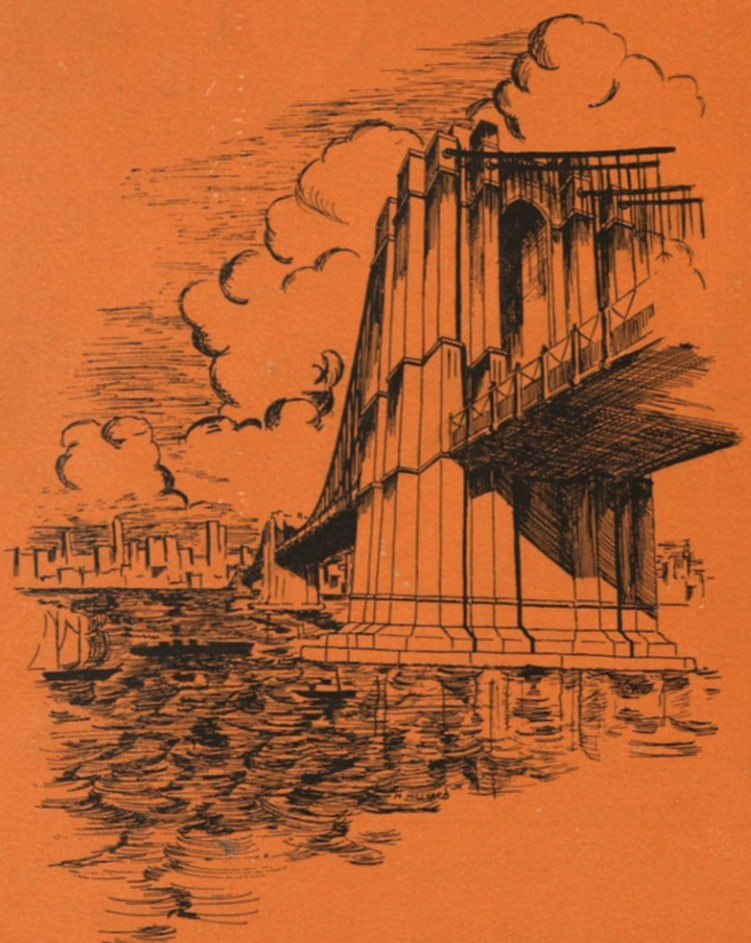
The COLORADO ENGINEER



MEMBER OF ENGINEERING
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THE COLORADO ENGINEER

VOLUME 26 NUMBER 4

May 1930

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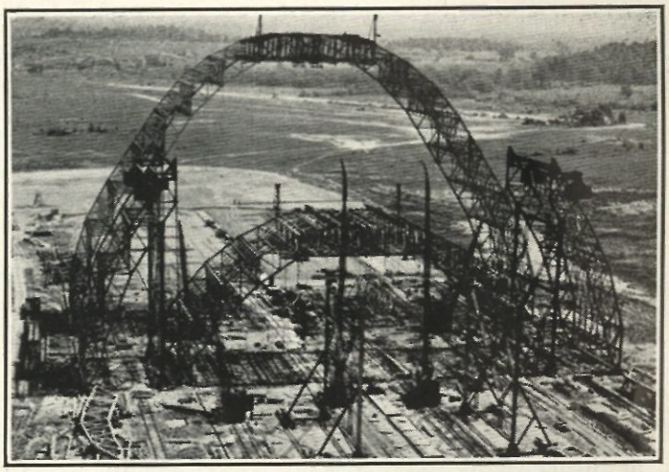
UNIVERSITY OF COLORADO

The LARGEST AIRSHIP DOCK IN THE WORLD

G. W. Gillard, '26



In this picture, the second arch is shown under construction.

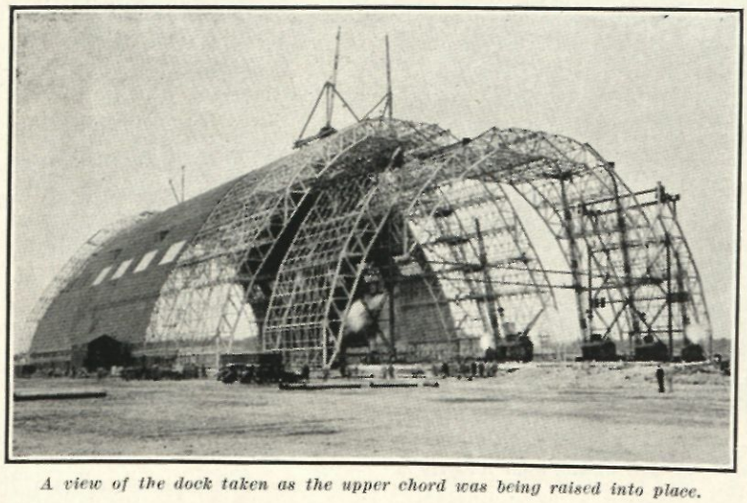
Contract for the construction of two lighter-than-air rigid airships of 6,500,000 cubic foot capacity was awarded the Goodyear Zeppelin Corporation of Akron, Ohio, by the United States Navy in October, 1928. When the first of these giant sister ships, to be designated the ZRS-4 and ZRS-5, takes to the air, it will be the largest dirigible in existence. In cubical content these ships will be about twice the size of the "Graf Zeppelin," two and one-half times as large as the "Los Angeles" and approximately thirty-five per cent larger than the R-100 and R-101, built in England.

But before construction of these two super-Zeppelins can begin, a factory and dock or hangar must be erected in which these ships may be built and housed. The erection of this gigantic structure is rapidly nearing completion. Construction had progressed sufficiently far by the latter part of October, 1929, to allow the beginning of construction on the first structural ring of the ZRS-4.

The Goodyear Zeppelin airship factory and dock is the largest structure of its kind in the world. It is 1,175 feet long between center lines of door tracks, 325 feet wide from center to center of arch pins, and 197.5 feet high from center of lower to center of top pins. It has a volume of approximately 45,000,000 cubic feet and an enclosed floor space of 364,000 square feet, which is by far the largest single uninterrupted floor area yet built. It is the largest structure in the world without interior supports. Ten football games could be played under its roof at the same time. It is equal in height to a twenty-two-story apartment building. It could house the airplane carriers, "Saratoga" and "Lexington", together with the Statue of Liberty and Washington Monument. The sheeting covering the structure, if laid out flat, would cover 18 acres.

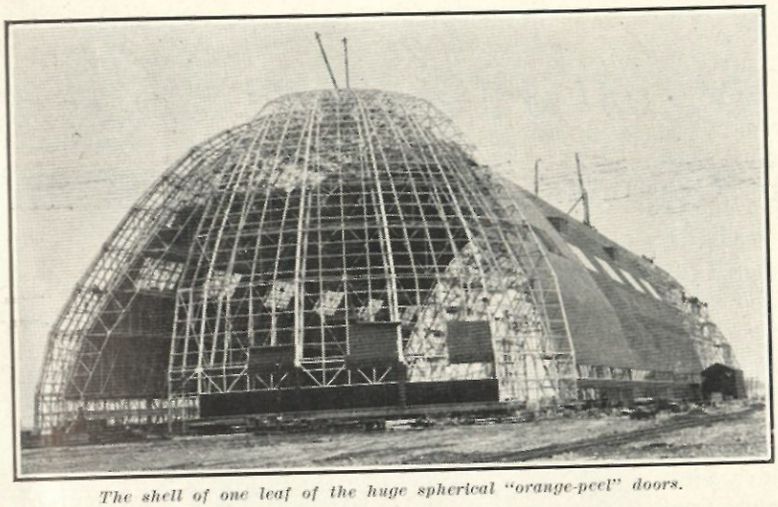
The large Zeppelin shed at Friedrichshafen, measures 787 feet long, 151 feet wide, and 115 feet high. It is built of structural steel with sliding doors at the ends. At Orly, France, two reënforced concrete hangars have been built which are 984 feet long, 298 feet wide, and 194.5 feet high. At Karachi, India, the British government has built their largest hangar for the proposed England-India service.

This structure has a length of 850 feet, a span of 230 feet, and a clear height of 170 feet. The largest hangars built so far in the United States are the Navy hangars at Lakehurst, New Jersey, and Belleville, Illinois. The Lakehurst structure is 803 feet long, 264 feet wide, and 172 feet high. The Belleville hangar is smaller, having a length of 810 feet and a span and height of but 150 feet each. Both have vertical doors that open from the center.



A view of the dock taken as the upper chord was being raised into place.

The shape of the new Goodyear Zeppelin factory and dock is somewhat like that of a semi-paraboloid. Sections taken across it would form parabolas, and a section taken longitudinally would form two half parabolas joined by a straight line. The structural design of the airship dock consists of eleven parabolic arches spaced on eighty-foot centers connected by a system of vertical and horizontal trusses which, aside from forming a bracing system for the structural shell, carry light trussed rafters spaced on ten-foot centers on which are placed Z-bar purlins on eight-foot centers. At each end of the main shell are placed two diagonal arches which meet the end arches at the door pins. The doors are similarly constructed with arched and braced



The shell of one leaf of the huge spherical "orange-peel" doors.

ribs. They are spherical in shape and resemble huge "orange peels" moving on trucks.

All steel for the shell is of structural grade with the exception of the main arch chords, which are silicon steel. All materials have been made to conform to the standard A. S. T. M. specifications, and all workmanship has been made to conform with the requirements of the American Institute of Steel Construction. Seventy-two hundred tons of steel have been used on the job, of which 2,400 tons are in the doors and 4,800 tons in the shell structure.

In the design, a great deal of study was given the effect of buildings of various shapes on the local air currents. Since, perhaps, the most difficult part of airship operation is the launching and docking of the ship, it is essential that the building should cause the least possible resistance to the prevailing air currents and not cause cross currents which would complicate the handling of the ship at the hangar. Data compiled in observing air currents at the Lakehurst hangar showed that the velocity of the cross currents around the doors (sliding type) often attained a velocity twice that of the normal wind currents. An airship cannot be launched or docked safely against a wind greater than a certain maximum. It is readily seen, therefore, how the usefulness of the dock is increased as the cross currents in and around the building are brought to a minimum. For example, if a ship cannot be launched at the Lakehurst hangar safely in a cross wind having a velocity of ten miles per hour because of 20-mile-per-hour cross currents set up around the doors, such a hangar is only half as useful as one of a shape which caused no increased local currents around the doors. It is this factor that decided the selection of the spherical or "orange-peel" doors on the Akron dock. Actual experiments carried out in miniature demonstrated conclusively that this semi-paraboloid-shaped structure offered the least resistance to wind currents and is, therefore, the most efficient type.

