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ROSE TECHNIC

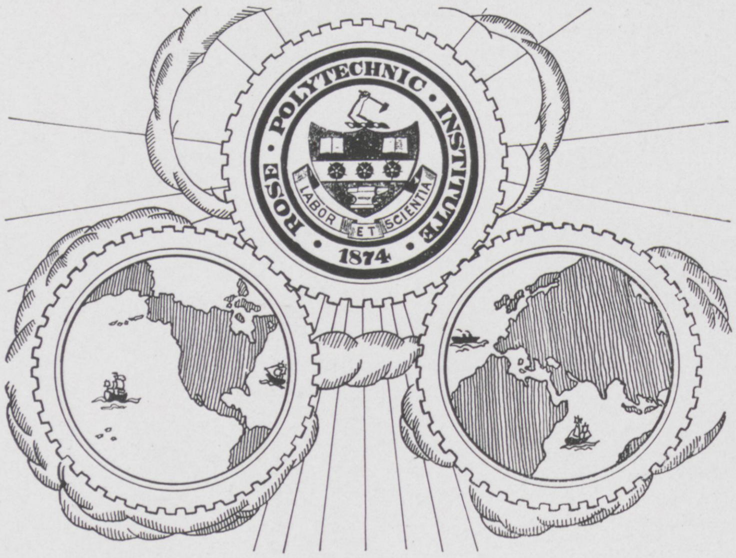
Vol. XLVII | February, 1938 | Number 5

Member Engineering College Magazines Associated

ROSE POLYTECHNIC INSTITUTE - - - TERRE HAUTE, INDIANA

MARKS-'35.

...SECOND SEMESTER BEGINS...



The field of engineering lies between management and labor. Technical men use capital, in the form of machines, with the organized effort of workmen to produce goods or power or transportation. Every engineering student must add to his knowledge of applied science some study of economics and labor administration. He must understand the problems of both groups between and with which he will operate. Modern engineering courses meet this requirement.

ROSE POLYTECHNIC INSTITUTE

TERRE HAUTE, INDIANA

Surveying
This
Issue

HOW strongly intrenched in industry is the art of die casting? To what extent has it been substituted for standard foundry casting and forging? In this month's lead article Mr. Zinngrabe explains the art itself, discusses its present applications, and speculates regarding its future.

ALTHOUGH matter has always been considered as having only three limiting states, colloids are rapidly coming to be recognized as a fourth state of aggregation. The distinctions between the various states are also not so well defined as might be supposed. Mr. Dillahunt presents his discussion concerning the modern concepts of these states of aggregations.

PRESENT developments in television indicate that it will soon become as common as radio. This advancement is the result of much hard work and the application of many diversified principles. Mr. Myers explains the principles of television projection and describes the modern experimental equipment.

—*M. B. S.*

THE ROSE TECHNIC

FEBRUARY 1938

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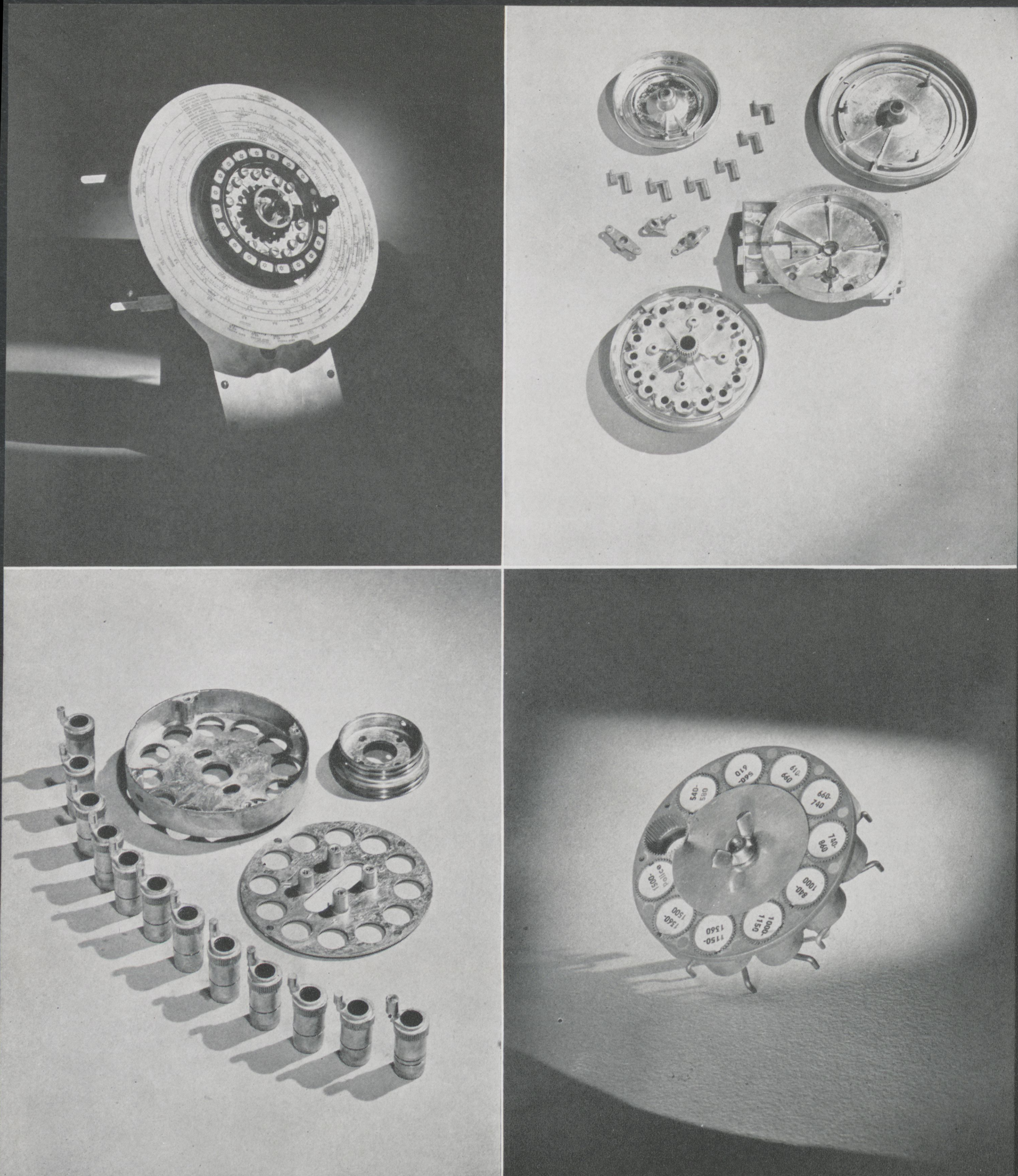


Cut Courtesy Electronics

Die Castings for Automatic Tuning

Close-fitting parts are necessary for automatic radio tuning. The frontispiece illustrates parts and assemblies of several automatic tuning controls which are composed primarily of die castings.

THE ROSE TECHNIC

THE TECHNICAL JOURNAL OF THE ROSE POLYTECHNIC INSTITUTE

Volume XLVII FEBRUARY, 1938 NUMBER 5

Die Casting

Claude L. Zinngrabe, m., '38

Die casting, a relatively new industry, has enjoyed a sensational growth during the past few years. Although the industry presents many technical problems, little material is available for study at present. Mr. Zinngrabe discusses the art of die casting and its ever-increasing applications to modern industry.

SOME thirty years ago it was discovered that molten metals, such as the alloys of zinc, aluminum, and brass, under high pressure could be forced into molds or dies to produce accurately dimensioned parts of strong and lasting quality. Thus the art of die casting was discovered. In recent years this art has grown into a major industry. The rapid advancement of the industry is largely due to the new uses and new developments in alloys discovered in metal, using industries and research laboratories of the large companies of the world. The expansion of the industry never could have resulted from improvements in die casting alone unless alloys suitable for this purpose had been available which satisfied the consumers' demands for finished products of permanent and economic properties. On the other hand, without the technique and skill of the die caster and mechanical perfection of the process, improved alloys alone could not have made possible the rapid growth of the industry.

Since its discovery die casting has increased in importance at an almost unbelievable rate. According to the New Jersey Zinc Co., the consumption of zinc castings alone has increased 30 per cent annually. This statement gives a good indication of the increasing popularity of die casting.

Metals and Alloys Used

In the skillful art of die casting, only certain alloys can be used. Any metal intended for die casting purposes must flow readily in the molten state and in cooling must form smoothly so as to prevent as far as possible the necessity of machining operations. To obtain these desired results, die casting alloys must have low melting points, high tensile strength, sufficient fluidity to permit the filling out of fine details in thin sections, a minimum tendency to attack parts of the machine, a firm surface texture, a low per cent of shrinkage, and high resistance to corrosion. The principal alloys fulfilling these requirements are those of zinc, lead, aluminum, brass, tin, and magnesium.

The alloying of the metals mentioned above is a simple and interesting process. The constituents of the alloy to be formed are placed in a large, open, bowl-shaped container made of steel or cast iron. This so-called cupola is supported by two rocker arms and equipped with several flues and turrets spaced near the top. Heat is applied to the outside of the bowl by means of a gas flame until a temperature of 1150° F. is reached for aluminum alloys, or 750° F. for white metal. The heating temperature is controlled as to the melting point of the alloy being formed. Temperatures exceeding the melting point by more than 100° F. will burn the low melting point constituents and render the alloy useless. While the alloy is in the molten state it is constantly stirred until all the constituents are well fused together. The slag and impurities are removed from the surface by means of small, hand-operated ladles, and the alloy is cast into small 3 and 5 pound pigs. Each pig is suspended in a long, shallow trough through which cold water is constantly running. As soon as the alloy solidifies, it is removed from the pig and is ready for use in the die casting machine.

Dies and Their Making

As the name implies, all die casting requires the use of metallic dies into which the molten metal may be poured. The selection of the proper steel, or steels, for these dies is an important factor. For this particular use the steel must have the following inherent properties: machineability, stability in heat treatment, resistance to heat cracking, resistance to deformation, toughness, resistance to the erosive and solvent actions of the molten metal, and ability to withstand elevated temperature. From the standpoint of these characteristics, chromium-vanadium steel is the most satisfactory for die constructions.

The building of dies is a very intricate and skillful process. Solid blocks of steel, as obtained from the mill, are shaped to the required rectangular dimensions on a shaper and then polished to a smooth surface on a grinding machine. Each die consists of two such blocks fitted together with steel dowel pins. Water ways are drilled through the back of each half to provide the die with a cooling system for quickly solidifying the molten metal. The design of the casting is then laid out on each half of the drilled block by the die makers. Care must be taken in this layout so as not to weaken the casting by faulty sectioning. The section is then placed on a milling machine and the design very accurately cut out. In work such as this, all dimensions are made to the closest ten thousandth of an inch. Immediately following the milling operations, the gateways are drilled, and the die fitted with push-out pins and plate. The purpose of the push-out pins and plate is to remove the casting from the die after solidification. The die is then stoned by hand with a very fine finishing stone until all surfaces are extremely smooth. After this finish-machining, the dies are placed in an electric resistance furnace and heated to temperatures ranging from 1600° to 1900° F. They are then quenched in oil to obtain the desired hardness. If, however, the steel used in construction has not been previously normalized and annealed, special treatment is necessary. The finished die is now ready for use.

Die Casting Machines

In the production of die castings, several important elements are involved, the most important being that of the machine. All die-casting machines consist essentially of a furnace and melting pot, a die, a die carriage, and various mechanisms for making contact between the melting pot and die, closing and clamping the die, forcing the molten metal into the die, unclamping and opening the die, and finally, ejecting the finished casting. These machines are of two general types: the plunger and the compressed air. In the plunger type machine, the molten metal is forced through a stationary gooseneck into the die by means of a reciprocating piston submerged in the melting pot. In the compressed air type, the molten metal is shot into the die by means of compressed air acting on a movable gooseneck. The pressure used in both machines varies from 150 to 1500 pounds per square inch according to the size and thickness of the casting to be formed. The closing mechanism of the machine is operated by hydraulic pumps which maintain a closing pressure of from 3000 to 5000 pounds per square inch. The die carriage holds the die and consists of two strong and rigid face plates: one, a movable plate holding half of the die and operating on the closing mechanism; the other, a stationary plate connected to the gooseneck and holding the other half of the die.

