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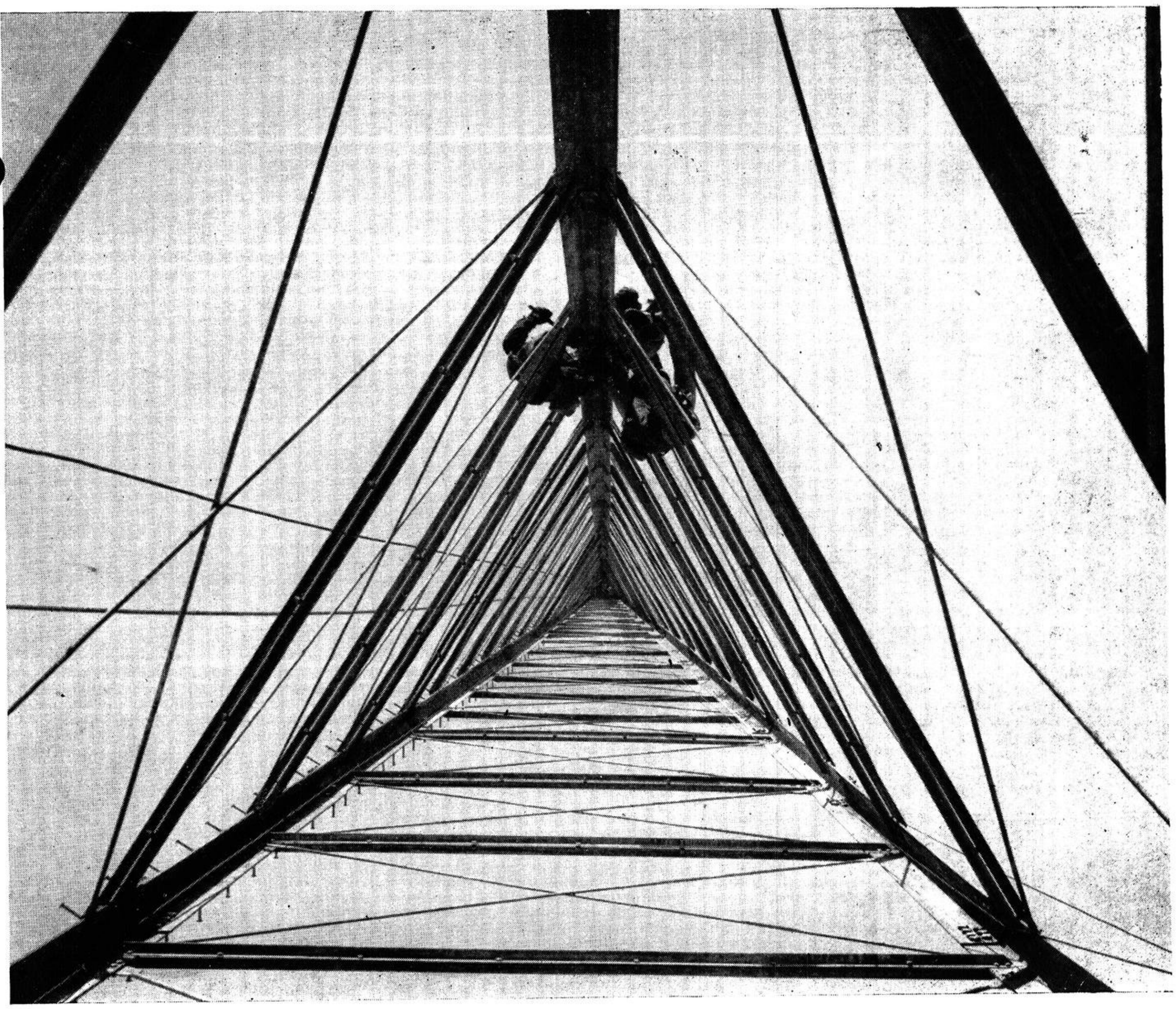

March, 1947

the WISCONSIN ENGINEER

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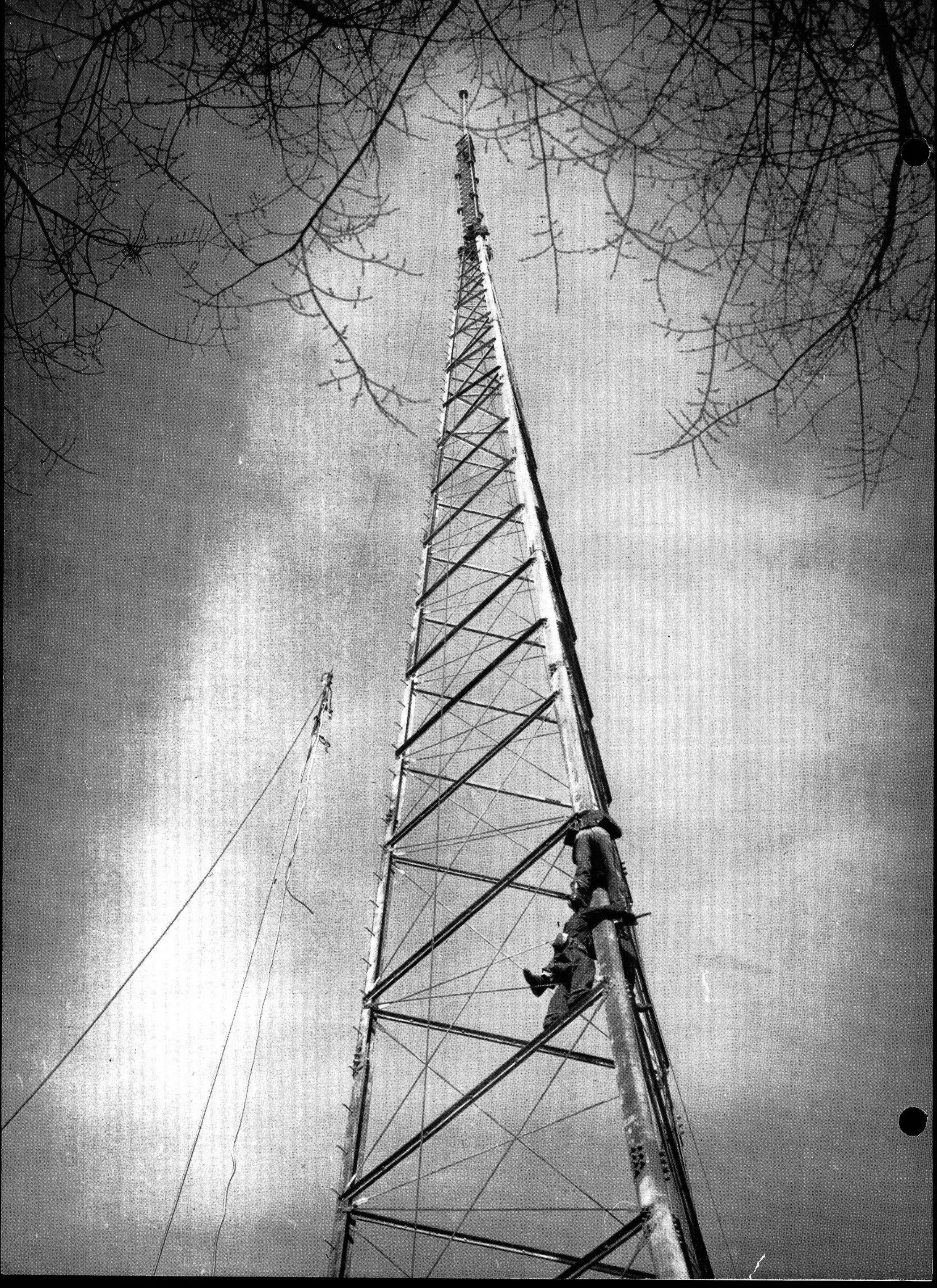
In This Issue . . .

COVER:

This maze of triangles is the geometric pattern which appeared to the camera when looking skyward from directly beneath the new F.M. Tower.

FRONTISPIECE:

A towering landmark behind Radio Hall, is the 294 foot F.M. transmitting antenna. Note the final bay being raised by the workmen as our photographer arrived.



The University's

F. M. Station

Nears Completion

by James Vasilion e'48

AMONG the many construction jobs being carried out on the University of Wisconsin campus, probably the most spectacular and surely the most landmarking is the erection of WHA's new F.M. radio tower just behind Radio Hall. Although the exact date for the maiden broadcast has not been set, the completion of the antenna tower has set the stage for WHA-FM, to go on the air. Material delay held up work for some time, but the University Station, the oldest station in the nation, wasted little time in erecting the huge tower once the material arrived. Present plans call for FM transmission during the time that WHA is off the air.

It seems almost ironic when looking up at the 294 foot tower that the sole purpose of the huge structure is merely to support four tiny doughnut shaped rings located near the top, but it will be up to these four rings, or Bays as they are commonly called, to radiate 3000 watts of radio frequency power provided by the General Electric F.M. transmitter.

A great number of problems in antenna construction have been simplified with the introduction of F.M. broadcasting. Most of those problems have been in connection with the costs of construction and location of the antenna. In conventional broadcast station setups such as WIBA, WGN, and WTMJ, the entire radio tower is made to function as a radiating antenna. This is a necessary procedure, because an electrical wavelength at broadcast frequencies is rather long. Take for example, the radio tower used at WGN's site. Their 680 foot tower is just a half-wave length at the operating frequency of 720 kilocycles, and the entire weight of the tower and pull of the insulated guy wires is supported by a huge insulator at the base of the tower. A structure of this size represents a sizeable investment, and necessitates an out-of-town location. The advantages of location in centers of population can't be overlooked since a greater number of people can be reached effectively with a given transmitter power. Some broadcasters have erected radio towers on tops of buildings in the heart of a city to take advantage of this fact, but have been forced to restrict the height of their towers to a value somewhat under 300 feet. Consequently, the radiating efficiency of the antenna has been inferior to that of the half-wave length antenna. F.M. antennas, on the other hand, are well suited to building-top locations. In fact, skyscrapers offer an ideal location since only a small supporting structure of about 50 feet is necessary to mount the Bays, and the antenna is many hundreds of feet above the ground. The theoretical range of an F.M. station depends directly upon the square root of the antenna height above ground. The actual range, however, is somewhat greater due to a slight bending of the radio waves as they travel. For example, the theoretical or line-of-sight range of WHA's F.M. station is just 28 miles, whereas the expected range based on experience is predicted to be 40 miles. The true range will be found after the station goes on the air and accurate field-strength measurements are made. Another important advantage of F.M. antennas is the fact that considerable power gains can be obtained economically merely by increasing the Bays in the antenna array. Any number of Bays from one to ten may be used with the greatest benefits derived from the greatest number of Bays. When only one Bay is used, power is radiated uniformly in all directions, and so a great deal of power is wasted from radiation directly above and below the tower. As more Bays are added to the antenna, that power which is normally wasted is caused to radiate at a lower angle with the horizon. The ideal condition is reached when all the power is radiated uniformly in the horizontal plane. With four Bays, as used on the University F.M. tower, the effective gain in power over an elementary half-wave length antenna will be 3.1 times. Therefore, the effective radiated power in the horizontal plane will be 9300 watts using a 3000 watt transmitter.