As it is desirable that airships head into the wind when landing, doors have been placed at each end of the structure, and the longitudinal axis of the hangar has been made parallel to the direction of the prevailing winds during flying weather.

Considerable study was also given the matter of wind loads, especially interior or suction forces, by the Goodyear Zeppelin Corporation engineers. Experiments and observations carried out primarily to determine the effect of various shaped structures on cross currents furnished valuable information on the magnitude and distribution of these forces. The wind, when meeting an obstruction such as this, deflects upward, often creating a partial vacuum over the upper parts of the building. This suction tends to force the roof of the structure outward instead of inward and peculiarly often reaches its maximum intensity on the windward side of the structure. It has been proved that these suction forces, which heretofore have been neglected by American engineers in designing buildings to resist wind pressures, may be several times as great as the directly applied wind pressure. For the Akron dock, the outward forces have been assumed at not less than one half the inward forces with provision for securing the roofing against outward forces equal to the inward or full direct forces.

Following are the assumed loads and stresses:

Loads:

Dead Load

1. 10 pounds per square foot on sheets, purlins, and rafters.
2. 20 pounds per square foot on laterals.
3. 30 pounds per square foot on arches.

Snow load

1. 30 pounds per square foot on all surfaces inclined less than 45 per cent in combination with dead load only; 15 pounds in combination with maximum wind load.

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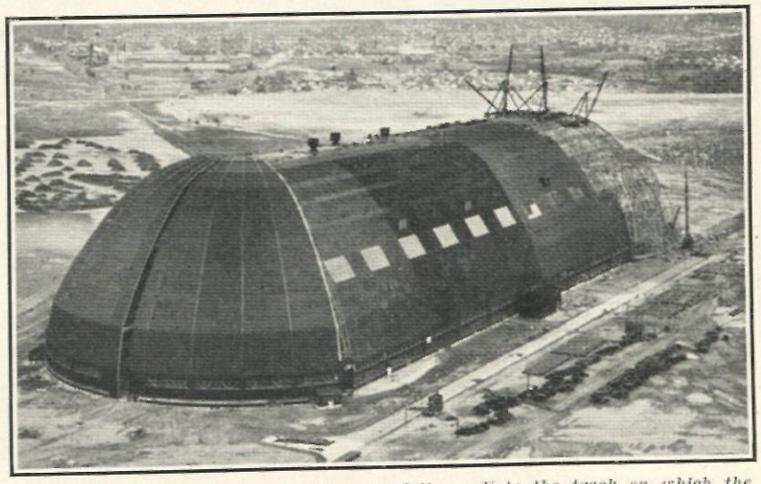


The dock from the air as it nears completion. Note the track on which the immense doors are rolled back. The City of Akron may be seen in the distance.

AVIATION LIGHTS UP!

Air Travel Cannot Cease With the Setting Sun

LESTER C. SIMPSON, '25

EVERY evening at one-half hour before sunset two thousand aviation beacons begin sweeping the skies to guide the ships that pass in the night. The night-long flashes of these revolving searchlights form the backbone of America's airways from lighted port to lighted port. Almost five hundred of these lighted airports exist at the present time and extensive plans are under way to improve the lighting on these fields and to light additional landing areas.

Recently a very prominent manufacturer of aircraft remarked to me that it was his firm belief that a curve could be plotted right now covering the progress of aviation. He added that this curve would show a direct relationship between airport development and this areonautical advancement.

There are some fifteen hundred landing fields in operation in this country where various degrees of service may be secured. Some offer little more than a clearing for landing, a faded wind cone for the landing direction, and a gasoline pump to replenish waning fuel supplies in the planes that happen by, and fortunately some offer facilities comparable to the service available at the larger railroad terminals.

The rating designation covering airports as issued by the Aeronautics Branch of the Department of Commerce is divided into three parts. One of these divisions covers the facilities for lighting. If it is so important that one of the three major considerations covers this activity, it is quite evident why the large group of unlighted ports is actively interested in installing equipment to give twenty-four-hour service. The lighting of railroad yards was found necessary to speed rail service, and it can be readily seen that adequate lighting is more vital to the advancement of a means of transportation which relies upon speed and twenty-four-hour availability for its existence.

The Aeronautics Branch of the Department of Commerce, working with the industry, has issued comprehensive data to guide those interested in airport development. The bulletin issued by the Department on this subject referred to most often is the "Airport Rating Regulations;" and an important supplement is another publication, "Notes on Airport Lighting," prepared by H. H. Blee, Director of Aeronautic Development. The equipment outlined in these bulletins is necessary for the satisfactory operation of the airports of the various classes described. Information regarding the intallation and operation of the equipment may be secured from the manufacturers and suppliers of this special apparatus.

WHAT THE PILOT SEES

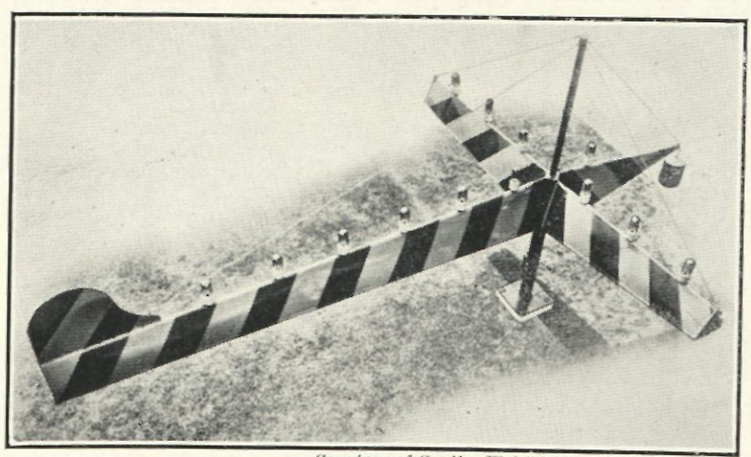
Perhaps the most graphic way to portray to you the outstanding phases of airport lighting would be to place you alongside the pilot in a plane approaching a port at night.

The first indication you have of the location of the lighted airport is the repeated swish of the rotating beacon before your eyes. You do not see a beam of light swinging around in the air as you do when you stand under a rotating beacon on an airport, but this light appears to suddenly build up in intensity and quickly diminish because you are looking directly into the beam and light source of the projector. These flashes appear six times per minute and may be visible, depending upon the atmospheric conditions, from several miles to as far as eighty miles.

Following these beacon flashes into the airport you are first interested in knowing about the major obstructions on and near the port so that you may be sure to keep free from their entanglements. These are indicated to you by red obstruction lights which surmount these hazards.

Upon determining the hazards which are to be avoided, you will begin to investigate the limits of the unobstructed landing area. This area is surrounded by clear or amber boundary lights which indicate to you that it will be safe to land within this area without striking any obstructions.

While circling the field to gather the information regarding the size of the landing



—Courtesy of Curtiss-Wright Airports Corporation.

A Qualis illuminated wind direction indicator. This large tee is slightly over twenty feet long and has a wing spread of approximately twelve feet.

area, you will look for the illuminated wind tee or illuminated wind cone, whichever is used on the airport, to determine which way the wind is blowing. Since it is important to land the craft into the wind, the usual precaution taken to indicate to the pilot the wind direction is the lighting of the wind tee with green lights to eliminate any possibility of confusion with other illumination.

If the field is not an all way landing area and there are hard surfaced runways, there will be groups of green lights at the ends of each of these runways to definitely mark their location. In approaching the port the pilot will glide over one group of the green lights and steer toward the other group of green lights marking the opposite end of the runway.

—Courtesy of Curtiss-Wright Airports Corporation.

An airport illuminated with one Sperry-AGA, 180-degree, Fresnel lens, high intensity arc landing field floodlight. (Note: This photograph was exposed but twenty-eight seconds and it shows the high intensity of illumination on the field.)

While the pilot circles the airport to gain this information the airport attendant will throw on the landing field floodlights to throw a sheet of light over the ground to give it as nearly as possible a daylight appearance. When this is done the pilot will glide into the port from the proper landing direction.

Upon landing the plane, the pilot will taxi his ship around to the apron of the hangars, which has been floodlighted, to carry on disembarking operations speedily and with safety.

The Illumination Equipment Used

The rotating beacon which gives you the first intimation of the airport location is essentially a high-powered searchlight rotated by an electric motor. A twenty-four-inch paraboloidal mirror redirects the light from a 1,000-watt, 115-volt, 500-hour airway beacon lamp into an intense narrow beam which has a divergence in the neighborhood of three to six degrees and a maximum candlepower of approximately two million. Almost all of the beacons have been equipped with vertical spread lenses which allow approximately fifteen per cent of the light to be directed upward from zero to twenty-five degrees so that the pilot will be in a part of the beam of a beacon as he flies near to and above the unit. Without this vertical spread lens the pilot would fly out of the beam path as he passed over the location. To better facilitate the visibility directly over the beacon, it may be equipped with Zenith light panels. These panels are glass covered openings in the top of the drum which allow otherwise trapped light to escape upward, forming a rotating fan beam.

To assure constant service of this type of beacon a spare lamp is kept in readiness to be put into place just as soon as the original lamp is burned out. These lamps are shifted through the use of an electrically operated automatic lamp changer.

A very effective auxiliary to the rotating beacon is a green, 360-degree, Fresnel lens, double light source, flashing beacon which may be operated to spell out Morse Code characters indicating just what airport it is. This beacon utilizes two 500-watt, concentrated filament floodlight lamps. The flashing of this auxiliary unit is usually accomplished by a contactor on the rotating beacon operated by the rotating mechanism motor.

The obstruction lights are either 1,000-lumen or 50-watt incandescent lamps (depending upon the source of supply) contained in weatherproof units and protected by ruby glass globes. The globes may be either of prismatic or plain glass.