Die Castings

Die-casting machines may be operated manually, semi-automatically, or fully automatically. Those operated manually are in extensive use and require skilled labor. Operators of die casting machines have a difficult and dangerous position. It is their duty to set the die up in the casting machine, regulate the temperature, refill the melting chamber as the metal is used, lubricate the dies as often as necessary, operate the compressed air or plunger system, and remove the finished casting. In performing these duties, the die caster is always subject to severe burns caused from the "spitting" of the machine. "Spitting" is the flowing back of the molten metal through the air valves, and is usually caused from impurities in the metal and air pockets in the metal feed line. There is constant danger of the loss of a limb while removing castings. The possibility of becoming overheated at any time is another disadvantage which makes the die caster's job unpleasant.

The product of the casting machine, as removed, is in a crude state. Excess metal around the edges, called the splash, must be removed by machining. The machining operations are simple. The splash and gate are removed by hand filing or punch-press and trimming die. If drilling, tapping, or turning operations are specified, they may be readily accomplished on small machines at a rapid rate and very low cost. The finished casting is of uniform size and shape, having a high degree of accuracy, sharpness of outline, and a superior surface finish which may be plated after cutting and coloring buff.

New Developments in Die Casting

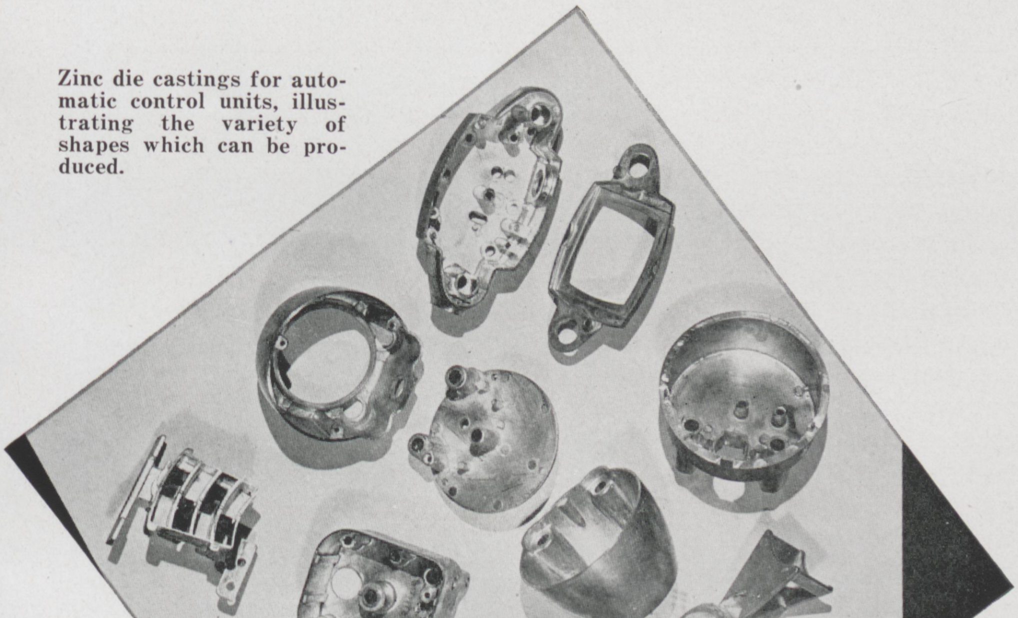
In the last few years, many new and outstanding developments have been made in the die-casting industry. The most important of these has been a new process discovered by the Aurora Metal Co., Inc., of Aurora, Illinois. This company has, by the use of a vacuum, developed a process whereby it is possible to make die castings of aluminum bronze possessing all the desired prop-

erties inherent to certain of its alloys. In this process the die is spotted over the pot of the melting furnace by an air hoist and lowered until the gate at the bottom of it extends down into the molten metal for several inches. With the vacuum line connections made, the upper part of the die is then evacuated and the alloy sucked in through the gate in one operation, the metal rising smoothly and continuously into all the cavities. The vacuum induced in this work ranges from 5 to 25 inches of mercury. The die used is made of a special alloy containing 89% copper, 10% aluminum, and 1% iron. This stronger-than-steel-alloy will withstand the melting temperatures of the aluminum-bronze alloys which range from 1,950° F. to 2,300° F.

The castings produced by this method have a tensile strength of 80,000 pounds per square inch and, unlike most die castings, can be heated to withstand tensile stresses as high as 100,000 pounds per square inch.

The outstanding advantages claimed for the vacuum die-casting process are that the impurities at the top of the melting pot, which are always present, are prevented from entering the die, and the thin aluminum-oxide film is deposited on the walls of the die and not on the casting itself. Another advantage attributable to this newly devised method is the accuracy with which the castings come from the dies. This is in addition to a smoothness and freedom from blow holes, which reduces the time and labor for machining operations to a minimum expenditure. Other advantageous characteristics of the aluminum-bronze casting are high resistance to shock, abrasion, corrosion, and exceptional wearing qualities.

Zinc die castings for automatic control units, illustrating the variety of shapes which can be produced.



Cut Courtesy Electronics

The simplicity of operation and the resulting high grade casting of this method has added considerably to the growth and advancement of the die casting industry.

The above process just described is only one of the many important recent developments in die casting. Because of space limitations, other processes can not be mentioned, but should the reader be interested, additional information can be obtained in the 1933, September edition of *Iron Age*.

Various Uses

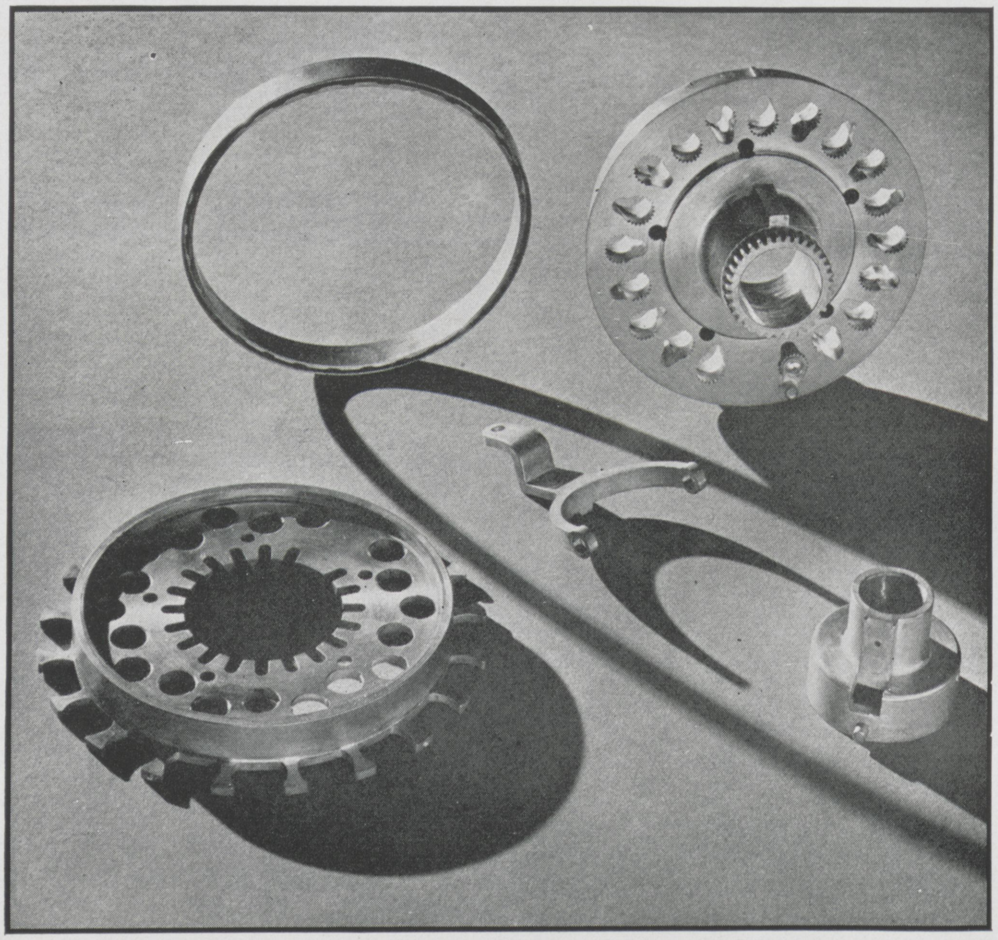
The die-casting industry is playing in increasingly important part in the production of things commonly used in sufficient quantities to warrant die expenditures of up to $14,000 for a single die. This is well illustrated by the automobile radiator grille and certain decorative units offered to the public by automobile manufacturers as a stimulus to demand, through improved "appearance." In earlier days these units were largely considered as extras outside of regular considerations. Today, because of die casting progress, the grille has become an essential unit in automobile construction.

The automobile industry is not the only consumer of die castings by far. The household utensil industry is largely dependent on the products of the casting machine. Many of its items cannot be produced in any other way and still equal cost and endurance of die cast utensils. An extensive quantity of toys, novelties, clocks, and fixtures are manufactured by die-casting methods as the increasing public demand warrants them. In the field of air-craft, die-cast parts have wormed their way. Rapidly the heavy, bulky machinery of the iron age is being replaced by the lighter, stronger castings.

Progress

The suddenness of today's progress can be pointed out by relat-

ing the fact that barely two years ago a very prominent die-casting manufacturer placed restrictive size range limits upon the future of the industry. As a producer, he said in effect, "The successful efforts of the industry will be permanently limited to a production of the smaller run of parts, and the industry will be competitive with stampings and with the foundry in such work only. Chronic headaches will be the total reward of those who attempt to develop markets for large die casting work." But today the ability of die castings to take a finish over both large and small defined areas has opened a field for large parts in many industries.



Cut Courtesy Electronics

Zinc alloy die castings, all of which are parts of a new automatic tuning device.

That the economic potentialities of the die-casting art still are largely unplumbed may be gathered from a zinc alloy application recently developed by the Hoover Co. for an automobile manufacturer. Here was a comparatively low production job, so far as total yearly volume is concerned, and yet the part—a step plate for sport models—was required for five different body styles. The solution was found in a simple die design which would accommodate all five castings through the use of interchangeable die sections. This one illustration shows clearly the reason for the increasing popularity and progress of the die-casting industry.

Five years ago brass die castings were being produced in Europe only, and then to a very limited extent. How little was known by American engineers concerning brass die casting is shown by an article published in an engineering journal at that time, in which the writer deplored the fact that the most useful nonferrous alloys, the brasses, cannot be die cast. However, the advantages that would result from successful die casting were too apparent to engineers and metallurgists to allow the problem to remain unsolved. Today, brass die casting has spread widely in Europe and there are numerous concerns in this country successfully engaged in the new art. The lack of knowledge is no longer a handicap to the industry, and its advancement should be rapid in the future.

New and improved methods of casting and the discovery of better alloys were not the only factors that influenced the progress of the industry. The development of advanced die designs extended the field of die casting to an endless variety of parts. Dies that are fully automatic, even to the operation of numerous cores, have been recently designed by expert diemakers. These automatic dies have done away with arduous labor, speeded up die casting, and eliminated the uncertainty and hazards of the human element. The machine shop rather than the foundry has in this way been largely responsible for the pronounced progress made in die-casting practice during recent years.

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The States of Aggregation

Joseph A. Dillahunt, ch., '38

Matter exists in three ideal limiting states; the solid, the liquid, and the gaseous. The transition from one state to another takes place under certain conditions of temperature and pressure which lead to a bewildering complexity.

When pure substances are intermingled, they commonly retain their individual states of aggregation. The two important exceptions are liquid solutions and colloids. Colloids are rapidly coming to be recognized as a fourth state of aggregation. No satisfactory explanation has been given for the anomaly of liquid solutions, leaving their true states of aggregation a conjecture.