Undoubtedly many small scale broadcasters will be attracted to the ranks of F.M. broadcasting once its many advantages are realized. There is room for at least two or three thousand separate F.M. stations on the air without causing interference according to the Federal Communication Commission. Perhaps this spells doom for the few powerful controlling broadcasters of this day. Only time will tell. Certainly they will receive a great deal more competition than ever before in the history of radio broadcasting. Radio listeners, on the other hand, will benefit by having the finest system of arual broadcasting possible at this stage of the art.

Powder

The art and science of pressing metal powders into dies and heat-treating the resulting compacts to produce strong coherent articles is known as powder metallurgy. There are of course innumerable variables which influence the physical properties of articles produced by this method. By controlling these, the powder metallurgist is able to obtain properties unobtainable by any other means. In many cases, with the refractory metals tungsten, tantalum, titanium, vanadium, molybdenum and their respective carbides, fabrication into useful forms is possible only by powder metallurgical methods.

Contrary to popular belief, powder metallurgy is not a new field but it is a field which has grown tremendously in the last twenty years as a result of applying modern scientific methods to an ancient art. Powder metallurgical practice probably had its beginning in 1829 when Wolloston published details for producing malleable platinum. At that time furnaces were not operating at temperatures high enough to fuse the metal for casting. The method used by Wollaston was to compact platinum powder containing a small amount of water in a toggle press and heat the compact obtained. While the cake was still hot it was struck squarely on top with a heavy hammer. The metal was then sufficiently consolidated to permit normal forging operations. The powder method of producing platinum was supplanted shortly after when suitable refractories and furnaces were developed to melt the metal and cast it into desired shapes. From 1830 to 1920 only a limited amount of progress was made in powder metallurgy, most of this being in the refractory metal field. It has been only since the first world war that we have seen large-scale production of powder metallurgical parts. Even today with man's highly developed research methods there is a great deal of work to be done before we can understand some of the fundamental principles of powder metallurgy.

Products are Many and Varied

There are several main divisions into which products produced by this method may be divided. We have the refractory metals and carbides which because of their high melting points and great hardness cannot be conveniently cast into shape or, if cast, cannot be machined to size. Alloys can be produced which are immiscible in the liquid state or have very divergant melting points by simply mixing the powders together in the desired proportions, pressing the powders in a suitable die, and heat-treating the compacts obtained. It is not necessary during heating to melt any of the constituents present. A very fine example of a product of this type are switch contacts for handling heavy currents. The contacts are made from a mixture of copper and tungsten powders, the copper providing the electrical conductivity while the high resistance to wear and temperature is supplied by the tungsten. Fig. (1) shows a variety of shapes made from mixtures of tungsten and copper powders. Other examples of alloys of this type are copper-graphite, copper-lead and iron-lead. A third group of products is that which has special structural properties. Heading this classification from a quantative standpoint are the porous bearings. Sometimes referred to as the self lubricating or oilless bearings, they were developed in 1921 by the General Electric Company. The bearings are made by pressing together a well blended mixture of copper and tin powders to which small additions of graphite were made. The pressed bearing is then heated to a temperature below the melting point of the bronze to sinter (stick) the powder particles together and remove the carbon leaving a system of intercommunicating pores. Oil is drawn into the pores by means of a vacuum, or is forced in under pressure. In service this oil is drawn from the bearing to the journal by capillary action.

In recent years there has been a tendency to replace some small machine parts with powder metallurgical pieces. Most of these replacements were made to save machining costs, as it was found more economical to make the article from powder than to cast a blank and machine it to size. This field has certain limitations as to size and complexity of parts, but it is felt that great strides will be made toward the further development of this branch of powder metallurgy. Watch gears made from metal powders is but one of hundreds of cases where a powder metallurgical product is replacing a previously machined part. Alnico magnets are now made this way because it was found much cheaper than trying to grind the cast product to size. Just a few of the more important uses of powder metallurgy have been mentioned here. A more complete list would include such applications as the pro-

Metallurgy

by William H. Smith m&m'47

—Photographs courtesy: American Society for Metals

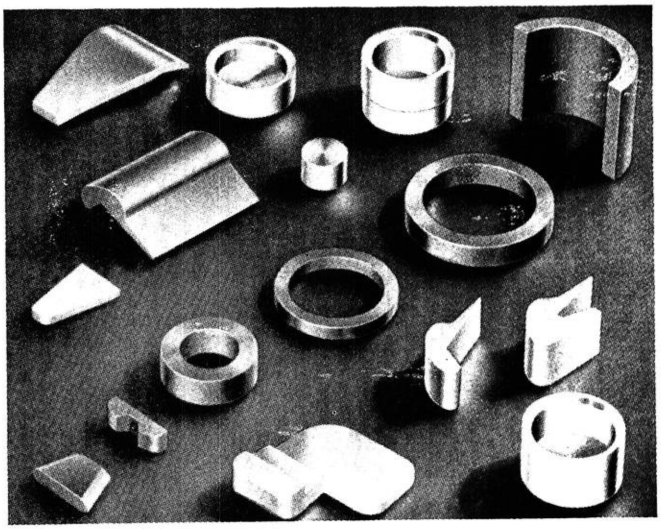
duction of master alloys, metallic filters, dental alloys, welding rods and filaments.

Production of the Powder

In order to illustrate the various steps in the production of parts from metal powders, the details in the manufacture of a tungsten carbide tool bit will be given. It should be remembered that the details for producing another part will be quite different, but the general methods employed and problems encountered will be similar. The production of the metal powder is a very special and complex field in itself and will be discussed only briefly. There are about a dozen different methods of making powders and each has a particular field of application. The particles may be round, angular, all of the same size, or involve a wide variation of sizes, depending upon the manner in which the powder was produced. Methods for producing metal powders include, machining, ball milling, sholting, (a process in which molten metal is broken up by a blast of air and solidified by falling into water), condensation of metal vapors, reduction of finely ground compounds such as oxides, electrolytic deposition, and chemical precipitation. No matter how the metal powder is produced the main concern of the powder metallurgist is the particle shape, size and size distribution, bulk density, i.e., the density of the uncompressed powder, flow characteristics, cohesive ability, chemical purity and oxide content. Before powders are purchased from manufacturers extensive laboratory tests are made to determine the type of powder which will produce the best articles. Powder manufacturers can usually meet the specifications given, but if this cannot be done a simple ball milling operation may be all that is required to obtain a satisfactory powder. For a tungsten carbide tool bit we would like an oxide free powder having a range of particle size from 1 to 20 microns (0.001 mm) with most of the powder less than 5 microns. Particle size measurements may be made by microscopic examination, surface area measurements, settling rates of the powder in a liquid and the transmission of light through a solution containing the powder. There is a great deal of literature available on particle size determinations and this should be consulted for further details.

Bonding and Pressing

In order to bond the tungsten carbide particles together and provide a soft matrix for the hard carbide, 12% by weight of cobalt powder is added. A properly proportioned mixture of the two is placed in a ball mill and blended together for about 30 hours. The action of the



A wide variety of shapes and products produced in powder metallurgy.

ball mill is to coat each particle of tungsten carbide with a thin layer of cobalt. After the milling operation, a lubricant such as paraffin or stearic acid, (½ to 2% by weight), is usually added to prevent excessive abrasion of the die walls as the hard carbide particles are rubbed against them during pressing.

Figure (2) shows a typical press used in the powder metallurgical industry. They are quite similar to presses used to make pills and candies such as "Life Savers" but operate at much higher pressures and have lower capaci-

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Meet your Department Head . . .

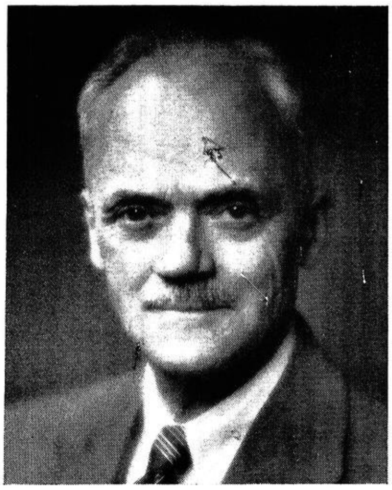
Leslie F. Van Hagan

Civil Engineering

by Jack Strohm ch'48

Leslie F. Van Hagan, chairman of the Civil Engineering Department, was born in Chicago on September 13, 1878.

He came to the University of Wisconsin to study engineering and received his Bachelor of Science degree in



L. F. Van Hagan

1904. Later, when he returned to the University he obtained his professional Civil Engineering degree. While in school he became a member of Tau Beta Pi.

Upon graduation in 1904 Professor Van Hagan taught drawing here at Wisconsin. In July of the following year he accepted a position as railway engineer for the Interoceanic Railroad Company and left for Mexico. It was then he took part in constructing the 350 mile railroad line from Vera Cruz to Mexico City over terrain that rose from sea level to an elevation of 10,000 ft. within the first 100 mile stretch. This route was the same that General Scott had taken for his conquest of Mexico City in 1847.

In 1907 Professor Van Hagan became assistant engineer of maintenance and ways for the National Railway System of Mexico. Everything proceeded smoothly until 1910 when rebel hands headed by Pancho Villa and Madiero started to overthrow the Mexican Government. Since the rebels considered the railroads to be operating for the welfare of the government, they made every attempt to destroy and render them useless. After taking his wife and child to Milwaukee, Professor Van Hagan returned to Mexico and undertook the job of keeping the lines open.

At one time the insurgents had shut off an important section of track in Southern Mexico. Having been sent to remedy the situation, he found that the rails on a high bridge had been torn up and thrown into a deep canyon. Several hours after he left this district the rebels attacked the ranch at which he had been staying and completely massacred the inhabitants.

Once, while constructing a bridge across a gulf, some people came from a village within sight of where they were working to report that the rebels had taken over the town and had the mayor and council locked up. At the moment they were recruiting men in the village to come down, burn the bridge, and slaughter the builders. Needless to say, the bridge was completed in record time.

Professor Van Hagan left Mexico in 1911 just two weeks before Pancho Villa and Madeiro captured Mexico City. When he arrived at Milwaukee he received offers from Wisconsin and Iowa to teach. He accepted the Wisconsin offer and has been here ever since.

In 1913 he became head of the railway engineering department and chairman of the civil engineering committee. He became head of the Civil Engineering department in 1939 when that department was formed from the combining of the separate railway, highway, topographic, and hydraulics departments, and he still holds that position.

