielding is also more effective because closer proximity of shield to elements can be obtained.

In some types of glass enclosed screen-grid tubes the anode is shielded in three different ways: (1) by an internal structure, (2) by a coating on the inside of the glass bulb, (3) and when in use, by an external "can." In the new metal tube, however, all of these functions are performed by the shell of the tube itself. The elimination of these internal shields is the one factor that contributes to the making of smaller sized metal tubes, most of which are approximately half the size of their glass-enclosed counterparts. In comparing the possible relative accuracy in the glass-type tubes and the metal tubes, the latter is found to be far ahead. Since the need of large spaces between inside parts of the tube and the shell are done away with, clearances can be much smaller, and the net result is a smaller, sturdier tube.



Comparative Cut-away models of a New All-Metal Tube (left) *and a Glass Counterpart Tube* (right).

—*Cut Courtesy G. E.*

It is readily seen that because of their smaller size the metal tubes require less space in a radio chassis, the elimination of external shields helping still further in this regard. In this way it is possible to do away with the so-called "dual purpose" tubes, made necessary during the past few years by the limited space in small receivers. Since single-function tubes perform much more satisfactorily, it is well that they can again be used throughout the circuit.

Because the envelope has become the shield and provision must be made to ground it, metal tubes have one more base pin than comparable glass tubes. Greater ease of inserting the tube in its socket has also been considered in the design. In the conventional glass tube two of the base pins are of larger diameter than the others, which necessitates the alignment of the larger pins with corresponding socket holes. In the base of the new tube all the pins are of the same diameter, and in the center is a longer insulated key pin. By placing this pin in a hole centrally located in the socket and rotating the tube until the key slips into its groove, the tube is easily inserted.

By the first of last August, 43 set manufacturers (88% of all R. C. A. licenses) had adopted metal for their entire lines or in higher-priced models. Practically all of those who have not yet adopted the new tubes vow they will change as soon as deliveries are assured and field performances have proved laboratory claims.

No industry can make so radical a change over night. It costs a great deal of money to tool up for metal tubes. There are 10 types in the line, and elements are similar to the old. Bases are quite different and the assembly is different. So the new tube is just now getting into the field.

Total tube sales for 1935 were 55,199,000, out of which 28,642,000 went for replacements. But the metal tube is not interchangeable, and therefore cannot be used in old sets without a wiring job. Consequently, there will be a large continuing market for glass tubes. As in the case of all new devices, time will prove the relative values of glass and metal tubes. The radio public will be the deciding factor.

Acknowledgment

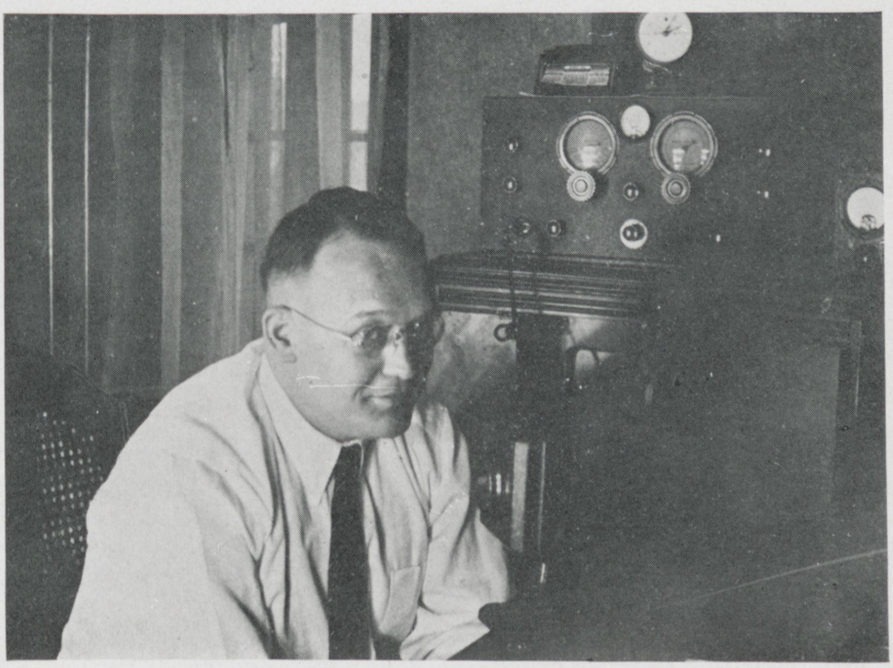
The author wishes to express his appreciation to the General Electric Company for their assistance in the preparation of this article and for the cut.

Broadcasting Equipment at Rose

Albert B. Mewhinney, e., '36

The 200-Watt Transmitter

THE latest addition to the field of applied radio engineering on the Rose Campus is the new 200 watt radiophone transmitter which was designed and built by Mr. T. A. Hunter. At the present time the transmitter is located in the office of the Physics Department and consists of the following circuits and tubes: one type 47 as a crystal controlled radio frequency oscillator, two type 46's in parallel as a radio frequency buffer or driver stage, and one type 203A as a radio frequency final amplifier. These circuits are sufficient for the needs of communication by code, which is merely the interruption of radio frequency power. However, if it is desired to communicate by phone, additional equipment is needed to vary the magnitude of the radio frequency power at audio frequencies. This is done by impressing amplified audio frequencies upon the radio frequency final amplifier stage. To accomplish this the speech equipment of the transmitter consists of the following units: a crystal microphone, a pre-amplifier using one type 57 tube, two type 56's in series, and two type 2A3's in Class B. This amplifier drives the final audio amplifier consisting of four type 46's operating in push-pull-parallel, which in turn modulates the radio frequency final amplifier.



Mr. Hunter at the 400-Watt Transmitter

This modulation is essentially the mixing or superposition of two types of energy, namely, radio frequency and audio frequency. The audio frequencies impressed on the microphone are amplified many times in special equipment built for that purpose. The radio frequency oscillations originating in the crystal oscillator are amplified by distinctly separate equipment as can be seen in the block diagram. The paths of these two types of energy are entirely separate until the final stage of the transmitter is reached. Here they are mixed. This mixing or modulation is in reality a translation of frequency. Radio frequency waves have the properties of radiating from wires and traveling through space. Audio frequencies do not have these characteristics. In order to transmit audio frequencies by air it is necessary to translate them to a radio frequency band. This is called modulation. When these waves reach a receiver they undergo the reverse process of modulation, that is, they are demodulated or detected. Here the radio frequency portion of the wave which only served as a carrier is discarded, and the audio frequency portion of the wave is reproduced in the loud speaker.

The power supply for the whole transmitter is completely self contained. No batteries of any kind are needed. The plate supply which consists of a high voltage transformer and a bridge rectifier sys-

tem delivers 1000 volts D. C. at 400 milliamperes and 500 volts D. C. at 400 milliamperes. The filament voltages are supplied by a separate transformer.

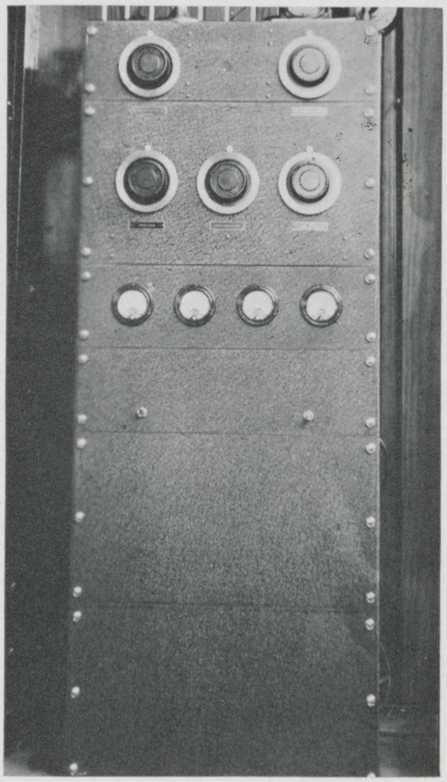
It is a well known fact that to obtain the maximum power from a generator the load resistance must match the internal resistance of the generator. This matching of resistances must also be carried out at radio frequencies if appreciable power is to be radiated from an antenna. In order to match the resistance of an antenna to the very different resistance of a transmitter, an impedance matching network is used. This is merely a combination of coils and condensers, which is placed between the transmitter and the antenna. This network serves the purpose of making the transmitter believe it is connected to a resistance equal to its own, and that the antenna is connected to a resistance equal to its own, thus allowing a maximum transfer of power between the two.

This network is tuned by means of the two upper dials shown in the picture of the 200 watt transmitter. The power supply is directly behind the bottom panel, and the next panel conceals the speech equipment. The two toggle switches control the plate and filament supplies. Reading from right to left the four meters read, respectively, oscillator plate current, buffer plate current, final amplifier grid current, and final amplifier plate current. The three dials above the meters tune the oscillator, the buffer, and the final amplifier stages respectively, reading from right to left. The transmitter is made of sheet steel enclosed on three sides and finished in black crystalline lacquer.

Radiating System

In order to transfer the power from the transmitter to the antenna without loss, some kind of a radio frequency transmission line which radiates no power must be used. A single wire type was chosen in this case to feed the antenna, which is 120 feet long and directly above the building. The single wire type of radio frequency transmission line is somewhat harder to adjust than other types, but it will give very efficient service if the line is connected to the antenna at the proper point. Under proper operating conditions the length of the single wire feeder has no effect on operation, while for other types of radio frequency transmission lines the length is very important.