Limiting States of Matter

Sometimes it is necessary to repress disturbing secondary phenomena in order that the basic phenomena to be studied may be readily apparent. Therefore, in beginning a study of the states of aggregation, it is necessary that two very highly specialized conceptions be stated in order that the disturbing features of that which is to follow be minimized.

If the equation of state of a gas is investigated, for example the dependence of its volume on the pressure and temperature, it is seen that the results would be rather complicated if the investigation were to be carried out at high pressure and low temperature. The results, however, become simpler and more uniform (the various gases become more and more similar in their behavior) if low pressures and high temperatures are chosen. It is therefore necessary to consider the state of gas at an infinitely low pressure as a limiting state to which all gases tend and which yields a clear basic concept, that of the ideal gas.

Diametrically opposed to the ideal gas is the ideal solid. As the ideal gas is the limiting state of matter at high temperatures and low pressures, so is the ideal solid the limiting state of matter at low temperatures and high pressures. The properties of the ideal solid are extremely simple: all mechanical and thermal properties are independent of the temperature; volume, compressibility and heat content have a constant value, and therefore the coefficient of thermal expansion and the temperature coefficient of compressibility and of specific heat have the value zero.

A Consideration of Actual Gases, Liquids, and Solids

The transition between the limiting states of matter, the ideal solid and the ideal gas, necessitates a consideration of actual gases, liquids, and solids. In other words, the real position of these forms as we ordinarily know them must be made clear.

Therefore, it is to be expected that many of the characteristics of ideal gases and ideal solids would be united in them. Moreover, it would also be expected that this would cause the appearance of a series of complex phenomena. Fortunately, when it is borne in mind that the three states of aggregation as we commonly know them, liquids, solids, and gases, are in reality transition substances between two idealized states, the disparity of the laws which govern them becomes more nearly understandable.

The Gaseous State of Aggregation

Matter in the gaseous state possesses the property of completely filling any available space to a uniform density. Among the most pronounced characteristics of the gases are lack of definite shape or volume, low density, and slight viscosity.

The ideal or perfect gas was previously defined as one whose internal energy is independent of volume and which obeys the equation of state:

$$pV = \text{a constant}$$

A gas fulfills these conditions under extremely low pressures and extremely high temperatures, that is, when the volume of the molecules is vanishingly negligible when compared to the total volume and when the attractive forces between the molecules is negligible except during collisions. Experiment shows, however, that when the concentration of a gas is increased the equation of state no longer expresses the behavior of the gas.

When a gas becomes concentrated, it is less compressible because the molecules of the gas are nearly incompressible when compared to the gas itself. Budde introduced a correction "b" for this volume and wrote,

$$p(V\text{-}b) = RT$$

In 1879, van der Waal pointed out that Boyle's law can be derived on the assumption that the molecules exert no mutual attraction, and this assumption is undoubtedly justifiable when the molecules are far apart at low pressures; it no longer remains true when the gas is strongly compressed. When increased pressure is applied to a gas, the resulting volume will become less than that calculated, owing to molecular attraction.

In other words, the molecular attraction and the applied pressure act in the same direction, and the gas behaves as if it were subjected to a greater pressure than that actually applied. It was empirically

shown by van der Waal that this correction is inversely proportional to the square of the volume, and, since it augments the applied pressure, the expression,

$$p+a/V^2$$

should be substituted for "p" in the equation stated above, "a" being the constant of molecular attraction. The corrected equation then becomes

$$(p+a/V^2) \quad (V-b)=RT$$

It must be emphasized at this point that the derivation of van der Waal's equation rests upon the assumption that the gas deviates but slightly from the ideal state. The equation is therefore only a first approximation of the behavior of imperfect gases. Hence, the quantitative application must be limited to moderately concentrated gases. On the other hand, it is to be expected that the equation may give a qualitative description of the behavior of condensed gases over a wide range. Since this is found to be the case, van der Waal's equation is usually employed as the starting point for a discussion of the relations between the gaseous and liquid states of aggregation. However, up to the present, no one has derived another equally simple equation which accomplishes more than van der Waal's, so that the retention of this equation is justifiable.

By use of complicated formulas of state, involving three other constants beside the gas constant, and by use of isotherms, it has been shown that the only definite difference between a gas and a liquid is the property of liquids to form an independent surface; that is, one not determined by the walls of the containing vessel. Other differences between gases and liquids are differences of degree and are not fundamental. Unless this distinguishing property of independent surface is exhibited, it is not possible to give a strict definition which will classify a dense fluid as either a liquid or gas.

The Liquid State of Aggregation

The characteristic difference between a liquid and a gas is that the latter will occupy the whole of a relatively large volume and have constant density throughout, while the former will not. However, as shown above, there exists no theoretical difference between a liquid and a (actual) gas. This is best shown when the substance (liquid or gas) is strongly compressed. All physical properties of the two states then become very similar. For carbon dioxide under a pressure of 1000 atmospheres, the product pVm is 22.415x1.748 liter-atmospheres at 30° C., and 22.415x1.780 liter-atmospheres at 40° C. And yet at 30° carbon dioxide is in the liquid state because under sufficient pressure it does not occupy the entire volume at its disposal with uniform density, while at 40° it fills the whole vessel uniformly at any pressure, and is therefore a gas.

If the range of temperature and pressure is limited to that in which the liquids have a relatively low density, then the van der Waal's or some related equation of state can be applied to the liquids as well as to the gases. Tamman assumed that, by applying very high pressures, liquids could be brought into an ideal limiting state, for which laws could be greatly simplified. For pressures between 1000 and 3000 atmospheres an equation of state was actually established for a number of liquids and was very similar in appearance to the gas law:

$$(p+n) \quad (V-Vh)=CT$$

where "n" is a constant cohesion pressure, "Vh" the volume at infinitely high pressure, and "C" an empirically determined constant. This equation states that within the range of its applicability the thermal coefficient of expansion (at constant pressure) is a constant.

At low temperatures and pressures the behavior of liquids is less uniform, so that a relatively simple and generally applicable equation of state cannot be set up. As a rule the thermal coefficient of expansion at low temperatures is small and then increases with increasing temperature. The compressibility at higher temperatures is greater than at lower temperatures, which would be expected since the volume is greater.

The lack of theoretical distinction between the liquid and gaseous states has previously been demonstrated. When the liquid and solid states are compared, there is again a lack of a theoretical and qualitative distinction. The most characteristic property of a liquid, as compared with a solid, is its relatively low viscosity. However, the particles in crystalline solid substances possess the same property to a certain degree. That this property in solids is finite and measurable is shown by the "flowing" of various metals while being worked, and the behavior of ice in glaciers.

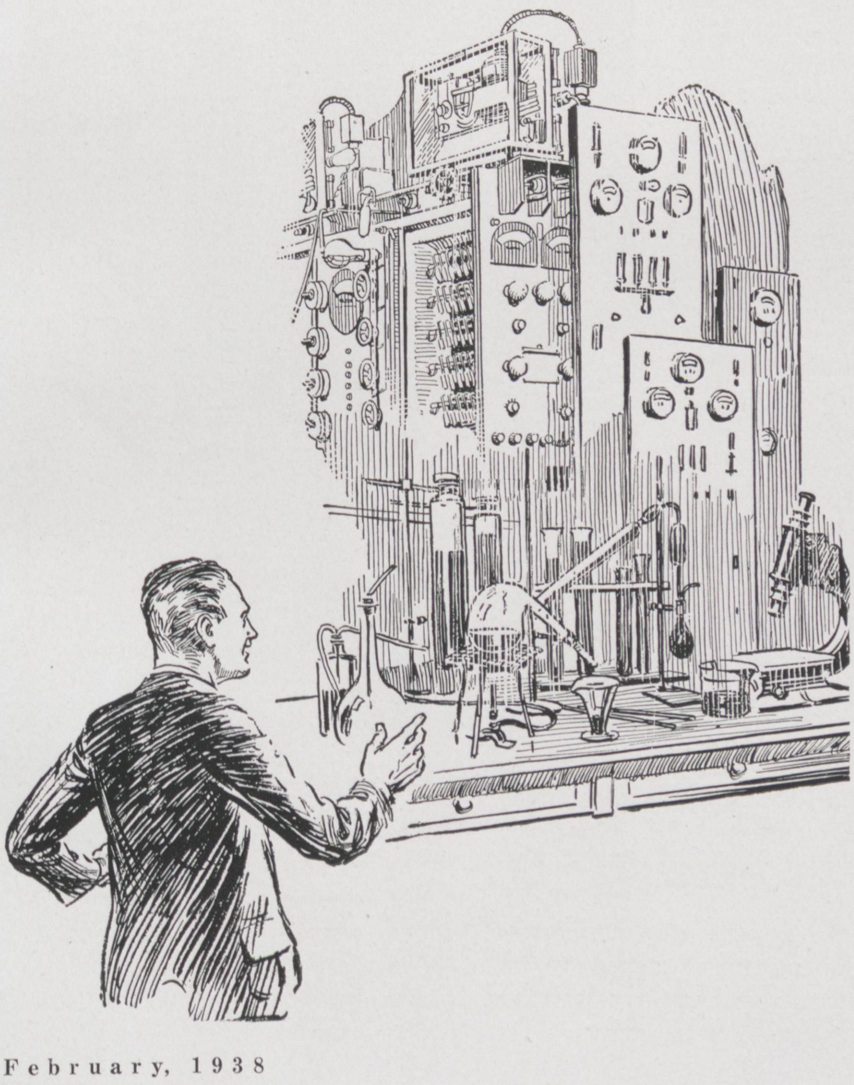
The distinction emphasized by early writers that matter in the solid state is distinguished from the liquid state assumed not only a definite volume but also definte form, the crystalline. Likewise, this distinction cannot be considered correct in the light of a study of the liquid crystals or crystalline liquids which are now known and whose properties have been studied. Further, the case of a liquid which solidifies without crystallizing must be considered. Such a substance, usually called a "glass", may be considered with equal justice, it being either a liquid or a solid. The justification of this conception follows from the agreement between crystalline and amorphous substances with respect to many thermal properties.

The Solid State of Aggregation

The ordinary conception of a solid represents it as a portion of matter possessing rigidity; that is, offering resistance to forces tending to deform it. The ordinary

idea is that solids differ from liquids in not being subject to flow. As previously shown, such a distinction has little value from a scientific standpoint because of its indefiniteness; for flow can be induced in nearly any solid by the proper application of a sufficiently great force. A much more fundamental definition among the states of matter follows from the fact that the majority of substances can exist in solid forms which are bounded by plane surfaces so oriented to one another that the whole possesses some degree of symmetry. A substance in this state is then said to be crystalline, and the state is called the crystalline state of aggregation. All other solid bodies are classed as amorphous and are to be regarded as nothing other than liquids of great viscosity. Among such substances are the glasses and resins.

The difference between amorphous solids and liquids is only one of degree. This is demonstrated by the fact that on heating, amorphous solids lose their rigidity by infinitely small increments and may become as fluid as water. The absence of any definite transition point renders futile any attempt at a compromise classification of such bodies as solids under one set of conditions and liquids under another. With crystalline solids, matters are very different. Every crystalline solid has a definite transition point at which it undergoes an abrupt change into a liquid with absorption of heat. Amorphous solids can be regarded as partaking in that continuity of state previously mentioned, which characterizes the transition between the ideal limiting states of matter. No such continuity or superfluity characterizes the transition from the crystalline state to the liquid state, so far as can be discovered. Investigations on the influence of tremendous pressures on the behavior of crystalline structures have shown that the transition to the liquid state invariably takes place when a definite temperature, which depends on the pressure, is reached. It may therefore be concluded that there is a fundamental difference between the crystalline and all other states of aggregation.



From comparatively early times it has been believed that crystals are to be regarded as structures built up by the symmetrical arrangements of some ultimate units, as contrasted with the random arrangements of these units in the fluids. The discovery by Freidrich and Knipping in 1913, acting upon a suggestion by Laue made in the previous year, that crystals act as a three-dimensional optical grating for X-ray has left little doubt that such is the case. The constituent atoms in a crystal are arranged in a definite pattern which is regularly repeated throughout the body of the crystal. In fluids, definite arrangements of atoms within the molecules undoubtedly persist, as witness the fact that liquids and vapors may be optically active, but the molecules themselves are distributed at random.