Professor Van Hagan is a member of the American Society of Civil Engineers, the American Railway Engineering Association, and the American Society for Engineering Education. He has been president of the Engineering Society of Wisconsin and of the University Club.

Ballistics;

the science of moving projectiles

by Art Nelson m'47

As Engineers you perhaps have done your share of calculating, but have you ever seriously considered the underlying causes of misses in long range rifle shooting? Of course the human factor and sight alignment have much to do with it, but there are other factors concerned as many of you know. Within the next few pages the most important of these will be brought to your attention. And possibly, when you get that one and only shot you'll have a better chance to bag your game, instead of an alibi.

Ballistics is the science of moving projectiles. This science has two main divisions, interior and exterior ballistics.

Interior Ballistics

Interior ballistics treat with events which happen during the time the cartridge explodes and the bullet travels out the barrel. During this short period, events happen with extreme rapidity. The firing pin strikes the base of the cap which crushes it against the anvil. The resulting heat and friction are enough to ignite the priming composition. This burns at extremely high temperature and pressure in about one micro-second. The pressure inside the case rises to approximately two-hundred atmospheres, and these hot gases, under high pressure, immediately rush into the powder chamber. Simultaneously the powder begins to burn. The powder burns more and more violently and the pressure increases as the cartridge case swells outward. When sufficient pressure is built up the bullet is released at the neck of the cartridge and begins its journey out the barrel. If the bullet has a "flay" base its sides are forced out against the side of the barrel until they make firm contact. This is important for gilt edge accuracy in this type of bullet. The hard jacketed bullets and boattails do not expand at the base but depend on their size and strength to barricade the gases. As the bullet moves out the barrel the gas chamber is enlarged, but the pressure still increases. Gradually the pressure, increasing at a degressive rate, reaches a maximum and the pressure begins to decline, the decrease continuing until the bullet leaves the barrel.

Exterior Ballistics

Exterior ballistics of a projectile begins at the instant the bullet leaves the barrel and ends when it is at rest. Gravity has the same effect on a projectile as any other falling object. A rifle bullet begins to drop immediately as it leaves the barrel. The well known formula for falling objects being:

$$H=\frac{1}{2}(GT^2)$$

Where H=drop in feet, G=the gravity constant, 32.2 feet per sec.^{2} and T=time in seconds.

The drop from a line, the axis of the bore, may be calculated if the actual time of flight is known. The bullet velocity is constantly decreasing, but a close approximation may be determined. However, these above calculations hold only for one condition, that is if the rifle barrel is level. This must be considered by hunters in hilly country, or mountainous areas. The allowance made for gravitational pull depends upon time of flight and the cosine of the angle of a horizontal line and the line of departure. Thus, giving the deviation from the line of departure:

$$\text{Cosine } \theta=\frac{1}{2}(GT^2)$$

When adjusting the sights of the rifle these suggestions may be of help to you. One minute is equal to approximately one inch at one-hundred yards. The rear sight is moved in the direction you want to move the point of impact. The bullet follows a curved path so the sights are for the most common range. For game at short distances, a point blank range would be desired. This sets the sight so the bullet never rises more than an inch over the line of sight. For long ranges the accuracy of sighting is handicapped too much by, "holding over". In this case it is necessary to set the sights at the longer range and hold accordingly for game at other ranges.

The Shape and Size of a Bullet

The shape and size of a bullet is another important factor in external ballistics. A blunt nose bullet fails to split the air as easily as the well shaped, "spitzer point". The diameter should be in correct proportion to its length to give the right sectional density. In the earlier days bul-

(continued on page 13)

Alternating Current

Selsyn Systems

by Harold Boettcher e'47

IN the last few years we have witnessed many new developments of the Selsyn principles and new applications of modified designs with an emphasis upon systems in which Selsyns exert control. The word "Selsyn" is unfamiliar to many, but the application of Selsyn principles to remote indicating problems has had a long and distinguished service.

The word "Selsyn" is an abbreviation of the expression "self synchronous". Structurally a Selsyn is a small salient pole synchronous machine whose field winding is excited with alternating current, (instead of direct current as in an ordinary synchronous machine), to provide a synchronizing torque when both the receiver and transmitter are at standstill.

A. C. Selsyn systems may be classified into three main types: 1) power Selsyns, 2) instrument Selsyns, 3) indicator and control Selsyns. In the first two classes extreme accuracy is not required. The power Selsyn is an adaptation of a wound rotor induction motor and of equivalent size. It, as its name implies, may develop a large amount of useful torque output. Instrument Selsyns are extremely small and light and carry only a pointer to indicate a position. The third class, indicator and control Selsyns, are midway in size and sufficiently accurate to measure their errors in tenths of a degree; hence, they enjoy a wide field of use.

The indicator and control Selsyn systems are of two basic types: 1) torque transmission, 2) voltage transmission.

The simplest form for electrical torque transmission is a Selsyn system composed of a Selsyn generator or transmitter, and a Selsyn motor or receiver. The motor carries a pointer or dial or turns a mechanical device. The Selsyn generator and motor are identical electrically and mechanically except that the motor has a damper flywheel attached to the rotor. The same single phase excitation is applied to both rotors. The currents flowing in the rotors induce by transformer action three voltages in the three secondary or stator windings which are Y connected and spaced 120 mechanical degrees. The corresponding stator windings of the rotor and the generator are connected together. Thus any lack of correspondence between the rotors of the motor and the generator will cause unequal induced voltages in the corresponding stator windings, thus a current will flow producing a restoring torque. When the rotors correspond, the stator induced voltages are equal and no current will flow. All voltages and currents, at standstill, are single phase, since only single phase excitation is applied. The magnitude of the voltage in each stator winding depends upon the position of the rotor with respect to that stator winding. The fact that these sets of voltages are a very accurate measure of the rotor position, is responsible for the widespread use of Selsyn systems.

The simplest form of electrical voltage transmission is a Selsyn generator—control transformer system. The generator and control transformer are electrically and mechanically identical as before with two exceptions: (1) no excitation is applied to the rotor of the control transformer, and (2) the stator of the control transformer is a higher impedance winding. The system is used to control or determine the rotation of a mechanical device. The induced voltage in the rotor of the control transformer is proportional in phase and magnitude to the relative direction and amount of displacement between the shafts of the two units. This voltage could be read on an indicating device or used to control a servo system. In the latter case the output voltage controls the application of power to the driving motor which rotates both the load and the rotor of the control transformer until the output voltage is zero and hence the position of the generator rotor and the control transformer rotor coincide.

Both of these systems possess errors. In systems involving Selsyn motorsstatic errors are introduced by (1) friction in the motor bearings, (2) friction in the mechanical load on the rotor, (3) an electrical error of the magnetic field, which is small. Representative values of maximum error vary from 0.6 to 1.5 degrees. Since motors have damper flywheels on their rotors to reduce oscillations, during transition periods or under continual rotation they will tend to produce a dynamic error two or three times as large as the static error.

(continued on page 24)

Ballistics

(continued from page 11)

lets were made of lead only, and were molded with flat bases, and a short nose. As velocities were increased a jacket was needed to hold the bullet shape constant and insure the correct spin. Jackets for army ammunition are made of copper and zinc, and with two types of bases, the flat base, and boattail. The boattail has a 9° taper which gives a more streamline projectile and lowers air resistance. As a means of comparison in overcoming air resistance, bullets are sometimes given a numerical value known as ballistical coefficient. This coefficient may be calculated by the formula:

$$C=W/ND^2$$

Where W is the weight in pounds, D is the diameter in inches, N is a factor accounting for bullet shape.

Wind and Air Resistance

Air resistance has a direct bearing on changes in the velocity of a projectile. Newton was one of the first experimenters of velocities of moving objects. His statements were: the faster an object moves the greater number of particles of air it meets in a given time and, the faster an object hits each particle of air the more momentum was taken out of the object. From this he based this law: the resistance varies as the square of the velocity. This law generally holds true up to about eleven thousand feet per second velocities, when bullets begin to meet much higher resistance. The sudden change in air resistance is due to the velocity of sound.

The increased air resistance at sound velocities may be shown by an incident in the history of the twenty-two long rifle cartridge. Here the lag theory must be considered, which is that wind drift depends on the lag time of the bullet. This will be discussed in a later paragraph. Twenty-two target men were shooting a long rifle cartridge of about eleven thousands feet per second velocity when the high speed cartridge was developed. One of their greatest problems in making perfect scores was wind drift. As the high speed ammunition came on the market many riflemen thought this was the answer to their difficulty, but to their sad disappointment the high speed bullet had almost twice the drift of the older and slower type. This phenomena is explained by the high air resistance of sound velocities. The high speed cartridge was going into sound velocities, and naturally slowed down faster than the low speed cartridge which was just leaving sound velocities.

Wind presents the problem of drift for the rifleman. The effect on the projectile is directly proportional to the velocity of the wind. The drift also depends on the sine of the wind angle. Contrary to popular belief, the drift of a bullet is not inversely proportional to the speed of the bullet. Drift is usually figured according to the lag theory. Lag is the difference between actual time and vacuum time of a bullet. Let us consider two cartridges of various speeds. The forty-eight grain, two-hundred and twenty swift, has a muzzle velocity of four thousand-one hundred feet per second, and if there were no air resistance to overcome, it would travel one thousand yards in one and thirty-six hundredths seconds. Actually it takes two and one-tenth seconds, which gives a delay time of seventy-four hundredths of a second. Using this formula:

$$D=\text{Sine}\ \theta\ L\ S$$

Where D is the drift, θ is the wind angle to the flight of the bullet, S is the speed of the wind in feet per second, in this case assumed at fifteen feet per second. The calculations will give a theoretical drift of eleven feet which is very close to the actual value. The army boattail with twenty-seven hundred feet per second muzzle velocity is moved only six feet in one thousand yards.

This seems to cover the high points as far as ballistics is concerned. If you want to get down to some of the finer points possibly a few of the references mentioned will answer your questions. So, when you miss that beautiful buck, or that wary crow, and you say, "The gun don't shoot straight," there may be an element of truth in it.

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Science Highlights

by Fred Pitschke m'47

An alumnus reports on Radar for the Great Lakes.

Westinghouse marine radar, in regular passenger service on Chesapeake Bay since early March, now is providing protection for essential freight shipments on the Great Lakes. The new installation—one of six to be made by leading manufacturers on as many lake fleets for comparative performance studies during the current shipping season—is on the William G. Mather, flagship of the fleet of the 96-year-old Cleveland-Cliffs Iron Company, plying to ports along the 1000 miles between Buffalo and Duluth.

Tests are being conducted by the Lakes Carriers Association with the cooperation of the U. S. Coast Guard and a committee representing the various manufacturers. Out of the season-long study will come recommended standards to future lakes radar equipment, according to C. M. Jansky, Jr., a Wisconsin graduate, who is a member of the firm of radio engineering and consultants which is in charge of the tests for the Association.