During the summer this transmitter was located in Iowa and



The 200-Watt Transmitter

operated in the 80 meter amateur band. From this location the maximum radius over which communication was held was 1000 miles. In the daytime the maximum distance for reliable communication was about 700 miles. This decrease is due to the changing height of the Kennelly-Heaviside layer of ionized gas, which affects radio transmission.

The existence of such a layer of gas was proposed independently and almost simultaneously by Kennelly, an American, and Heaviside, an Englishman. This layer seems to vary in height above the earth from 5 to 15 miles. It has an action upon radio waves similar to that of a water surface upon light. When a beam of light is directed toward a surface of water, it will be reflected upward. If the angle of direction is made larger, there will be a position beyond which the light is absorbed and very little is reflected. In the same way a radio wave traveling upward from the earth will strike the Kennelly-Heaviside layer and be absorbed or reflected depending upon the angle of direction. The reflected waves may return to the earth at some distant point and be picked up by a receiver. Such a reflected signal will fade rapidly, corresponding to variations in density and height of the ionized layer.

From his home in Iowa, Mr. Hunter contacted many of the friends in this area which he made last fall while transmitting code lessons with his 400 watt transmitter. This transmitter is shown in the above picture.

The 400-Watt Transmitter

The radio frequency circuit of this larger transmitter consists of a type 47 crystal oscillator, a type 46 buffer, two type 210's as a second buffer, and two type 203A's in push-pull as a final amplifier. The speech equipment of the 400 watt transmitter is the same as that of the 200 watt transmitter except that the final audio amplifier consists of two type 203-A tubes operating in Class B. The power supply for this transmitter is similar to the first one described, except that it is necessarily much larger and heavier. All the power transformers and filter chokes for both transmitters were constructed at Rose. With this transmitter operating in the 160 meter amateur phone band, Mr. Hunter has talked with stations all over the United States excepting those on the West coast. This transmitter would cover still larger areas if it were operated in the 80 meter amateur band, be-

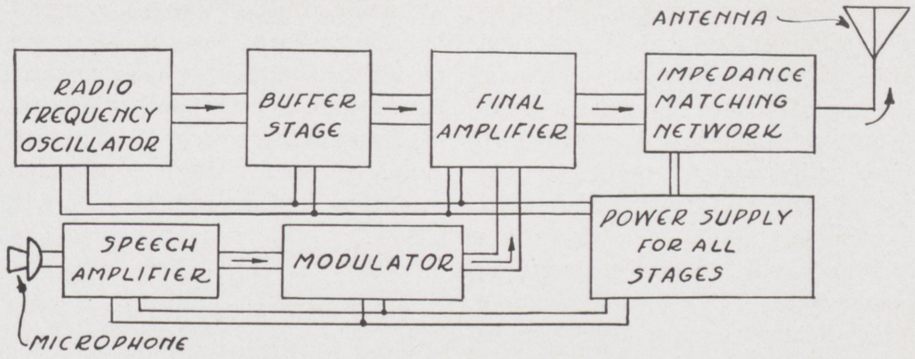


DIAGRAM OF TRANSMITTER COMPONENTS

cause within limits it is possible to communicate over greater distances with the same power by increasing the frequency.

At the present time Mr. Hunter is operating either transmitter by remote control from his Edgewood Apartment, using a two wire telephone line and a system of relays to turn on the transmitter. The telephone line carries the direct current which operates the relays and also carries the voice frequencies to the transmitter.

Thus it can be seen that these two transmitters, in addition to being a practical application of radio engineering, also constitute a definite source of publicity for Rose, since Station W9NBZ is well known throughout the middle West.

Diesel Engines in the World of Today

Lawrence Carroll, e., '37

THE Diesel type of engine will become dominant, headlines tell us. News flash following news flash announces outstanding performance on land and sea and in the air. A Diesel-powered racing car whirls the five-hundred-mile Indianapolis racetrack at an average speed of eighty-six miles per hour; a giant bus speeds from New York to Los Angeles in ninety-one hours at a total fuel cost of $21.90; the Navy installs a Diesel in its newest submarine; and an airplane so powered covers thousands of miles at a fraction of normal cost.

All these events are fact. The Diesel has been doing astonishing things and has established itself as a dependable, economical motive force. Headlines tell only part of the story. As to its future commercial possibilities, the value of the Diesel has to be appraised in a less sensational manner. Among engineers there is a great difference of opinion regarding the Diesel's future; hence the possibilities of this engine will have to be gauged from the progress made internally in the perfecting of the engine, and from a consideration of external factors bearing upon its commercial use.

Contrary to popular opinion, the Diesel is not radical or new, but was invented in 1898. The "why" and definition of a Diesel engine is contained in a booklet of The Caterpillar Tractor Company:

"A Diesel engine is an internal combustion engine in which the fuel is ignited by the heat of compression, and is so named because the early development of this engine had as one of its most active proponents, Dr. Rudolph Diesel. Dr. Diesel starting with the simple fact that compressing any body of air causes it to become heated, made computations which convinced him that if the compression were carried far enough, sufficient heat would be generated to burn powdered or liquid fuels. For instance, if air is compressed to 375 pounds per square inch, the temperature will rise to 500°. If fuel is sprayed into such highly heated air, combustion will immediately take place.

The basic principle of the Diesel type of engine can best be understood by comparing the action of a four cycle Diesel engine with that of a four cycle gasoline engine, with which most people are familiar. In both types of engine there are the same four strokes in the cycle, namely, intake, compression, power and exhaust.

On the intake stroke, the gasoline engine draws in from the carburetor a mixture of gasoline and air. The Diesel type engine has no carburetor, and draws in this stroke only air.

On the compression stroke, the gasoline engine compresses the combustible mixture to about 80 pounds per square inch. In the Diesel type engine, the high compression produces sufficient heat to ignite the fuel which is injected into the cylinder at this point. In both cases, the burning of the fuel then produces the power stroke.

On the exhaust stroke, the action in the Diesel type engine, like that in the gasoline engine, is the scavenging of the combustion chamber."

Early Diesels were cumbersome, rough in operation, and odorous; hence first application very naturally took place where these characteristics were no drawback. They were used in the stationary power field for generating electricity, pumping, and so on. Later they came into marine use. In both fields the Diesel has been widely applied and vastly improved, but its performance has not been highly dramatic. The public, being only indirectly concerned with the means of lowering power costs, has paid little attention to the inroads of this engine. Now, with Diesels appearing in trucks, airplanes, and railcars, it is a different matter. These most recent developments are arresting.

Diesel power is now applied in the following six distinct fields: stationary power; marine; railcar; trucks, busses, and tractors; passenger cars; aircraft.

Before we discuss what the Diesel has done in these various fields and what it may be expected to do in the future, let us look a moment at the reasons why the Diesel has taken its place in industry. Its advantages are explained, in part, in the bulletin of The Waukesha Motor Company. They speak of automotive application, but the advantages stated are true of all Diesels.

"A Diesel engine uses cheap oils and, on account of the higher efficiency of its working cycle, burns them more economically than could be done in a carburetor engine, even if a satisfactory method of carbureting these heavy oils could be devised. Assuming a Diesel oil cost of six cents per gallon and a gasoline cost of twelve cents per gallon, a Diesel engine will perform the same duty as a gasoline engine with a saving in fuel costs of 60% to 75%.

In performance the Diesel's low speed torque characteristics give it another advantage. If a sudden load is thrown on a Diesel engine its operating speed will not drop nearly as quickly as a gasoline engine's; in other words, it will "hang on" and "lug" better. It is harder to "kill". On a day's run with a truck or bus negotiating mountains, hills, and plains, this lugging ability piles up greater daily mileage."

The Diesel has established itself securely in the stationary power field by demonstrating its ability to reduce costs. In outlying communities it is providing power for industry, and even in the heart of metropolitan cities it has made way in the face of supposedly adequate public utilities facilities.

Since costs are the deciding factor for stationary power, the desirability of the Diesel over the other power producers must be determined in each instance in the light of oil and coal costs, the amount of steam needed in process work, and the local energy rate cost. We are likely to see Diesel development make quite rapid strides in communities where electric power rates are high, where power must be transmitted long distances, or where a community is too small for an economical power plant. These facts are set forth by "Power":

"The shift to the more favorable attitude of public utilities within the past year or two in based primarily upon the decrease in installed cost per kilowatt. The overall cost of a complete Diesel generating plant of moderate capacity, including land and building, may now be estimated at about $85 per installed kilomatt, according to the A. S. M. E. progress report, as compared with $150 a few years ago. This reduction which is greater than the general drop of price in machinery during the same period, can be expressed by advances in design and construction of large Diesels."

Diesels have been installed in every type of seagoing craft from the small privately owned vessel to the large ocean liner. It is a well recognized producer of marine power and a large proportion of the total Diesel power in use goes to sea. Phillip H. Smith writing for Scientific American says:

"It is growing more popular for small craft, but increases for large craft appear to await a revival of interest in world shipping. Recently the Navy and Coast Guard have been among the most prominent buyers of Diesels, and this governmental use, together with installations in the new German "pocket battleships", is perhaps most responsible for drawing public attention to possibilities in this field."