A state of aggregation which is stable within a definite range of temperature and pressure is called a "phase". The majority of substances may be obtained in one or more crystalline phases, one liquid phase, and one vapor phase. It appears, however, that a restricted group of organic substances are capable of forming yet another phase intermediate both as to occurrence and as to properties between the crystalline and liquid phases. As previously mentioned, substances in this state are termed "liquid crystals" to indicate their transitional nature.

It should be understood that liquid crystals, or crystalline liquids as they are often called, do not combine the properties of the liquid and crystalline states. If our previous ideas as to the ultimate natures of these states are

correct, this would be an obvious impossibility. This is due to the fact that in the one state the constituent particles are assumed to be distributed at random and in the other state to be arranged in definite, symmetrical space patterns all obeying the one fundamental law of rational indices. The particles obviously cannot be at the same time both in a random arrangement and in a definite geometrical arrangement obeying the law of rational indices. Rather, the properties of liquid crystals indicate that these are intermediate between the two states in the sense that while there may be a primitive arrangement of molecules in one plane or around a common axis, this arrangement is not sufficiently elaborate to permit obedience of the law of rational indices. Since the term "liquid crystals" may lead to misunderstanding of the true nature of substances in this state, and since it seemingly subordinates the state to the liquid and crystalline, whereas it actually possesses its own peculiar characteristics, it has been suggested that this designation be abandoned and the term "mesomorphic state" substituted.

States of Aggregation in Solutions

Having completed our study of pure substances in the gaseous, liquid, and solid states of aggregation, we now proceed to a study of the behavior of the homogeneous molecular mixtures, or solutions as they are more often called. The three physical states of matter which we have in the case of pure substances extend also to solutions, so that this subdivision of solutions is also both natural and convenient.

It is well known that gases will mix in any proportion and, theoretically, it should therefore be possible to affect a molecular mixture of any given number of substances by vaporizing them at a high temperature. Actually, this is rarely practicable, since a great many substances like sugar decompose before vaporizing, and it becomes necessary to resort to some other method.

In the case of gaseous solutions the molecules are so far apart that, in the absence of chemical action, they are in most cases practically without influence on each other. This is demonstrated by the absence of heat effects on mixing and the relatively small effect when they are allowed to expand into a vacuum. Under such circumstances the physical properties are related to those of the constituents in the simplest way. In the first place, owing to the small mutual attraction of the molecules in the gaseous condition, gases mix in all proportions to form true solutions. It is not surprising to find that in the gaseous solutions each constituent retains its physical properties unchanged and that most of the physical properties of such solutions are therefore additive and may be expressed simply as the sum of the magnitudes of each constituent with respect to the property in question. It is therefore apparent that in the case of gaseous solutions the state of aggregation does not change in the presence of other substances.

In certain cases two solids may form physical mixtures that are homogeneous and must therefore be classified as solid solutions. As examples of this type of solution there are certain mixed crystals and certain alloys of metals. The laws of solutions may be applied here only as an approximation. The same is true to a large extent in certain cases of liquid solutions possessing high viscosities.

In addition to solid solutions of the type just discussed, there are interstitial solid solutions, in which foreign atoms interpenetrate the space lattice, to occupy spaces between the original atoms. The solid solutions of hydrogen in platinum and palladium are of this type. Finally, we occasionally encounter subtractive solid solutions in which certain atoms of a complete lattice are regularly dropped out without causing the lattice structure to collapse.

In solid solutions the atoms of the respective substances, although intermingled, retain the same characteristics which they held in their pure state. Therefore, it may be said that in solid solutions the state of aggregation of a substance is not changed in the presence of other substances.

Of the three types of solutions, the liquid solutions are by far the most important, since most chemical reactions in nature and in the laboratory are brought about in liquid solutions. An enormous amount of work has been done to

gain a knowledge of the physical behavior of the constituents of liquid solutions as this must form the basis for the interpretation of the conduct of these constituents under all circumstances.

No part of a true liquid solution is distinguishable from any other part, even under the ultramicroscope, showing that the intermingled particles that form the solution are apparently the individual molecules of the intermingled substances. This is what is implied when we speak of a solution as being a molecularly dispersed mixture.

Solutions of liquids in liquids and solids in liquids are the two outstanding types of liquid solutions. It has already been shown that in solutions of the gaseous and solid types, the intermingled substances retain their respective states of aggregation. This might be expected to carry over to the case of liquid solutions; however, there is such an abundance of experimental data to the contrary that it is impossible to draw such a conclusion. An outstanding example may be drawn from the phenomenon of osmotic pressure.

The first direct measurements of osmotic pressure were made by the botanist, Pfeffer, in 1877. The significance of Pfeffer's measurements were first perceived by van't Hoff, who pointed out the existence of a striking parallelism between the properties of gases and the osmotic properties of liquid solutions. Van't Hoff demonstrated that the product PV is a constant for solutions, just as it is for gases according to Boyle's law and he further demonstrated that the osmotic pressure is proportional to the absolute temperature just as it is for gases, i.e., P/T=constant.

Moreover, the two relations may be combined to give the same constant R as is obtained for gases;

$$PV = nRT = \frac{g}{m}RT$$

where P is osmotic pressure, V is the volume of the solution, and g is the weight of solute having a molecular weight of m.

The discrepancy between experiment and theory in solutions is not peculiar to osmotic pressure. Ideal solutions are very rare, and we have to accept the fact that the behavior of solutions is too complicated to be explained by the relatively simple laws that have thus far been developed. Undoubtedly the nature of the solvent itself is affected by the presence of the solute.

Colloids as a State of Aggregation

About the beginning of the modern period of chemistry, as the science began a rapid development along descriptive and analytical lines and the concept of solubility became well defined, investigators observed that substances ordinarily considered insoluble (gold, arsenic trisulfide, sulfur, aluminum hydroxide) could sometimes exist in apparently homogeneous solutions. Due to instability of these solutions, the indirect manner in which they had to be prepared, and a special deportment in certain other respects, it gradually became customary to differentiate between these "pseudo-solutions" as Selmi (1847) called them, and ordinary solutions of sugar, salt, alcohol and the like. The pioneering work along these lines was done by many eminent workers, but was given a certain unity by the classification and lasting nomenclature proposed by Thomas Graham.

During the five decades following Graham's work, the ever increasing number of experimental and theoretical investigation of these "pseudo-solutions" provided a richness of data that encouraged efforts toward systemizing them into a new branch of science. It gradually became clear that the feature common to these solutions was a state of subdivision intermediate between that of the ordinary or crystalloidal solutions and gross homogeneous bodies of pure substances. The emphasis shifted from "colloidal substances" to a "colloidal state of aggregation", as universal as the gaseous, liquid, or solid states.

Both ordinary and colloidal solutions are now recognized to be, in a broad sense, dispersed systems that comprise a dispersed part and a dispersion medium, and differ principally in degree of heterogeneity. In the typical ordinary solutions the dispersed part is subdivided into units, often single molecules or ions, that are of the same order of magnitude as to atomic dimensions and the range of molecular forces; that is, a few microns. Whenever one or more of the dimensions of the dispersed unit appreciably exceeds this standard, regardless as to whether the unit is one or more molecules, behavior characteristic of colloidal solutions may be expected to appear in some form or other.

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Television Principles and Equipment

Ora E. Myers, e., '38

Television has been a mere fancy for many years. At last it is reaching the state of perfection that is necessary for commercial use. Mr. Myers reveals the recent developments of television in the following article.

FOR more than ten years the Radio Corporation of America has been conducting research work looking toward the development of television. In May, 1935, the following three point plan was formulated:

1. The establishment of the first modern television station in the United States, incorporating the highest standards of art.

2. The manufacture of a limited number of television sets for receiving the transmitted programs. These were being placed at strategic points of observation in order that the television system could be tested, modified, and improved under actual service condition.

3. The development of an experimental program service with the necessary studio technique to determine the most acceptable form of television programs.

Since that time, however, great progress has been made, although it has been kept secret for the most part. But the basic priciples of television have not been changed. The discovery of electricity and the development of electrical communication laid the foundations for the future realization of television. The fundamental principle of television is the dividing of a picture to be transmitted into elements, converting the illumination on each element into electrical impulses, transmitting these impulses in an orderly manner and sequence, and finally reconverting them into appropriately positioned light upon a viewing screen.

In May, 1873, the discovery of the photo-resistive properties of selenium enabled a picture to be converted into electrical energy. Hertz discovered the photo-electric effect fifteen years later. At first the television picture to be transmitted was separated into small elements, the illumination on each element was converted into electrical current, and each current was sent by a separate wire. But in 1884 Nipkow proposed to send the picture point by point or to scan the picture. This enabled the transmission of the picture over a single communication channel. The scanning disc was invented about the same time. Forty years later came the development of the thermionic amplifier and gas discharge tubes, and then it was possible to demonstrate television images transmitted by radio waves. Within the last few years Dr. V. K. Zworykin has developed an electrical method of scanning to replace the scanning disc. His invention is the iconoscope. He also developed the kinescope, which is used to reconstruct the images after being transmitted.

The units for television transmission from the studio include: the iconoscope camera, the picture signal and synchronizing signal amplifiers, the control and switching equipment, the modulating and radio transmitting equipment. The units comprising the television receiver are: a radio receiver, the kinescope, and its horizontal and vertical deflecting equipment. A complete picture of these television principles and equipment is meant to be shown in this report.

The Iconoscope

The iconoscope is a modern version of the electric eye. The name is derived from two Greek words meaning "image observer." It consists of two main parts which are enclosed in an evacuated bulb. One part is the photo-resistive mosaic consisting of a metallic plate covered with a large number of tiny photo-electric cells insulated from the plate and from each other. The mosaic acts similarly to the retina of the eye. It transforms light energy from an image into electrical charges and stores them until they can be transformed point by point into electrical impulses and transmitted. The transformation is brought about by an electron gun scanner, comparable to the nerve in the eye. The mosaic consists of a large number of silver globules, each of which is photo-sensitized by caesium. Between this mosaic and the signal plate is a sheet of mica. When there is a voltage between the plate and the picture element, there is a capacity between the mosaic and plate, and condenser action appears. When light from the projected picture falls on the mosaic, each element emits electrons and thus a positive charge is left on the condenser element. The magnitude of this charge is a function of the light intensity. When the electron beam which scans the mosaic strikes the element, the element receives electrons from the beam and is discharged (the electrons cancelling the positive charge on the element.) In modern pictures the frame or picture frequency is thirty; that is, thirty pictures are scanned per second. The electron beam releases instantaneously the energy stored on an element during one thirtieth of a second.

The electrical impulse created on the opposite side of the mosaic energizes the amplifier in the circuit. In the circuit of a single photo-electric element, the electron gun and the mosaic are both enclosed in a vacuum bulb. The number of photo elements in the mosaic is many times greater than

the number of picture elements, which is determined by the size of the scanning spot or beam.

Scanning

In the latest methods of scanning the frequency used is thirty frames per second. Motion pictures used twenty four frames per second. The eye can not distinguish more than ten frames per second as separate pictures but sees them as a continuous scene. The modern method of scanning used is odd line interlaced scanning, 441 lines to the frame being used. An electrostatically focused beam of electrons is deflected vertically by the magnetic field produced by a saw-tooth wave form of current and horizontally by a magnetic or electrostatic field produced by a saw-tooth wave form of voltage of a much higher frequency. The generated pattern or path of the beam is therefore a combination of these two.

Odd lines are scanned during odd vertical saw-tooth cycles, whereas even lines are scanned during the even vertical saw-tooth cycles. Thus the picture is covered twice within each scanning cycle, the odd numbered lines being presented by the eye the first 1/60 of a second, the even numbered lines in the second 1/60th. This method of scanning seems to be satisfactory and it seems likely that it will not be changed. 441 lines make a clear picture and a picture which is large enough to be suitable when viewed from a distance 4 times the picture height. For a picture 7 inches high, this means a viewing distance of 28 inches would be required.