Captain C. O. Rydholm, Marine Superintendent of Cleveland Cliffs, explained the narrow channels which connect the several lakes constitute some of the busiest waterways in the world and poses a particular problem of close-in navigation. In addition, radar's long-range information should be most helpful in expediting ship movement under the rapidly changing weather conditions encountered on the lakes.

Radar will facilitate the movement of cargo, and although lake captains have set an enviable record of safe operation over the years, it will afford an extra measure of safety for crew, cargoes, and ships.

The installation is of the plan position indicator type and thus provides a continuous picture of ship traffic and shoreline conditions throughout a range of from 100 yards to 32 inches of the vessel at all times. Operating frequency of the unit is in the 9320 - 9430 megacycle band.

Wisconsin prof hails the "flying magnetometer" as a boon to prospecting.

Of all the developments in wartime research, the flying magnetometer is the most useful in mining prospecting, Dr. Louis B. Slichter, professor of geophysics at the University of Wisconsin, declared in a General Electric Science Forum at Schenectady, N.Y.

"Magnetic mapping from airplanes," Dr. Slichter said over WGY and WGFM, "can serve to distinguish areas having no prospects for ore, and to reveal geological conditions which are known to be favorable."

For example, he pointed out, the barren granites of the Canadian shield could presumably be separated from the productive basic and metamorphic areas.

In the western states, the flying magnetometer should be of value in tracing the geology of the mountain ranges out under the valley floors, where the bed rock is concealed by outwash from the mountains.

"During the recent war, highly-sensitive magnetic instruments were developed which were able to detect submarines several hundred feet below the ocean surface, from airplanes flying several hundred feet above the sea," Dr. Slichter asserted. "These air-borne magnetometers have been adapted to geological reconnaissance and will enable the rapid and economical magnetic surveying of large, inaccessible areas."

Another quite different application of the flying magnetometer, according to Dr. Slichter, is the mapping of the terrestrial magnetic field over the entire surface of the earth from pole to pole.

"This job was never adequately accomplished by the slow and expensive non-magnetic ship," the geologist explained. "The airplane should enable final completion of this age-old project which was well begun 300 years ago by Newton's good friend, the astronomer Halley.

"Let us hope that more complete magnetic mapping of the earth will stimulate the achieving, at long last, of a satisfactory explanation of the causes of the earth's magnetic field."

Freshman Honor List

HIGH HONOR RATE

E. D. Baugh	3.000
R. R. Johnson	3.000
D. M. Wichern	3.000
C. H. Bassford	2.917
H. N. Theisen	2.857
C. S. Bahr	2.824
D. L. Fisher	2.824
F. C. Hengst	2.824
C. W. Hibbard	2.824
D. L. Jarosh	2.824
T. F. Kinzer	2.824
R. M. Katz	2.824
R. A. Moreau	2.824
James Peter	2.824
A. C. Porath	2.824
H. A. Schopler	2.824
R. A. Bush	2.813
J. G. Franchini	2.813
W. F. Ames	2.786
R. B. Mackenzie	2.786
T. L. Weber	2.769
D. J. Dessart	2.765
T. J. Iltis	2.765
T. W. Nabor	2.765

HONOR RATE

R. H. Schoessow	2.714
D. O. Barth	2.706
H. L. Carlson	2.706
R. L. Cattoi	2.706
D. H. Ferrell	2.706
A. B. Fontaine	2.706
J. T. Gaustad	2.706
R. G. Johnson	2.706
A. R. Knop	2.706
E. A. Ohm	2.706
L. J. Petranek	2.706
W. E. Racine	2.706
D. R. Schroeder	2.706
M. J. Steil	2.706
J. E. Wille	2.706
R. A. Greenkorn	2.647
P. O. Kirchoff	2.647
J. J. Michel	2.647
C. Navratil, Jr.	2.647
C. E. Voelker	2.647
D. R. Carlson	2.643
J. R. Vinette	2.643
J. C. Burton	2.615
H. A. Holtum	2.615
E. M. Rulseh	2.615
C. H. Wilhelmsen	2.615
F. H. Jaeger	2.600
J. K. Johnston	2.600
R. Mendolsohn	2.600
J. S. Spindler	2.600
R. A. Blattner	2.588
E. J. Cook	2.588
J. W. Coonen	2.588
J. C. Landkamer	2.588
R. A. Manske	2.588
F. C. Pritzlaff	2.588
J. R. Whitman	2.588
W. W. Groff	2.571
R. M. Lawrence	2.538
H. Q. Angle	2.529
R. W. Bull	2.529
R. G. Craig	2.529
R. H. Gerhardt	2.529
E. S. Hassel	2.529
C. W. Larsen	2.529
A. M. Nemetz	2.529
Mahlon C. Smith	2.529
R. A. Thiede	2.529
J. P. Almon	2.520
F. E. Mahan	2.500
F. W. Kufrin	2.471
K. W. Livermore	2.471
D. W. Miller	2.471
M. F. Murray	2.471
L. J. Schlimgen	2.471
Manhon Wong	2.471
N. E. Hogue	2.467
R. S. Hogan	2.412
H. J. Hovelsrud	2.412
D. F. Miller	2.412
R. E. Miller	2.412
C. E. Olson	2.412
W. B. Smalley	2.412
R. J. Walsh	2.389
H. F. Onsager	2.385
L. M. Mork	2.357
J. R. Beischel	2.353
F. T. Coldwell	2.353
B. H. Fellows	2.353
W. H. Limbaugh	2.353
A. Miecskowski	2.353
A. W. Mullendore	2.353
N. J. Thompson	2.353
J. J. Yerges	2.353
R. E. Averill	2.333
R. C. Lind	2.333
J. E. Steiner	2.333
R. J. Amundson	2.294
R. B. Anderson	2.294
E. O. Busby	2.294
J. L. Cleasby	2.294
D. G. DeCoursin	2.294
R. W. Krause	2.294
J. R. Martin	2.294
J. F. McCoy	2.294
C. W. Metzker	2.294
K. T. Ziehlke	2.278
S. E. Comstock	2.267
C. L. Olson	2.267
J. A. Haven	2.250

SECOND TERM FRESHMAN ENGINEERS

HIGH HONOR RATE

H. L. Myhre	3.000
D. A. Plautz	3.000
William Woelfer	3.000
H. R. Wahlin	3.000
J. E. Gonce	2.994
D. F. Stoller	2.895
T. M. Ryan	2.842
M. Siegel	2.824
V. E. Herzfeld	2.813
J. J. Sanders	2.813
R. C. Boyle	2.800
M. W. Demerit	2.789
R. F. Jacobson	2.789
A. F. Jones	2.765
A. C. Roecker	2.765
R. G. Michael	2.750

HONOR RATE

R. E. Rayford	2.722
R. K. Ausborne	2.737
P. J. Hassett	2.714
D. L. Purdy	2.706
R. J. Gerlach	2.688
R. J. Martens	2.688
J. T. Cleary	2.667
A. L. Porter	2.667
R. C. Allen	2.647
S. R. Cray	2.647
R. W. Spalding	2.632
P. G. Spink	2.625
R. P. Cox	2.600
H. A. Schmidt	2.588
N. H. Larney	2.556
C. E. Downham	2.529
J. Hrupka	2.529
W. E. Selbrede	2.529
J. C. Wagner	2.529
R. E. Olson	2.526
R. E. Schara	2.500
L. E. Stieghorst	2.500
D. V. Fulton	2.471
D. A. Mickelson	2.471
R. L. Swartz	2.467
G. E. Albert	2.444
J. A. Langemak	2.438
H. W. Muetzel	2.438
H. D. Crinion	2.412
L. M. Maresh	2.412
B. O. Roberts	2.412
R. R. Powers	2.353
R. A. Schlintz	2.350
W. F. Meggers	2.333
J. E. McCourt	2.313
H. W. Jones	2.294
R. A. Schmid	2.294
W. A. Zarris	2.294
J. O. Franklin	2.286
L. A. Groh	2.278
B. W. Johnson	2.278
R. F. Udell	2.267
Henry W. Preu	2.250

Powder Metallurgy

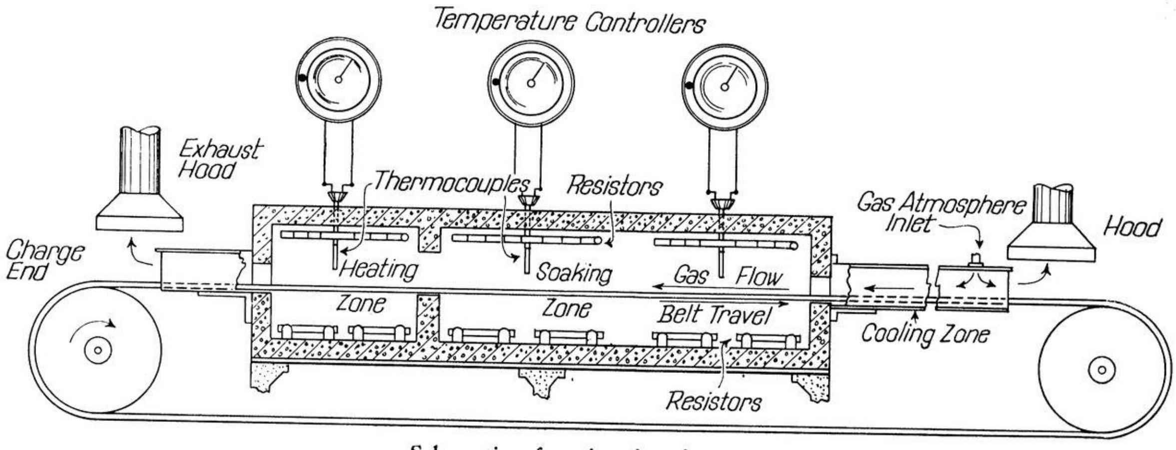
(continued from page 9)

ties. A thorough study of pressing problems in the laboratory is necessary to determine optimum pressing rates, pressures and techniques. Pressures of approximately 30 tons per square inch are commonly used for compacting carbides. Two recent pressing developments are, the hot pressing method, in which the powder is pressed and sintered at the same time, and the vibrating press which shakes the die containing the powder while it is being compressed, thus eliminating some of the air spaces.

Shrinkage Influences the Die Design

The dies in which the powders are molded are usually made of a very hard steel and in some cases may be lined with cemented carbide inserts. Surfaces of the die which come in contact with each other and the powder are given a very fine finish to eliminate as much frictional resistance and wear as possible. A slight taper to the die cavity is helpful in removing the pressed compact from the die during ejection. An important consideration in die design is the packing density of the powder and the shrinkage which takes place during sintering. The unpressed powder usually occupies three times the volume of the pressed briquette and during sintering a linear shrinkage of from 5 to 20 per cent may occur. Before production dies are drawn up the exact values of the packing density and shrinkage are determined. The cost of the dies and their useful life are often the determining factors in the successful operation of a plant and therefore a great deal of experimentation is done before costly production dies are purchased.