When it comes to mobile equipment-installation in cars, trucks, railcars, and airplanes, the Diesel steps out into a field where it has yet to win its spurs. It has, however, accomplished feats which have stirred the imagination, created much furor among engineers, and generally stimulated a vast amount of thorough research. Phillip Smith explains this development in the mobile power field as follows:

"The development of Diesels has been mainly in the direction of cutting weight and raising engine speeds. The low-speed type of Diesel weighs about 100 pounds per horsepower, whereas 400 pounds was once acceptable. And radically new types have been developed having weights and speeds comparable to their spark-ignition counterparts. For example, the six-cylinder Cummins Diesel for trucks and busses, delivering 125 horsepower at 1800 revolutions per minute, has a weight per horsepower of 15.6 pounds, while six cylinder standard spark ignition engines for similar use, of comparable horsepower and engine speeds, have a weight per horsepower ranging from 10 to 14.9 pounds."

The high economy of a Diesel powered auto is amply shown by the words of William F. Sturm in

speaking of a trip made by a Diesel automobile:

"The actual average per gallon with the car running wide open most of the time and no attempt made at fuel economy, was 27.2 miles, which includes distance between cities and mileage used within city limits demonstrating the car. The fuel cost per mile was less than three mills, yet the car weighed 6000 pounds."

It is logical to expect Diesel development where rapid acceleration, vibration, and easy starting are of paramount importance, and this is what we find. High speed Diesels are going into railcars and meeting with great success. Who has not heard of the Burlington *Zephyr*, for example?

"This light weight ultra-modern train, powered with a Winton 660 horsepower Diesel covered the 1015 miles between Denver and Chicago in a non-stop run of 13 hours, cutting the normal running time in half and making a top speed of 112.5 miles per hour. Authorities predict that Diesels will play a major part in railcar development and that American roads will follow on the heels of the European where Diesels have become prime movers for new equipment."

These high speeds are supplemented by other advantages as explained in an issue of the "Rose Technic".

"Its great flexibility together with its many other advantages presents a topic for discussion itself. The fact that no overhead wire or third rail is needed in the self-contained unit greatly reduces the first cost of installation. By using direct current generators, which would be practical in power transmission lines, a direct current series motor having a high starting torque may be used to great advantage. These features, inherent to the Diesel-electric locomotive, render it readily adaptable to freight yards and terminals."

Another logical field for immediate exploitation is motor truck transport. Here again progress is being made. Within the past two years eight truck manufacturers have added standard Diesel-engined models to supplement their regular lines, and engine makers are offering Diesels for original installation or replacement.

The final use of the Diesel which will be considered here is that in the aircraft field. The present status of the Diesel in aircraft is stated as follows:

"Before we see Diesels in the hands of the motoring public we are more likely to see them propelling aircraft. While no airplane producer can be found who is pushing Diesel development at present, although Packard has a Diesel airplane engine, much attention has been paid to it by research groups. The National Advisory Committee for Aeronautics, for example, has been investigating the two stroke Diesel engine. And the Army and Navy continue to show active interest, because the low fuel consumption would afford wider cruising ranges and definite economic advantages on routes or flights exceeding 500 miles."

Continuing the advantages of Diesels for aircraft use, we find in "Scientific American" the following:

"Another interesting point in the Diesel is the fact that it will operate successfully in any position. All engines using carburetors are dependent upon gravity as far as correct functioning of the carburetor is concerned. With the Diesel worry as to position in a steep climb or in stunting is entirely eliminated."

Certainly, with the increasing interest in the Diesel and with the continued effort toward its perfection, its use will grow. In the stationary power field and marine field, its place is secure, and the advent of the small, lighter weight, high speed type is giving a certain mobility to this power source. In railcar and motor truck transportation definite progress has been made, but it promises to be some years before Diesels will cut any large figures in passenger cars. Here, as in aviation, much experimental research remains to be done before the Diesel becomes commercially practical. Cattell puts forth his views thus:

"Engineers are continually debating the range of usefulness of the Diesel engine and most of them agree that in its present state it can be economically operated as a subordinate source of power under many conditions."

Remarks are often made such as this:

"Industries are slowly awakening to the possibilities of the Diesel and if it were not for the present lack of money undoubtedly more Diesels would be installed."

Whether the Diesel can successfully push aside many present producers of power is more than can be said, but we do know that in many applications the Diesel engine is providing a great connecting link between efficiency and the world of industry.

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THE ROSE TECHNIC

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Basketball Returns

THE Technic greets with pleasure the announcement that intercollegiate basketball returns to the athletic program of Rose.

Although the decision was made at too late a date to arrange a full schedule, it is hoped that a satisfactory schedule will be arranged so that the squad will be rewarded for its efforts.

During the past four years the intercollegiate sports program at Rose has consisted solely of football. The results have not been gratifying on the whole, and consequently Rose has not received much favorable attention. During this time the number of outstanding football players has been very small; on the other hand there was in school during this time a large group of men who had been outstanding basketball players in high school. It seems a bit ironical that basketball should return to the athletic program after most of this group has been graduated. Nevertheless, basketball is back, and whether or not it has come back to stay depends largely upon the interest and cooperation shown by the students, both as spectators and participants. Let's get back of the squad, and let's give them our wholehearted support.

Why Chemical Engineering Economics

Psychologists tell us that all life can be measured in terms of four mental or emotional hungers that are just as real as those of the physical sort. Recognition, response, security and new experience guide every life, although the balance may vary with different people or at various times in the life of the individual. For most of us, the events of the last few years serve to set apart and emphasize the inevitable conflict between the desires for security and new experience. We become known as conservatives or liberals. We are one but not the other —notwithstanding the fact that these are times when every decision of life calls for a considerate, open-minded balancing of values.

"New" may well be the watchword for 1936. It applies to nearly every concept of government and business. We are in a period of experimentation, when many things will be tried and although most of them will inevitably fail, we will make progress if we learn as we go. On the other hand, prejudices, preconceived notions, and discounted results can lead only to the end of experiment and back to where we started months ago.

Even though most of the progress in science has resulted from experiment, we chemists and engineers as a class are among the last to want to see experimental methods applied in the economic and social world about us. Our training, if any in subjects other than science and mathematics, has been in the classical schools of economics and history where laiseez-faire and dog-eat-dog individualism were the reigning doctrines. Now comes the time when other things are more important than material achievements. Witness this challenge to engineers made by Secretary of Agriculture Wallace at a recent meeting of the A. A. A. S. in Boston:

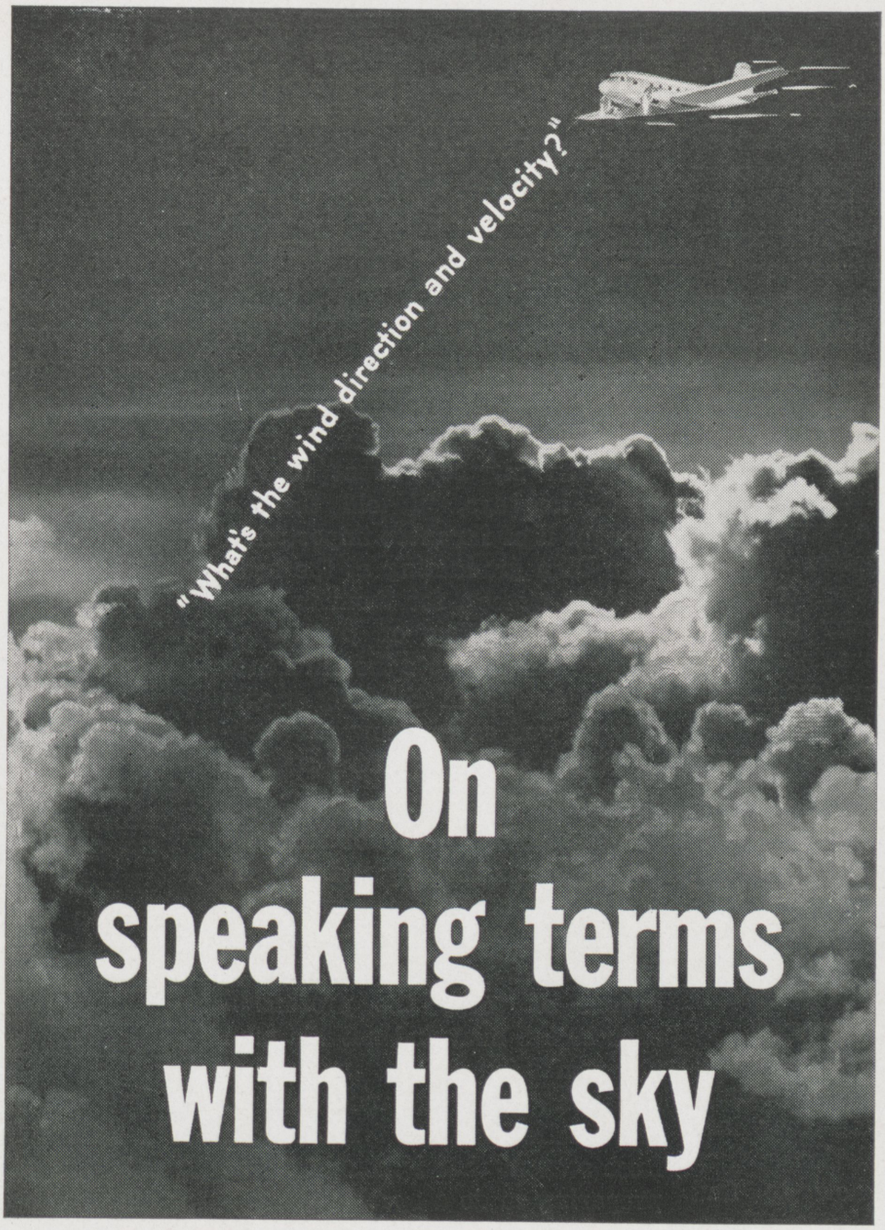
"Trouble, if it comes, will not be in the inability of scientists and technologists to understand man and to call out the best that is in him. In solving this limitation the scientists and engineers have all-too-often been a handicap rather than a help. They have turned loose upon the world new productive power without regard to the social implications . . . Science and engineering will destroy themselves and the civilization of which they are a part unless there is built up a consciousness which is as real and definite in meeting social problems as the engineer displays when he builds a bridge. The economist and the sociologist have not yet created this definite reality in their approach. Can you, trained in engineering and science, help in giving this thought a definite body?"

