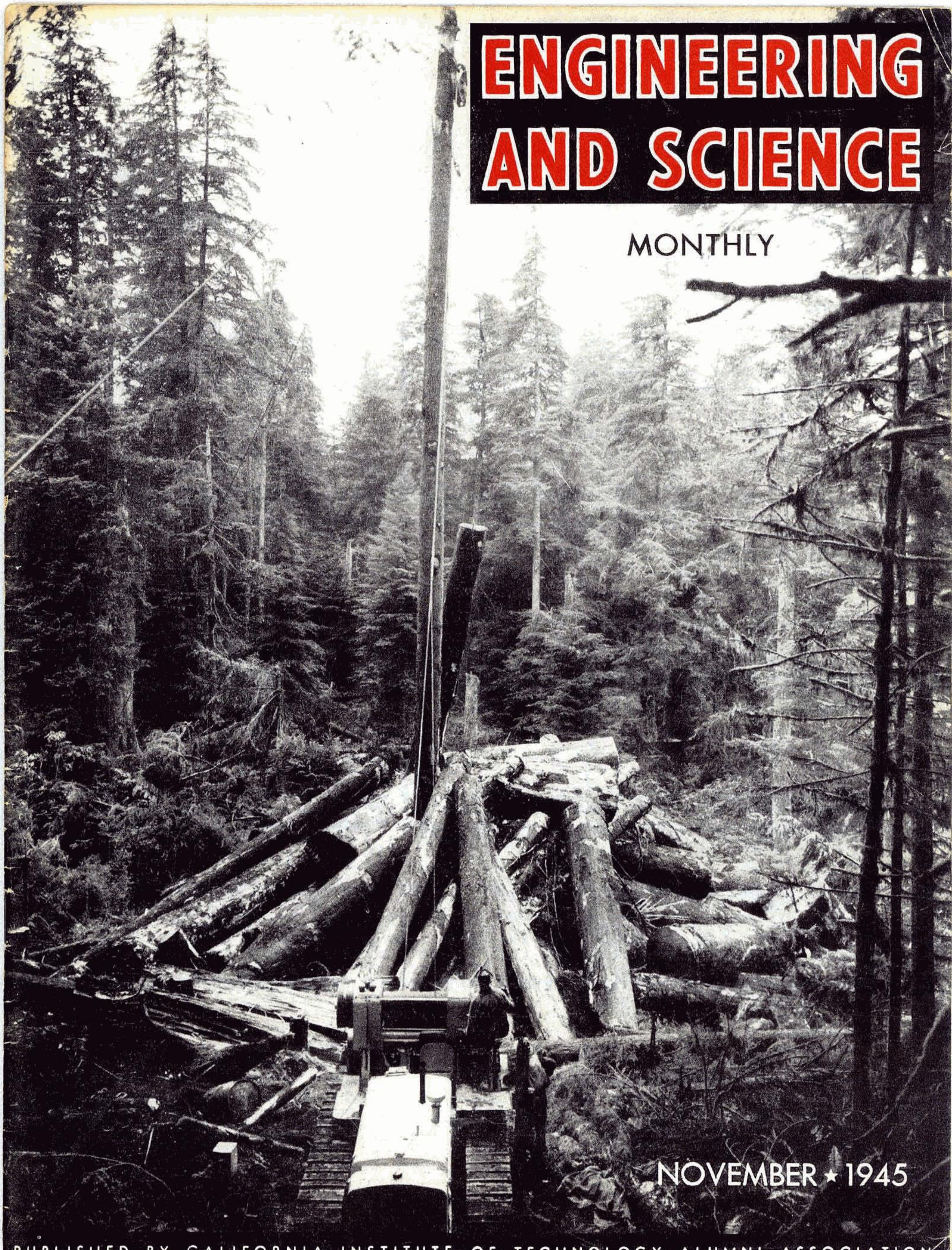
ENGINEERING AND SCIENCE

MONTHLY



NOVEMBER ★ 1945

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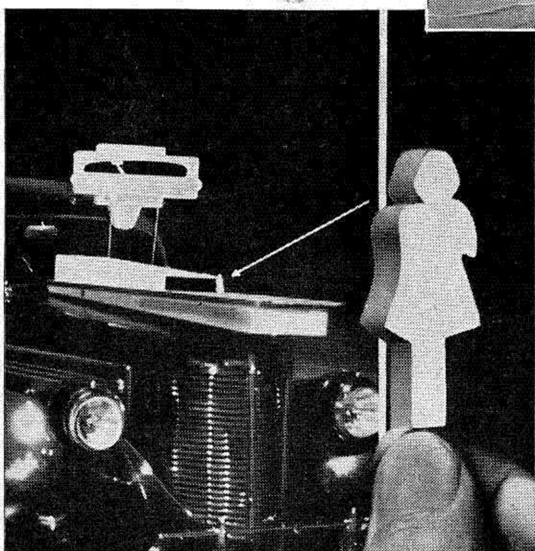
So you'll be safer

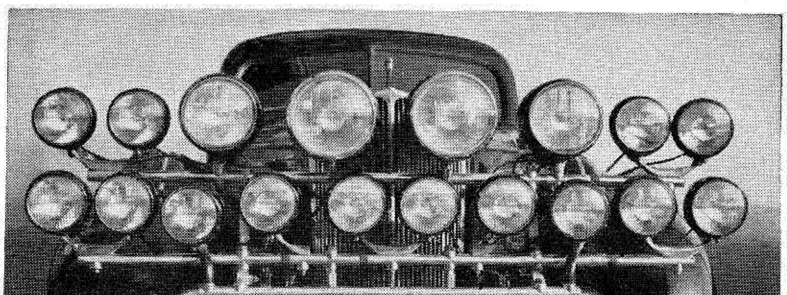
Radar will make travel safer. General Electric scientists are working along these lines. Among many other G-E developments are better street lighting, which reduced night traffic accidents in one city 93 per cent in ten months . . . a tiny gage which prevents accidents to workers around cranes . . . a new hay-drying system that helps prevent farm fires caused by storing wet hay.