After ejection from the die the briquette may go directly to the sintering furnace, or, in case a lubricant has been added, a low temperature, pre-sintering operation is necessary to remove the lubricant. The wax or stearic acid is removed by volatilization and a very slow heating rate is necessary in order to give gases near the center of the compact time to diffuse to the surface. If very fast heating rates are used the volatilized wax may build up such a high pressure in the center that it will actually blow the piece apart. A normal cycle for wax removal is to bring the compact from room temperature to 250° C. in six hours and allow it to soak at this temperature for four hours. It is often necessary to carry out this operation in a reducing atmosphere to prevent excessive oxidation of the surface of the compact.



Schematic of a sintering furnace.

The Sintering Process

Sintering is done at elevated temperatures, but it should be realized that this is by no means necessary. A common example of bonding taking place at room temperatures is seen when two clean Johansson blocks are placed together.

(continued on page 30)

Saint Pat's Dream

The good saint dreamed,
In fancy dim saw scenes drift by,
Saw lawyers pass until it seemed,
The whole of life had gone awry!

He dreamed--in dreaming planned,
A day of days, a joy indeed,
For all true sons within the land,
Who duty-bound upheld his creed.

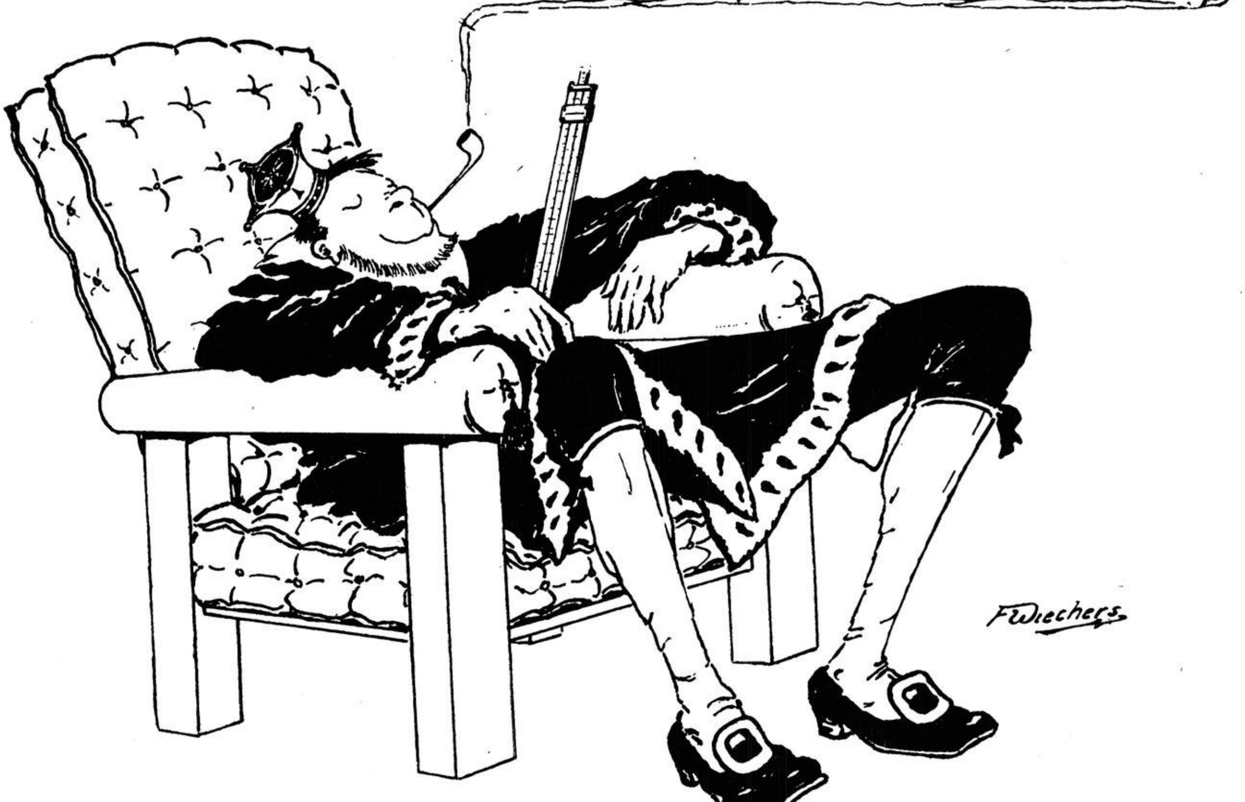
Saw the gathering of his forces,
Hurling war cries to the breeze,
Lords of Nature's vast resources,
Masters of the land and seas.

Saw lawyers bowing, lawyers scraping,
Filling all the air with wails,
Heard them pleading and beseeching,
Saw them ride along on rails!

And the P. A. D.'s did grumble,
And the Fiddledephees did groan,
Egg-filled pockets made them tremble,
As they stood before the throne.

"Hail the King!" the plumbers shouted,
And the shysters bowed in fear,
Their downfall plainly flouted,
By old Saint Pat the Engineer!

BY R. DEWITT JORDAN



ST. PAT

George Zuelke

Outstanding Irish name on the St. Pat Parade is that of George Zuelke, the candidate drafted by the Civils. On the other hand, George may have the goods on those Civils since he was also their candidate back in 1944. (He didn't win.)

Born in Antigo, Wis., George first came to the University of Wisconsin in 1941, entering as a Civil. Uncle Sam called in 1944 and he entered the Navy, went through E.T.M. school and took a cruise in the Pacific on a Destroyer Escort. Returning to the campus last fall he again became an active member of the A.S.C.E., of which he is a past president. At the present time he spends the greater part of his time on his thesis, "The Measurement of Air-inclusions in Fresh Concrete Mixtures." When, (if), that sheepskin arrives in May, George says that he will probably stay around to do some work on a master's.

Although he gives fishing and photography as his hobbies, I know he has another because that amber fluid I've seen him drinking in the Rathskeller isn't coke.

The electrical engineers' candidate for St. Patrick is a living example that "St. Patrick was an engineer". He is a big Irishman by the name of Harry McMahon, a sophomore electrical who hails from Portage, Wisconsin. Harry was introduced to the world 28 years ago (there's a rumor that it was on the 17th of March), and in 1936 he graduated from Portage high. After working two years in Portage, he entered the University of Wisconsin, in the School of Commerce. In 1941 the long arm reached out, and Harry became Private McMahon. By the time the war was over the Private became a Tech. Sergeant in the Air Corps, and an instructor for radio operators at Orlando, Florida.

In November, 1945 Harry was handed his ruptured duck and told to go out and do good in the world. So, in the spring semester of 1946 he entered the Electrical Engineering school, and is well on his way to be one of the active engineers on the campus. He is a pledge of Kappa Eta Kappa, professional electrical engineering fraternity, and of course has the solid backing of A.I.E.E. and all of the electrical engineers. He also has the solid backing of Mrs. McMahon, for Harry has been a member of the legion of married men since 1943. So far no junior St. Pats or Patricias have appeared on the scene.

Harry McMahon

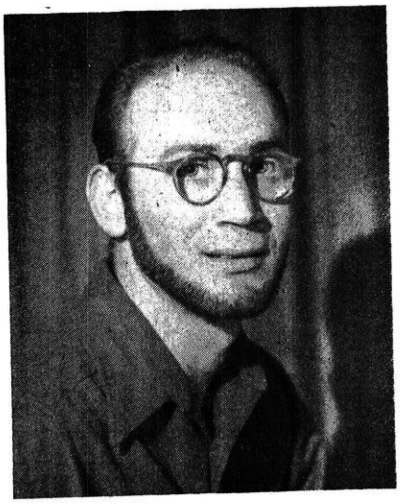
CANDIDATES

Emphasizing the fact that he is one fourth Irish, Frank R. Walker is the candidate representing the Mechanicals in the 1947 St. Pat's celebration. Although Frank gives his home town as Wautoma, the records show that he was born in Milwaukee and spent the first ten years of his life in Dearborn, Michigan. (Showing Henry how to make his cars, I suppose.) Frank also spent two years at Lake Worth, Florida just previous to his entry in the Navy in 1943. He gives that word Navy rather quietly since Uncle Sam saw fit to keep his feet on fertile soil.

An active member of M.E.S.W., Frank also spends considerable time on outside activities especially in the dorm choir and he was formerly a member of the University A Cappella Choir. He gives his hobbies as photography, swimming, and hiking as well as being an ardent classical music lover.

His beard, (get this), is of the red curly variety and it really goes well with his dark black hair. Frank gives welding as his favorite lab and since he is the bashful type, explained that his mother is his only girl.

Frank Walker



William Hershopf

Representing the Min. & Mets. is William Hershopf, (also Irish), who hails from Long Beach, New York. Although classified as a Min. & Met. senior, Bill is a graduate of the University of Wisconsin School of Education, having received his degree in 1941. After graduation he went into his chosen field and taught for some two and a half years before entering the service. The Army decided that Bill's talents could be best used in the Corps of Engineers, and as a result his three years were spent in that department.

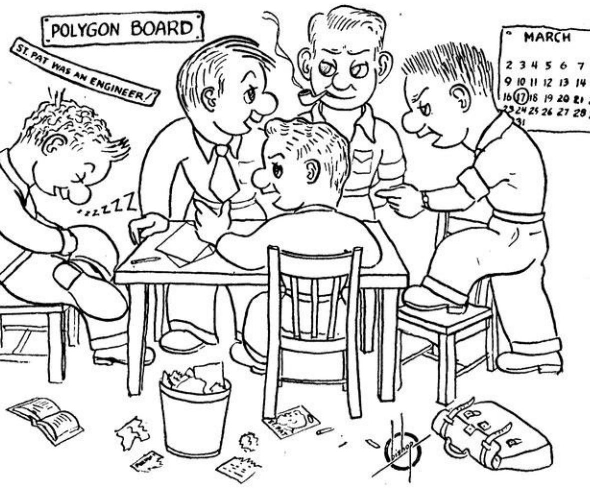
Returning to his alma-mater after discharge, he is continuing in Engineering and hopes to graduate a Mining and Metallurgical Engineer this year.

Chemical's Candidate Not Chosen

Although they are getting a late start, the Chemical Engineering Society are still confident of doing their share in the St. Pat contest. As we go to press they have not elected a candidate, but rumor has it that they have something special in the offing.

Campus Highlights

by John Tanghe e'grad



Polygon organizes (?) for St. Pat's Day.

Engineering News Bureau

The usual difficulties and "red tape" encountered by engineering students and societies attempting to get publicity for their activities in the Daily Cardinal have been virtually eliminated by means of a new system made available to the Engineering School early this month.