—From Chemical and Metallurgical Engineering.

"Wasted" Engineering Training

THE student engineer, seeking to adjust college endeavor to nebulous dreams of future professional activity, may be allowed a pardonable degree of dismay as he

(Continued on Page 16)



FAR above the clouds, on all the leading airlines, your pilot is always within hearing and speaking distance of airports—via Western Electric radio telephone. ¶ This equipment, made by the manufacturing unit of the Bell System, is helping the airlines to set a notable record for fast, safe transportation. Teletype—another Bell System service—speeds printed weather information to airports. Long Distance and local telephone facilities, too, play important parts in airline operations. ¶ Bell System services reach out in many directions to the benefit of industry and commerce.

You can "fly" home by telephone, in a couple of minutes. Why not do it tonight? Station-to-Station rates are lowest after 7 P. M.

BELL TELEPHONE SYSTEM

(Continued from Page 14)

scans the catalogue of alumni occupations. For he there discovers so many of the old boys to be engaged in activities remote from calculus and mechanical drawing as to suggest the utter futility of four or five years of grinding preparation, the future application of which seems more than doubtful, judged by the careers of these earlier technically trained man. Perhaps he asks himself in these moments of apprehension, "Why an engineering education?" His skepticism may be easily understood as a very natural reaction to the negative appearance of this catalogue criterion.

Yet there are many excellent and conclusively favorable answers to his question sometimes from quite unexpected sources. I quote one of those which recently came to my attention:

"When employing men who may become future junior officers," said President Arthur F. Hall, of the Lincoln National Life Insurance Company in an address to other insurance executives, at their special request, on the secret of the Lincoln Company's excellent organization, "we favor technically trained men because they are trained to think analytically, they know where and how to find sources of information, and are more likely to understand people because of the analysis they give to both persons and things."

Had it occurred to you, as a student at Rose, that you might be preparing to become an executive officer of a life insurance company? Not just an employee down somewhere in the lower ranks, but a top executive? Perhaps not, but President Hall has his alert eye on the lookout for your type. Note, however, that he expects you to have *two* prime qualifications:

First—Ability to analyze things.
Second—Ability to understand people.

President Hall goes on to amplify this emphasis on understanding people as well as cold hard things:

"When my boys went to college", he says, "I told them I thought it of far more importance, even than graduating at the head of their classes, for them to have an understanding of people. I wanted them to note the difference in the quality of thinking people did, as well as to know the technical side of their own business or profession."

What Rose alumnus of wide experience will not emphatically endorse this second quotation! And the old boys will tell you something more, namely, that under the conditions of today the profession chooses the man and not the man the profession, except in unusual instances. This was true back in the nineties as well. I recall as a Rose student that I thought I was preparing to do a specific thing—design and help build steam and gas engines. But when the fateful day came to find a job, no engine company in the country seemed to need an incipient engineer. It took only three months for an unsought, unforeseen, and quite different opportunity to divert the hopeful steam neophyte into electrical engineering; and another day arrived when the executive and business side of industry surprised the hopeful electrical candidate into a management phase of activity.

I think the great majority of these old Rose men, who may have seemed to you to have wasted their years in acquiring a type of training they ultimately abandoned, will tell you that they are where they are because of this "wasted" training and because they supplemented what Rose gave them with a development of their appreciation for and cultivation of personality, the making of friends, and the polishing up of their somewhat latent gentility and social adaptbility. If and when you doubt the usefulness of your years at Rose, ponder the quoted statements of President Hall. Give thought, too, to the following statement of Mr. E. B. Meyer, president of the American Institute of Electrical Engineers, which I quote from his letter to Institute members in the November issue of the Institute's publication, *Electrical Engineering*:

"I believe that no matter what specific line of activity offers itself or may be decided upon for a life work, the young engineer will find that his engineering training has furnished the best possible foundation whether he becomes a scientist, professional engineer, educator, business man, lawyer, or banker."

IN MEMORIAM

The Rose Student body and the members of the faculty were greatly shocked by the death of Robert Danner, a member of the senior class here at Rose.

Mr. Danner would have been graduated from the Institute next spring as a civil engineer. He entered Rose as a sophomore in February, 1933. During the two years prior to that time, he had been a student at the General Motors Institute of Technology, Flint, Michigan.

To his brother, Rufus Danner, who was graduated from Rose in 1934 as a mechanical engineer, and to his parents Rose extends its deepest sympathies.

SPORTS

Edited by
Harry E. Garmong,
ch.e., '36

EDITOR'S NOTE:

Mr. Buis, the staff Sports editor, has been ill for some time. The staff wishes to thank Mr. Garmong for writing the Sports for this issue.

Football Awards

At a recent meeting of the Student Athletic Association the following men were awarded varsity letters and sweaters: Hufford, Campbell, Laughlin, Tait, Cavanaugh, and Garmong, seniors; McCullough, Wodicka, and Fox, juniors; Fuller and Stanfield, sophomores; Montgomery, Krider, and McKee, freshmen. The two senior managers, Spain and Walker, were also given sweaters.

The other members of the squad, those men who did not receive awards but who practiced faithfully night after night only to "warm the bench" during a major part of the games, certainly deserve more praise and thanks than has been given them during the past season. The fellows who constituted this group surely received their share of practice bruises, but obtained very little fun and pleasure playing in actual games. Rose deeply appreciates the service which these men have rendered. We know that they will not become discouraged, but will be out there fighting again next year.

Intramural Basketball

With the close of the football season, intramural basketball will again make its appearance at Rose. This sport has proved to be very popular with the students since its introduction three years ago. Coach Phil Brown, who directs and officiates at all games, has made up the program. As scheduled, games will be played until about January 15, at which time intercollegiate basketball will be the order of the day.

Every student in school is urged to take part in these games which are held in the gymnasium after school hours. The school provides all of the necessary equipment with the exception of shoes, which must be furnished by the player. It is an established rule at these contests that any man who dresses for a game must play at least seven minutes; consequently, win, lose, or draw, everybody has a good time.

At the start of the season it seems that the four teams represented will be very well matched; however due to the superior brand of ball displayed by the Chemical team, it should be rated first, with the Mechanical, Electrical, and Civil teams finishing in the order named.

The Civil team, which has always been strong in the past, suffered greatly by graduation last year. There are a few tall men on this team to make it a constant threat; but due to inexperience and lack of reserve material, the civils should find plenty of opposition this season.

The Electrical team, last year's tournament winner, also lacks reserve material. The Electricals always play a more or less "dark horse" brand of ball. They very often do the unexpected and may finish right up near the top.

As usual, the mechanical department will furnish a fairly strong team. The lax manner in which training rules are observed by some of the members of this team should handicap it to a great extent; however, the mechanicals may finish either second or third for the season.

Some high class intramural basketball should be displayed by the Chemical team during the coming season. This team has always been noted for the scientific game it plays. Height, speed, basketball ability, and very capable reserves are possessed by this Chemical team, which should breeze through the season undefeated.

Lineups of Intramural Basketball Games

Electrical—11

		F.G.	*F.*	*P.*
F.	McCullough	3	0	2
F.	Wells	0	0	0
F.	Denehie	0	0	0
F.	Neyhouse	0	0	0
C.	Duenweg	1	0	0
G.	Mewhinney	1	0	1
G.	Fox	0	1	0
		5	1	3

Civil—12

		F.G.	F.	P.
F.	Krider	0	0	1
F.	Drieke	0	0	2
F.	Lucas	0	0	0
C.	Ricketts	2	0	1
C.	Coady	1	0	0
C.	Tait	1	0	0
G.	R. McKee	0	0	0
G.	Forsyth	1	2	0
		5	2	4

Mechanical—16

		F.G.	F.	P.
F.	Ricketts	0	0	1
F.	Cantwell	3	0	1
F.	Kasameyer	0	0	1
F.	McCullough	0	0	1
C.	Eckerman	0	2	1
G.	Hufford	3	0	1
G.	Laughlin	1	0	0
G.	R. McKee	0	0	1
		7	2	7

Chemical—26

		F.G.	F.	P.
F.	Walker	1	0	1
F.	Hardin	0	0	1
F.	Garmong	0	0	1
F.	Forsyth	0	0	0
C.	Wodicka	4	0	2
C.	Reddie	1	0	0
G.	Wolf	4	0	2
G.	Ladson	2	1	0
G.	Smith	0	0	0
G.	Davis	0	1	0
F.	White	0	0	0
		12	2	7

Intercollegiate Basketball

For the first time in four years Rose Poly will have a varsity basketball team. Coach Brown has not announced the schedule as yet, but he has several irons in the fire and promises that eight or ten games will be played this season.