The boundary lights are either 600-lumen or 25-watt incandescent lamps contained in weatherproof units and protected by either clear or amber glass globes. It has been customary to support these boundary lights on pipe standards approximately two and one-half feet above the ground. These standards have repeatedly been struck by aircraft, and the first step to give these units greater daylight visibility was to surround the pipe standards with painted metal cones. Recently the Curtiss-Wright Airports Corporation engineers developed a boundary light unit, the cone of which is the sole sup-

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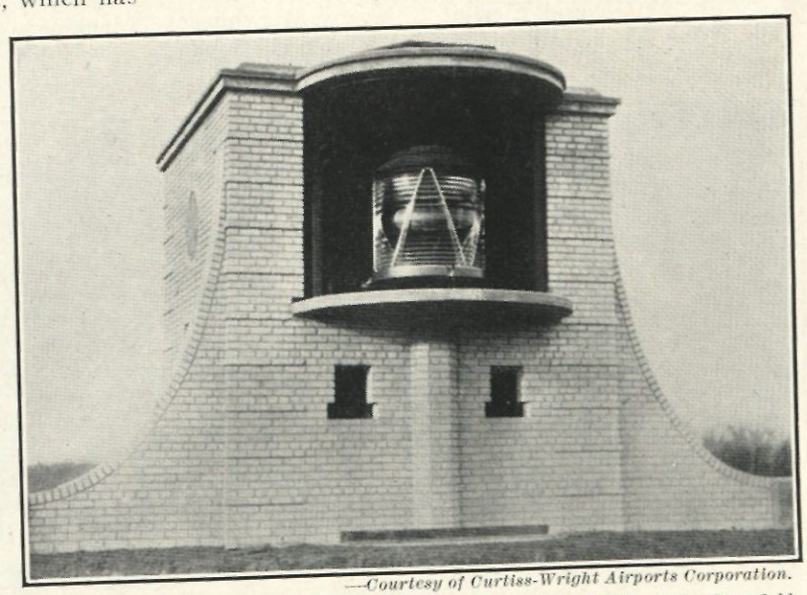

—Courtesy of Curtiss-Wright Airports Corporation.

Sperry-AGA, 1,000 m.m., Fresnel lens, full automatic, high intensity arc landing field floodlight mounted in the floodlight house at Reynolds Field, Chicago.

130,000 MILES TO WORK

HORACE B. VANVALKENBURGH, '30

HALFWAY to the moon! That is how far the 1930 graduates will travel from their Alma Mater to even commence the business of wresting a living and a few comforts from this cruel, heartless world. Ever since Frederick W. Whiteside, of the class of 1897, romped over to the headwaters of the Platte, the graduates have had the wanderlust. His total travel was about 150 miles. The class of 1900 raised this to 3,270 miles, stacking up a colossal average of 654 miles apiece. The class of 1910 rang up 32,435 miles for an average of 818 miles per person, while 1920 didn't fare so well—30,715 total and 653 for an average. But the class of 1929 had the spirit of its Western forbears and reached a total of 85,555 miles from Boulder for an average of 866 miles apiece—about as far as from Boulder to Oklahoma City or Billings, Montana. And now the class of 1930, with Lindbergh's conquest fresh in mind, chalk up 130,910 miles for an average of 1,470 miles apiece, a distance equal to that from Boulder to Detroit.

These men, who are stepping out so boldly into the world this year, are shown in the remarkable photograph below. If the reader will look closely, he will see the chains with which the Seniors were held down to enable this picture to be taken.

Since over half the class are going to be within a few hundred miles of Canada, 200 miles really should be added to their distance—but their trips will probably be on the sly or incognito.

These dauntless wanderers will be distributed as follows:

ELECTRICALS

With the General Electric Company at Schenectady, New York, will be located Frank C. Bobier, Bryan R. Burke, Archie Camp, Howard F. Cummings, William J. Dowis, Adam J. Freeman, Robert L. Gordon, James Keachie, Lawrence Keltz, Merrill J. Martz, Warren D. McKelvey, John R. Outt, William D. Paulson, and Ervin H. Pemberton. Paul Shelton will be located at Lynn, Massachusetts, with the same company.

With Westinghouse Electric and Manufacturing Company will be Charles A. Dana, Chester Dively, Alvin E. Franks, Floyd J. Freeman, and Paul J. Krutak, all at Pittsburgh.

The American Telephone and Telegraph Company calls Leonard Phelps to Denver, George Stemmler to New York City, and Frank W. Horn to the Bell Laboratories in Chicago.

Carl J. Taylor and Frank E. Luethi will work for the Public Service Company of Colorado at Denver.

C. R. Double, James P. Dresen, Douglas Kuwano, Henry A. Standring, and Vernon O. Walters have not yet decided which position to accept.

MECHANICALS

At Schenectady with General Electric will be Frank C. Allen, Kenneth K. Cooper, Harry J. Deines, Gordon Kennedy, Parker D. Shepperd, Eugene E. Stoeckly, and Horace B. VanValkenburgh. Norman A. Parker at Lynn, Massachusetts, and Emmett H. Heitler at Fort Wayne, Indiana, will go to work for the same organization.

Westinghouse claims Ralph J. Coffey and Edwin Wray at Pittsburgh; Harold Ewing at Philadelphia; Elmer K. Hansen at Mansfield, Ohio; and Glenn Newell at Wilkinsburg, Pennsylvania.

Robert Trout will be employed by the York Ice Machinery Corporation at St. Louis.

(Continued on Page 196)

Heroes of this modern trek.

THE HONORARY SOCIETY OF LUBRICATING ENGINEERING

LUBRICITY SHALL LACK NO CHAMPION

OIL CAN

FRICTION SHALL NOT THRIVE UNOPPOSED

ILLUMINATING CHAPTER

Just as the balmy spring weather is making the sap flow in all the trees, the vines, the flowers, and in almost everything and everybody, it is making a golden stream of light summer oil flow from the "OIL CAN." The "OIL CAN" got its share of the annual spring disease, but with a little extra effort and a few longer hours, we have managed to keep the enemy, friction, well under control.

The "OIL CAN" is preparing to be very busy keeping a careful vigilance over all the grease cups and oil pumps that will be in use on Engineers' Day. Our records show that in previous years more oil has been used on Engineers' Day than on all of the rest of the days, combined excluding the Applefest and the Engineers' Ball. We have ordered an almost inexhaustible supply of very oily oil, and we are sure that no bearing will want for drink on this day of days. Engineers' Day is also the day that the "OIL CAN" makes known the identity of its oiliest senior oiler. Everyone is urged to be present at the little meeting that will be held in the afternoon of May 22 and hail the champ. Be sure and don't miss this meeting, for you may be the lucky man; anyway roll might be taken.

The "OIL CAN" has organized a large committee of rushers to get some fresh material for next year's staff of oilers. During one great search for men one of the committeemen read in one of the small-town papers that a new installation of transformers weighed about 2600 horsepower. We are exerting our oiliest to get the inventor of this new unit of weight to join our future force of oilers. We are even prepared to offer him twice the usual allotment of oil if he will join us.

The contest is over, and the "OIL CAN" is pleased to announce the winner of the individual high speed airplane oilers with the especially developed contents. The fortunate people are the members of the Junior class. We invite each member of this oily class to call at the "OIL CAN" office and try to collect his prize. The Seniors were runners up, with the Sophomores next and the Freshmen last.

Eric Miles, junior electrical, is said to be putting the finishing touches on a three-phase direct-current transformer of his own design. We are unacquainted with the details of this apparatus, but if such a unique device uses oil, the "OIL CAN" will be only too glad to furnish the necessary lubricant in recognition to Mr. Miles' great work.

W. W. Sutherland, sophomore, announced to the physics class that when a black glass was held before a light, it transmitted black light. The "OIL CAN" is making a hammered lace bicycle, lubricated by milk-weed molasses, to be presented to him on Engineers' Day.

Ed "Stinky" Davis, junior civil is responsible for an astounding inquiry. "Is the failure of gear teeth due to pyorrhea?" The "OIL CAN" is firmly convinced that there is something to this trend of thought, as in all its experience it has never seen a gear use a tooth brush.

Norman Parker, senior mechanical, has advanced a theory for the operation of a very economical internal combustion engine. During a discussion of the Diesel engine, Parker asked the professor why water could not be injected instead of oil. He maintained that the heat of compression would vaporize the water, and the engine could run by the expansion of the steam that would be formed. Although this engine would cut a big hole in the oil industry, the "OIL CAN" will award Mr. Parker one barrel of fuel for his new engine.

William Billow, junior, wants to know whether rawhide gears are cut or cast. Bill is probably developing a new process for casting rawhide gears. If he is successful, he will be presented with a can of raw linseed oil.

Joe Powers, senior mechanical, when asked when the density of mercury was 13.6, replied that such was the case at sea level. Joe's explanation gives us another correction to make in the barometer; and for his discovery, the "OIL CAN" will present him with a bottle of a new oil that has a positive density only at sea level.

Jack VanValkenburgh, sophomore mechanical, has gained the "OIL CAN'S" recognition by some of his brilliant answers to a few questions asked him on a quiz. His answers were as follows:

Question: "How are rainbow colors produced in soap bubbles?"

Answer: "Rainbow colors in soap films are due to certain characteristic things."

Question: "What are thermo-couples made of?"

Answer: "They are made of certain things which are trade secrets and can't be told."

We are sure that Jack deserves some great reward for his very definite answers, and we are ordering an extraordinary prize for him.

During a discussion of a Diesel engine installation in a ship that was 700 feet long, "Wally" Patterson fell into a temporary state of coma. As the

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VOLUME XXVI, NO. 4 | Founded 1903 | MAY, 1930

EDITORIALS

ADIEU

When our work will have been completed with the distribution of this issue, we, the senior members of the staff of 1930 will vacate our posts in favor of our successors. We have enjoyed our work, which fact prompts us to recommend to the underclassmen that many enjoyable and instructive hours may be spent on the staff of THE COLORADO ENGINEER.

To the alumni contributors to the columns of Volume 26, we wish to express our appreciation as well as to the students who have assisted us in our work. Not enough credit can be given to our faithful staff assistant, Miss Grace Black, who so ably has continued her work on the Alumni Section and Directory. To Professors W. O. Birk and W. C. DuVall we are greatly indebted for the active interest they have taken in our publication.

With these few words we step out of the office, bid adieu to our readers, and wish success to our Junior staff who will succeed us.

ENGINEERS' DAY

One day each year we Engineers, associated in the minds of our more aristocratic fellow-students with slide rules and rough clothes, gain recognition on the campus. We are, after a fashion, "on parade" before the University, and our place of business is open to all who are interested enough to inspect it. This day is our day. Its events are traditions, and, like all other traditions, are remembered and faithfully repeated each year.

This year, for the first time in several years, attendance at the afternoon address is not required. We, as engineering students, are expected to be enough interested in the profession to want to hear what a successful practicing engineer has to tell us. We should be as much interested in that afternoon event as we are in any other of the day's activities. The whole program is made up as much for our enjoyment as for the pleasure of the visitors. This year's procedure is a departure from the past, but we are confident that there will be no lack of interest on the part of the students in any part of the program, for, after all, it is a day of achievement for us. The day is our own. We can make it a success by taking advantage of the opportunities it affords.

ON TO COLORADO

In October the tenth annual convention of the editors and business managers under the Engineering College Magazines Associated will be held at the University of Colorado. Because the privilege of acting as host to the representatives of the magazines throughout the country is always hotly contested, we engineers are particularly honored by this selection.