Under the new system, originated by Harold May (ME 4), editor of the Wisconsin Engineer Magazine, arrangements have been made with the staff of the Daily Cardinal to print engineering news items in a special column of the paper twice each week. Up until now, publicity badly needed to stimulate interest in the activities of engineering groups has been difficult to obtain for lack of a channel through which to submit articles to the Cardinal staff.

The Wisconsin Engineer office in the M.E. Building has been offered by Harold May to serve as the clearing house for all such news stories. According to the new system, all a student or society need do to get an article in the Cardinal is to write the news up in a clear and correct form and place it in the Wisconsin Engineer mailbox in the lobby of the M.E. Building. Engineering news items of any kind (not gossip!) will be accepted as long as they are accurate and of interest to students at large, and submitted promptly, since stale information is not news.

Although the plan originated with Harold May, the operation and organization of the service is being handled by Russ Pavlat, EE 4. Russ corrects and edits all articles before submitting them for publication.

Here's a real opportunity for engineering students, fraternities, faculty members, etc. to publicize their activities and put the Engineering School on an even par with the "other half" of the university!

•

Triangle Fraternity

A "Gay Nineties" party highlighted the social program at Triangle fraternity last month. In keeping with the spirit of the gay 'nineties, guests were picked up in a horse drawn carriage before the party. Those attending wore costumes appropriate for the occasion.

St. Pat's Day activities also held a high spot in the recent chapter activities. Members of the fraternity have been proud of their ownership and control of "Oscar", the famed steam man made of pipe. They claim the lawyers don't stand a chance of stealing him this year. Chapter actives have invited any interested engineers to visit the fraternity house and kiss the blarney stone imported from Ireland years ago.

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New A.S.C.E. Officers

Members of the student chapter of the American Society of Civil

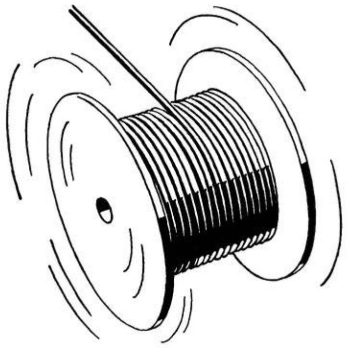
(continued on page 22)

NUMBER 6 OF A SERIES

Newsworthy Notes for Engineers

What is CV?

CV is the answer to a tough problem. It stands for Continuous Vulcanization—a process developed by Western Electric engineers to speed-up and improve production of rubber-insulated telephone wire. It proved so efficient a process that more than thirty outside manufacturers have introduced CV into *their* plants.



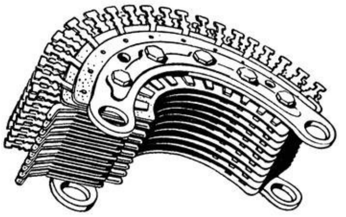
Under previous methods, the rubber compound was fed by hand into a forcing or tubing machine which extruded it upon the wire. The conductor with this unvulcanized covering was coiled in pans in a layer of powdered soapstone and sifted chalk, with each flat coil separated from its neighbor by another layer of soapstone and chalk. The insulated wire in the soapstone and pan was afterwards placed in a steam vulcanizing oven and cured for approximately 45 minutes. An additional reeling or coiling operation was required and the complete process took from one to three hours depending on the insulation wall thickness.

Now the continuous insulating and vulcanizing machine—developed and built by Western Electric engineers—does the whole job in one operation. Rubber compound and bare wire are both fed continuously into one end of the machine and then through steam at high pressure which cures the rubber insulation in approximately 7 seconds. The insulated wire is taken up on reels in continuous lengths up to 30,000 feet in a fraction of the time required under the old panning process.

Halving the steps on Step-by-Step

Simplifying production of over 1,000,000 Step-by-Step "banks" per year—for use in dial telephone exchanges—gave Western Electric engineers an interesting assignment.

One of several types of "banks" consists of 200 brass terminals, assembled in 10 levels, the terminals of each level accurately positioned on a crescent shaped phenol fibre insulator which separates them from the next level. The entire assembly occupies a space of but 4½" x 2½" x 1½". Initially, banks were made in ten steps: (1) spray varnish on phenol fibre strips; (2) punch insulators from these strips; (3) punch *individual* terminals from coils of brass sheet; (4) assemble a preliminary pileup, picking up each terminal by hand,—200,000,000 per year, and accurately positioning it on the varnished insulator; (5) bake; (6) compress to secure terminals to varnished surface of insulators and then dismantle preliminary pileup; (7) make final assembly, inserting additional insulators and spacers; (8) bake; (9) compress and tighten clamping screws; (10) cut off excess length of screws and line ream mounting holes.



Western Electric engineers streamlined these ten steps into five: (1) punch insulators from *unvarnished* phenol fibre strips; (2) punch terminals, leaving them connected to each other, and wind into rolls; (3) automatically separate terminals from roll and eyelet to insulators in punch press equipped with dial feed tools; (4) make final bank assembly; (5) compress and tighten clamping screws.

Results—a 30% reduction in manufacturing cost, an improvement in quality, and more economical utilization of manpower and facilities.

Manufacturing telephone and radio apparatus for the Bell System is Western Electric's primary job. It calls for engineers of many kinds — electrical, mechanical, industrial, chemical, metallurgical — who devise and improve machines and processes for large scale production of highest quality communications equipment.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Campus Highlights

(continued from page 20)

Engineers elected their society officers at the meeting held on Thursday, February 6. Those elected were: Morton Luck, president; Charles McKee, vice - president; Howard Buer, secretary; and Art Plautz, treasurer.

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KHK Formal Pledging

Twenty-one electrical engineering students were received as pledges into Kappa Eta Kappa, national semi-professional electrical engineering fraternity, at the formal pledging ceremony held last month. Those received as pledges were: W. R. Braun, C. F. Cheney, H. A. Childs, N. W. Engberg, J. A. Ebert, J. M. Evans, R. F. Gottsacker, J. P. Mann, D. C. Martin, H. F. McMahon, D. W. Morrill, C. W. Pearson, G. M. Raasch, E. G. Ristola, S. J. Reilly, R. K. Roe, G. S. Scholes, D. E. Seeley, R. L. Sharp, R. W. Spink, and L. R. Stelter. Chairmen of activity committees were selected at the same meeting.

On February 22, the officers of the fraternity, together with Pro. R. R. Benedict of the Electrical Engineering Department, who is national president of KHK, were hosts to five members of the National Executive Council from the University of Minnesota at a dinner held in the Beefeaters Room of the Union. Among those in the delegation from Minnesota was Mr. J. M. Quealy, national secretary-treasurer of the fraternity. At the dinner plans were discussed for the national convention to be held at

(continued on page 31)

Selsyn Systems

(continued from page 12)

In Selsyn generator—control transformer systems we find only electrical errors. Statically they are: (1) inherent design errors, (2) manufacturing errors due to tolerance variation. The maximum error should be small, not exceeding 0.3 degrees. The accuracy is limited by the small output voltage at very small angular displacements.

In actual operation, the rotation of the rotor induces a voltage in the stator, in addition to that induced by transformer action, thus producing an operational error. In both systems, unbalanced line impedances will increase the error. In the motor such unbalanced impedances cause a variation of torque; in the control transformer a variation in output voltage. Thus if exciting capacitors are used in the stator to improve the poor power factor, they must be balanced within one per cent. Likewise the stators should be balanced. An unbalance of one per cent in the stator impedances, (or the lines connecting these stators), will produce a ten per cent increase in the error.

To decrease the errors, the original system may be paralleled with a second system geared 16:1 or 36:1, thus increasing the accuracy of the system and obtaining extremely small system errors.

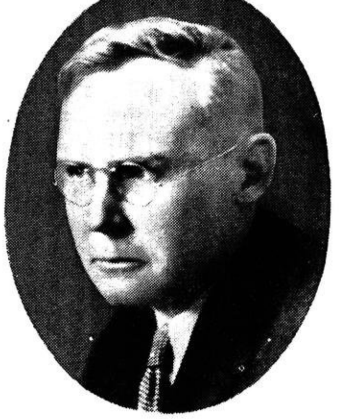
The need and use of remote indicating and control devices is widespread. The recent war has opened many new fields for the Selsyn repeator systems and soon we will see them in common operation in our everyday life.

Du Pont *Digest*

Items of Interest to Students of Science and Engineering

The Synthesis of Nylon

Chemists of original nylon research team honor memory of Dr. Carothers at the dedication. They are: J. W. Hill, Ph. D., M. I. T. '28; H. B. Dykstra, Ph. D. Ohio State '27; G. J. Berchet, Ph. D. Colorado '29; J. E, Kirby, Ph. D. Iowa State '29; E. W. Spanagel, Ph. D. McGill '33; D. D. Coffman, Ph. D. Illinois '30; and F. J. Van Natta, Ph. D. Michigan '28. Dr. Carothers received his Ph. D. from Illinois in 1924.



Dr. Wallace Hume Carothers

1896-1937, was the first organic chemist in industry to be elected to the National Academy of Sciences. During his short scientific career he made contributions that have greatly enriched American life.

Recently the Nylon Research Laboratory near Wilmington was dedicated as "The Carothers Research Laboratory," in honor of the late Wallace Hume Carothers and his classical researches on the structure of polymers, the mechanism of polymerization, and the invention of nylon.

In 1928, a group of chemists under Carothers began a study of polycondensation which led eventually to the discovery of nylon. The project was part of a program of fundamental research to discover scientific facts which might be of eventual value in laying a foundation for applied research.

As the first point of attack, they chose the condensation of dibasic acids with glycols and reaction materials which would preclude the formation of rings. They obtained linear polymers of molecular weights between 2300 and 5000.

Molecular Weights Increased

After two years, a significant advance in linear polymer preparation was achieved. Through the use of the molecular still, it was possible to obtain materials of molecular weights between 10,000 and 25,000, which, when molten, could be drawn into filaments.

More important, the cooled superpolyester filaments could be further drawn into fibers several times their original length and thereby acquired luster, tensile strength, elasticity, pliability, and toughness much greater than the initial polymer. In contrast with ordinary textile fibers, their tensile strength was unchanged by wetting.

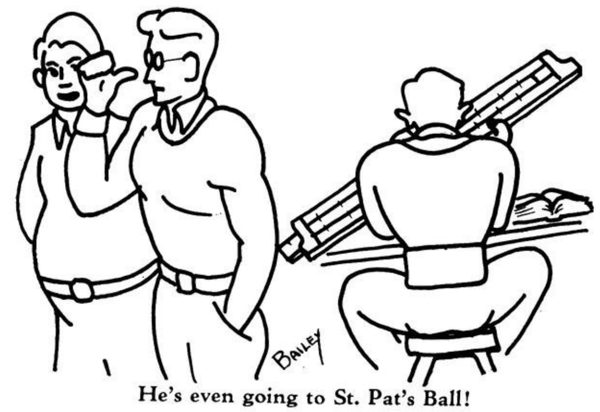
The striking properties of the fibers aroused the hope of finding a commercial fiber from some type of linear superpolymer. Investigation showed, however, that fibers from the polyesters were too-low melting and too soluble for textile purposes. Mixed polyester-polyamides were also not of interest in this category.