Working on developments such as these, G-E engineers and research scientists are helping to make life safer for you. *General Electric Co., Schenectady, N. Y.*

Radar prevents collision. This actual photograph taken on the bridge of the "American Mariner," U. S. Maritime Service Training Ship, shows General Electric's new peacetime radar Electronic Navigator helping plot a safe course. The officer is looking at the G-E Navigator's radar screen, which shows him the position of the ship and the objects around it. On ships or planes, in fog or darkness, radar will warn pilots of unseen hazards.



2-inch doll saves lives. Central character of an ingenious apparatus to test street lighting is a tiny doll that represents the average pedestrian as seen at a distance. The complicated device measures visibility and glare. It was devised by General Electric engineers to help make streets and highways safer for night driving.



Bug-eyed auto was the car used in development of G-E Sealed Beam headlights adopted by the automobile industry. The Sealed Beam headlamps give more and safer light. Tests show that the average G-E Sealed Beam lamp gives 99 per cent as much light near the end of its life as it did when brand new. About 45 lamps of Sealed Beam type have been developed by General Electric for the Army and Navy.

The best investment in the world is in your country's future.

KEEP ALL THE BONDS YOU BUY

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BY-LINES

A. J. HAAGEN-SMIT

Dr. A. J. Haagen-Smit, professor of bio-organic chemistry at the California Institute of Technology since 1940, is chiefly recognized for his investigations dealing with the isolation, structure, determination, and synthesis of naturally occurring compounds, among them plant hormones. Combining a hobby which dated back to his student days in Utrecht (A.B. 1922, A.M. 1926, Ph.D. 1929) with work in his field, he recently directed investigations on the chemical analysis of essential oils from the guayule rubber plant.

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NICHOLAS A. D'ARCY, JR.

Nicholas A. D'Arcy, Jr., received his technical training in civil engineering at the California Institute of Technology with the class of 1929. He was first employed by Consolidated Steel Corporation as a field engineer and later as manager of the San Joaquin Division. For 10 years he was intimately associated with oil-field machinery development while employed by Emsco Derrick and Equipment Company. Mr. D'Arcy is a partner of the Charles W. Carter Company, Los Angeles, and has written numerous articles on oil-field equipment.

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Caption for Cover Illustration: Logging with hoist equipped with torque converter increases daily footage of logs handled and triples wire line life. (See article, Hydro-Kinetic Drives, Hydraulic Torque Converters and Hydraulic Couplings, pages 10-16.)

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ENGINEERING AND SCIENCE
Monthly

The Truth Shall Make You Free

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ENGINEERING AND SCIENCE MONTHLY

Edited at California Institute of Technology

ENGINEERING AND SCIENCE
Monthly

Vol. VIII, No. 11 November, 1945

The Month in Focus

Control of the Atomic Bomb

THE MAN in the street, weary of war and longing for the good things of peace, and the scientist, increasingly alarmed by the frightful prospect of a still more destructive war, were agreed on one fundamental fact. The atomic bomb must be controlled! But control meant many things.

A recent Gallup poll indicated that to the public control meant keeping for our own use the secrets of the atomic bomb; but to most scientists control implied international cooperation, reached by the difficult means of first, national, then international commissions. The goal of international control of the atomic bomb is a must, for we shall be deceiving ourselves if we think that the possession of such weapons by ourselves or by any small group of nations makes war less probable. On the contrary, it will promote international friction, jealousy and ill will, and an entirely false sense of security. We shall be deceiving ourselves if we think that it will be possible to keep these developments for our own exclusive use. The atomic bomb does not depend on any particular secret "invention" and no discovery was involved that is not generally known. The present bomb is one of several possible and more or less obvious solutions based on knowledge to which every civilized nation has contributed and has access. We have no monopoly on knowledge, and any nation that can afford the effort can do what we have done and will no doubt do so if we insist on withholding information. The fact that it has been done has demonstrated the soundness of the theories and principles involved and anyone who undertakes the development now can do so with complete confidence of success. Furthermore, it is now known which ones of the several possibilities have been most successful so that no time need be wasted in working up blind alleys. It is not impossible that the job could be done in three years or even less if sufficient effort is put into it. To say the least, our bargaining power will be weaker then than it is now.

INTERCHANGE OF SCIENTIFIC INFORMATION

We shall be deceiving ourselves if we think that any group of men, whether military or government, can retain a monopoly on this or any other important part of science. The men in whose sweat the atomic bomb was made are free men, and their work was based on the work of other free men before them. They cannot be kept in isolation, working in secret to produce more destructive weapons. They are urgently needed for more important things, for it is not the atomic bomb that is the great asset to civilization, but the men who made it and the science that made it possible, and science does not thrive in concentration camps. Unquestionably, scientists have contributed much toward the winning of the war, but their greatest contributions were not made during the war, they were made during the twenty or more years of peace preceding the war, when we studied and learned the tricks that made the new devices possible and trained the men that produced them and used them so well.