Actual practice will start about January 15. Many good basketball players, former high school stars, and intramural basketball performers, now enrolled at Rose, have signified their intention of reporting for the first practice session. The present intramural program will help a great deal in getting these men into condition, and it should only take a short time to form the quintet which will represent the school in intercollegiate contests.

Alumni requested the insertion of varsity basketball into the athletic program at Rose. The request was granted, and now it is up to the student body to back this team. Intercollegiate basketball was discontinued at Rose four years ago because of a lack of support. The school has had good basketball teams in the past, and if only the student body will show the proper spirit, there is no reason why we can not have successful teams in the future.

ALUMNI

By

Merton Scharenberg, m.e., '38

Obituary

A recent letter reports the death of Francisco V. Aguilera at Manzanillo, Cuba. Mr. Aguilera graduated from Rose with the class of 1903 in the Department of Electrical Engineering. However, he changed his profession and graduated from the New York College of Dentistry in 1919. At the time of his death, he was a surgeon-dentist at Manzanillo. Surviving him are his wife and three children.

Marriages

Mr. J. Harold Dicks married Miss Ann Kammerer on November 30. The ceremony took place in St. Benedict's Church, Terre Haute.

Mr. Dicks graduated from Rose in 1930, and is now employed by the Public Service Petroleum Company of Chicago as assistant manager. The couple will be at home after December 15 at 174 East Pearson, Chicago, Illnois.

Mr. Robert A. Wilson and Miss Harriet Thomas were recently united in marriage. Included in the guest list to the ceremony were Mr. Wilbur Wilson, '27, and Mr. H. L. White, '32.

The couple will make their home in Peebles, Ohio, where Mr. Wilson, since his graduation in 1932, has been employed by the W. S. Heer Engineehing Company.

Mr. Elwood Divine and Miss Elsie Libbert, both of Terre Haute, were married Thanksgiving morning. The couple will make their home on North Twenty-Eighth Street.

Mr. Divine was a member of the class of 1934, and is now connected with the Smith-Alsop Paint and Varnish Co.

Mr. Mack Decker married Miss Marcia Tibbetts of Brazil, on November 10. Mr. Decker attended Rose with the class of 1935. The couple's new home is on North Walnut Street, Brazil.

Here and There With The Grads

ex'02 Frank A. Kattman is the Resident Engineer Inspector for the P. W. A. at Evansville.

'14 Vere S. Calvin, Assistant Construction Engineer for the State Highway Commission, has been transferred from Crawfordsville to Rochester.

'20 Gordon K. Woodling, Chief Draftsman of the Prest-O-Lite Company, has been transferred to West Allis, Ohio.

'32 Albert L. Ahlers, with CCC, is District Construction Officer for 21 camps in Montana. His headquarters are located at Fort Missoula.

William A. Haynes has started the Signal Apprentice Course with the Pennsylvania Railroad. He is located at Pittsburgh.

John E. Povelones is now affiliated with the Soil Conservation Service at Spencer, West Virginia.

Norris V. Engman, with the C. M. St. P. & P. R. R., has been transferred to Milwaukee.

Brent C. Jacob is now an engineer of the North American Manufacturing Company of Cleveland.

'35 John K. Loman has a position with the Haynes Stellite Company of Kokomo.

Virgil E. Shaw has accepted a position with the Louisville Cement Company of Louisville, Ky.

Wayne G. Siegelen is employed by the State Line Generating Company at Hammond, Ind.

ex'38 Max T. Yeley is working in Alma, Michigan, but expects to return to Rose next year. His address is 525 Richmond Street.

New York Rose Tech Club Holds Meeting

The Rose Tech Club of New York City held its annual dinner and meeting on December 5 in one of the private dining rooms of the Advertising Club of New York City. This get-together is held every year during the ASME convention and is known on its program as College Reunion Night.

President Paul N. Bogart of the board of managers of Rose and Dr. Prentice attended the meeting and brought to the alumni an interesting account of the events of the past year at Rose. Edward J. Hegarty, '15, president of the New York Rose Tech Club, presided over the meeting as toastmaster.

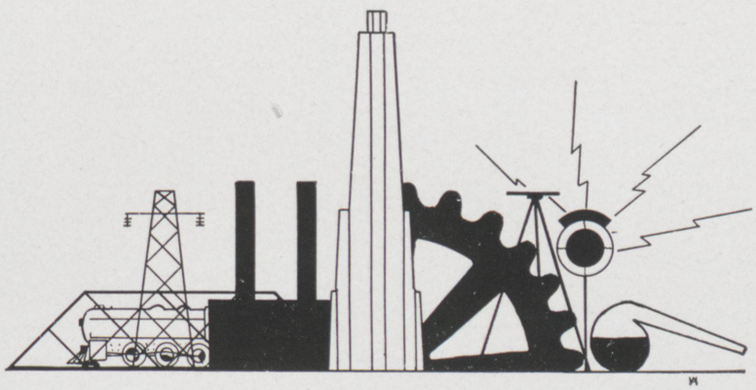
Pittsburgh Rose Tech Club Holds Meeting

On December 6, the Pittsburgh Rose Tech Club held a dinner meeting at the University Club. Mr. Bogart and Dr. Prentice joined the

(Continued on Page 25)

THE ROSE SHOW

A Unique Exhibition

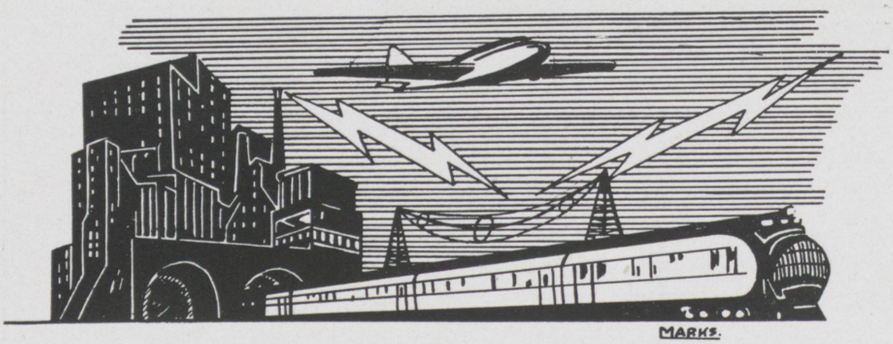


The Rose Show will be a remarkable exposition of scientific and engineering exhibits. Interesting and startling demonstrations will be given of modern feats in the world of technology.

The students of Rose Polytechnic Institute announce the

FIFTH ROSE SHOW

To be held in April, 1936



Research and Progress

by

Charles Macdonald
m.e., '36

Mirror for 200 Inch Telescope

ON November 26 the world's largest piece of glass, the 200-inch mirror for the world's largest telescope, finished cooling at the Corning Glass Works.

This huge telescope mirror was poured December 2 last year and has been cooling ever since in an annealing oven. Dr. J. C. Hostetter, director of development and research, and Dr. G. V. McCauley, physicist in charge of disc making, entered the oven, and after crawling over the surface on hands and knees, reported that the mirror was barely warm and that apparently it was a perfect piece of glass.

The mirror will be taken from the oven and packed for shipment to the California Institute of Technology at Pasadena where it will be housed in a special air-conditioned building for the polishing operation.

Million-Pound Pressure Machine

Dr. P. W. Bridgman has developed two very interesting pieces of equipment at the research laboratory of physics at Harvard University.

One is a pressure chamber formed by a steel cone and a form-fitting steel block. The other is a new machine which squeezes thin discs of material between two rotating steel pistons. Between the pistons of this machine a pressure of 750,000 pounds is reached. This compressive stress and the shearing stress set up by the rotation reveal many new facts about materials.

The pressure chamber produces pressures of 1,000,000 pounds per square inch, the highest ever reached by man. Many interesting phenomena can be observed, such as making ice which melts forming boiling water, and causing graphite to scratch steel. This boiling hot ice, ice which melts into water above the boiling point, is one of the two new kinds of ice made in the pressure cone. The other kind is cold ice. Five kinds of ice were known previously, one of which was hot but not boiling.

Engineering Employment

Much of the credit for improved business conditions belongs to the scientists and engineers who are creating new materials and processes, designing the machinery for production, and developing the products which have made the old so obsolete.

Some of the progress in product development has been unveiled at the recent expositions. The machine tool industry, at its 1935 show, displayed amazing developments along the lines of control, precision, and production. The recent automobile shows prove that that industry has been very active.