Research on Fibers

The possibility of a commercial fiber development seemed remote, but the intuition that frequently accompanies research genius prevailed, and Carothers was encouraged to direct his research on superpolymers specifically toward spinnable fibers. A polyamide from 9-aminonanoic acid gave a fiber of 195°C. melting point, equal in strength to silk, and clearly indicated the possibility of obtaining a material for fibers of commercial utility.

In 1935, the superpolymer from hexamethylene diamine and adipic acid was first synthesized. It melted at 263°C., was insoluble in common solvents, tough, elastic and had the best balance of properties and manufacturing costs of any of the polyamides then known.

A third period of research covered commercial development. The task was enormous, and to reduce to a minimum the "time between the test tube and the counter" a large force of some of the most competent chemists, physicists, chemical and mechanical engineers available was assigned to the project. The story of the manufacture of nylon will be told next month.



He's even going to St. Pat's Ball!

Alumn

Electrical

NIELSEN, ARTHUR C., ee'18, and his son, Arthur Jr. teamed together to win the United States Father and Son Tennis Championship, held recently at the Longwood Cricket Club in Brookline, Mass. Previously, the teammates won the father and son championship held during the National Clay Court Tournament at Cleveland, and later Art Sr., teaming up with his daughter, Peggy, won the father and daughter contest.

Mr. Nielsen, Sr., was varsity tennis captain in 1916, 1917, and 1918, and his son was captain of the 1940 team and co-captain of the 1941 team. A. C. Sr., has been hailed by the **Boston Traveler** as the "all-American tennis papa of 1946".

Both father and son work at the A. C. Nielsen Co., Chicago, one of the largest marketing research organizations in the United States.

INGEBRITSEN, OTIS C., ee'47, is now working at the Underwriter Laboratory, Inc. at 207 E. Ohio St., Chicago, Ill., as an assistant electrical engineer in the electrical department of the Chicago division. His home address is 3525 N. Keating Ave., Chicago 41, Ill.

Civil

CAHILL, RALPH H., c'13, village engineer and commissioner of public works at Whitefish Bay, Wis., has been appointed a commissioner for the Metropolitan Sewerage Commission of Milwaukee County.

BOND, COL. AUBREY H., c'17, is deputy division engineer for the U.S. Corps of Engineers at St. Louis, Mo. During the war, he organized the Seventh Combat Battalion and the Forty-eighth Engineer Combat Regiment.

JOHNSON, COMMODORE ROBERT C., c'17, who led the Sea Bees at Iwo Jima, assumed his duties on February 1 as executive vice-president of the Siesel Construction Company of Milwaukee.

WEAVER, DR. WARREN, c'17, director of the division of natural sciences of the Rockefeller Foundation, New York, has been named by the Navy to a board of civilian research advisers who will act technical consultants on scientific matters.

LIDICKER, WILLIAM Z., c'27, is with the Knappen Engineering Company of New York City.

LENSCHOW, HENRY J., c'30, has been appointed city engineer of Tomah, Wis.

Notes

by R. Zirbel m'47

LI, EU-DIEN, ms'39, is engineer with the Eddy Engineering Corp. at Shanghai, China.

COOPER, ROBERT C., c'41, has been appointed city engineer of Rice Lake, Wis.

TENNEY, VERN W., c'41, who lost a foot during the war, is doing graduate work in sanitary engineering at the University of California.

PETERS, ROGER W., c'42, with the National Advisory Committee for Aeronautics at Langley Field, was married on October 13 to Sarah Johnston of Hampton.

BAUMAN, MERRITT R., c'44, who is a designer with the Ansul Chemical Co., of Marinette, Wis., was presented with a son on September 13.

BECK, EARL J., c'44, received his master's degree in June, 1946, and shortly thereafter married Margaret Peter of Milwaukee. He is now at Yuma, Ariz., with the Bureau of Reclamation on the Gila Project.

Roy Erichsen

ERICHSEN, ROY H., c'44, is now with John W. Cunningham and Associates, consulting sanitary engineers, of Portland, Oregon. Two of the members of the firm are Wisconsin graduates. John Cunningham received his BS in 1908; F. S. Zeidlback was a graduate in 1910.

PORATH, DONALD A., c'44, is a construction engineer with the Navy Department at San Francisco.

ANDRAE, RICHARD W., c'46, is with the Magnolia Oil Company at Dallas, Texas, working on plans for a proposed 20-inch pipe line. He was married on December 31 to Sally Hosford of Merrill, Wis.

S-t-a-t-i-c

by Jack Hinkley m'47

Jim Woodburn m'48

Be it known to all the folks
We couldn't cause a grin,
They always cut the better jokes
And put some clean ones in.

•

Mother: "Didn't I tell you not to go out with perfect strangers?"

Daughter: "But, mother, he isn't perfect."

•

Money doesn't always bring happiness. A man with ten million dollars is no happier than a man with nine million.

•

C.E.: "I can't see what keeps the girls from freezing."

Co-ed: "You're not supposed to."

•

Men prefer well formed women to well informed women.

•

Even when a girl is pretty as a picture, most fellows like to see an attractive frame.

Doctor: "You've been working too hard—what you need is recreation. If I were you I'd go home and take my wife out to a movie."

Patient: "OK Doc, thanks a lot. By the way, what's your address?"

•

M.E.: "Drinking makes you beautiful."

Music Major: "But I don't drink."

M.E.: "But I do."

•

The weaker sex is the stronger sex because of the weakness of the stronger sex for the weaker sex.

•

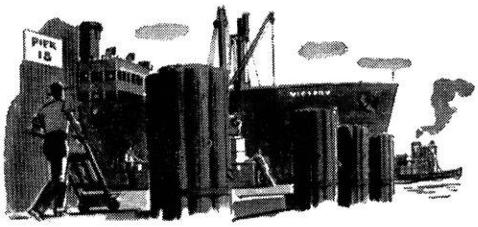
A young Brooklyn soldier was on maneuvers in Oregon. Having a few minutes to himself after evening chow, he strolled out into the woods and soon came back with a handful of rattles off a rattlesnake.

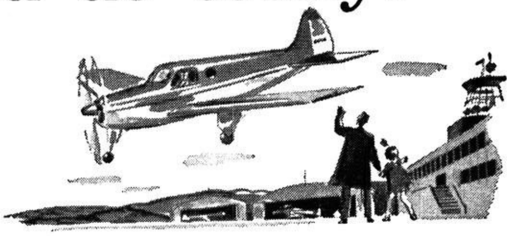
"Where in the world did you get them?" gasped his alarmed companion.

"Off'n a woim," replied the lad from Brooklyn.

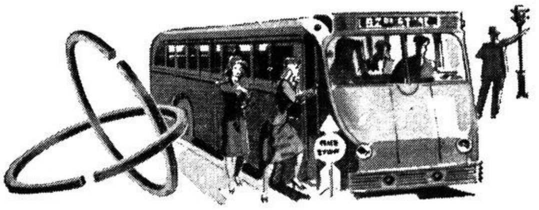
(continued on page 36)

What did you do today?

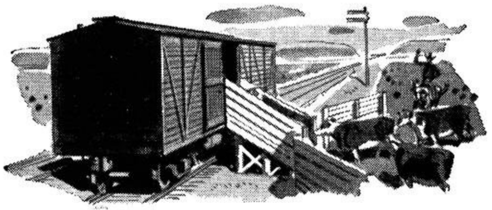




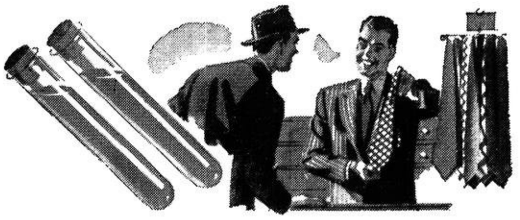
If you visited the waterfront[1]......or watched a plane[2]

...or turned on the radio[3].......or boarded a bus[4]....




...saw a freight car[5].......or went to the dentist[6]....

...lighted a candle[7].........or bought a necktie[8]......

KOPPERS

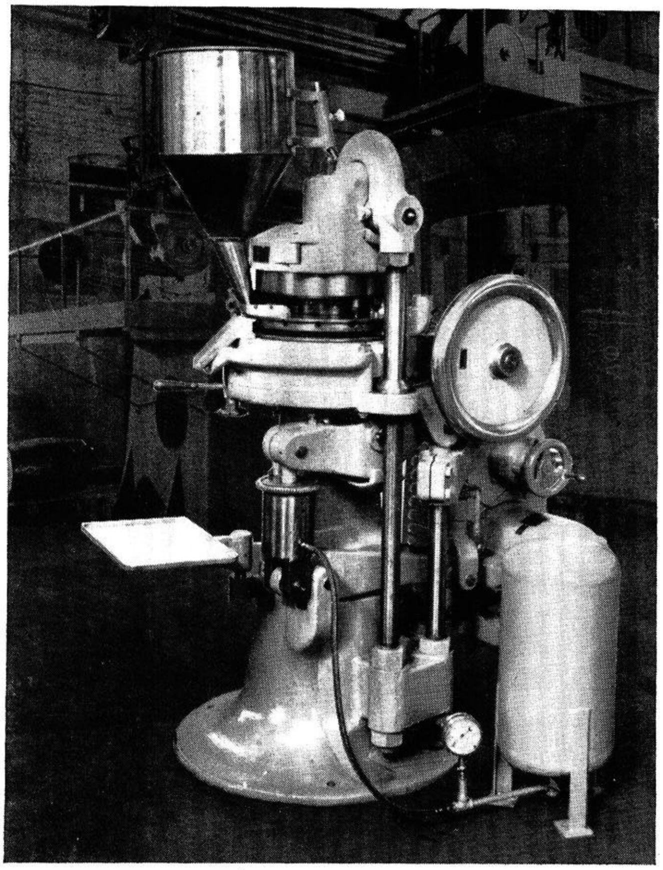
you saw a Koppers product in use[9]

1. Wood piling, pressure-treated by Koppers to protect it against marine borers. **2.** Koppers Aeromatic variable-pitch propellers. **3.** Koppers chemical ingredients for plastic radio cabinets. **4.** Koppers American Hammered Piston Rings. **5.** Wood for car construction, pressure-treated by Koppers for extra-long life. **6.** Koppers chemical ingredients for novocain. **7.** Koppers candles. **8.** Koppers chemicals for use in making dyes. All these are made by Koppers . . . as well as scores of other useful and familiar things. All bear the Koppers trade-mark of quality . . . the symbol of a many-sided service. Koppers Company, Inc., Pittsburgh 19, Pa.