Now that the war is over, it is a matter of the greatest importance that we return to a normal healthy development in scientific research and training, for only in this way can we replenish our depleted stocks of new ideas and manpower. This can be done if we not only permit but encourage free and untrammelled exchange of knowledge and ideas, not only within our own country or within a small group of countries but without reservation between all nations. The values of such interchange are so great that no nation can afford to refuse to cooperate, for refusal would brand such a nation as a menace to society, whether that nation be Russia or the United States. Surely, international relations are complex and difficult, but they are not improved by stockpiling atomic bombs or any other kind of aggressive armament. Neither can they be improved as long as barriers such as now exist between ourselves and the

Russians are permitted to prevent free exchange of knowledge and opinion. We have no reason to believe that Russia has any warlike intentions, nor has Russia reason to think that we have, but in this matter, believing is not enough: we must know and so must they. Mutual promises and assurances are not sufficient: all nations must be willing to submit to whatever control is necessary to insure that no one nation or small group of nations can secretly prepare for aggression and thus menace other nations. This means that the barriers must be broken down at whatever cost. The alternative is war.

A GROUP OPINION

In an open letter to the President and the Congress of the United States of America, members of the faculty of the California Institute of Technology and of the staffs of the Huntington Library and Mt. Wilson Observatory seek to present their conclusions on atomic energy legislation in the hope that their views may be helpful to the President and to the legislators in arriving at a means of control for the atom bomb.

This action has been an outgrowth of a series of weekly seminars which started in early October at C. I. T. Participating in the seminars and stating their views on the problems of the atomic age have been men who understand the full implications of the problem involved. Among the leaders in the discussions were: Dr. Robert A. Millikan, Dr. Charles C. Lauritsen, Dr. Paul S. Epstein, Dean Ernest C. Watson, and Dr. Linus Pauling.

Their close association with the work done in the atomic field and their sincerity in hoping for a solution to control the atomic bomb through international understanding and agreement adds importance to the letter which we are printing in this issue. It merits profound consideration.

An Open Letter to the President and the Congress of the United States of America

WE, the undersigned, address you in our capacity as private citizens concerned about the future of our country and of civilization itself if faced by another war. We have studied and discussed the atomic-energy legislation now before Congress and have formulated such conclusions as we are able to reach for whatever use you and the country at large may wish to make of them.

Almost any sacrifice to bring about international responsibility is justified.

We believe that World War II has demonstrated with fearful clarity the urgency of intelligent, informed, persistent and sacrificial effort by all nations to prevent the occurrence of a still greater catastrophe.

We believe with Niels Bohr that "only international control of every undertaking which might constitute a danger to world security will in the future permit any nation to strive for prosperity and cultural development without constant fear of disaster."

We believe that scientific facts cannot be kept secret for long, and that other nations will discover how to make atomic bombs within a few years. Unless that short time is used to establish international control, an armament race may ensue with results even more disastrous than they have been in the past.

We believe, therefore, that the United States should take the lead in negotiations seeking to establish this international control with its appropriate inspection procedures.

The first step is national control. Immediate action is necessary.

We believe that national control must precede international control. Therefore, a national commission should be set up immediately to execute this control.

We believe that additional functions of this commission should be (1) to advise in the formulation of policies and procedures for international control, and (2) to protect and foster scientific research on atomic energy and its utilization for non-military purposes in order that the achievement of nuclear fission may prove a boon to mankind instead of a menace to civilization.

We believe that this commission must have broad powers. We say this in spite of the fact that the very idea of control and secrecy would be intolerable to all of us if such restrictions were not necessary. We accepted controls during the war as essential to victory; we believe that we must now accept controls as equally essential to peace.

The composition of the Control Commission is of utmost importance.

We believe that the nature of the phenomena attending the release of atomic energy and its exploitation makes it mandatory that the Control Commission be chosen from science as well as from industry and government. Moreover, only a commission on which science is adequately represented can fairly judge the degree to which freedom of scientific research needs to be restricted in the national interest.

We believe, moreover, that the personnel of the commission should represent in knowledge, integrity, and ability the best that is available without regard to political affiliation or official position, and that they should approve international control as an ultimate objective.

We believe that, while the Johnson-May Bill in its present form may require substantial modification, this should not be allowed to prevent prompt and decisive action.

We pledge support to an all-out effort in the cause of international cooperation.

We believe that you, truly representing the desire of the American people, are exerting yourselves to the utmost in the cause of a new world order of international cooperation in which the menace and fear of war will be eliminated. To this end we pledge our support.

We believe that you will not fail us. You will not fail a world which is looking to you for courageous leadership.

November 8, 1945

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Essential Oils

By A. J. HAAGEN-SMIT

ONE of the attractions of the subject of essential oils appears in its manifold aspects, its interest to the chemist, the plant physiologist, the pharmacologist, the historian, and, last but not least, the psychologist. When the historian and the psychologist are discussing this subject, they may well argue about the question of why Ulysses, the Greek traveler, was detained by Circe. The answer is that she used an odoriferous principle, which many present-day oil firms would like to lay their hands on. A similar secret was possessed by Helen of Troy, to whom Venus revealed a secret perfume, which was responsible for her fabulous beauty. While the secret of such magic perfumes was lost, later generations tried to make up for this in quantity, and even wise men, such as Diogenes, could not escape paying attention to the subject of perfumes. He is reported to have remarked that it was most wasteful to pour the oil on the head, whence the scent rose in the air and benefited only the birds, whereas by using it upon the feet one bathed the whole body in the delightful odors.