By the scanning process the image is transformed into electrical impulses which are then amplified.

Transmission

For a 441 line, 30 frame picture the total band width required for transmission is 8.6 mega cycles which means a maximum modulation frequency of 4.3 mega cycles. This width has been calculated by formula, but experiments prove that a width 0.64 times 8.6 m.c. is adequate. Standard band widths of 6 m.c. have been assigned for transmission of television pictures. Ultra-high frequencies must be used for television transmission. Frequencies between 42 and 90 m.c. (not including the 56-60 m.c. amateur band which is not available for television use) have been set aside for experimentation. In this frequency range only seven stations are possible in one interference area, but this area extends only from 100 to 200 miles, and outside it these channels can be duplicated. When a 6 m.c. band width is used, there must be a separation between sight and sound bands of about 3 m.c., or the upper side band of the sight channel will interfere with the sound which is transmitted at higher frequencies. The necessity for such a wide band of transmission is brought about because of the large number of picture elements which determine the quality of the picture. The number of elements determines the frequency band which must be superimposed upon the radio carrier.

The field frequency for the amplifiers and generators is 60 cycles. In addition to horizontal and vertical deflection generators which produce the current and voltage saw tooth waves, there are synchronizing generators which will be explained later. The synchronizing signals and sight or video signals are carried through coaxial cables to the modulator and oscillator and power amplifiers. Then the synchronizing video and audio signals are transmitted.

Synchronization

In order for the cathode ray beam at the receiver to be brought in step with the beam at the iconoscope, a synchronizing system must be used. For sending synchronizing signals to the receiver the impulses produced by the deflecting generators of the iconoscope are fed into the amplifier, united with the video signals, and sent over the picture signal channel. These impulses do not interfere with the picture signal because they occur at an instant when the picture is not being transmitted.

The horizontal and vertical synchronizing impulses are sent together, but they have different wave shapes due to the time of duration of both signals. This difference in wave shape is utilized at the receiver for the purpose of separating these two impulses at the receiver end. The maximum picture signal amplitude is adjusted so that it is always less than the horizontal and vertical signal amplitudes, those of the latter signals being equal.

The three signals are separated at the receiving end, and they pass through the radio receiver and amplifier and are applied to three separate units: the vertical deflecting system, the horizontal deflecting system, and the input to the kinescope. The kinescope is a cathode ray tube used in the television receiver. The synchronizing impulses do not affect the picture on the kinescope because they are transmitted at a time when the cathode ray beam is extinguished, that is, during its return to the left side of the picture which it is scanning. The signal between the scanning lines upon which the horizontal synchronizing impulses are superimposed is called a "black" signal. The vertical impulse is superimposed upon the "black" signal between pictures. The video signal can not go beyond the "black" amplitude, and this fact assures that the video signals will not interfere with the synchronizing action.

Reception

Several types of ultra-high-frequency antennas have been tested to find the most suitable one for receiving programs in the average homes. The most efficient type is the directional antenna, but this type can not be used if

television stations are transmitting from different directions. A vertical half-wave antenna connected directly to the receiver has been found satisfactory for most homes. In order to receive signals from a number of television transmitters, it may be necessary to have more than one antenna.

Two receivers are used, one for sound, the other for picture reception. The sound receivers used are similar to any radio receiving set. A single tuning adjustment controls reception of both sound and picture signals. Under present day systems the audio and video carrier waves are spaced a fixed frequency away from each other. The receiver has a single radio-frequency tuning system which consists of two coupled radio-frequency circuits having sufficient band width to accept both carriers and their side bands simultaneously, and which consists also of an oscillator which beats with the two carriers to produce two intermediate frequencies one megacycle apart. These frequencies are supplied to two separate intermediate amplifiers which are tuned for the sound and picture signals, respectively. Thus the sound and picture signals are tuned in together.

The kinescope in the receiving set is used to reconstruct the images formed by the iconoscope and transmitted. It is a cathode ray tube and is similar to the iconoscope in construction. An electron gun is situated in the long neck of the tube, the tube being in the shape of a funnel. The inner surface of the cone is silvered or metallized to serve as a second anode. The purpose of the second anode of the tube is to accelerate the electrons coming from the gun and to form an electrostatic field to focus them into a small threadlike beam. This beam of electrons strikes the flat end of the tube upon which is a flourescent screen. The screen absorbs electrical energy and emits light, producing the same images which were emitted from the iconoscope.

The electron velocity in the kinescope as well as in the iconoscope beam must remain constant so that the sharpness of the image will not be destroyed. A control element in the tube varies the intensity of the spot of light on the screen so that the light intensity variations of the original picture are reproduced.

The material used on the screen is a synthetic zinc orthosilicate phosphor which is almost identical with natural willemite. This substance has high luminous efficiency and has a good time lag, that is, the glow dies off after one thirtieth of a second or just after a frame has been completed with the electron beam. Also the color of the light emitted by this material is green, and the eye is very sensitive to this color.

The discussion of the kinescope which reproduces the picture to be viewed by the audience concludes the explanation of television equipment.

Conclusion

Dr. Alfred N. Goldsmith, well known in the field of radio and sound pictures has outlined six requirements for successful television:

1. A progressive and cooperative attitude on the part of the government in regulating the art. In England television work is carried on solely by the government. Progress is faster by this method, but many men believe that better work can be done by individual enterprise.

2. A sufficient number of television broadcast stations.

3. A program-building organization which can provide interesting material.

4. Sound engineering and manufacturing methods for providing receivers.

5. A group of home-lookers to view and appreciate the programs provided for them.

6. Advertisers to support the service by sponsoring television programs.

Much new and different talent must be found for television broadcasts. Broadcasts will be delivered much the same as scenes are made for the movies in Hollywood. There will be stylists, make-up men, cameramen, lighting experts, scenic designers, and scenario writers. Showmanship will be very important since the people will expect as much from television pictures as from the movies. Illusion will also be important and for this reason studio audiences will not be allowed to see broadcasts. Back-stage technique will be kept as secret as possible.

The persons being televised must wear weird make-up to bring out the true tone values of the face. Yellow powder, brown lipstick, and blue and green preparations must be used in order that a favorable reproduction is made at the receiving end.

Young ladies will probably announce television programs as they do in England now.

Both major networks are working busily on all these problems, and it is probable that actual television broadcasts to our homes will be made in a very few years.

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Reconstruction of Rosie

When Rosie roves the jungle, her
trumpetings resound,
The other animals are still, and
tremor shakes the ground.
She walks her way triumphant,
and all the people shout,
"Make way for old Rose Poly, the
Elephant is out!"

So read the words of the first verse of one of our songs. It gives an impression of a real blood-and-thunder elephant if ever one existed. The figurative elephant is there full force, but the mascot itself—! Our paper mache and chicken wire excuse for an elephant of which we are so proud looks like a derelict produced out of the idle fancy of Miss Glotz's first grade art students—or some similar creative geniuses. Any self-respecting engineer should look upon it with disdain. Let's be self respecting engineers!

It is easy to be critical of the old; now let's be constructive for the new. A mascot such as "Rosie" is a fine thing; we should have one by all means. But let's make a good one—one worthy of engineers—one worthy even of Rose Poly engineers. Let's make the biggest, best, and most realistic elephant that ever rode on four wheels—an elephant that can move his trunk, swish his tail, and stand on his hind legs. And there is no reason why we can't do it. Students in machine design could design it; students in foundry and shop could make and assemble the parts. This work would be just as instructive and more practical than much of the work now done in these departments. The expense would not be great. It might take one year to build; it might take three. But we would have something of which we could be justly proud.

A school as small as Rose can use all of the favorable publicity that it can get. A mechanical elephant would be unique—it would rate articles in papers all over the country. Some schools have nothing of which to be proud; some have one thing. With the proposed reconstruction of "Rosie" we could be proud of two things: excellent engineers and the best mechanical mascot in the country.

R. S. K.

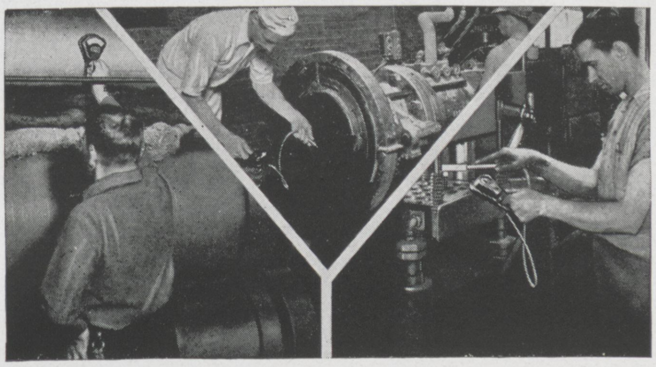
Laboratories

One of the essential parts of engineering training is laboratory work. This work not only gives the student experience in the use and manipulation of various apparatus, but it also affords him an opportunity to get valuable experience in writing brief, clear, and concise reports. A manager of a plant sometimes has no other contact with a man than through the reports that he turns in; therefore, it is necessary that the man have the ability to write good reports.

Since laboratory training is important, it is essential that the students derive the maximum benefit from it. At Rose, we have a system whereby the instructor assigns definite experiments for each laboratory class. However, this system tends to greatly decrease the initiative of the typical student in applying himself to the best advantage during laboratory periods. This results usually in a lack of enthusiasm causing the typical student to skip through his work in the easiest manner. Naturally he does not derive the greatest benefits from his efforts.

One of the eastern schools has solved the problem by using a system which operates in this manner. The students are sent into the laboratory for a three hour period, and during that time may perform any experiments they choose. The results obtained are reported to the instructor when the experiment has been completed. In grading the student, the instructor considers not only the results, but also the value of the experiment which the student elected to perform. Again recalling the fact that many students cannot be relied upon to work on their own initiative, it seems evident that this type of student probably would accomplish nothing in such seemingly liberal assignments. Therefore, only a portion of the laboratory periods are conducted in this way. During these free assignments, the reliable student can perform a series of experiments which will be not only interesting to him, but which also will be of practical value. Furthermore, by the time he becomes a senior he will undoubtedly be better able to select a suitable subject for his thesis.

N. G. W.



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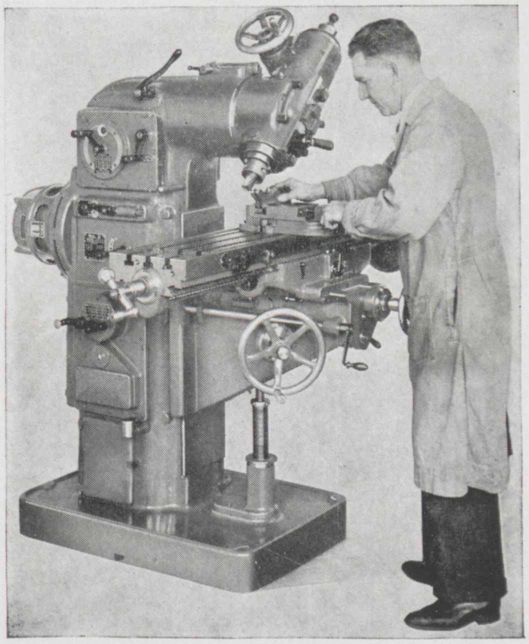

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April 7, 8, and 9

Campus Activities

edited by
J. Edward Taylor,
ch., '40

Irish Eyes Are Smiling

Wendell E. Carroll, president of the student council, has announced that the council selected Edward H. Eckerman to lead the committee for the observance of St. Patrick's Day.

Historical records ascribe great feats of engineering to the patron saint of the Emerald Isle; thus the custom of his present-day sword bearers to honor the engineer of Erin has its foundation .

The following seniors have been invited to work in adjunction with the general chairman for the Shamrock Dance: C. W. Lundgren, J. R. Hayes, and W.E. Alexander, finances; J. A. Greenland, M. L. Stanfield, and J. F. Shake, publicity; J. A. Dillahunt, J. H. Wilson, and R. W. Dispennett, entertainment; and R. L. Pearce and R. A. White, decorations.