Powder Metallurgy

(continued from page 16)

The atoms of the two very highly polished surfaces are brought into such intimate contact that they exert an attractive force on each other and the blocks can be separated only by the use of considerable force. From this it can be seen that sintering is merely the bonding of solid bodies by atomic forces. The effect of high temperatures and pressures are simply to facilitate this bonding by increasing atomic mobility and bringing the atoms closer together. Sintering furnaces may be gas burning, electrical resistance, induction heating or any other form of industrial furnace. An electrical resistance furnace for sintering porous bearings and watch gears is shown in figure (3). A protective atmosphere is used in the furnace to prevent oxidation during sintering and, in the case of carbides, to prevent excessive decarborization. By far the most common gas used is the mixture obtained by burning hydrocarbon gases, such as coke oven gas, with premixed air in a suitable converter. Nitrogen, carbon dioxide, ammonia, and hydrogen have also been used extensively. Vacuum sintering has been practiced on a laboratory scale but has not been developed on a commercial scale to any extent due to the high cost of maintaining a vacuum. In many cases a low temperature sintering treatment is first given the piece after which it is removed from the furnace. The part has a chalky texture after this treatment but is strong enough to be machined and ground to the size and shape desired. The shrinkage which occurs during this first sintering period is about five per cent. After the piece has been machined it is put back in the furnace and heated to the final sintering temperature. Allowances must be made in machining for the additional shrinkage which will occur on further sintering.



A typical rotary press used in powder metallurgy.

After sintering the article is usually close enough to the desired size so that machining operations are not necessary. In some cases where a better surface is desired, or the dimensions must be held more accurately, the sintered compact is forced through a sizing or coining die to bring it to size. With proper die design and strict control of the production operations powder metallurgical parts can be made as accurately as machined ones. A tungsten carbide tool bit bonded with cobalt and made in the manner described will have the following properties: Rockwell hardness 87.5 to 90 (A scale), transverse rupture strength of 300,000 psi., compassion strength—625,000 psi. and an impact strength of 1.10 foot-pounds.

There are very definite limitations to the powder metallurgical method and they should be thoroughly understood. A knowledge of casting, machining, and die casting operations are required by the powder metallurgist. Before production is started on any new part an investigation is made to determine whether or not some other method would be more economical or give a better product. The price of metal powders are quite high and dies for pressing and coining may be so costly that it would be economically impossible to manufacture the article. From an engineering standpoint we are limited to articles of definite sizes and shapes. Very long pacts of small cross-section can not be produced as the center will remain unpressed due to frictional forces between the powder and die walls. Even in sections of moderate length special precautions, such as pressing from the bottom and top simultaneously, must be taken in order to obtain uniform density throughout the length of the specimen. Only by extensive laboratory tests and supervision of production methods can articles be produced successfully by the powder method.

Campus Highlights

(continued from page 22)

the University of Kansas this spring.

At present KHK members are busy working on activities for the St. Patrick's Day campaign. Future plans include a formal initiation and alumni banquet to be held March 29 and a spring formal dance to be held late in April.

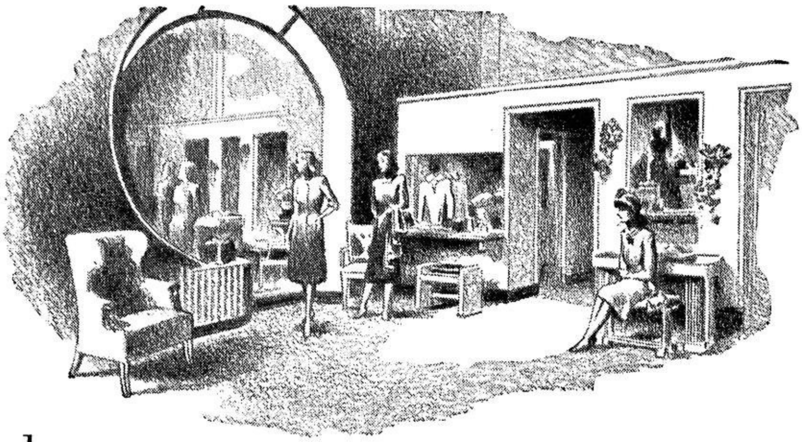
•

St. Pat's Day—March 17

Festivities fitting and proper for the traditional celebration of St. Patrick's Day this month have been arranged by Polygon Board. The main events highlighting the festivities include the beard-growing contest, St. Pat's dance, and the election of "St. Pat of 1947" from the candidates of the engineering societies.

Ed Hillery, president of Polygon Board, announced the following chairmen for the St. Pat festivities: Ed Ansell, EE 4, general chairman; Ed Brenner, ChE 4, promotions; Harvey Nienow, ME 4, publicity; Ed Hammer, ME 2, arrangements; Art Shaw, ChE 4, finances; Fred Pitschke, ME 4, tickets and buttons; and co-chairmen Jack Crow, EE 3, and Jane McKenna, EE 3, decorations. These chairmen are being assisted by a number of sub-chairmen.

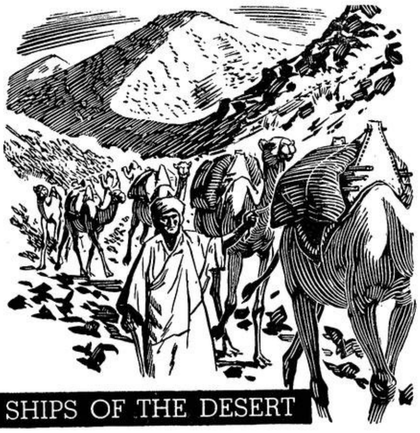
The St. Pat's dance will be informal and open to engineering students and their guests. It will be held on Saturday evening, March 15, in Great Hall of the Union. During the intermission the beard-growing contest will be judged and the winner of the St. Pat's campaign will be crowned.



THE STORY OF CHROMIUM

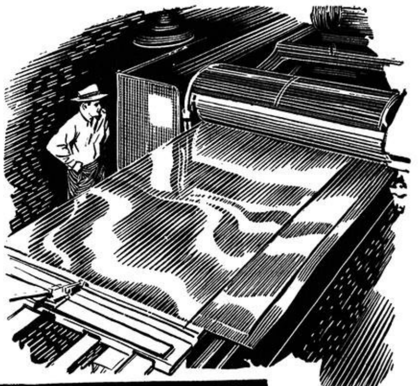
COLOR FOR ARTISTS

The yellows, blues, and violets of the artist's palette; the red of the ruby, the green of the emerald — all come from chromium, a metal named from the Greek word *chroma*, meaning color. Discovered in 1797, this metal was for years just a laboratory curiosity, but is now top-ranking among alloys.



SHIPS OF THE DESERT

Caravans of camels laden with chromite ore have often formed the first link on an assembly line thousands of miles long. From the mines of Rhodesia, Turkey, Russia, and India this valuable ore starts its long journey to Electromet furnaces, where dozens of different types of chromium alloys are produced.

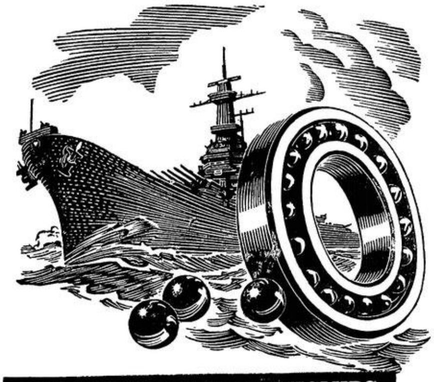


VERSATILE ALLOY

This silvery-white metal, used with steel and iron in amounts from 1 to 35 per cent, imparts many of its own desirable properties. To stainless steels, chromium gives resistance to heat, rust, and corrosion—to heat-treated steels, strength and resistance to shock — to cast iron, hardness and wear resistance.

NOT JUST SKIN DEEP

The luster of stainless steel withstands all weather conditions—on streamlined trains as well as on skyscrapers. For hospital, food, and dairy equipment, too, this steel is popular, since it is so easy to clean and sterilize. And for the oil and chemical industries, its resistance to corrosion and heat makes it ideal.



BEARINGS TO BATTLESHIPS

Axles and armor plate, dies and drills, shafts and springs — these are made from engineering steels that must have the hardness and strength necessary to withstand wear and strain. That's why engineers specify steels with 1 to 3 per cent chromium for applications where dependability is essential.

It's Been A Long Time

... since Electromet started to produce ferro-alloys — 40 years ago. In fact, as far back as 1897, a plant in Virginia, which later joined Electromet, was the first to produce ferrochrome commercially in the United States. Electromet is constantly developing new and better alloys, among them the low-carbon ferrochrome essential in the production of stainless steels. You will learn more about chromium and other alloys by writing to our Technical Service Department for the booklet, "Electromet Products and Service."

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

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P-19455A

Electromet

TRADE-MARK

Ferro-Alloys & Metals

S-t-a-t-i-c

(left over from page 28)

Prof: "Here you see the skull of a chimpanzee, a very rare specimen. There are only two in the country—one in the national museum, and I have the other."

•

Cop: "How did you puncture this tire?"
Driver: "Ran over a milk bottle."
Cop: "Didn't you see it in time?"
Driver: "Naw, the kid had it under his coat."

•

A justice of the peace in a small Maine town was called upon to perform his first marriage ceremony. After he had the knot safely tied, the young couple continued to stand before him as if expecting some further rite, whereupon the justice stammered out, in a desperate attempt to round off the ceremony with something of a religious turn, "There, there it's all over! Go ye forth, and sin no more!"

•

Stranger: "I've come out here to make an honest living."
Native: "Well, there's not much competition."

•

A young man was seen dashing after the "400" as it left the Beloit station. He grabbed the rear platform of the train and swung himself aboard about a block from the station. As he stood there gasping for breath an old-timer who was standing on the platform commented to the effect that the modern generation had very little stamina.

"Why, when I was your age, young fella, I thought nothing of chasing a train for two miles or more!"

"You might be right, Pop," the young man replied, "but I missed the train at Janesville."

•

"This coffee tastes like mud."
"Well it ought to. It was ground this morning."

•

12th axiom of Economics—Girls without principle draw considerable interest.

•

I think he's regaining consciousness, doctor, he tried to blow the foam off his medicine.

•

A salesman making a month's stay in town bought some limburger cheese to eat in his room. When he got ready to leave, he still had half of the cheese left. Not wanting to pack it, nor leave it lying open in the room, he went over to the windowsill, carefully removed a plant from the window box, buried the cheese, and replaced the plant.

A few days later he received a telegram from the hotel: "We give up. Where in hell did you hide it?"