The important place these substances took can be gauged from the opposition they created. Solon, among the Greeks, and Julius Caesar, among the Romans, forbade the sale of perfumes, which sometimes were showered over the guests from the ceiling of the building. During the reign of King George III, in 1774, the British Parliament passed the following law: "All women of whatever age, rank, profession or degree whatever, virgins, maids or widows, that shall from and after this act impose upon, seduce and betray into matrimony any of His Majesty's subjects by the use of scents, paints, cosmetics, washes, artificial teeth, false hair, spanish wool (a kind of rouge), iron stays, hoops, high-heeled shoes or bolstered hips shall incur the penalty of the law now in force against witchcraft and like misdemeanors and the marriage upon conviction shall stand null and void."

It has been suggested that if fines should take the place of imprisonment, our problems of taxation would be solved.* In any case, legislation in such matters is not confined to the past. A similar unimaginative and unemotional law agency is the Federal Food and Drugs Administration, which refuses to believe in the scents which clear befuddled minds, help in all illnesses, and at the same time lead to thrilling adventures and romance. From the reactions of such governing bodies, we may conclude that the interest of the people in these oils has been great and the urge must have been strong to increase the number of perfumes. The discovery and conquest of countries and the waging of wars were chiefly caused by the desire to increase the wealth of the conqueror, and down the course of history perfumes and spices have been of prime consideration in this respect.

*A. Hyatt Verrill, *Perfumes and Spices*, L. C. Page & Co., Boston (1940).

FIG. 1. Title page of a book on distillation, by Brunschwig (printed in 1500).

In the early periods the resins and oils obtained from plants were burned on altars, and extensive recipes are found in Egyptian manuscripts. The Israelites, during their exile in Egypt, became acquainted with the use of these perfumes and salves, and some of their recipes are recorded in the Old Testament, where it is stated that the Lord ordered Moses: "Take unto thee three principal spices: pure myrrh, 500 shekels, and sweet cinnamon half so much and of sweet calamus, 250 shekels, and of cassia, 500 shekels, and of olive oil a hin."

While only crude resins and oils were used chiefly in ointments and in certain combinations, as incense to be burned, progress in scientific research made it possible to separate the volatile and odoriferous principles from the plant material. This was a great step forward, since it made it possible to preserve the smell and flavor of a much larger number of plants. It had been observed that boiling water carries with it the volatile material and that after condensation strongly smelling oil droplets appear on the surface of the water. These oil droplets soon form a liquid, to which is given the name of essential oils, because they are easily volatile and are thus distinguished from the fatty oils. The volatility and the derivation from plants are the characteristic properties of these oils, and it is for this reason customary to include volatile plant oils obtained by other means than direct steam distillation. Bitter almond, mustard,

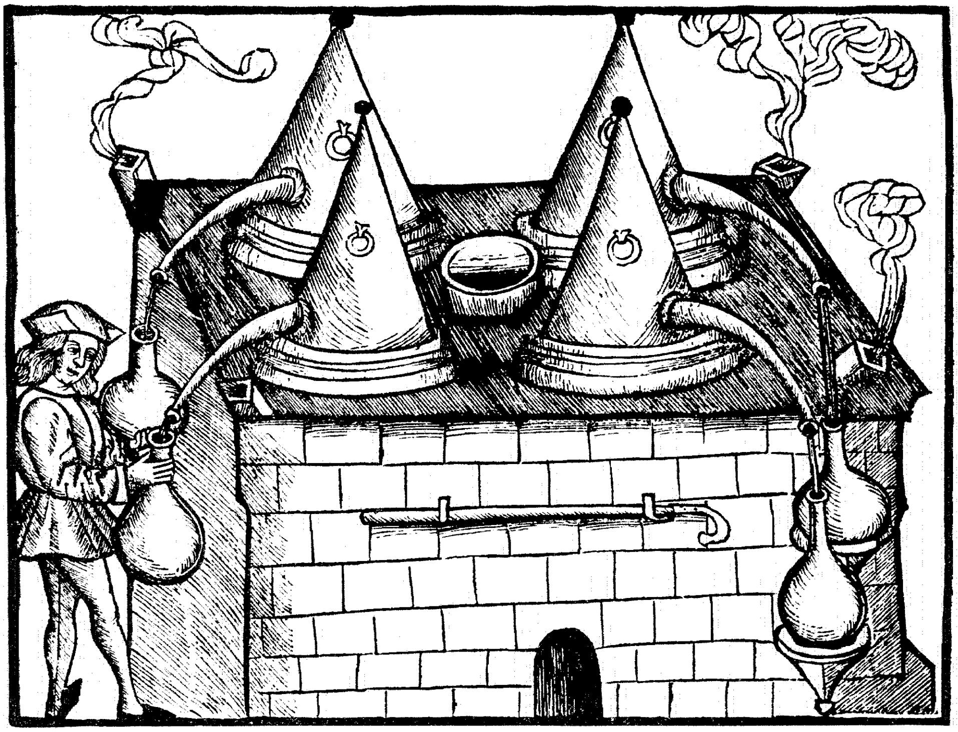


FIG. 2. "Rosenhut," distillation apparatus of 1500. Reproduced from Gildemeister and Hoffmann, Die Atherischen Ole, p. 224 (1910).