Most of the new developments in product design are due to the greater activity of engineering departments, and a good indication of this activity is the increase in the number of engineers employed. In a recent survey of 368 companies, conducted by the Product Engineering Magazine, the following percentages of increase in engineers employed for 1935 over 1934 were reported:

67	machine tool companies	51%
10	printing press manufacturers	50%
33	instrument manufacturers	39%
17	conveyor and shop-crane makers	29%
	aircraft engine manufacturers	25%
25	non-metal working machinery companies	23%
32	domestic appliance manufacturers	22%
20	food and packaging machinery companies	20%
11	automobile manufacturers	17%
53	power plant equipment makers	14%
16	business machine manufacturers	8%
28	construction, mining, and farming machinery makers	5%
12	textile machinery manufacturers	1%
	railroad equipment manufacturers	0%

The average for these 368 companies is a 21% increase in the number of engineers employed during 1935. The total number employed was 6,057 in 1934 and 7,334 in 1935. The increase since 1932 has been about 91%.

High-Strength

A case-hardened glass having from four to six times the strength of ordinary plate glass is being made by the Libby-Owens-Ford Glass Co. This glass also has a high resistance to the effects of heat. It is claimed that hot lead can be poured on a piece of this glass

which has been placed on a cake of ice without causing the glass to crack. A piece of ordinary plate glass that has been finished to size, edged, and polished, can be treated to acquire these properties. The glass is put in an electric furnace and heated very nearly to the plastic state, and then it is subjected to blasts of cool air.

Gear Shift with 11,000 Speeds

It is reported that the California Institute of Technology has developed a gear shift having over 11,000 definite speeds. This is believed to be the largest number of gear changes ever obtained through a positive gear shift. Four shaft levers are employed, each having a number of different positions. This gear shift is employed for controlling speeds in connection with equipment used for testing pumps of the Colorado River aqueduct. The pump speeds start at ½ r.p.m. and can be increased by half-revolutions to 5,000 r.p.m.

Belt Drive for Aviation Use

A report was recently issued concerning a 300-hour test of a well known type of six-cylinder automobile engine connected by six belts to an airplane propeller. The belts were of the V-type, running over steel pulleys. The results were fair, considering the unfavorable working conditions. The main purpose of the test had a bearing on the matter of low priced airplanes. For such a plane a low priced engine would be necessary, and the automobile manufacturers might be interested in lightening their engines so that they could be used for the belt drive.

World's Largest Diesel Engine

The recently installed 15,000-kilowatt Diesel engine at Copenhagen, Denmark, is said to be 50 percent larger than the next engine in size. It is part of a large electric power station. This engine is a double-acting, two-stroke, "uniflow scavenger" type, with mechanical injection. It operates at 115 r.p.m., has eight cylinders of approximately 33 inch diameter, and a stroke of 59 inches.

Campus Activities

Edited by

Norman Wittenbrock

ch.e., '38

Assembly Program

AT a recent assembly Mr. John B. Hunley of the class of 1903 gave an interesting talk about bridges. Mr. Hunley is the Engineer of Bridges and Structures for the C. C. C. and St. L. Ry. Co. In the course of his talk he outlined the development of bridge building and bridge engineering. He pointed out that even though bridges have been used from the earliest times the science of bridge building was not developed until fairly recent times. The different types of structures which have been used during the past century were explained. Mr. Hunley also told of his personal experiences in the field of bridge engineering.

Debate Club

RECENTLY the Debate Club held its first meeting of the year. At that time it was decided to hold tryouts for the debate team the week before Christmas vacation. Everyone interested in debating is invited to try out for the team. At the present time debates have been scheduled with Butler, Indiana Law School, Evansville College, and Indiana State Teachers College. The debate team will attend the debate tournament at North Manchester College in February. The president of the club for this year is Warren Sentman.

Faculty Members Attend Meeting

PROFESSOR Child has been elected to the American Institute of Chemical Engineers. Together with Mr. Mann he attended the twenty-eighth annual meeting of the organization on November 13, 14, and 15. The meetings were held in the Deshler-Wallick Hotel at Columbus, Ohio. Technical articles of interest to chemical engineers were read. One article of particular interest was given by Dr. Walter Clark of the Eastman Kodak Company. He talked on "Recent Developments of Photographic Applications". Some of the other papers of interest were "Industrial Medicine and Industrial Toxicology" by Dr. G. H. Gehrmann of the DuPont Company, and "Controlled Atmospheres for the Heat-treatment of Steel," by H. W. Gillet of the Battelle Memorial Institute. While at Columbus Professor Child and Mr. Mann went through the following plants: The Griggs and O'Shaughnessy dams, The Marble Cliff Quarries Company, City of Columbus Water Purification Works, The Mead Corporation Pulp and Paper Plant, and the Battelle Memorial Institute. They also attended the Homecoming of the Chemical Engineering Department of Ohio State University.

Professor Child and Mr. Mann both report that the meeting was quite worthwhile.

Military Ball

The Military Ball fulfilled all expectations this year by living up to its reputation of being the most colorful dance of the school year. The Ball is attended each year by many people who particularly enjoy a formal dance. Before the dance a formal dinner was given for the members of Tau Nu Tau, our military fraternity, their guests, and the honor guests.

The Ball was held at the Terre Haute Country Club on December the fourteenth. The club house was beautifully decorated in red, white, and blue bunting and flags. The music and entertainment for the evening were furnished by Jimmy Joy and his orchestra.

The honor guests at the Ball were Dr. and Mrs. Prentice, Mr. and Mrs. Paul N. Bogart, Captain Joseph Stevenson and Miss Mahley, Major and Mrs. Knipmeyer, Captain and Mrs. Hutchins, Captain and Mrs. Chinn, Colonel T. L. Sherburne, Chief of Staff of the Indiana Military Area, Major Bulger, Lieutenant and Mrs. Hawkins, Warrent Officer and Mrs. Kearns.

The committee in charge of the ball consisted of William Kasameyer, general chairman; Daniel Overholser, orchestra; Louis Duenweg, finance; William Creal and Harry Garmong, decorations; Paul Bennett, place; Warren Sentman,

tickets and programs; Joseph Walker and James Campbell, publicity.

Radio Club Meets

On December sixth the Wabash Valley Radio Club held a meeting in the Physics lecture room at Rose. Two seniors from Rose were the speakers. There were demonstrations with each of the talks. Edward Denehie talked upon "Measurement of the Characteristic Impedance of Transmission Lines", and Albert Mewhinney spoke on "Capacitive Termination for Transmitting Antennae".

Reserve Officers Dinner

The Faculty and the Cadet Officers of the Rose Battalion were invited to attend the annual dinner of the Reserve Officers of Indiana. The dinner was held on December seventh at the Scottish Rite Cathedral in Indianapolis. Most of the Cadet Officers from Rose attended the dinner. The speakers were The Honorable James J. McSwain, M. C., Chairman of the Military Affairs Committee, House of Representatives; Mr. Nelson Macy, National President of the United States Navy League; The Honorable Paul V. McNutt, Governor of Indiana; Rear Admiral John Downes, U. S. Navy; Brigadier General Wm. K. Naylor, U. S. Army; The Honorable John W. Kern, Mayor of Indianapolis; and Colonel Thomas L. Sherburne, U.S. Army. The toastmaster was Lieutenant Colonel Raymond S. Springer, Infantry Reserve.

Alumni

(Continued from Page 20)

Pittsburgh alumni on the return trip, after attending the New York Rose Tech Club meeting. As usual, this group was keenly interested in the college events and displayed a high degree of enthusiasm at its meeting. Arthur W. Worthington, '06, is president, and William W. Reddie, '12, is secretary of the Pittsburgh Rose Tech Club.

Terre Haute Rose Tech Club

Following the example set by the Pittsburgh Rose Tech Club, which initiated the plan of alumni scholarships and which sent its first scholarship student to Rose last year, the Terre Haute Rose Tech Club has appointed a scholarship committee with the intent of offering alumni scholarships. The members of this committee are: Sterling Pittman, '22, chairman, Ray Harris, '29, Adam Grafe, '25, Allen Merrill, '16, and Hugh Wallace, '15. The officers for the coming year are: Ray Harris, president, and Hugh Wallace, secretary-treasurer.

FRATERNITY NOTES

Blue Key

The Rose Tech chapter of Blue Key held an initiation on November 22nd for the new men elected this fall. Four seniors, Duenweg, Walker, Kasameyer, and Sentman, and three juniors, Wells, Wischmeyer, and Coons were initiated. The affair was held at the Elk's Club where a banquet was served for the new members. After the banquet President Prentice spoke on "The Advantages of the Small Educational Institution".

The chapter wishes to congratulate these new men.

Sigma Nu

The alumni held a meeting at the chapter house on the night of November 19. Eighteen members attended.

Football letters have been awarded to Fox, Fuller, McCullough, and Tait. Dick Spain received his letter for serving as football manager for the past four years.

Steve Cauley, who is working in Hammond, Indiana, spent the Thanksgiving holidays in Terre Haute. Brother Cauley visited his wife here, who was in the Union Hospital as the result of an automobile accident.

All of the Nus spent the holiday season in their respective homes except Brother Fox, who visited Brother Donie in Vincennes.

Tau Nu Tau

Tau Nu Tau military fraternity is pleased to announce the pledging of the following men: Lieutenant Hawkins, Assistant Professor of Military Science and Tactics, and R. Averitt, L. Carroll, E. Coons, C. Cromwell, E. Cromwell, A. Foley, P. Giffel, H. Halberstadt, J. Hughes, W. Snedeker, J. Sonnefield, J. Stineman, and T. Wells.