Perhaps very few realize how much this will mean to us and why we were so anxious that the convention should be held on our campus. Yet it is only natural that we should want these men who are to be our guests, most of whom are from large eastern schools, to see how we work; to inspect our equipment, our school, and our campus. We want them to view our mountains, and to carry back with them some of our appreciation of and admiration for our institution and its surroundings. It will be a pleasure to have these men see for themselves wherein the merit of the College of Engineering of the University of Colorado lies, although there is no doubt in our minds as to our position relative to other institutions.

We are already in communication with these other schools that will send us their representatives in the fall. We shall be glad to have them—they are eager to come. For October, then, the slogan will be "On to Colorado."

OUR CONTRIBUTORS

GORDON W. GILLARD, B.S. (C.E.), '26, has been with the Goodyear Tire and Rubber Company in the Mechanical Goods Department since 1927. His story of the erection of the huge dock at Akron should be of great interest to all of our readers.

R. P. LEBARON, B.S. (C.E.), '28, is the author of an article on the new Empire State Building in New York City which is now in the process of construction. LeBaron who is connected with the McClintic-Marshall Company tells of the unique features of this skyscraper.

LESTER C. SIMPSON, B.S. (E.E.), '25, formerly the editor of THE COLORADO ENGINEER, is now Manager of the Airport Equipment Sales Department of the Curtiss-Wright Airports Corporation. Since the problem of airport lighting is a most modern one, we feel that all will be interested in Simpson's instructive discussion.

THE FAKE CORRESPONDENCE SCHOOL MENACE

According to a bulletin broadcast by the American Association of Engineers there are a number of "fake" correspondence schools that are annually cheating unsuspecting youths out of millions of dollars. While it is pointed out that there are some legitimate and worthy correspondence schools, the association has declared war to rid the nation of the "flourishing educational crooks."

Through the medium of misleading advertising, these organizations round up their "students" and after a few weeks' training turn them out upon the world as "engineers." This practice not only robs the innocent participant, but also throws a degrading reflection on the graduates of the legitimate institutions.

In taking sides with the American Association of Engineers, we repeat that legitimate correspondence schools do exist and are worth while. These schools should be encouraged and patronized. With very little judgment the "fake" schools can be discerned. It is for us to boycott these organizations and to exert our influence whenever possible so as to clean up the menace and to lessen the number of unfortunate victims.

AN ALARMING EXODUS?

A situation which not only is quite natural, but also which is to be expected has been questioned. We refer to the fact that a great percentage of the graduates of the College of Engineering leave the state to begin their life's work. The experience of our college is quite typical of how engineers spread over industry. Because there are too few industrial organizations or engineering projects in Colorado to absorb all of the graduates of the state technical schools we ought not get the erroneous impression that these schools should not exist. Even should the graduate choose to leave the state instead of remaining (granting that he could be placed), this, even, does not indicate that he is unworthy of his education. Furthermore, state schools are supported primarily for the purpose of educating the children of the citizens of the state, and by doing this they do their share in elevating the general standard of education. Although Colorado seems to send a number of her valuable men to foreign states, she in return receives equally valuable educated men who are in a better position to serve her distinctive needs. The situation, then, is not alarming—if conditions were any different, it would be then that investigations should be made.

SUMMER VACATION

The discoveries of science are without limit or discretion. The mere tilting of the earth's axis just twenty-three and one-half degrees from a line perpendicular to its orbital plane indicates that summer is fast coming upon us.

Some of Colorado's men leave her for the larger field of combat where the stakes are contentment and success. Power to them and the courage which they bear with them. They are her sons.

Younger men will range the country learning the battle formations in the field. It requires a goodly period of back-breaking work with pick and shovel to convince students that there is art even in humble things. Bridges, dams, roads, factories, ships, power plants, and laboratories—here they will be found learning the game and the spirit of the engineer.

And even before those first days of October, when school life sits so lightly with us, perhaps, we will know that beams really do carry compressive stresses at the top surface. A moral victory for the faculty.

ALUMNEWS

(Continued from Page 181)

Louis J. Schnell, e, has been laid up in the hospital for the last two years as the result of a piece of high explosive shell, received in France during the war, imbedded in his brain.

Ralph P. Paden, e, is kept busy as sales engineer with the General Electric Company, covering a portion of West Texas a little larger than the state of Indiana.

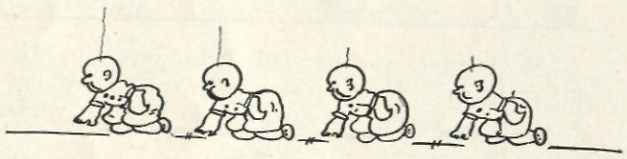
John W. Howard, c, and wife announce the birth of a daughter, Anne, on May 13, 1929.

Louis A. Connelly, e, is working on the talkies with the R. C. A. Victor Co. at Scotia, N. Y. He says he will be glad to see any Colorado men who are in his territory.

Ira Hahn, e, and wife announce the arrival of a daughter, Joan, born December 10, 1929.

'25

James H. Harvey, e, and wife announce the arrival of a daughter, Joanne Dean, born September 23, 1929.



John F. Dole, c, is the proud father of a son, Charles Robert, born July 13, 1928.

John P. Cooney, c, is in charge of the Louisville, Ky., work of the L. B. Fugitt Construction Co. of Chicago. They are at present constructing an underpass for the Southern Railway. He and his wife also wish to announce the birth of a son, David Paul, on March 10, 1929.

Walter Higdon, c, is a bridge designer with the C. R. I. & P. Railroad, doing steel and concrete design.

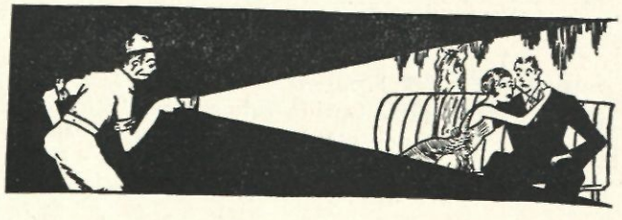
'26

Wilbur O. Richards, e, is in charge of technical copy writing for the Z. F. Potter Co., advertising agency of Syracuse.

Erwin W. Holman, e, is now research engineer in acoustics at the Bell Telephone Laboratories, New York City.

J. R. Andrews, ch, is now employed by the Navy Department as Assistant Chemist for the Inspector of Naval Material.

R. S. O'Neil, m, has assumed the duties of exterior lighting specialist for the southwestern district of the Westinghouse Electric & Manufacturing Co. His headquarters are at Tulsa.



'27

Warren Raeder, c, assistant professor of civil engineering at the University of Colorado, was married on March 20, 1930, to Miss Emily Katherine Andrew of Fort Smith, Arkansas.

Almon D. Thomas, e, is now with the distribution transformer engineering department of General Electric Company at Pittsfield, Mass.

William G. Edwards, Jr., e, is one of three Colorado men in the General Electric Patent Department in Washington, D. C. There are only thirteen men in the department; so the percentage of Colorado men is high.

'28

John C. Jackson, Jr., ch, announces the arrival of a daughter, born May 10, 1929.

Philip Milstein, c, writes that he is engaged in some very interesting work for the American Bridge Company at Wissahickon, Philadelphia, Pa.

M. S. Bitner, c, is with the State Highway Department of Texas. He recently had charge of the Inspection and Engineering on a 500-foot bridge over the Navasota River.

Edward Whitehead, e, was married in the latter part of February to Miss Myrna Louise Snyder.

William C. Royal, e, finds telephone cable development work at the Kearney plant of the Western Electric Company very interesting.

Lloyd B. Nelson, e, is field engineer in District "C" of the Public Service Company of Northern Illinois, at Highland Park.

Charles B. Moody, m, was married in the summer of 1929 to Miss Kathleen Morris of Denver.

Robert M. Braggins, Jr., e, is with the General Railway Signaling Co. in Rochester, N. Y. He is engaged in circuit design of signaling systems.

Colton Babcock, e, says he is having a big time and wishes to assure everybody that he is not as lonesome as he was last year.

'29

Michael R. Muhovich, e, writes that at present he has the privilege of dragging heavy cables for medium sized transformers. He also states that being on night shift he has an opportunity to find out the habits and peculiarities of that strange bird, the night owl.

Walter A. Merriam, e, spent three months in Sharon, Pa., learning all about transformers. He is now in engineering school studying electrical apparatus. He is employed by Westinghouse.

H. Luther Intemann, a, is working for his M.S. in civil engineering at the University of Illinois.

(Continued on Page 200)

EXCHANGE REVIEWS

A COMPARISON OF STEAM AND DIESEL POWER

Purdue Engineer—March, 1930

Under a wide variety of conditions, Diesel-electric outfits can and do produce current at much lower operating costs than are possible with steam-electric equipment of considerably larger capacity.

The purchase cost of a Diesel engine is greater than that of an equally powerful steam engine; but being self-contained and furnished with nearly all accessories, the additional cost of the added units required by a steam engine is saved. The steam engine represents only a third to a fourth of the total steam plant cost, which involves a heating plant as well as mechanical conveying appliances, more apparatus and special foundation, more labor for erection, and greater plant volume.

The full-load and over-all efficiency of the Diesel engine is between 25 per cent and 35 per cent, and this is nearly constant over a wide range of sizes; corresponding efficiency for the steam engine runs from 5 per cent to 9 per cent.

The life of the Diesel engines is at least as long as that of modern steam engines, which is estimated at twenty-five years.

One of the great advantages of the oil-burning engine is its standby power. It can remain cold for days or weeks, and yet be running at full capacity one or two minutes after it is set in operation—running as easily as though it had been kept in continuous use. The reserve steam plant, on the other hand, can only make a quick start when fires are kept bright and at least some steam pressure maintained at high cost. Keeping steam power always available involves a steady loss.

THE COOLIDGE DAM PROJECT IN ARIZONA

California Engineer—March, 1930

The Coolidge Dam Project was completed in the latter part of 1929, nine months ahead of contract schedule. It is the first multiple dome dam to be built, and is second only to the Roosevelt Dam in quantity of water impounded. It was built under the general direction of Major C. R. Olberg, Assistant Chief Engineer of the U. S. Indian Service, at a cost of $5,500,000. The dam is situated on the Gila River, nine miles below its confluence with the San Carlos River, and 120 miles from Phoenix by road. Its structure consists of three domes (convex side upstream), two buttresses, two intake towers, two spillways, and a twenty-foot highway on top of the dam. A hydro-electric plant and an outdoor substation are housed by the center dome.