The second principal method consists in extraction with fats and vaseline. This process is especially used to concentrate flower oils, which would be easily decomposed at the higher temperature during water distillation. In the extraction with fats, we can distinguish two methods:

1. Use of liquid fat under heating, called maceration: and

2. Enfleurage, whereby the volatile material is absorbed in substances such as vaseline and paraffin, at room temperature. This last method is especially used on flowers which have a low content of oil but are continuously producing and evaporating their fragrant substances. In this way it is possible with jasmine, for example, to obtain by enfleurage five times more essential oil than by extraction with some solvent. The enfleurage is carried out by putting the flowers on wooden frames about two inches high and two or three feet square, in which a glass plate is placed. On both sides of the glass plate is applied a fatty layer on which the flowers are spread. On top of this frame a new one is placed, filled in the same way, until large stacks of these frames are piled one upon another. The essential oils given off by the flowers are taken up by fat, and the same fatty layer can take up the essence of many layers of new flowers.

The absorbent material, the fat or vaseline, is then removed by treatment with alcohol or other solvents, and the resulting concentrated flower extract is ready to be sold.

and wintergreen oil obtained by enzymatic action, or lemon and orange oil obtained by simple pressing, can be distilled with steam and are therefore included among the essential oils. Also included are oils obtained by extraction.

MANUFACTURE OF THE OILS

The distillation of steam is the most frequently applied separation method for these oils. The amount of compounds which we find in the essential oils boiling between 150-300° C., their vapor pressure at 100° C., the boiling point of water, is considerable—for camphor 20.4 mm., for pinene, the chief component of oil of turpentine, 147 mm. In a mixture of oil and water the oil contributes, therefore, materially towards reaching the atmospheric pressure at which distillation occurs and will boil at a temperature somewhat lower than 100°, *i.e.*, 96°, whereas without the help of water the pinene would boil at 155-156° C. The components of the essential oil are, therefore, in a steam distillation less exposed to higher temperatures: less decomposition takes place, and a better-smelling product is obtained.

The essential oils in plants are contained in cells, mostly with reinforced walls. It is necessary before distillation to open up these oil containers by grinding or cutting the seeds or other parts of the plant. In its simplest form, this material is poured into a still; the outside is heated and the vapor condensed. This procedure was described by Herodotus and Pliny, but the method is still used in the country by farmers, whose stills do not differ greatly from those shown in *Figs. 1, 2 and 3.* By the more modern methods, the water vapor necessary for carrying over the oil is produced in a separate still or apparatus and the steam is blown through the plant material. The production of this type of oil is limited in the United States to oil of turpentine, peppermint, eucalyptus, erigeron, witch-hazel, wormwood, and lemon-grass.

CHEMISTRY OF THE OILS

The oils and extracts obtained in these ways consist of

FIG. 3. Distillation apparatus with condenser tubes. Reproduced from Gildemeister and Hoffmann, Die Atherischen Ole, p. 226 (1910).

a great variety of substances. Some of these may constitute an odoriferous principle; others will be odorless impurities, or may even detract from the value of the oil by their smell or, for example, their solubility properties. In the search for pure principles and possible means of preparing these synthetically, considerable efforts have been made in the analysis of the oil. It has been found that the oil consists of compounds belonging to many groups of organic compounds, consisting of carbon, hydrogen, and oxygen and in some cases containing in addition sulphur and nitrogen.

It is possible to arrange these compounds in groups, which, because of their structure, suggest similarity in their formations. One group of substances consists of molecules of straight-chain hydrocarbons, such as we find in *Pinus sabinus,* which gives us an oil consisting of 70 per cent n-heptane, resembling normal gasoline. Other representatives of this group are found in the stearoptenes present in precipitates formed in many oils. Another group consists of substitution products of benzene, chiefly n-propylbenzene derivatives; examples of these substances are to be found in eugenol, from clove oil.

A third group contains a number of compounds which show connections with nitrogen metabolism, such as indole in orange flowers and allyl isocyanates in mustard oils. A fourth group that we may distinguish consists mostly of hydroaromatic hydrocarbons and their oxygen derivatives. These compounds show a remarkable similarity in their structure, since they can be divided into a number of branched C_5 chains, as shown in *Fig. 4.* This building principle links the components of essential oils called terpenes (C_{10}), sesquiterpenes (C_{15}) with the diterpenes (C_{20}) present in resins, vitamin A, and the chlorophyll alcohol, phytol. Triterpenes with 30 carbon atoms are built along the same lines; we find saponins present in the roots of some plants. Many of the yellow or orange plant pigments belong to the tetraterpenes with 40 carbon atoms. In natural Hevea, as well as guayule, the same principle unites 1000-2000 of these C_5 units.

FORMATION IN THE PLANT

On the basis of the structural peculiarities of the components, we can draw the conclusion that the complexity of the oil composition is caused by the excretion or secretion of products formed in many metabolic processes taking place in the plant. Microscopic examination of the plant shows that only distinct cells or spaces in the plant tissue are filled with oily droplets, which are difficult to distinguish from fatty oils. In many cases these glands are epidermal cells or modifications of these, such as the excretion hairs. The secretion product is usually accumulated outside the cell between cuticula and the rest of the cell wall. A slight touch is sufficient to break this thin outer membrane and to cause the release of the oil with its typical smell. The internal glands are spread throughout the plant and these intracellular glands have often grown to form long canals, coated on the inside with a layer of thin-walled cells. The oil is deposited in these canals, but the exact place of their formation is not known. Also the circumstances under which the oils are secreted are far from known. It is suspected that for many of the oil components a relation exists with photosynthetic activity, whereby carbon dioxide is reduced and synthesized to carbohydrate. A support is given to these ideas by studies on the effect of climatic and soil conditions, whereby it has been shown that generally light favors formation of the oils and that the optimum coincides with the most active growth period in plant life.