For the past few weeks members and pledges have been hard at work in preparation for the Military Ball, which was held December 14 at the Terre Haute Country Club. Jimmy Joy and his Orchestra furnished the music for the Ball this year.

Theta Kappa Nu

Theta Kappa Nu has adopted a new type of business meeting. The chapter wishes to present this new plan to the other fraternities on the campus. Matters relating to finances and fraternity business are discussed in a closed meeting. The members and pledges then hold an open meeting together. Since this plan of meeting has been adopted there has been a great deal more interest in the chapter meetings.

The rabbit hunt held last month was very successful. Everyone enjoyed the rabbit supper given at the home of Brother Harrod following the hunt.

Plans are being made for the annual Christmas Formal. The next social function after this dance will probably be an open house on New Year's Eve.

Brother Foley and Pledge Neyhouse have announced they intend to challenge the Benna brothers.

The chapter president, William Lindeman, and Miss Ruth Casebeer were married Friday night, November 29. Congratulations, Bill.

Theta Xi

Kappa chapter of Theta Xi was very pleased to have as one of its recent guests, Mr. Harold P. Davison, National Executive Secretary of Theta Xi. Mr. Davison commented upon Theta Xi's Seventieth National Convention held recently in New York City. He mentioned some of the methods used by other colleges in their rushing programs. He also pointed out the fact that ours is one of few colleges which use the deferred rushing system.

Kappa enjoyed having many of its alumni back for its recent reunion. Several members of both the Indianapolis and the Louisville Alumni Clubs were present for the business meeting which was held in conjunction with the reunion.

Alpha Chi Sigma

Iota chapter of Alpha Chi Sigma has just completed its pledging activities and has acquired the largest pledge group in its history. The twenty new men who were pledged this year are: W. Snedeker, '37; W. Alexander, J. Dillahunt, W. Serban, and W. Wolf, '38; R. Burger, L. Davis, R. Hawkins, R. Kahn, R. Ladson, R. McKee, J. Pies, W. Reddie, J. E. Ross, J. Rustamier, G. Smith, P. Stark, R. Weldele, K. Wiram, and L. Yaegar, '39.

The pledge banquet was held at the Elks Club on Friday night, December 6. Forty-three men attended, this number including members and pledges of Iota and members of the Terre Haute Professional chapter.

This banquet was also the occasion of the alumni visitation to the chapter by our district councelor, Dr. Marvin C. Rogers, of Whiting, Indiana. He expressed himself as being well pleased with the condition of the chapter.

Alpha Tau Omega

On Sunday, November 23, Gamma Gamma chapter conducted an initiation for its pledges. The men taken into the active chapter were: seniors Robert Shattuck, Louis Duenweg, and Byron Pearson; juniors Clyde Cromwell, and Edward A. Coons; and sophomores Clemens Lundgren. The Brothers were presented their pins by the Chief of Province, Brother J. J. Maehling.

The province conclave was held on December 8, at Purdue. Several of the active members attended.

The chapter house has been redecorated.

HUMOR

Edited by

Bob Shattuck
ch.e., '36

Recently Mr. Denehie attended a theatre in which incense was being burned to give an oriental atmosphere to the show. Sniffing the air, he said scornfully to an usher, "I smell punk."

"Right," said the usher, "You go stand in the corner."

"Does Bill Lindeman live here?"

"Yeh, carry him in."

Dr. Genschmer must be a very old man. It is said that he used to teach Caesar.

Mick: "What have you been doin'?"

Mike: "Playing golf with Doc Sousley."

Mick: "Who won?"

Mike: "He did! What do you think I am, a fool?"

—*Modulus*, '28.

Frequently a basketball player has printed on the back of his jersey the name of the man or the business firm that has financed the purchase of his suit. It is planned to deviate slightly from this procedure in the case of the Rose team. It is felt that a more logical insignia might be, "Playing through the grace of Doc Sousley."

Where the West Begins

Simple: "What makes your cook so bow-legged?"

Ton: "He got that way from riding the ranges."

—*Stanford Chaparral.*

Isn't Nature Grand?

Mark Twain said that when he was a boy of fourteen, his father was so ignorant that he could hardly stand to have the old man around, but when he got to be twenty-one he was simply astonished at how much the elderly chap had learned in seven years.

—*Union Electric Magazine.*

The girdle manufacturer lives on the fat of the land.

—*De Laval Monthly.*

Mr. Chinn: "Now this exam will be conducted on the honor system. Please take places three seats apart and in alternate rows."

Professor Bloxsome: "Mr. Roberts, why all the quotation marks on your exam paper?"

Robo: "Courtesy to Mr. Salisbury who sits on my left."

Insignificant Papa: "Isn't it time he should say 'daddy'?"

Fond Mamma: "We've decided not tell him who you are until he gets a little stronger."

The Dean of Women was lecturing to a group of young women. During the lecture she said, "I regret to say that there has been kissing going on right under my very nose."

—*The Kansas Engineer.*

Salisbury (hunting for a fourth at bridge): "Bridger?"

Freshman (shaking hands): "My name is Peterson. I'm glad to know you."

Some Place

Mr. Pearson (one of the senior civils in the engineering school) says that in the town in which he was reared water played a very unimportant role. According to him, one time the water supply was shut off on Monday evening, and no one missed it until the following Saturday night.

"Miss Roedel, will you see what you can find on 'The Kentucky Cardinal'?" asked Professor Knipmeyer.

"Certainly," replied Miss Roedel as she began looking through the card file under "religious".

"The Cardinal was a bird," advised Professor Knipmeyer.

"I am not interested in his personal habits," she retorted.

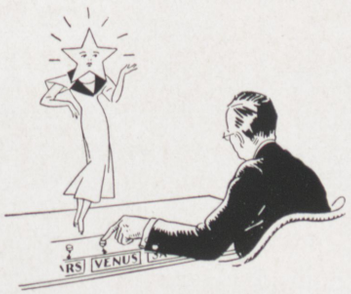
G-E *Campus News*

EDITORIAL BOUQUET

IT IS very pleasant to have people say nice things about one. The pleasure is curiously heightened, however, when the nice things are said in a roundabout way—never intended directly to reach one's ears. General Electric recently was honored in such a manner on the editorial page of the Spokane, Washington, *Chronicle*, and the Company is still basking in the warmth of the glow generated. The editorial, in part, read as follows:

"An exposition at which inventors of the Pacific Northwest will display their work will be held next month in Portland.

"It will probably be a revelation to those who see it. Most persons find it hard to think of great men coming from 'near at home.' When one speaks of inventors or scientists, the Northwest citizen thinks of the General Electric laboratories, or of observatories in California, or clinics in Vienna. . . ."



CELESTIAL PUSH-BUTTON CONTROL

HEAVENLY bodies a million times fainter than the faintest star the eye can see unaided will be brought to the earth for inspection and photography at the touch of an electric push button when the McDonald Observatory on Mt. Locke in western Texas is placed in operation. The observatory building itself is almost completed, but the technicians of the Warner and Swasey Company at Cleveland are "making haste slowly" with the polishing of the 82-inch reflecting mirror. They estimate that another 12 or 18 months will be needed before the mirror is ready for installation. The 45 tons of moving parts of the telescope will be at the command of a single individual, who will be able to take his stand upon an observing bridge and virtually order the stars to parade before him. The motors and complete electrical control to make this possible have been manufactured for the builders of the telescope by General Electric.

VOICES FROM THE SKY

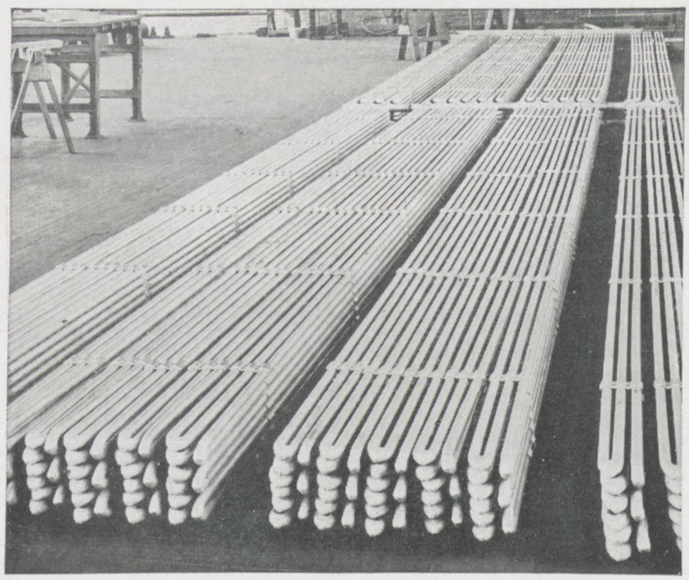
WHEN the Whiteface Memorial Highway—a road leading to the summit of the 5000-foot Whiteface mountain in the heart of the Adirondacks—was dedicated this autumn, voices came down from the sky on a beam of light. There was nothing mystical about this performance, however. The beam of light came from a 24-inch G-E searchlight on the summit of the mountain. The voices were those of President Franklin Roosevelt and New York's Governor Herbert Lehman.