In constructing the canals from the dam many of the contours of old Indian canals were used. In the hot season there is no surface water in the land served by this dam; however, water can usually be found fifty feet below the surface. Thus, irrigation is effected directly by a canal system, and indirectly by generating hydro-electric power which runs pumps which, in turn, pump up well water. Two penstocks, which are controlled from the two intake towers on the up-stream side of the dam, supply water to a hydro-electric plant. These towers have their intake openings at a height of sixty-four feet. The principal part of the power generated is utilized by the Nevada Consolidated Copper Co., at Hayden, Arizona. When full storage is realized (about 1,200,000 acre feet), the lake formed will be approximately five miles wide and twenty-two miles long. A total of 201,000 cubic yards of concrete were used; and then a finishing touch of one and a half inches of gunite was put on the upstream faces of the domes; this coating is reënforced by wire mesh, and serves to guard against leakage. Two vertical 9,200 hp. reaction type turbines furnish the power for the two 6,600 kva. generators. Because of severe lightning storms and the inaccessibility of a great part of the transmission lines for repairs, the lines are over insulated in remote sections. The operation of the plant at present is not entirely automatic; but is so designed that, should other hydro-electric plants be constructed below the dam, all plants can be controlled from a central point by a load dispatcher.

THE TRANSPORTATION OF OIL

Tech Engineering News—March, 1930

Because the oil production in the United States was less than a hundred barrels a year prior to 1859, its transportation from the fields was of little importance. Transportation of oil became a problem about 1865, however, when production increased to 2,500,000 barrels a year.

Samuel Van Sickle was the pioneer in oil piping, for he constructed a four-mile, two-inch pipe line from Miller's Farm to Pithole, Pennsylvania, in 1865. This proved to be of such decided convenience that more short lines were soon constructed to convey oil to the railway centers.

Increased consumption of oil created a large demand for economical transportation, which has since been supplied by pipe lines. In 1875, sixty miles of four-inch pipe were laid to carry oil from the northern Pennsylvania fields to Pittsburgh. In 1880, a 103-mile five-inch pipe was laid from Hillards, Pennsylvania, to Cleveland, Ohio. Antagonism against the building of these lines was so great at the time that armed guards were necessary to prevent them from being torn up at night.

At present there are about 100,000 miles of trunk and gathering lines in the United States which contain approximately 17,000,000 barrels of oil and rep-

(Continued on Page 202)

CAMPUS NEWS

ENGINEERS' DAY PROGRAM IS ARRANGED

Sergius P. Grace, Assistant Vice President of the Bell Telephone Laboratories to be honor guest and speaker

ON MAY 22 the Colorado Engineers, with many prominent engineer visitors from all parts of the country, will celebrate the ninth annual Engineers' Day sponsored by the Colorado Engineering Council of Denver.

Mr. Sergius P. Grace, Assistant Vice President of the Bell Telephone Laboratories, Inc., will speak and present a demonstration in the afternoon on the "Marvels of Sound Transmission." Mr. Grace is a graduate of the University of Michigan, class of 1900, has spent thirty years in the development of telephony and has many amazing scientific discoveries to his credit. He will arrive in Boulder a day or two ahead of time in order that he may set up his eleven trunks of apparatus in the Lecture Theater preparatory to his demonstration.

Sergius P. Grace

Mr. Grace's lecture will be different from anything that has been previously witnessed in Boulder. During his talk he will demonstrate such remarkable technical achievements as: the artificial larynx, a Victrola playing a picture, delayed speech, and speech scrambled and unscrambled again. Enthusiastic audiences in large cities in both the East and the West have enjoyed Mr. Grace's clear, concise manner of explaining his apparatus and theory.

Regular Program to be Followed

Junior and Senior engineers will spend the morning preparing the shops for inspection, placing the "E" on Flagstaff, and lighting the one on the Power Plant stack.

The day will officially open at one o'clock to the shriek of the siren at the Power Plant. Registration will also start at this time. From 1:15 to 2:15 p. m. the shops will be open to visitors and the annual baseball game between Seniors and Faculty members will take place. The program will start in the Lecture Theater promptly at two-thirty. After Mr. Grace's address the award of the Colorado Engineering Council, given to the most outstanding senior engineer, THE COLORADO ENGINEER keys, and the much coveted "OIL CAN" will be presented.

Admission, because of the limited number which may attend, will be by free ticket only—the tickets to be secured from the office of Dean Evans.

Guests, faculty, and students of the College of Engineering will enjoy a banquet at the Boulderado Hotel at six-thirty in the evening. Mr. C. M. Lightburn, president of the Council, will act as toastmaster. From seven o'clock to ten-thirty there will be Open House at all of the engineering buildings, to which all are welcome.

Committee Named

Working with Alvin Franks and the other officers of the Combined Engineers is the following committee headed by Horace Van Valkenburgh, chairman: Emmett Heitler, Publicity Chairman; Kenneth Shields, Peter Steinert, Fred Knoth, Jeff Buck, James Dresen, George Stemmler, Fred Dowling, Kenneth Cooper, Ralph Coffey, Harold Sheda, Kenneth Custer, and John Hayes.

OUTSTANDING ENGINEER TO BE NAMED

In 1927, the Colorado Engineering Council originated the plan of presenting a gold medal to the outstanding engineer of the graduating class. This medal has been presented each year at the annual assembly held on the afternoon of Engineers' Day. The method of selecting the recipient of the medal is as follows: The faculty of the College of Engineering selects ten men from the graduating class, basing their selection on the following qualities: integrity, scholarship, citizenship, personality, school activities, athletics, and good fellowship.

From this list of ten, the students, by popular vote choose three, and from the three so chosen, the Colorado Engineering Council chooses the outstanding man. The ten men chosen this year by the faculty to be voted on by the students are: Bryan R. Burke, Emmett H. Heitler, Merrill J. Martz, Norman A. Parker, Thomas J. Rasmussen, Kenneth E. Shields, Peter S. Steinert, Eugene E. Stoeckly, Carl J. Taylor, and Maury Witcher. On May 22, one from this group will receive the coveted medal of the Colorado Engineering Council.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

To begin the Spring quarter, W. F. Dowling was appointed to take charge of the program presented by A. I. Ch. E. on Engineers' Day. At the next meeting, S. A. Ionides, an Oxford graduate and a consulting engineer, presented a short review of problems which he has been called upon to solve. Moving pictures featuring the explosive and glass industries comprised the third meeting of the quarter. All meetings, except the last, were then given to business and the chemical program for Engineers' Day. At this one last meeting of the year, Professor Hunter delivers his annual speech to the Chemical Engineers.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Professor H. M. Westergaard of the University of Illinois, who is on a year's leave of absence to study the structural problems of the Boulder Dam, entertained the student branch on April 2 with a most instructive talk on the "Features of the Analysis of Dams." On April 7 the University group was host to J. F. Coleman and G. T. Seabury, president and secretary respectively of the A. S. C. E. Classes in the civil department were dismissed for the afternoon in order that the students might hear these men. Only once in the history of the local chapter has a secretary spoken, while never before has the president of the American Society been a guest of the University.

"Developments in the Use of Cement and Concrete," a paper by George M. Ricker, and "Dam Failures and Their Lessons," by Dean C. Muckel made up the program of April 16. On May 7 John L. Fellows presented a paper on "Ancient Highways and Vehicles"; Harvey C. Olander read a review of "The Life of John Butler Johnson"; and R. L. Cooper discussed the "Life of Theodore Cooper."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

According to George Stewart, secretary of the student branch of A. I. E. E., the organization began the quarter with an intensely interesting "Westinghouse Night." Mr. William Trudgian of the Class of 1907, now head of the Utility department at Denver, gave an address on the "History of George Westinghouse." In conjunction with his talk he showed a group of slides under the title of "Pioneer." A two-reel motion picture of the manufacture of the Westinghouse steam turbine was shown during the evening.

April 16 was "Telephone Night." The program was furnished by Mr. Roy Schrodt and Mr. W. G. Rubel, transmission and protection engineers for the Bell Telephone Company. Mr. Schrodt's lecture was illustrated by both slides and phonograph.

Election of officers for the next year will be held at the next meeting of the organization.

COLORADO E. C. M. A. CONVENTION PLANS OUTLINED

Next October, the University of Colorado will extend a hearty western welcome to the delegates from twenty-three engineering college magazines at the tenth annual convention of the Engineering College Magazines Associated. The date of this conclave is not definite, but it will be a three-day program.

After registration on the opening morning, delegates will enter meetings and round-table discussions which will continue for the first two days of the convention. At one of these meetings an eminent technical journalist will speak.

Visiting engineers will be acquainted with the campus on one of the first two afternoons of the convention. Moreover, THE COLORADO ENGINEER will provide a very novel form of entertainment to the guests, the Engineers' Apple Fest. The program also includes a banquet at the rustic Blanchard's Ranch, followed by an informal dance.

Since the delegates will be eager to see the grandeur of the Rockies, they will be taken by auto to beautiful Estes Park on the last day of convention, and will enjoy a beefsteak fry at noon.

THE COLORADO ENGINEER staff is endeavoring to make this convention a real success. It can not fail, for Colorado is mile high now. ON TO COLORADO!

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The student branch of the American Society of Mechanical Engineers at the University of Colorado celebrated the fiftieth anniversary of the founding of the Society by holding a special meeting on Tuesday night, April 18, 1930. A brief outline of the origin and growth of the Society was given by Joseph H. Powers. His talk was augmented by lantern slides, and additional speeches recorded on a phonograph record by two prominent members of National Organization.

On Wednesday night, April 16, 1930, George Wagner gave a talk on "Combustion and Stoking Equipment." His talk was also illustrated by lantern slides. Refreshments were served after the meeting.

Arrangements for the Mechanical Engineers' exhibits on Engineers' Day, and plans for the annual A. S. M. E. fry completed the activities of the Society for the quarter.

COLORADO ENGINEER ENTERTAINS AT BANQUET

THE COLORADO ENGINEER Staff held its annual banquet at Blanchard's on Tuesday night, May 6, 1930. About thirty-five members of the staff attended. Emmett H. Heitler acted as toastmaster, and short talks were given by Professor W. O. Birk, Professor W. C. Du Vall, Dean H. S. Evans, and Joseph H. Powers. Reports were given at this time by chairmen of committees in charge of the E. C. M. A. convention next year.

(Continued on Next Page)

CAMPUS NEWS

(Continued from Preceding Page)

CHI EPSILON

After a smoker held by the organization at the house of the Pi Kappa Alpha fraternity on April 25 the following junior civil engineering students were pledged: Kelly Benton, Sherman Decker, Richard Dittman, Harvey Hillyard, Fred Houck, Fred Knoth, Philip Pickering, Walter Reiman, Onslow Shallenberger, and Arthur Bell. After the initiation of these men during the latter part of the quarter, the election of officers for the coming year will be held.