It would seem as if many of the secreted compounds were by-products in a number of syntheses important

(Continued on Page 16)

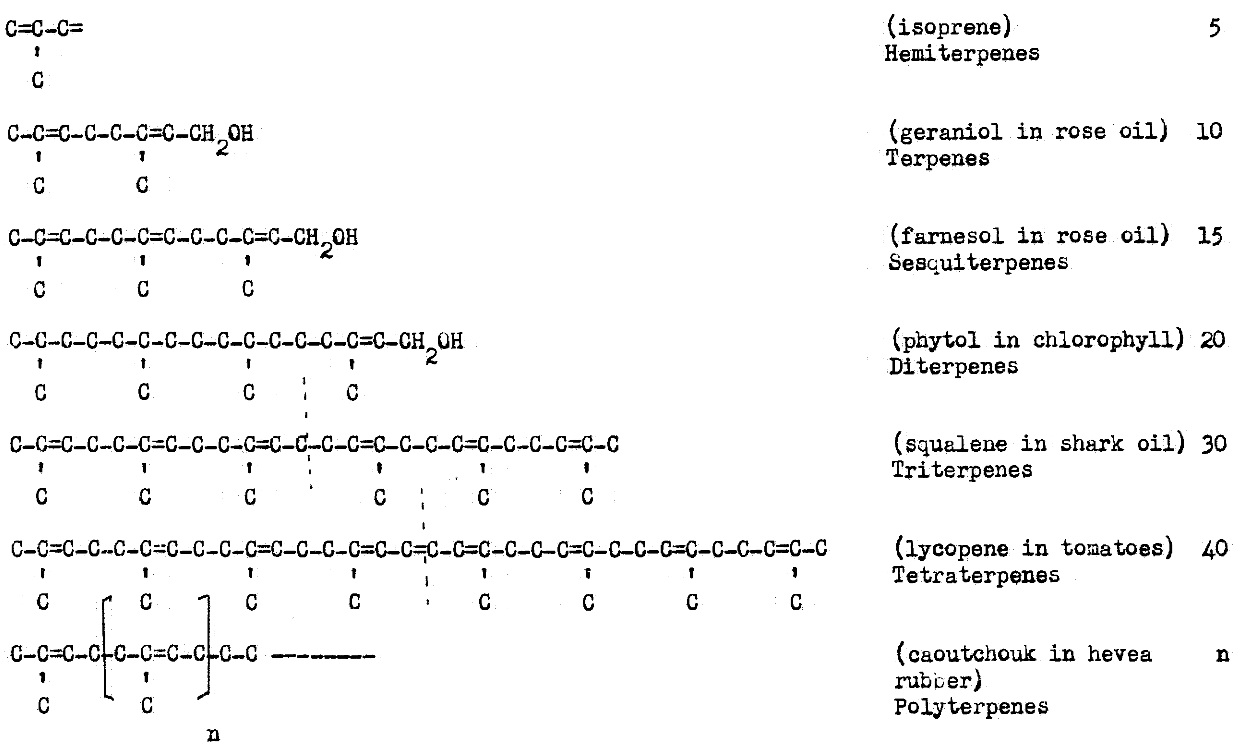


FIG. 4.

Hydro-Kinetic Drives, Hydraulic Torque Converters and Hydraulic Couplings

By NICHOLAS A. D'ARCY, JR.

WIDESPREAD interest in hydraulic drives was created in this country when hydraulic couplings were incorporated in several popular automobiles. This was the outgrowth of the inventions of Dr. Ing. Hermann Foettinger in Hamburg, Germany, over 30 years ago. Dr. Foettinger developed both the hydraulic coupling and the hydraulic torque converter for use in Diesel-powered vessels having up to 20,000 horsepower available for driving the propeller.

The use and development of hydraulic drives spread to Sweden, where the Ljungstrom works further developed the hydraulic torque converter under Lysholm-Smith patents, and to England, where Vulcan-Sinclair developed the hydraulic coupling. The Swedish applications were made largely to rail cars and the English applications to trucks and buses.

It has been in the last four or five years that widespread industrial development has occurred in these two hydro-kinetic drives. The American Blower Corporation was sub-licensed by Vulcan-Sinclair to manufacture hydraulic couplings, the Twin Disc Clutch Company licensed under Lysholm-Smith patents to manufacture industrial hydraulic torque converters and hydraulic couplings, and Spicer Manufacturing Corporation to manufacture torque converters for automotive uses. These three American organizations are rapidly extending the uses of hydro-kinetic drives, and new industries are rapidly availing themselves of the advantages of this development.