At an earlier meeting J. Ewing Ross, vice president of the junior class, was elected financial secretary of the Student Council for the fiscal year. Considerable time was devoted in an effort to improve the constitution of the association.

Commencement Speaker

Dr. Harvey Nathaniel Davis, president of Stevens Institute of Technology at Castle Point, N. J., will be the guest speaker at the commencement exercises on June 4.

The Institute is fortunate in securing Dr. Davis who has found time to become an inventor, an author of several textbooks, and president of the American Society of Mechanical Engineers in addition to entering the ranks of the nation's prominent educators.

He was graduated from Brown University in 1907 and continued at Harvard and Rutgers Universities to win his A.M. and Ph.D. degrees. He has since been awarded a number of honorary degrees in science and engineering.

During the World War he conducted research work with helium gas for government developments and later he served as an aeronautical engineer for the United States Air Corps.

He is a member of the Phi Beta Kappa and Tau Beta Pi honorary scholastic fraternities, and among others, the American Association for the Advancement of Science, the Academy of Arts and Sciences, the American Society of Mechanical Engineers, the American Mathematical Society, and the Society for the Promotion of Engineering Education.

Assemblies

George R. Armstrong, general superintendent of construction for the Louisville Gas and Electric Company, returned to the Institute on Thursday, January 14, to address the student body at the weekly convocation. Mr. Armstrong was graduated in 1921. He was originally invited for December 2 but was forced to postpone the trip because of a motor accident.

The speaker graphically illustrated the calamitous Ohio River flood which occurred last spring and the problems his company had to solve to maintain its invaluable service during such adverse conditions. Mr. Armstrong gave his lecture a decidedly interesting flavor with numerous anecdotes involving humor as well as pathos.

Extra Time Valuable

The Rose bureau of statistics recently revealed a number of interesting facts pertaining to the cash value of the students' spare time. These figures, which were compiled in connection with a national survey, are important since they prove that it is within the means of any individual to enter college if he is willing to devote a few hours to outside work.

In the four divisions which are included under the category of earnings, the institute provided 130 jobs in the 1936-37 school year which were held by ninety five different students out of the total enrollment of 192. By divisions: The National Youth Administration provided forty-six students with a total income of $3,040; scholarships, which truly represent work after hours, added

$6,525 for forty-one students; working loans amounted to $4,059 for twenty-seven students and miscellaneous items totalling $2,506 were distributed between sixteen students.

The total of $16,130 amounts on the average to $170 each, or well over one-half of the regular tuition and book expenses for 49½% of the student body. In addition to this an undertermined number were employed outside of the school.

Scientia

If one is ever in need of concentrated, easily found knowledge concerning either the theoretical or practical sides of the twelve branches of science, the new "Scientific Encyclopedia" which the Van Nostrand Publishing Co. has just completed will be of interest. The value of this unique work lies in the fact that although each subject has been treated with an authoritative completeness by a noted scientist, the cross-indexed volume has simplicity which renders it most usable. The connection with Rose is the fact that Dr. Ralph K. Strong, head of the chemical department, was given the signal honor of being invited to act as contributing editor responsible for the section of the book on chemistry.

Rifle Club

Bang! Bang! Don't be startled, the indoor gallery of the R. P. I. rifle club is open, and the members are merely getting in a little intensive practice for the imminent matches. Organized in 1914, the club is one of the most popular on the campus today because for a nominal membership fee any student may indulge in this sport and at the same time develop proficiency in the use of small bore and .30 calibre rifles under the competent instruction of Warrant Officer Sylvester Kearns. "Sarg" is is coach of the club and spends a great deal of his time in this work. Rifles, ammunition, etc., are furnished through the military department.

Club rules require members to fire at least ten rounds in the four positions each week, and a keen competitive spirit must be displayed since the men who get the highest scores in any week automatically become team members for the next week.

Each season the club enters both a varsity and an R. O. T. C. team in many intercollegiate postal matches and certain special matches such as the National Hearst Match, the Fifth Corps Area Match, etc.

The varsity team at present is comprised of the following men: Gaylord Barrick, Paul Bell, Stanley Craig, Edward Eckerman, Maurice Fleming, Charles Howlett, Thomas Lane, Chancellor Montgomery, Ernest Palisin, Victor Peterson, William Schilling, Robert Underwood, John Whitesell, William Wolf, and Walter Zehnder. Maurice Johns replaces Gaylord Barrick on the R. O. T. C. team, which is open to military students only. Otherwise the varsity team remains intact.

In the latest matches the Rose varsity team ranked in third position in a ten high, all position, postal match with the University of Michigan, Rutgers University, and the Missouri School of Mines. In a similar match the R. O. T. C. team was defeated by the Oklahoma Military Academy, 3492 points to 3394.

A. A. U. P.

The Rose branch of the American Association of University Professors met on Tuesday, January 11, at the University Club rooms in the Deming Hotel. President Edwin W. Mann presented a summary of the national meetings which were held during the Christmas holidays at Indianapolis. Dr. D. B. Prentice, Dr. R. K. Strong, Professor C. C. Knipmeyer, Dr. W. N. Baker, and Dr. W. D. Crozier who also attended the meetings gave short reports.

Dr. Prentice presented a paper dealing with the relative merits of examinations employing essay type questions and those embodying problems of the so-called "objective" type.

A. S. C. E.

C. K. Calvert, chief engineer of the Indianapolis Water Company, spoke at a meeting of the Rose branch of the American Society of Civil Engineers on the evening of January 18.

The meeting, which was held in the clubrooms of the University Club at the Hotel Deming, opened with a short business session at 7:30 o'clock. Dinner was served following this meeting and Mr. Calvert detailed the technical side of the purification of water for his interested audience.

The Rose branch of the society, headed by Professor Edward A. McLean and Professor Roland E. Hutchins, journeyed to Knoxville, Tenn., on Sunday, January 30. Monday the chapter inspected the various experimental and testing laboratories which the government has established to gain information on such vital subjects as reforestation and flood control.

On Tuesday the alumni in the vicinity entertained the visitors in the cafeteria of the University of Tennessee before they toured Chickamauga Dam and points of historical interest, such as Lookout Mountain and Signal Hill. Later Mr. T. P. Pendleton, a project official, demonstrated the process of multiplex and cadastral mapping.

The Wheeler, Wilson and Pickwick dams were visited on Wednesday to complete the chain. They continued to Memphis on Thursday in order to inspect this famous water system. This is the largest city in the United States which depends entirely on ground water for its supply.

Research and Progress

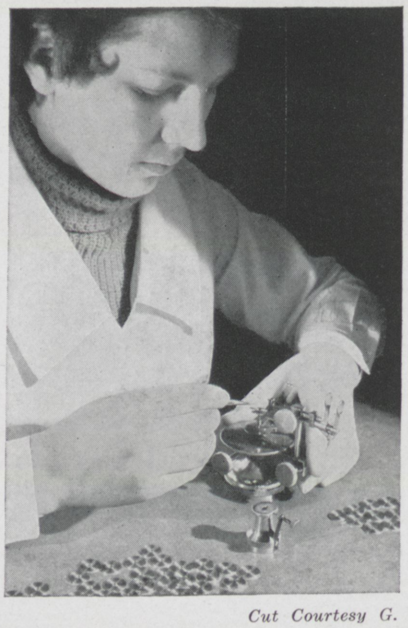
edited by

Lawrence J. Giacoletto, e., '38

Accuracy

Few people realize the accuracy required in manufacturing recording instruments and meters. Although manufacturing tolerances for instrument parts are unusually small, the remarkable property of the finished instrument is that it can withstand severe shock and vibration.

Almost all accurate measuring instruments contain small jewels (sapphires) for minimizing the friction of moving parts. The jewels are scarcely larger than the head of a common pin, yet they are ground with a cup-like depression to receive the sharply pointed steel pivots. The making of the pivot points is another intricate problem. The pivots are first sharply pointed with a jeweler's lathe, the cutting tool being a spinning disk of white, translucent stone. The point is next rounded to a radius of about ½ the diameter of a human hair. Although the moving mechanism that a pivot may support is small, the pressure at the pivot point may be as large as several thousand pounds per square inch. Another important part of an instrument is the spring whose length, breadth, and thickness must be accurately specified. Exact thickness of the spring is of added importance in that the torque exerted by the finished spring varies directly as the cube of the thickness. Most springs of this general nature are formed by passing a bronze wire, only three one-thousandths of an inch in diameter, through highly polished, powerful rollers. The wire is flattened to a uniform thickness of nine ten-thousandths of an inch, and width of one one-hundredth of an inch. They are then cut to correct length, wound into tiny spirals, and tempered in an electric furnace. The springs are then tested for uniformity.



Cut Courtesy G. E.

"Accuracy"

The finished instruments are finally given a severe test under various operating conditions before they are placed into service.

New "X" Particle

In various experiments carried out in past years, physicists have discovered that in some cases they could not express a suitable energy conservation equation. In these cases, a certain amount of mass or energy was lost without any suitable explanation of its disappearance. This discrepancy has led to the postulation of the existence of a hypothetical particle, neutrino, which was assumed to have a mass equivalent to that of the electron but differed from the electron in that it had a zero charge.

Drs. Carl Anderson and Seth Neddermeyer of the California Institute of Technology were the first discoverers of a particle which might be the answer to the dilemma. Their discovery was confirmed by Drs. J. C. Street and E. C. Stevenson of Harvard. A new theory as to the possible origin of these "X" particles was advanced by Prof. G. E. M. Jauncey of Washington University in an informal meeting held at Indianapolis, Indiana, of the Physics section of the American Association for the Advancement of Science. Prof. Jauncey's investigations, although hotly contested by some scientists, seemed to indicate the presence of various particles whose masses varied between that of a proton and an electron.

Dr. Jauncey's theory of the origin of the "X" particles is as follows. The "X" particle is originally an ordinary particle such as an electron of rest mass equal to M_0 traveling with a velocity of V_0. The particle is struck by a photon (a particle of light energy) and the photon partially absorbed causing an increase in the rest mass to M_1 and a change in velocity to V_1. The collision is characterised by the conservation of both kinetic energy and momentum. The result of the collision is a new particle of rest mass greater than that of an electron but possessing a charge equal to that of an electron. In the event that the particle loses mass energy while producing ions or emitting radiation, the previous process is reversed and may finally revert back to the electron. This theory directly contradicts the old concept of electrons and protons as fundamental building blocks.

While the original discoverers of the "X" particle measured its mass to be 130 times that of an electron, Prof. Jauncey's theory would per-

mit particles of different masses depending on the energy in the initial photon.

Candid Camera for Highway Study

The Bureau of Public Roads has made a study of the habits and actions of motorist in passing other vehicles. The purpose of the study was primarily to determine the width of highway necessary for the safety and convenience of modern traffic.

The method of making the study was unique. A motion picture camera was mounted upon a bracket just outside the driver's window; a mechanical arrangement enabled the driver to operate it while driving. The observer selected a vehicle and followed 200 to 300 feet behind, near enough to get a good picture but far enough to encourage a third vehicle to pull in between. Just as the middle vehicle pulled out to go around the leading car, the camera was started and the entire passing maneuver photographed for future study. Furthermore the observer drove at the same speed as the car being followed, and this speed was recorded. The place of passing was also marked for examination and measurement of road conditions. The observer was able to study the position on the pavement of all kinds of vehicles passing in the same or opposite directions.

Studies made on two lane highways of 18, 20, and 22 foot widths, surfaced with portland cement or bituminous concrete, resulted in the following information. As a general rule, motorists allow ample clearance when passing other vehicles. Both cars and trucks follow the centerlines of traffic lanes closely when being passed. The average clearance of passenger cars ranges from 3.8 feet on 18 foot surfaces to 4.9 feet on 22 foot surfaces. For opposite direction passing the range is from 4.0 to 5.7 feet.

Speed has an effect on the car's position on the pavement. As the speed increases, drivers tend to travel farther away from the right edge of the road. Two cars going in the same direction require more road width than two cars travelling in opposite directions when passing. On pavements only 18 feet wide, the left wheels of the passing vehicle are often driven on the shoulder.