ALPHA CHI SIGMA

Alpha Chi Sigma began its Spring quarter activities with its annual smoker, given by the senior members at the Kappa Sigma house. One meeting in May was devoted to a fry. Alpha Chi Sigma also had the honor of being guests at the Boulder meeting of the Colorado Section of the American Chemical Society. The name of the freshman having the highest chemistry average will be engraved on the Alpha Chi Sigma cup in Dr. Ekeley's office this year as is customary. The National Convention will be held in Minneapolis, Minnesota, June 16 to 20, and Richard Lynch, '31, will represent the Colorado Chapter. Initiation was held for the following pledges at the beginning of the quarter: Carleton Long, William Wolf, Frank Seibert, Lloyd Jensen, Edward Hubman, John Porter, Lawson Border, Walter Rule, and John Hayes.

SIGMA TAU

Members of Sigma Tau and their guests were entertained at dance which was given at Blanchard's Lodge on Saturday night, April 12.

The annual beefsteak fry was held on Tuesday, April 29, in Gregory Canyon. Professor Hutchinson had charge of all arrangements. After the fry a meeting was held to select pledges for the coming year. The following men were pledged: James Keachie, Kenneth Cooper, Edwin Davis, John Hayes, Gilbert Kullgren, Douglas Holford, Earl Sechler, Malcom Claggett, Elmer Schwalm, Harold Sheda, Walter Schmidt, and Fred Knoth.

Initiation for the men will be held the latter part of this quarter.

ETA KAPPA NU

Eta Kappa Nu, professional electrical engineering society, had a fry for its members April 11. Some of the juniors were invited, and the following men were pledged: W. K. Billow, Charles Church, Paul Church, William Wildhack, John Nelson, A. G. Buck, and Elmer Schwalm. H. S. Sands, President of the Denver Chamber of Commerce, and the Consulting Engineer for the City of Denver, was given associate membership in the society.

SIGMA TAU FRATERNITY IN HONOR ASSOCIATION

At a recent meeting of the Association of College Honor Societies in executive session, Sigma Tau was elected to full membership in this group. The election of Sigma Tau was made possible by the first expansion the association has made since its founding, increasing the active membership from six to eight societies, and the selection of this organization as the seventh member was based upon the importance of its activity in promoting scholarship. The Association of College Honor Societies now includes Phi Beta Kappa, Tau Beta Pi, Sigma Xi, Phi Kappa Phi, Alpha Omega Alpha, The Order of Coif, Sigma Tau, and Omicron Delta Kappa. The association has made provision for the admission of additional honor societies to limited membership.

ECKEL PARTICIPATES IN ILLINOIS DEDICATION

At the dedication services of the new Engineering Building at the University of Illinois at Urbana on May 2 and 3, Professor Clarence L. Eckel, head of the Department of Civil Engineering here, took part in the program. Professor Eckel, who was away from Boulder for about two weeks, inspected some of the recently completed engineering projects in and about Chicago while enroute.

SENIOR ENGINEER MARRIES

Eugene C. Bush, senior mechanical, has just announced the news of his wedding by passing out cigars to his classmates. He was married Saturday, May 3, to Miss Arlene Howard of Denver. "Gene" plans to combine business with pleasure by going to Bethlehem, Pennsylvania for his honeymoon. The couple plan to leave early in June for that city, where the groom will be employed by the Bethlehem Steel Company.

TAU BETA PI

Colorado Beta Chapter of Tau Beta Pi has just pledged the following men: Jack Brunton, instructor in the Mechanical Engineering Department, David Beach, Charles Church, Lewis Harms, Frederick Hunsicker, Frank Lightburn, and Anders Rasmussen, juniors in the College of Engineering. Initiation for the group will be held later in the quarter.

The fraternity will entertain with a dinner-dance at Blanchard's Lodge on Friday night, May 16. About twenty-five couples are planning to attend.

This will include the active members, the pledges, the faculty members, and some of the alumni members of the organization. Emmett H. Heitler and Joseph H. Powers are in charge of the arrangements. Fred Harding's orchestra will furnish the music.

The freshman who has the highest average for the past year will have his name placed on the Tau Beta Pi placque which is in Engineering Building No. 1. The winner will not be announced, however, until third quarter grades are turned in.

AMERICA TRAVELS IN HIGH

MANHATTAN'S "NEWEST MONSTROSITY"

(Continued from Page 171)

floor and running to different elevations where they are cut out in groups. There are four serving the floors from the sub-basement to the 7th, ten from the 6th to 20th, eight from the 18th to 25th, ten from the 24th to 43rd, eight from the 41st to 57th, eight from the 55th to 67th, and ten from the 66th to 80th floors. Passengers wishing to go to floors from the 81st floor to the roof, inclusive, must transfer at the 80th floor to one of two elevators running only between the 80th floor and the roof. There is one elevator running from the roof to the top of the mooring mast. There are four freight elevators in the building, one pair serving the floors from the sub-basement to the 26th floor and the other pair serving floors to the 80th floor.

With this system, having a few elevators, each serving a small number of floors, it is possible to give quick, dependable service throughout the entire building. A record for the length of a single lift of an elevator is established in this building, the longest lift being about 986 feet.

A record of no mean significance will be set if the erection of the structural steel is carried out on schedule. It is planned to erect 52,000 tons of steel in about 160 working days, or an average of about 325 tons a day.

THE LARGEST AIRSHIP DOCK IN THE WORLD

(Continued from Page 173)

Wind load

1. 80 pounds per square foot for the upper portion of the building and 40 pounds per square foot for the lower on sheets, purlins, and rafters.
2. 37.5 pounds combined with internal forces of 125 pounds per square foot on all bracing and arches.
3. 15 pounds direct horizontal pressure per square foot on external surfaces only, with no consideration of interior forces; used only when stresses due to this load exceed those from wind load (2).

Working stresses:

Dead and snow loads

18,000 pounds per square inch on structural grade steel.

24,000 pounds per square inch on silicon steel.

Maximum stresses due to wind load

24,000 pounds per square inch on structural grade steel.

32,000 pounds per square inch on silicon steel.

All steel manufactured in accord with standard A. S. T. M. specifications:

Carbon steel—ultimate tensile strength: 55,000-65,000, yield point 30,000 min.

Silicon steel—ultimate tensile strength: 80,000-95,000, yield point 45,000 min.

There are no expansion joints in the entire structure. The center arches are fixed in position. All other arches are carried upon rollers allowing the entire structure to expand freely as a whole from the center to each end. Under a maximum range of temperature, the end arches will move laterally approximately four inches, which motion is taken up partly by the pins themselves and partly by the doors, and is absorbed by the deformation of the door frames. The horizontal component of the thrust from the arches is taken up by reënforced concrete ties under the building floor.

Undoubtedly, the most striking and unique feature of the structure is the large spherical doors. Each leaf, of which there are two at each end, is similar in shape to a quarter of a half of an orange peel. Visualize this one-eighth of an orange peel 212 feet high, 214 feet wide at the bottom, weighing 600 tons, and hinged at the top with a huge hollow forged pin resting on forty forged-steel, double-flanged, 27-inch-diameter wheels running on two rails like a railroad track, and a fair idea is obtained of what one leaf looks like. Each door is operated separately by an ingenious "rack drive" system which keeps them under full control at all times.

The building is located in a level plain between low hills. The preparation of the site required the cut and subsequent fill of some million cubic yards of earth. The soil consisted of two feet of muck and twenty-eight feet of sand, gravel, and clay underlaid by solid limestone. The two feet of muck was removed and the excavation filled with about six feet of selected gravel. Thirteen hundred McArthur type piles, carrying maximum loads of thirty tons each, driven to bed rock, support the structure. Concrete circles support the doors and hold the rails on which the door trucks ride. The entire floor is concrete, and a concrete service tunnel extends the entire length. There are no raised obstructions which might hinder docking or launching operations; everything including rails has been kept flush with the floor surface.

Although the building is provided with 23,000 square feet of skylights, all operations will necessarily require artificial light. All offices and shops are placed inside the structure. These shops and offices will be heated, although no attempt will be made to heat the structure as a whole. The roofing is a corrugated and insulated material of special design.

FORMER PROFESSOR CHANGES JOB

We have just learned that Mr. J. B. Marcellus, formerly professor of civil engineering at the University of Colorado, but for the past two and one-half years employed as Chief Engineer of the Marland Estate at Ponca City, Oklahoma, has accepted a position as Consulting Engineer for the Federal Land Bank of the Eighth District at Wichita, Kansas.

STUDENT TAKES JOB

J. A. Hultquist, senior electrical, has accepted a position as junior engineer with the United States Patent Office at Washington, D. C.

COLORADO

COLORFUL

THE KEY STATE OF THE NEW WEST

Warrior Peak in San Isabel Nat'l Forest. Below: Rodeos are a summer attraction. Colorado's orchards yield abundantly.

What is Colorado . . . . to you? Just an oblong place on the map?

If you're one of the few people who haven't been to Colorado, you've missed some real enjoyment. And if you've only been to Denver on business, or to Pikes Peak for a brief stopover, you have little knowledge of why Colorful Colorado "offers more in terms of real living."

If you knew Colorado, you would like to live here —and you would live in happiness, with more friends, more recreation, more good health and most delightful conditions for your work.

But don't take our word for this. Come up to Colorado on a vacation or business trip; investigate conditions in your occupation and see for yourself. Measure the low living costs. Note the great variety of outdoor joys that cost little or nothing. Look at the bright offices; the convenient, lovely, uncrowded residence districts; the comfortable farms with their abundant production of delicious eatables; the spaciousness that prevents undue traffic congestion; the ideal conditions for wage earners.

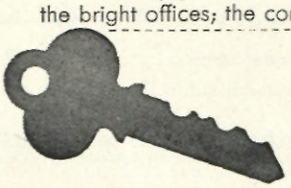
Come at any time of year—and compare the weather with what you'd be having back home.

Colorful Colorado's scenery is famous everywhere. But incomparable though it is, Colorado's scenery is the background—not the main attraction. Colorado's scenic splendor merely means that whether you are at work or play, you only have to look up to fill your eyes with a flood of soul-satisfying beauty.

Come up the next chance you get. Overnight from half the nation, two nights from almost anywhere, Colorado is near enough for the shortest vacation. And bring the family—let them have a wonderfully good time, too! The coupon below will bring you accurate information.

THE COLORADO ASSOCIATION

Colorado fruits and vegetables . . . both fresh and canned . . . have a delicacy of flavor possible only from Colorado climate and Colorado soil. Ask for them and note the difference!