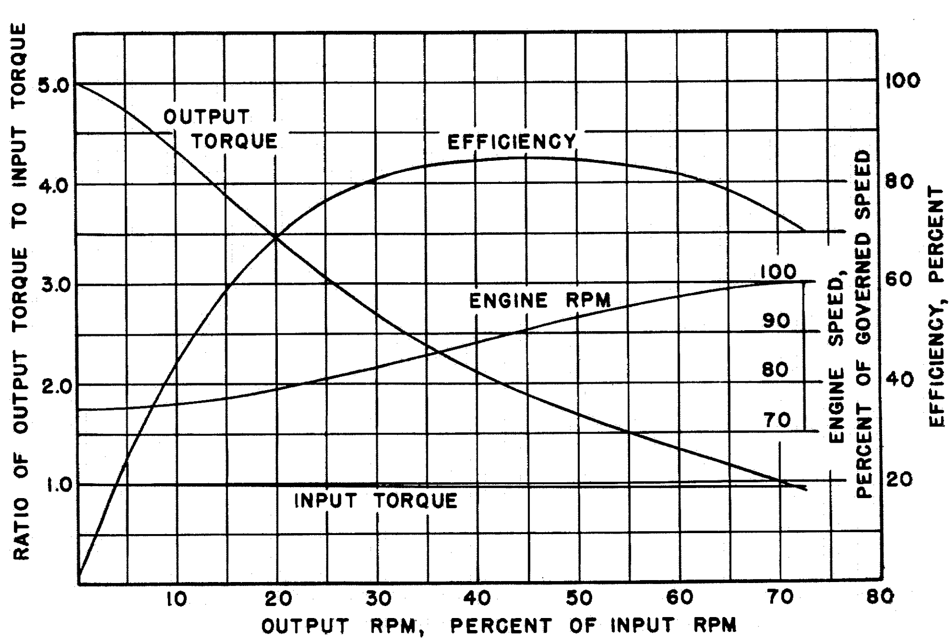
Positive-drive hydraulic units are also in widespread use in the United States, but this type of drive is a separate and important field which will only be touched upon at this time.

ADVANTAGES OF HYDRAULIC DRIVES

The original developments of Dr. Foettinger were connected with the development of the Diesel engine. Some simple device was needed to absorb the torsional vibrations and "un-equality" of operation of this engine, and the hydraulic torque converter and hydraulic coupling proved to be the devices needed. One of the most important advantages of all hydro-kinetic drives is the reduction of vibration and smoothing-out of the flow of power from internal combustion engines. In addition, they absorb shock loads, prevent stalling of the engines, and provide a smooth method of starting a load. These fundamental characteristics of the hydro-kinetic drives apply without regard to whether the unit is a hydraulic torque converter or any of the several types of hydraulic coupling.

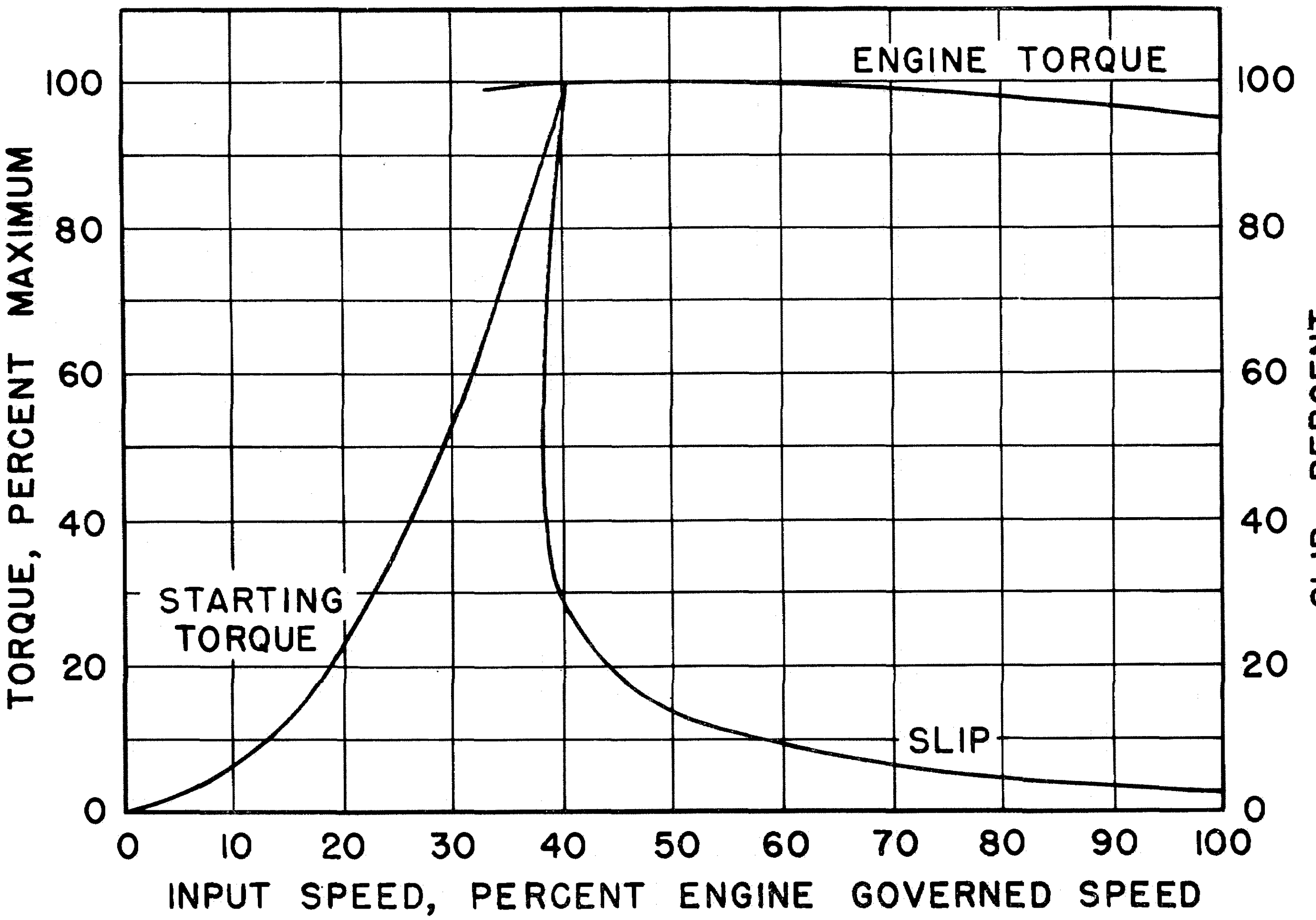
Hydraulic torque converters have the further advantage of developing high output torque at low output speeds while maintaining high operating speed in the prime mover. The over-all efficiency of the torque converter reaches a maximum of approximately 83 per cent, which is low compared to certain electrical units, but it allows the prime mover to develop full input horsepower by running at maximum speed. For this reason the output horsepower from a torque converter is often higher than with mechanical transmissions with the engines operating at reduced speeds.