President Roosevelt's words, dedicating the highway, were carried on the light beam seven miles from the mountain to the crowd at the Lake Placid airport. Governor Lehman had spoken over the light beam the night before. He was so interested that, after the dedication ceremonies were finished, he spoke again to demonstrate the equipment to the members of his family. Both night and day demonstrations were successful, although once or twice during the day the words faded to faintness when small clouds floated by the mountain top and partially obscured the light beam.

Two-way communication was carried on by means of short-wave radio equipment located at the airport. G-E engineers, who made this special installation, had to transport a gas-driven power plant and a dozen or more storage batteries to the mountain top to operate the talking light beam.

96-205DH

GENERAL ELECTRIC



SEVEN HUNDRED WELDS—were needed to make this assembly of aluminum piping.

New Metals Emphasize Desirability of Jointless Design

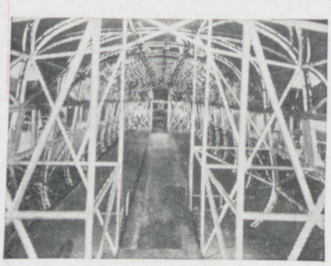
Welding Preferred Method for Fabricating Jointless Designs from New Materials

By H. E. ROCKEFELLER*

Welding is an important aid in securing the full benefit of the newer light weight alloys, corrosion- and stain-resistant steels and other ferrous and non-ferrous metals. Jointless welded designs in these new metals make the finished product attractive in appearance, efficient and economical to use and enable it to be priced salably.

In All Industries

Fabrication by welding can be undertaken without heavy capital expenditures and carried out at low cost. Welding is used in every industry for maintenance, for construction and for the fabrication of many products. The welding of mechanical refrigerators and gas ranges is typical of its production applications. Other typical applications include welding of chromium steel for resistance to sea water corrosion on seaplane pontoons, welding aluminum fuel tanks for airplanes, welding of the frame work of alloy steel on the new high speed railroad trains, welding of stainless steel beer barrels and innumerable other familiar products.



HERE'S HOW—the framework of the light weight, streamlined rail cars for high speed is Lindewelded from chrome-molybdenum steel tubing.

Welding is Simple Production Tool

Welding is the preferred method of fabricating almost every design in modern metals. Jointless welding can be done rapidly with a minimum of preparation of the pieces to be joined. Under procedure control providing jigs for positioning pieces, production can be as rapid and as free from rejections as any highly developed factory process. From the plant equipment standpoint it is easy to adopt welding. From the personnel standpoint the welding technique is quickly acquired through instruction by competent engineers.

For Jointless Strength and Safety

Products fabricated by welding are jointless, leakproof, permanent and safe. Improved methods of testing make it possible to tell exactly what stresses or loads a jointless welded assembly can take. Metals of different compositions, providing the most suitable material for the service it is to perform, can be welded into sound unified assemblies forever free from any of the losses which occur from joint failures.

Specialized Welding Assistance

To utilize the new alloys and metals fully, the advice of competent engineers in welded design is advisable. The Linde Air Products Company, a unit of Union Carbide and Carbon Corporation, has for many years specialized in the development of new ways to use oxy-acetylene welding. Linde Engineers will gladly consult with you without obligation, and help you use welding and

IN JIG TIME—using jigs, welded joints can be made quickly in any commercial metal or alloy.

organize for welding production. This assistance can be secured by a telephone call to any Linde Sales Office. They are located at Atlanta — Baltimore, Birmingham, Boston, Buffalo, Butte—Chicago, Cleveland — Dallas, Denver, Detroit—El Paso—Houston—Indianapolis—Kansas City—Los Angeles—Memphis, Milwaukee, Minneapolis—New Orleans, New York—Philadelphia, Phoenix, Pittsburgh, Portland, Ore.—St. Louis, Salt Lake City, San Francisco, Seattle, Spokane and Tulsa.

Everything for oxy-acetylene welding and cutting—including Linde Oxygen, Prest-O-Lite Acetylene, Union Carbide and Oxweld Apparatus and Supplies—is available from Linde through producing plants and warehouse stocks in all industrial centers.

* Engineer, Development Section, The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation.

Surveying This Issue

MR. Wodicka has written our lead article this month entitled "A Survey of Rayon Manufacture." This article starts with the early attempts to prepare artificial silk and leads up to the present time, giving the present processes for its manufacture and the quantities of rayon which are being produced.

MR. Averitt presents the second of his series of three articles on "Fuels." This month he discusses liquid combustibles.

THE editor has written the third article this month, which is a general discussion of "Centrifuges." An article written by Mr. James G. Brown of the class of 1934 is to appear in a future issue of *The Technic*. Mr. Brown will present various applications of centrifugals.

—*C. D. O.*

THE ROSE TECHNIC

Engineering College Magazines Associated
Mr. Leonard Church, Chairman
501 Guardian Bldg., Cleveland, Ohio

Arkansas Engineer	Kansas State Engineer	Oregon State Technical Record
Colorado Engineer	Marquette Engineer	Purdue Engineer
Cornell Engineer	Michigan Technic	Pennsylvania Triangle
Illinois Technograph	Minnesota Techno-log	Rose Technic
Iowa Engineer	Nebraska Blue Print	Tech Engineering News
Iowa Transit	N. Y. U. Quadrangle	Villanova Engineer
Kansas Engineer	North Dakota State Engineer	Washington State Engineer
Penn State Engineer	Ohio State Engineer	Wisconsin Engineer

WARREN S. SENTMAN, *General Manager*
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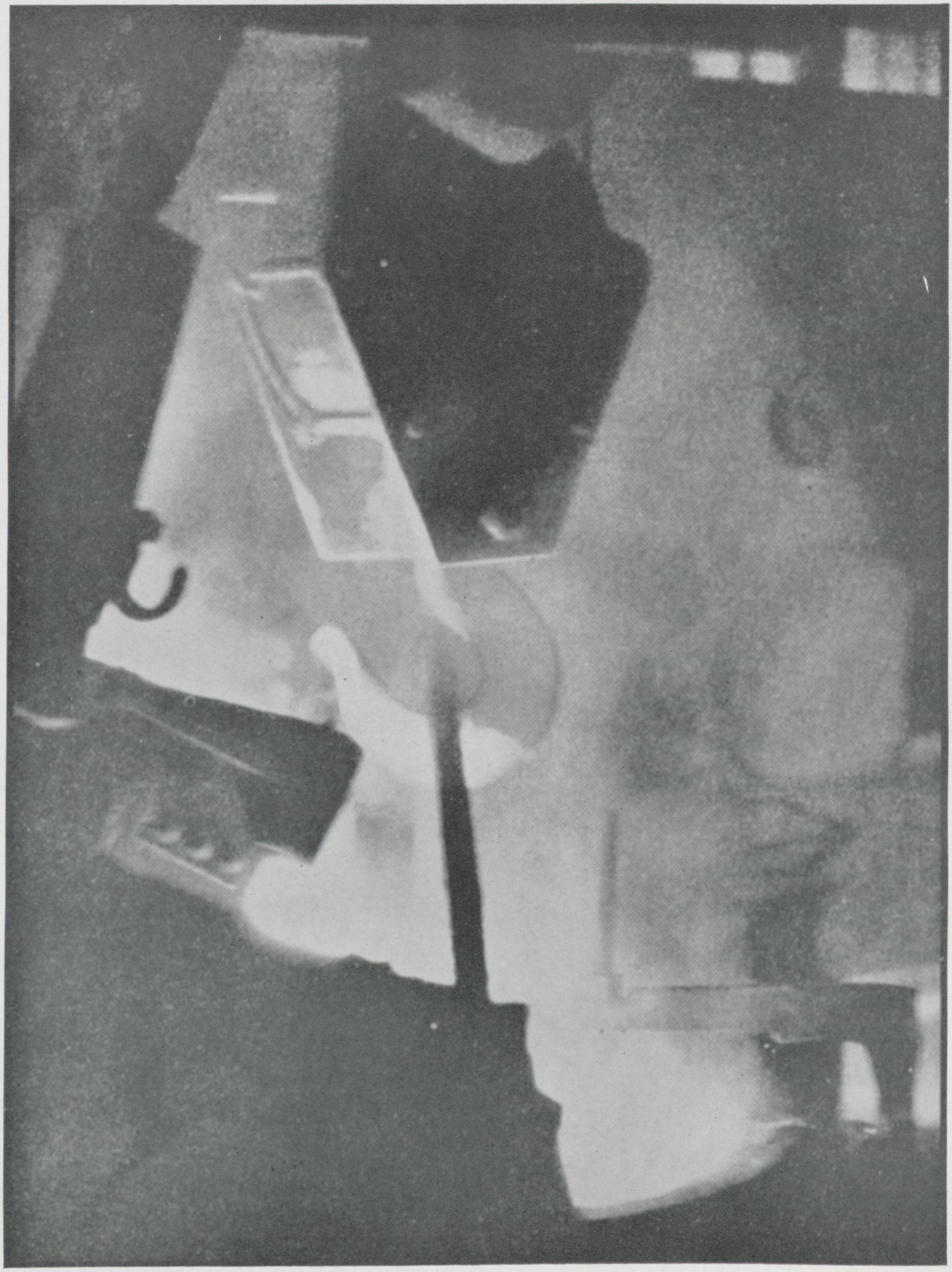

Steel *Photo by Ritasse*