In general, it was found that roads 18 feet wide are too narrow either for passenger cars alone or for mixed traffic; that pavements 20 feet wide are inadequate for dense traffic involving trucks, but are reasonably satisfactory for the more lightly traveled roads with few trucks; and that a road width of 22 feet is entirely adequate, safe, and comfortable for modern mixed traffic.

Dew Point Potentionmeter

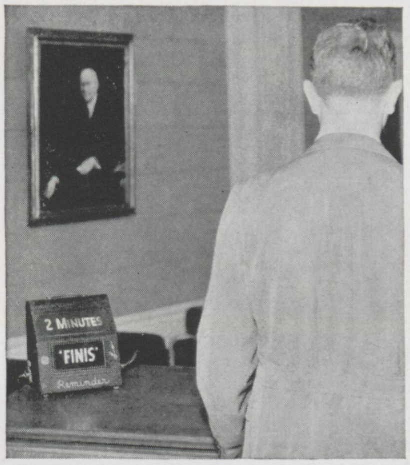
In many manufacturing processes, the amount of moisture in the atmosphere, or humidity, must be maintained within close limits. A new portable instrument employing the dew-point method of measuring moisture content has recently been announced.

The gas whose moisture content is desired is permitted to flow through a gas chamber. A mirror within the chamber is allowed to cool slowly until a spot of dew is formed at its center. A thermocouple is located at the center, and by balancing the thermocouple voltage by means of a potentiometer, the dew-point temperature may be read directly on the scale. By means of suitable hygrometric tables, the moisture content can be obtained from the dew-point temperature. The instrument has a usuable range from -40° to 130° F.

Speech Timer

Program chairmen will welcome the automatic speech timer shown in operation above. The timer automatically flashes a warning to the speaker two minutes before he is to finish his address. When this period has elapsed, the word FINIS is flashed on the reminder, and a low-toned chime notifies him that his speaking time has ended.

The control for the reminder consists of a small portable apparatus with a calibrated dial on the front so that it may be set for any duration of time up to 30 minutes. This control may be located on the chairman's table or any other convenient position. The "heart" of the reminder is a Telechron motor which operates a set of switches which in turn operate small relays in the unit on the speaker's table. Serious consideration is being given to the installation of this device in several well known Rose classrooms.



Cut Courtesy G. E.

"Speech Timer"

The Triograph

Electrocardiography is concerned with the measurement and registration of bioelectrical potentials which are produced by the rhythmic contraction of the heart in human and animal organisms. From the measurment of these bioelectrical potentials, it is often possible to analyze heart ailments. In the past, the measurements have been studied exclusively on the time basis in which the rhythmic beating of the heart was discerned from successive peaks on the potential-time curves. H. E. Hollmann of Germany has described a method of observation which not only makes possible the oscillographic description of the

heart potential, but in addition gives its direction in the body and its rotation during each heart beat.

Mr. Hollmann has named the instrument used in making these measurements the Triograph. In order to more completely understand the operation of the Triograph, the bioelectrical potentials arising from heart beats must first be generally understood. For each contraction of the heart, bioelectrical potentials are produced throughout the entire heart. The individual heart potentials are governed by highly complicated laws concerning the anatomical structure of the heart muscles. However outside of the heart, the individual heart potentials add up to form a resultant potential which is also a vector potential since it has a direction designated as the electrical axis of the heart. Both the direction and magnitude of this vector heart potential will vary from instant to instant. It is the function of the Triograph to reproduce these variations for visual observation.

In order to obtain the resultant heart potential, correctly proportioned potential components are tapped off the surface of the body. The limb electrode connections which are generally standardized in electrocardiography are as follows: (1) Connection to the right arm at the socket point (2) Similar connection to the left arm (3) Connection to the upper extremity of the thigh. Geometrically the three connections form an isosceles triangle with the heart located at the center. The potential between points are therefore separated by 120 degrees in space and can be considered as an unsymmetrical 3 phase supply whose addition vectorially yields the resultant heart potential. The three component potentials are first amplified individually by three amplifiers, and the outputs of the amplifiers are connected to three deflection coils which are spaced 120 degrees apart around the cathode-ray tube. The cathode beam adds up the component potentials in proper phase relationship yielding a pattern of the resultant heart potential. In making the observations, it is necessary to completely enclose the patient in a Faraday shield so as to eliminate electrostatic pickup. The electrocardiograms obtained are then compared with those of a normal healthy heart to determine any irregularities.

Cathode-Ray Phasemeter

Recent research in the measurement of the impedance of the human body and also of the phase angle of that impedance has necessitated the construction of highly sensitive instruments. A method of measuring the phase angle of the human body by means of a cathode-ray tube has recently been described.

Basically, the measurement consists in placing the output of a radio frequency oscillator across two impedances in parallel. One impedance consists of the unknown whose phase angle is to be measured in series with a large resistance so that the current through the combination is essentially in phase with the voltage across the combination. The second impedance consists of a condenser and a potentiometer which acts as a phase rotator. This set up will be recognized as a phase bridge, and by comparing the voltage drop across the unknown with that across the potentiometer and condenser, the phase angle of the unknown can be determined. The instrument used for comparing the voltage is the cathode-ray tube. The horizontal deflecting plates are used for one voltage, and the vertical deflection plates are used for the other voltage.

In making the actual measurements, a two way switch is connected between the phasemeter and the unknown impedance such as the human body. A noninductive rheostat is connected to one side of the two way switch. By throwing the switch alternately to the test impedance and the rheostat using a vacuum tube voltmeter as an indicating device, the rheostat can be adjusted so that the voltage drop across it will be the same as across the unknown impedance. Then with the switch on the pure resistance of the rheostat, the cathode image is adjusted to some reference point assumed to be the zero point. The switch is then thrown to the unknown impedance and the phasing potentiometer in series with the condenser is adjusted to bring the cathode image back to the zero switch. The amount of adjustment required by the phasing potentiometer is a measure of the phase angle of the unknown. In order to amplify the phase reading, one of the voltages of the phase bridge such as the voltage across the phasing potentiometer and condenser is tapped off and fed to a distortion tube which produces a series of harmonics. A tuned circuit picks off the eighth harmonic, and this is the voltage that is compared with the unknown by means of the cathode-ray tube. The phase is thus amplified by an eight to one increase in frequency.

The phasemeter can be used to measure phase differences of the order of 0.0005 radian. Since in use it is first zeroed on an impedance equal to the unknown impedance whose phase angle is to be determined, the final phase reading is essentially independent of the magnitude of the impedance. This is quite useful when making measurements on the human body where the impedance of the body may vary considerably under the effect of change in muscular tension.

Measurements of this general nature have been very instrumental in opening a new field in the correlation between the physical constants of one's body and the state of health of the individual.

Sports

edited by
Robert N. Ladson, ch., '39

On January 7, 1938, the Rose Poly Engineers traveled to Anderson to play Anderson College of that city. Both teams played hard and fast basketball, but at the end of the game, Anderson held an edge of twelve points, 49-37.

At the beginning of the game Anderson, who traditionally holds a jinx over Rose when playing on the Anderson floor, started fast and peppered the basket from all angles at will. As a consequence, after only five minutes had elapsed, the score was 13-1, Anderson. The bewildered Rose defense dragged itself together somewhat and slowed the pace. At the half Anderson was leading 25-18.

For the rest of the game the play was fairly even, but the Engineers were never quite able to get within striking distance. Several substitutes were inserted into the game in an attempt to gain additional scoring power, but the attempt was futile. Near the end of the game Rose Poly drew within five points of tieing the score, but three quick baskets gave Anderson the winning advantage.

Offensively the game was a battle between the two centers. Colwell, Rose center, garnered 23 points on nine field goals and five foul shots while Van Dyke collected 22 points on ten field goals and two free throws. The game was rough throughout, but not many personals were called on either team. Van Dyke is incidentally the leading scorer in Indiana College basketball, and Colwell has the highest average of points scored per game.

Rose vs. St. Joseph

On January 12, 1938, the Rose Poly basketball team traveled to Collegeville, Indiana, and played St. Joseph College of that city. The game was very rough, but not many personal fouls were called. St. Joseph came out on the long end of the score, 43-35.

During the first half, the play was decidedly in favor of Rose Poly. The team started fast and gained a 7-3 lead in the first eight minutes of the game. For the remainder of the first half Rose continued to lead, and the score at the half was 15-11. Defensively the Engineers played excellent ball, and held Scharf to a total of one field goal. On offense Rose utilized a fast break to good advantage and when slowed down, used a deliberate style particularly suited to the short men on the team.

In the second half, Scharf, captain and high scorer for St. Joseph, broke loose several times to make his one-armed tosses good. St. Joseph had approximately all larger men than the members of the Rose squad, and this was the deciding factor. It was a battle of fast breaks in which the Engineers were on the short end.

Colwell with fourteen points and Ladson with twelve were high for Rose, while Scharf scored thirteen points.

Rose vs. Earlham

On January 14, 1938, Earlham College of Richmond, Indiana, opened the Rose home season at the miniature Rose Poly gymnasium confident of winning by virtue of their earlier 52-26 victory. Earlham started fast but were forced to the limit to subdue the fighting Engineers. The final score was 48-36.

During the first half Earlham had excellent luck on their shots and built up a five point lead. However Rose Poly was fighting hard and tenaciously held the score nearly even. In this period the crowd was given many thrills by the fast breaking offenses of both teams. The half-time score was 22-17.

At the beginning of the second half Rose Poly dropped considerably and allowed Earlham to gain a substantial lead. Approximately five minutes before the game ended Earlham was leading 47-25. At this point the Engineers took time out and talked over the situation. From then on, the Rose Poly team displayed a wonderful drive to score eleven points while holding the "Quakers" to one point. This was an excellent example of the traditional spirit and fight that is always evident in Rose teams. Despite a top heavy lead there was still enough power in the Rose team to try to overhaul Earlham. Impartial spectators agreed that if the game had lasted five minutes longer Rose would have won.

In this very exciting game, Colwell and Ladson were high scorers

for Rose with seventeen and fourteen points respectively. The scoring on the Earlham team was evenly divided with Freeman leading with nine points.

Rose vs. Taylor

On January 17, 1938, Taylor University visited the Rose Poly gymnasium for an intercollegiate basketball game. Taylor, led by Stuart and Hanley, won the game 43-28.

In the first half the play was very listless and slow as neither team seemed ready to show any offense. Taylor was satisfied with firing the ball from far out on the floor. At this type of game they proved very adept, and Stuart and Hanley accounted for sixteen points by this method. Offensively, Rose Poly never did get started. Colwell was very successfully guarded and collected only four points. The score at the half was 28-12.

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In the second period, Rose employed a much tighter defense and stopped everything Taylor could offer. However, the Engineers could not get much of an offense started and fell short of winning. In this second half Rose scored sixteen points and Taylor scored fifteen.

Colwell was high for Rose Poly with twelve points while Stuart of Taylor scored fifteen.

Rose vs. N.C.A.G.U.

The Normal College of the American Gymnastic Union from Indianapolis came to Rose Poly on January 20, 1938, and went away on the small end of the score 51-30. This was the initial win of the season for Rose Poly and the showing was very impressive.

In the first half the play was very even. Rose Poly initiated a newly acquired fast break which found "Rosy" Colwell out ahead of the N. C. A. G. U. defense on several occasions. Also, the Rose team employed a new semi-zone defense that kept the opponents out on the floor. It was virtually impossible for them to get near the basket. The score at the half was 22-18 in favor of Rose.

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In the second period Rose Poly began to work hard and ran up a considerable lead. The defense continued to function as well as expected and N. C. A. G. U. was held to twelve points. In this half many substitutes were used and they demonstrated their proficiency at scoring. The final score was 51-30.

Colwell, high scorer for the Rose team scored a total of twenty three points and played only a little more than half of the game. Bowker, small forward for Normal, scored seventeen points.

Rose vs. Wabash

On February 2, 1938, the Wabash College team of Crawfordsville played Rose in the Rose gymnasium. They were excellent in defense and came out ahead 33-20. This was approximately the same score that they won by in an early season game.