THE COLORADO ASSOCIATION, 703 Kit Carson Bldg., Denver, Colo.

Send me the booklet, "Up in Colorful Colorado."
Include specific information about_____

Name_____

Address_____

AVIATION LIGHTS UP!

(Continued from Page 175)

porting member of the vapor-proof unit and lamp. The lamp is served through a flexible cord and disconnecting pothead so that if the unit is struck it may be overturned without damaging the electrical circuit and seriously damaging the aircraft. These cones are painted chrome yellow with a black band to increase their visibility. Quite a number of installations such as at Roosevelt Field, Long Island; Reynolds Field, Chicago; and other well-known airports, have been made and the units are giving satisfactory service nightly.

To indicate the wind direction the first step taken was to illuminate the standard cloth cone with incandescent lamps contained in porcelain enameled steel reflectors. Recently an illuminated wind direction indicator was placed on the market and is receiving favorable comment. This large tee, slightly over twenty feet long and with a wing spread of approximately twelve feet, is alternately striped with black and chrome yellow bands to give high daylight visibility. To allow the wind tee to be more quickly found, it is recommended that it be located in the center of a forty-foot circle constructed of white stone. To give night time visibility the indicator is outlined with 25-watt lamps contained in vapor-proof units and protected by green glass globes.

The favorable approach lights, when used, are similar to the boundary lights except the globes are of green glass and the cones are striped with alternate black and chrome yellow 45-degree segments. The same size lamps as are used in the obstruction lights are placed in these green globes.

Without doubt the most important part of the airport lighting is the floodlighting of the landing area itself. The main problem is to illuminate the ground evenly to a fairly high intensity without allowing the beam to rise vertically to the extent that it will confuse approaching pilots through glare. To secure these results it is necessary to use an extremely high intensity light source of the smallest possible cross sectional area and an optical system which will keep the beam within definite vertical limits. The Sperry high-intensity, full-automatic arc mechanism equipped in the 1,000-m.m., 180-degree, Fresnel lens, landing field floodlight gives a maximum beam candlepower of four million with a vertical divergence of only one and three-quarters degrees, or less than one degree upward from the center line of the beam. This is the lowest divergence of any landing field floodlight in existence. The full-automatic arc mechanism allows this unit to be controlled remotely from the control tower on the airport. The operation characteristics of this unit have been so satisfactory that they are being installed on the coast-to-coast chain of Curtiss-Wright airports where they are available to the entire aviation industry. At each of these airports 500-m.m., 180-degree, Fresnel lens auxiliary units containing 3-kw. 32-volt, incandescent lamps, are being installed to supplement the operation of the arc unit. An automatic changeover panel is being used to illuminate

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AVIATION LIGHTS UP!

(Continued from Page 193)

the auxiliary incandescent units should there be a failure in the main light. This precaution is not demanded by the Department of Commerce Rating Regulations, but every conceivable effort is being made on these air terminals to assure one hundred per cent safety.

The customary procedure in the past has been to illuminate the exterior walls and roofs of the hangars and airport buildings with incandescent lamps contained in porcelain enameled steel reflectors. These units were supported from the walls and roofs by pipe standards. With the increased tendency toward more artistic airport buildings, the unsightly appearance of this type of installation is being discouraged and the lighting of the exterior surfaces of many airport buildings is now being furnished by 500-watt and 1,000-watt, 180-degree, Fresnel lens, Sperry hangar lighting units which harmonize very satisfactorily with the architecture.

One lighting unit which is not directly connected with the landing operation is the ceiling projector. This is a narrow beam, high-intensity searchlight which is projected upward usually at an angle of sixty-three degrees twenty-six minutes. The point at which the beam of this projector strikes the overhanging clouds is considered the height of the ceiling. To expedite the reading of this height from the ground to the ceiling, the projector is usually used in conjunction with a direct reading ceiling height indicator or alidade. With this information of the ceiling height the airport operators may forward the data to the other airports and the pilots may be notified before taking off. They will know that they must fly below this altitude to view the signal lighting equipment.

The interior lighting of the hangars is a problem similar to factory illumination, but care must be

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AVIATION LIGHTS UP!

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taken to illuminate properly under the surfaces of the wings of the planes in storage.

All of the reputable manufacturers and distributors of airport lighting equipment are in a position to furnish engineering recommendations on the proper placement of their equipment, and these sources should be consulted in the preparation of a lighting recommendation.

No doubt your city has an airport. Have you visited it, or do you visit it often? If you have not, I am confident that the activities you will see there will be not only instructive but interesting. Perhaps the interest you take in the local activities may be instrumental later in the sane development of your city's airport. No more constructive service could be given to his community by the technically-trained man than an interest in this activity.

130,000 MILES TO WORK

(Continued from Page 176)

Ogden W. Bodenheimer will take graduate work at Stanford University, while Joseph H. Powers will trek to Yale with the same idea in mind.

Eugene C. Bush is to be with the Bethlehem Steel Company at Bethlehem, Pennsylvania; while George Wagner will go with the Babcock and Wilcox Company.

Robert Chamberlin will be employed by E. I. Du Pont de Nemours and Company.

American Link-Belt Company calls John E. Lindrooth to Chicago and Western Electric will claim Allen C. Stephenson at New York City.

Fred Ritzman will become a partner in the Ritzman Cement Company at Canon City, Colorado.

Adolph Q. Lundquist, Albert Hunsicker, Frank J. Leyner, and Earl Rice, at this time have not made a decision as to which offers to accept.

Civils and Architecturals

The American Bridge Company will employ Kenneth E. Shields, Keith A. Shields, and Harvey Olander at Ambridge, Pennsylvania; Martin F. Maloney at Gary, Indiana; and Arthur Bradfield at Penncoid, Pennsylvania.

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130,000 MILES TO WORK

(Continued from Page 196)

Thomas S. Bailey will be with Western Electric at Chicago where Marshall Pitney will be employed by the McClintic-Marshall Construction Company.

Roy Lee Taylor will make his debut in the contracting business at Wichita Falls, Texas.

Peter Steinert will be employed by the Dorr Co. at Denver and George Ricker by Stone and Webster at Boston.

Fred Montgomery, Dean Muckel, Merton E. Ridge, R. A. Lillicrop, Carson Riddle, Carl Vinger, Stanley Wicks, Maury Witcher, and John I. Thomas are so far undecided as to what specific method they will use to set the world on fire.

Chemicals

General Electric will cause Thomas J. Rasmussen, William Stiles, and Walter E. Rule to go to Schenectady.

Kenneth Custer and J. B. Koehler will be located in Denver with the Gates Rubber Company.

With the American Smelting and Refining Company at San Francisco will be Max B. Gardenswartz, Paul J. Harrison, Robert Oliner and Moses A. Lopez.

Fred E. Walter will be located at Parlin, New Jersey where he will work for the E. I. Du Pont Company.

Kenneth O. Stowell has accepted a position with the Imperial Oil, Ltd., at Sarnia, Canada.

Charles C. Hay will work for the Proctor and Gamble Soap Company.

Miss Janie Moore intends to stay in Boulder next year where she will further pursue her chemical studies.

OIL CAN

(Continued from Page 177)

words drifted into "Wally's" ear, however, he suddenly exclaimed, "What! A Diesel Engine 700 feet long." The "OIL CAN" recognizes and appreciates Patterson's efforts to keep the boys honest.

Politics had so affected A. C. Stephenson, senior mechanical, that in Railway Operations class he continually referred to the "Brown System of Discipline without Suspension" as the "Hare System." We recommend that Steve be presented with a well-oiled egg in token of his efforts to keep the old Colorado Spirit alive.

Eugene E. Stoeckly, senior mechanical, during a recent flooding of the hall in Engine III, tried a very oily method of draining the water. The scheme started off fine, but Stoeckly had to go home for a change of clothes before he could continue sopping up the water.

Bruce Norfolk, junior architect, wins one pound of cold cream and a bucket, to be used in priming pumps, for his discovery in Building Sanitation Class. When he was asked how a steady flow of water might be obtained from a pump, he stated that two pumps might be used. Afterwards he explained his observation by saying that the pumps should be suitably timed to discharge alternately.

ALUMNEWS

(Continued from Page 182)

William P. Brinsky, e, is at present engaged in the construction department of the Railway Signal Company, installing train control of the latest type on the Boston and Maine Railroad.

Charles D. Beach, c, spent the summer with the Missouri Valley Bridge and Iron Company building a bridge across the Missouri River at Wolf Point, Montana.

Thomas W. Abbott, ch, is in the cap department of the Eastern Laboratories, Explosives Division, of the Du Pont de Nemours & Co.

Mr. and Mrs. A. M. Unger, e, announce the arrival of Patsy Leone on December 30, 1929.

Orlando Welch, c, dropped in the office in Boulder the other day on his way to the Northwest where he is to work.

Francis C. Coyne, c, has been engaged in hydrographic work and in investigational work for Conference of Upper Basin States for allocation of the waters of the Colorado River.

George Sievers, m, visited Boulder last month and attended the Sigma Tau dance. He is working for the Coleman Truck Company of Littleton, Colorado. George is going to write an article for THE COLORADO ENGINEER on "Four-wheel Drive Trucks."

Paul Turnure, e, former business manager of THE COLORADO ENGINEER, is working in the Mechanical Engineering Department of the Dorr Company at Denver.

EXCHANGE REVIEWS

(Continued from Page 183)

resent a billion-dollar investment. Since about a billion barrels of oil flow through these lines annually, this represents an investment of a dollar a barrel of annual capacity.

Although pipe-line transportation is more expensive than bulk ocean transportation, its cost is only about one-half of the railroad tank-car rate.

Since pipe lines are used only during the life of the wells they serve, they are located above the ground when possible. A trunk line is divided into units, each of which can operate for a limited time independently of the other units. Oil of high specific gravity is heated before delivery to the pipes, as it is more economical to pump the oil hot than in the more viscous and cold state. Pumping stations are generally located every thirty or forty miles along the line, and they impel the oil at a velocity of about four miles an hour under a pressure of 700 pounds by means of reciprocating or centrifugal pumps. The tanks from which they are supplied have capacities up to 80,000 barrels and are made of steel with vapor-tight roofs to prevent evaporation. Loss by evaporation is so great that tanks are now painted with white or aluminum paints to reflect heat.

Pipe lines are run straight, except to avoid major topographic or economic features. When crossing water, the line is sunk to the bottom. Telephone and telegraph lines are erected along the right-of-way so that operations are under the control of a dispatcher.