In the first half, Wabash gained its margin of victory. The score at the end of this period was 23-10. This first part of the game featured the long shooting Hawkins of Wabash. On three occasions he fired away from the center of the floor and connected. Incidentally, the first four shots Wabash took were good for two points. Rose Poly could not get going and scored only three times from the field.

In the second half Rose settled down and held Wabash to ten points. In this display of defensive strength Wabash was held scoreless for eight minutes. However, the Wabash defense was very strong, and Rose could score only ten points.

Colwell was high for Rose with nine points while Voslow and Hawkins of Wabash scored eight points each.

TERRE HAUTE
ENGRAVING CO.
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Alumni Notes

edited by
Robert S. King, m., '40

Here and There With The Grads

'05 J. Edward Daily, formerly General Superintendent of the Youngstown Sheet and Tube Company at Chicago, is now Manager of the Chicago district.

'14 Walton L. Woody has been transferred from his position as manager of the Cleveland plant to that of manager of the Sharon, Pennsylvania plant of the National Malleable and Steel Castings Company.

'20 Walter L. Osmer, formerly with the Newlin-Johnson Co., has become manager of sales and advertising for the Dix Lumber Company of Terre Haute.

'31 Clarence W. Hoff with the TVA has been transferred to Chattanooga as engineering aide.

'32 Paul F. Froeb is sales engineer for the Ideal Commutator Dresser Company, Sycamore, Illinois.

'36 Richard W. Spain with the Owens-Illinois Glass Company has been transferred to Columbus, Ohio.

Obituary

Mr. H. S. Heichert, Rose '97, died at Orlando, Florida, Friday morning, December 31, 1937. The funeral was held in Pittsburgh. Mr. Heichert was chief engineer of the Pittsburgh Plate Glass Company.

Wedding

Announcement has been received of the marriage of Mr. E. Sheldon Johonnott to Miss Alice Mae Winton of Terre Haute, Saturday, January 15. The ceremony took place in the First Congregational church of Terre Haute with Rev. Isaacs officiating. Mr. Johonnott is a graduate of Rose, class of '29, and is now connected with the State Conservation Department in Indianapolis. Mrs. Johonnott is a graduate of the Indiana State Teachers College. Their residence is 2606 North Alabama Street, Indianapolis.

Correction

In the January issue of the Technic there appeared an editorial error saying that Samuel S. Forsythe was with the Sheffield Steel Corporation at Tulsa, Alaska. The location should have been Tulsa, Oklahoma.

The Editor's Mailbox

Honolulu, Hawaii

Dear Sir:

Your little paragraph on the editorial page of the December issue, asking whether we agree or disagree with the editorials, prompts me to write concerning the editorial in the November number entitled "Military Intervention". I am further induced to write about it because an editorial of similar tenor recently appeared in the paper published by the students of the University of Hawaii, the editor of which happens to be an American of Japanese ancestry. It would be interesting to me to know how far the "peace at any price" sentiment really exists among our college students.

There appears to be no good reason for reproaching an army, or the people who are backing an army, that has been campaigning for a long time, if they become war-weary. If I remember correctly the history which I once read, Alexander was compelled to abandon his India campaign because his good Greek soldiers had become war-weary and wanted to go home, yet these were men of proven courage and fighting ability and they were led by a great general. Similarly, there is a good deal of reason why the people of England and France who remember the years from 1914 to 1918 should be anxious to avoid another war. I myself had the honor of wearing an officer's uniform in 1918, and though I did not leave the soil of the United States, there might even be some slight excuse for me if I had pacifistic tendencies; but the men of present college age have had no such personal experience of military things, and know of warfare only by hearsay. Is it possible that the quality of courage in the young men of the United States has deteriorated?

The answer to such a question as this is usually that a higher type of moral courage is required to oppose the trend of majority thought than is required to be a fighter in an army. Of this I am not at all sure. It requires moral courage to cause a young man who does not approve of murder, to join himself with others in an army because he feels that the welfare of his people requires him to do so. I can understand that William Lloyd Garrison must have had moral courage, and I can understand that a man who insists on speaking his thoughts in a country which is under dictatorial rule may require much moral courage, but in looking on at some student "peace" demonstrations, it seems to me that

the "moral courage" claim is to a considerable extent a camouflage for an attempt to obtain publicity by doing something spectacular which transgresses the usual rules of conduct of the locality in which the move is made. My observations of human conduct have led to the conclusion that high moral courage is very seldom advertised by the person who possesses it.

As we read history and try to forecast what may happen from the record of what has happened, it appears likely that the United States will not soon enter a war of aggression, and that whatever war we may take part in will be one forced upon us against our wishes. It is to be remembered that wars occur either because someone else has something which we want, or because we have something which someone else wants. In the latter case, if the United States should allow its military and naval strength to wane, it is entirely possible that we might have a war forced upon us against our wishes, in spite of friendly neighbors and protective oceans. In such circumstances, which might be described as a case of "kill or be killed", it would be better for us to carry the fighting to the other party's soil, rather than have it take place on our own. That is, a "defensive" war may be fought on foreign soil, and from a military point of view, it should be, if possible.

The people of the United States should be slow to assume a holier-than-thou attitude in connection with present conditions in the world. The Mexican war is an episode in our history which included phases which we cannot point to with pride, and which have been very lightly dealt with in our school histories. Lowell's "Biglow Papers" will give a slight idea of what some of the current comment was in New England, at that time.

Finally, it is a fact that some people on earth are living under conditions such that they consider their lives to be hardly worth preserving, and hence they do not shrink from war. If any change of circumstances should reduce the American standard of living to a similar low point, it is fairly certain that we should become involved in war, perhaps both external and internal, whatever our humanitarian principles might be. Remembering these things, it is well to be idealistic, but we should be careful not to let our idealism carry us away from the knowledge of human conditions as they actually exist.

Yours very truly,

Carl B. Andrews, '08.

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This and magazines of a similar nature in other engineering schools are being used for this purpose by the largest utility whose owners are scattered over the world but who are, for the most part, small investors living in the United States.

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MERTON B. SCHARENBERG,
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Humor

edited by

James E. Ducey,
ch., '40

DAFFYNITIONS

Involute—a person who has to go around in a wheel chair.

Cycloid—a one-eyed monster.

Libido—something society says you have, but cannot exercise.

Detour—the roughest distance between two points.

Coach—a fellow who will gladly lay down your life for the school.

Bolshevik—a brainstorm surrounded by whiskers.

Hot Dog—hamburger in tights.

Calf Improver—silk hose.

Optimist—one who expects to pass Integral the first time he takes it.

Pessimist—Same fellow one semester later.

Once there was a woman who named her three dogs Meany, Teeny, and Paderewski. Meany was the meanest, Teeny was the teeniest, and Paderewski was the pianist.

Overheard in a conversation between two girls: "Is he a man, or is he a Normalite?"

Ruth rode on my new cycle car,
On the seat in back of me.
I hit a bump at fifty-five
And rode on ruthlessly.

—*Harp.*

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Ah Fui sat on Chu Chui track,
Ah Fui no see Chu Chui.
Chu Chui no see Ah Fui.
Ah Blui.

—*Wisconsin Engineer.*

Grizzy: "Sir, is there much graft in the army?"

Capt. Hawkins: "Oh sure. Even the bayonets are fixed."

Frosh Chem. Engineer (leaving Chem. Lab.): "What's that funny smell?"

Soph. Chem. Engineer: "That's fresh air, you sap."

They stood upon the steps,
Their lips were tightly pressed,
The old man gave the signal,
The bulldog did the rest.

—*Wash. State Engr.*

And then there was the girl who was so dumb that she thought that VAT 69 was the Pope's telephone number.

—*Oshkosh O'Gosh.*

"Are you in business now?"
"Oh, yes. The sauce business."
"How's business?"
"Worse dis year."

Hickory, dickory dock
The mouse ran up the clock.
The clock struck one,
Our story's done,
Because there was but one
Mouse and he sure got slugged.

—*Wayne Engineer.*

"Do you know why traffic lights turn red?"

"No, why do they?"

"You'd turn red, too, if you had to stop and go in the middle of the street."

—*Idaho Blue Bonnet.*

Overheard in the Physics Lab.: "And the barometer—how much is it, Abie?"

"Oi, it's a bargain— only 29.98."

"Light house no good for flog," says Chinaman. "Lighthouse he shine. Whistle he blow, flog bell he ring, and flog he come just the same. No glood."

—*Wayne Engineer.*

Two small boys, living in the city, were discussing their experiences of the week-end. One boy had visited his grandfather in the country and seen many interesting facts of nature. Here is his story of the most peculiar.

"I went out to the pig-pen and found one large and seven little pigs. The small ones were chasing the large pig round and round the pen. After so long a time the big one, from exhaustion, couldn't run any longer so the little pigs all jumped on and ate the buttons off his vest."

—*Ark. Engr.*

All night with his baby the Dr.
Sat up and he walked her and Rr.
Whatever he'd try,
She'd continue to cry,
Till at length the poor medico Sr.

G-E *Campus* N*ews*

TEST ALUMNI DAY

TO celebrate the third annual reunion of engineering graduates of General Electric Test, men all over the world gathered in groups to listen to the international radiobroadcast of the reunion at Schenectady, N. Y. Officers and prominent members of P.T.M., or Past Test Men's Association, sent greetings to their fellow Testmen over the General Electric shortwave stations, W2XAD and W2XAF.

More than 15,000 men have graduated from G-E Test—a course which enables them to supplement

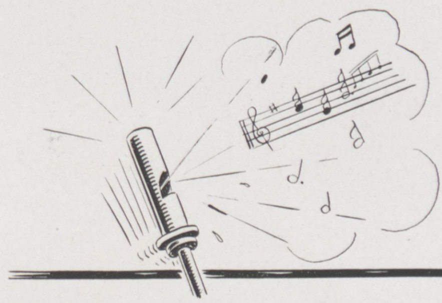
their theoretical knowledge with a practical training. Test graduates today hold many responsible positions in the Company. Others have gone into every walk of life—engineers, lawyers, utility executives, farmers, industrial leaders, bankers, and many other professions. There is, however, one tie which binds them all—their experience "on Test," and to many of them that experience is recalled with somewhat the same enthusiasm as days in college.

OIL FROM WATER

DOWN on the shores of Lake Maracaibo in the steaming jungles of Venezuela, the Dutch Shell Company owns rights to a fifty-mile frontage. Here it has drilled hundreds of wells to make available the rich oil found in deposits ranging from 1500 to 5000 feet below the lake surface.

The natural gas which accompanies the oil deposits has for years been used to power the wells. In spite of this cheap source of power, General Electric engineers under the supervision of E. E. Thomas, Kansas State '22, were able to convince officials of the Dutch Shell Company that it would be more economical in the long run to use electricity instead of natural gas and gas engines for operating power. As a result, a high-voltage line will be erected along the lake shore, from which step-down transformers will distribute current to the motors in the producing areas.

The Lago Petroleum Company has wells in a section paralleling the Dutch properties and extending ten miles out in the lake, which has already been electrified. The combination of these two companies makes the largest electrified system of its kind in the world, from which 400,000 barrels of oil are shipped daily to refineries in Aruba and Curacao, N.W.I.



WHISTLING GASES

GASES are liquefied to be used as cooling agents and to conserve storage space. Chester W. Rice, Harvard '10, consulting engineer in the Schenectady Works of the General Electric Company, has developed a method of thus processing gases more readily by making them whistle.

To liquefy a gas by this method, it is necessary to compress it to 3,000 pounds per square inch, cool it, and pass it through a series of tubes into a liquefying chamber where the pressure is released through a valve in the form of a whistle, producing a further escape of heat energy. Mr. Rice's whistle is so pitched as to convert the greatest amount of heat energy into sound energy. To be effective, however, the sound energy must be carried away from the liquefying chamber.

Developments such as this are being made by college graduates who were at one time "on Test." Many of them have been off the college campus but a few years and are entering a career in one of the many business and engineering fields in the General Electric Company.

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