GEOPHYSICAL EXPLORATIONS

Wisconsin Engineer—March, 1930

It is a very valuable aid to the engineer to be able to draw conclusions as to the composition of material under the earth's surface by scientific means. Five principal methods of geophysical exploration have been devised which depend on the various physical properties of different substances.

The magnetic method is in many ways characteristic of the other methods and depends on several phenomena: that is, that a magnet affects a compass needle and that certain substances when placed in magnetic fields become magnetized, the strength of these magnets for a given field depending on the susceptibilities of the substances. By measuring the distortions of the earth's magnetic fields caused by a deposit of ore, or by setting up outside fields and measuring the strength of the magnetic effect of the ore, the location, size, and constitution of the deposit can be estimated.

The electrical method depends on the conductivity of materials. Natural currents formed in the earth or artificial currents set up in the earth by planting electrodes in the ground are used. Most of the current travels in curved paths which extend deep into the ground. The conductivity of the substance through which the current passes can be measured in this way.

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EXCHANGE REVIEWS

(Continued from Page 202)

The electro-magnetic method depends on the several electrical characteristics of ore. A sending apparatus sets up both electrical and magnetic fields which penetrate the earth. The receiving apparatus receives the currents, magnetizations, and polarizations set up by the materials below.

The gravitational method makes use of a delicate instrument known as a torsion balance, which consists of equal masses swung at different levels by a thin wire and aluminum rod arrangement. A heavy mass attracts the lower weight with greater force. The magnitude of this force depends on the density of the ore.

The seismic method takes into consideration the density, elasticity, and other properties of substances. Buried charges of TNT are set off and the sound waves passing through the suspected material is recorded from different places.

ZRS-4 AND 5, AMERICAN MONARCHS OF THE AIR

Armour Engineer—December, 1929

The Goodyear-Zeppelin corporation has contracted with the United States government for two airships which will surpass in size all previous enterprises in the field of lighter-than-air craft.

The first of these will be the ZRS-4. Its gas capacity will be about twice that of the Graf Zeppelin; and although only fifteen feet longer, its diameter will be thirty-five feet greater, illustrating a new development in design.

The framework of the ship is composed mainly of transverse rings connected by longitudinal girders which extend from nose to tail. Unlike other ships of this type, there will be three corridors—one along the keel and the other two about 45 degrees on either side; this plan facilitates maintenance and inspection.

The gas to be used is helium. Since this non-inflammable gas is available, the motors can be housed within the hull, affording a roomy engine compartment, where a mechanic can easily maintain and repair the engine. Because of fire hazard in hydrogen ships, previous design has placed the engines without the body of the ship, making the motors difficult of access and also increasing the wind resistance.

One of the unusual features is a storage compartment for five completely assembled planes which may be raised or lowered through a T-shaped opening in the bottom of the ship.

Power is supplied by eight motors developing 4480 h.p. which will give a maximum speed of 83.8 m.p.h. Valving expensive helium gas is made necessary by condensers placed in the exhaust, which will utilize the water obtained from combustion for ballast.

The hangar to house these two ships will cover nine acres, and its construction is an engineering problem in itself.

(Exchange Reviews Continued on Page 206)

FRONT-WHEEL DRIVES

The Pennsylvania Triangle—April, 1930

Introduction by an American firm of the front-drive automobile marks a new era in the automotive industry.

The history of the front-drive car in America is mostly a racing history, but it is replete with progress and accomplishment. Harry Miller, a Los Angeles engineer, was the first to introduce the front-drive in an Indianapolis Speedway race. Since that time (1925), the front-drive has been developed so far that one of the most beautiful cars of the present era is equipped with front-drive.

The front-drive car has many advantages. Unencumbered space for the body, although not properly referring to the front-wheel drive itself, usually is mentioned as the most important of all the benefits made possible by this design.

Due to the fact that the driving force turns as the wheel is cramped in steering, the tendency to skid is decreased. Consequently, curves can be negotiated at high speeds.

The front drive appears to have an advantage over the rear-drive in plowing through a level stretch of fairly soft snow or mud, assuming equal weight on driving wheels in both cases. Here a component exists that tends to lift the front wheels over the mud or snow while the rear wheels following in their tracks.

There are some disadvantages of the front-wheel

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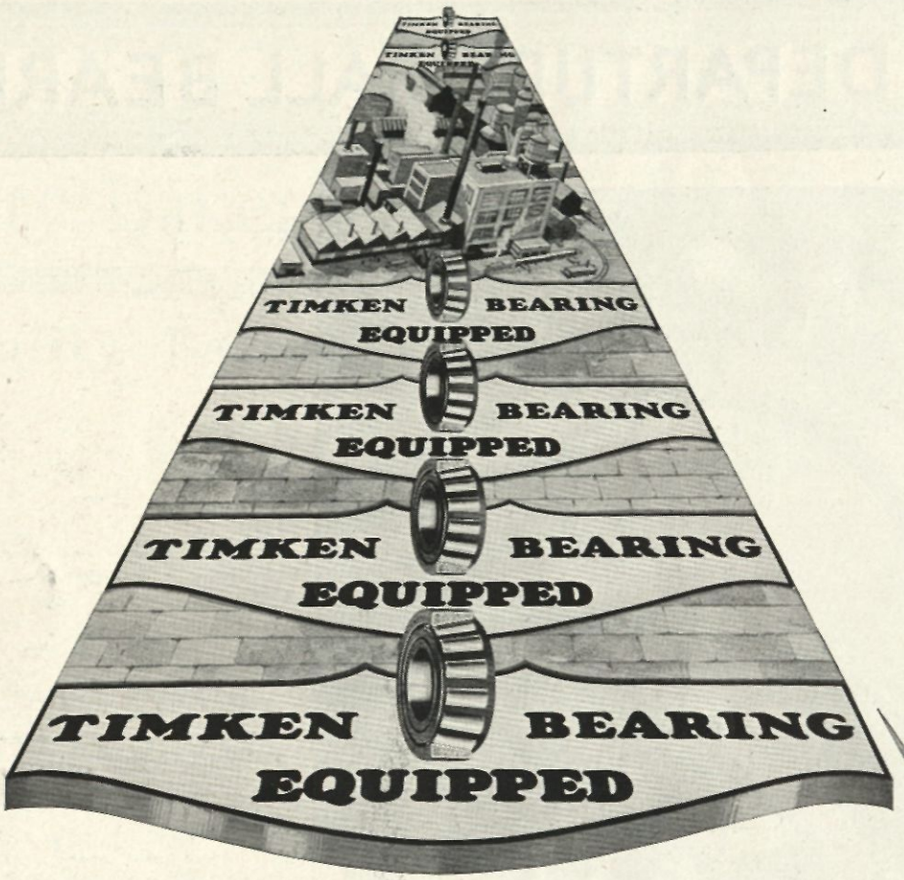

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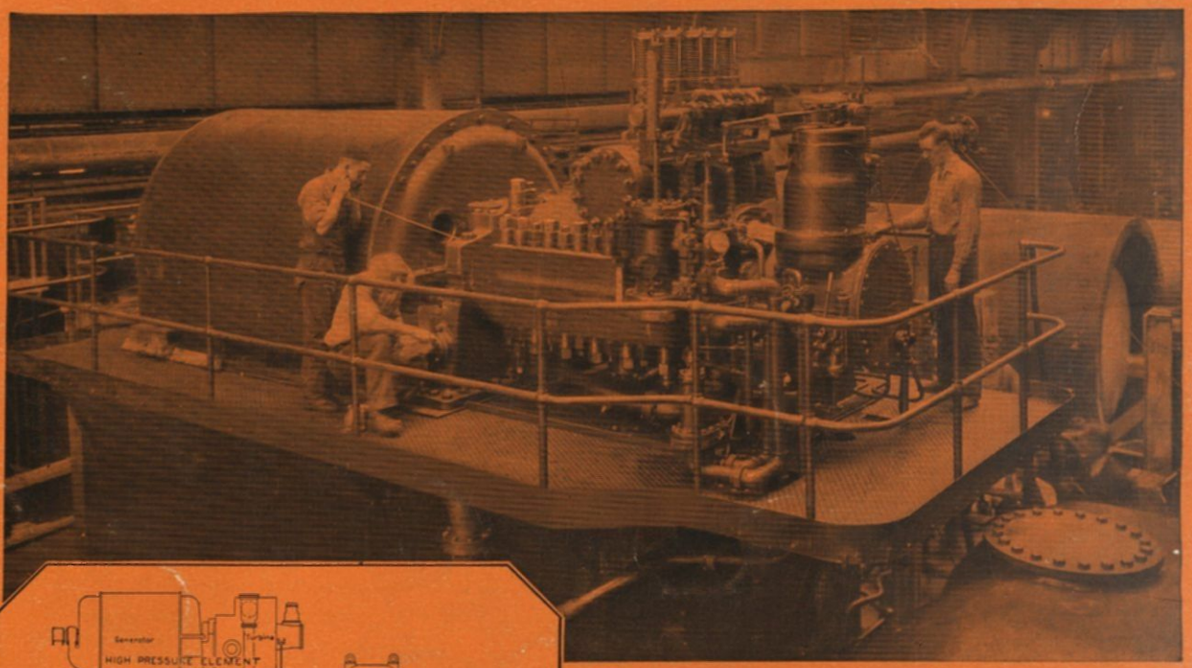

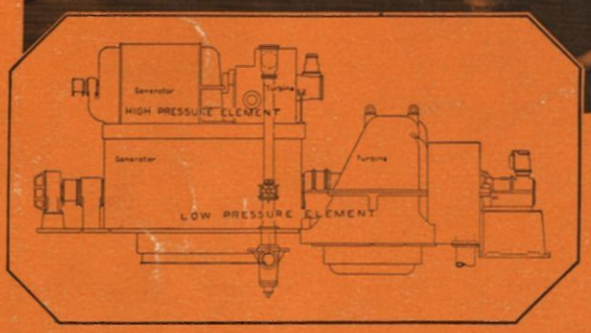

Elevation of the G-E vertical compound turbine-generator

Learning the Latest Word in Turbine Construction

An important departure in apparatus engineering is the General Electric vertical compound turbine-generator. In this machine, the high-pressure element, heretofore separate, is built on top of the low-pressure generator.

This compact construction does away with the necessity for building a separate foundation for the high-pressure unit, permits the use of one set of air coolers, requires less piping, and conserves floor space.

Test men—veterans, as well as more recent graduates of engineering colleges—take charge of the machine after assembly, test for oil leaks, bring it up to speed and check balance in the initial run, and set the emergency and operating governors. Electrical tests follow after the generators are coupled on. This work is part of the training program for general, industrial, sales, or advanced engineering work with the General Electric Company.

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