The hydraulic coupling, on the other hand, has a maximum efficiency of over 95 per cent, but the output torque of a coupling can never exceed the input torque. From these radical differences one can see that each type of hydro-kinetic drive has its own particular advantage, and care must be used in selecting the correct unit for any particular installation.



AT LEFT:

Ratio of output torque to input torque.

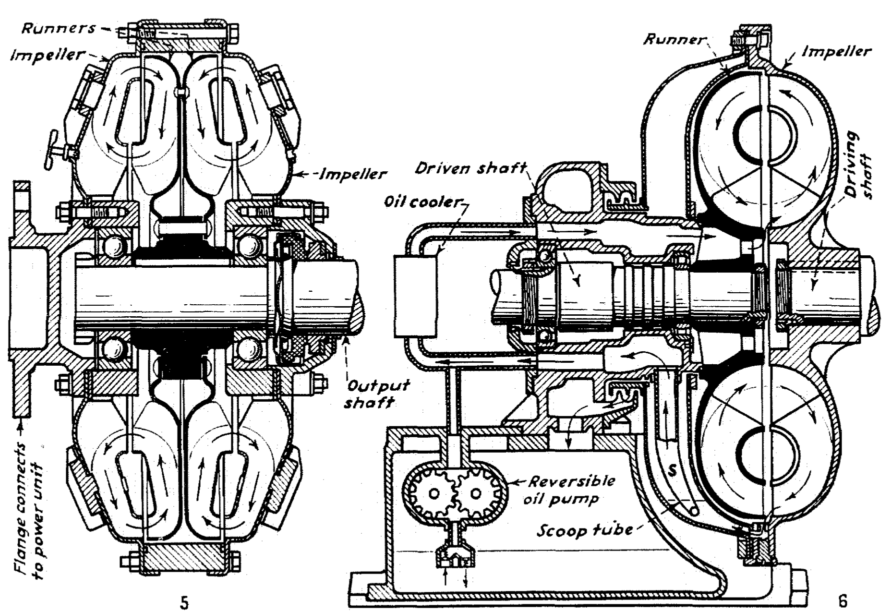


Performance characteristics of hydraulic coupling used with an internal combustion engine.

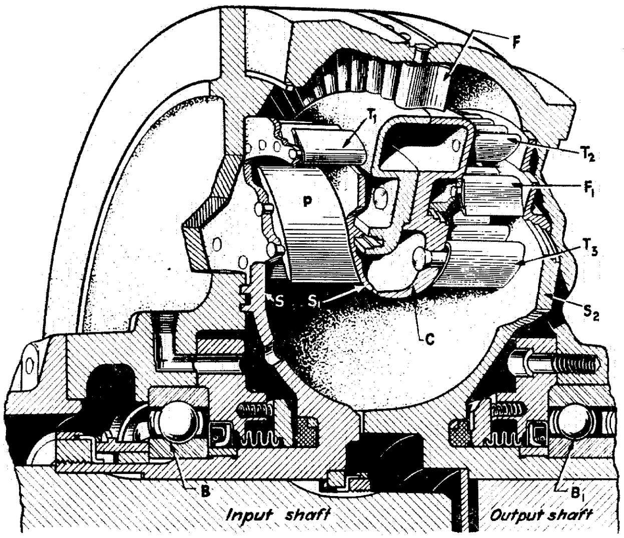
BASIC PRINCIPLES OF HYDRO-KINETIC DRIVES

Both the hydraulic torque converter and the hydraulic coupling are closed-circuit hydraulic units consisting of a pump or impeller on the driving end and a reaction member on the driven end. The rotation of the impeller imparts kinetic energy to the fluid in the closed circuit and drives the fluid to the outer periphery of the unit. The turbine member then absorbs the kinetic energy of the fluid in its blades and the fluid, having lost its velocity, is returned to the central portion of the unit. The impeller again picks up the fluid and the cycle is repeated. There is no mysterious characteristic imparted to the fluid at high velocities, as has sometimes been described. The entire action is based on well-known laws of hydraulics.

There is no positive connection between the impeller and the turbine member, and this feature allows the fluid to absorb shock, absorb vibration, and provide smooth starting. Both torque converter and coupling depend upon the kinetic energy imparted to the fluid for their drive. Both units transmit horsepower in proportion to the cube of the speed of the driving member and the fifth power of the diameter. Both units de-



AT LEFT: Axial hydraulic forces balance each other in this twin coupling. AT RIGHT: A variable-speed coupling in which working fluid is removed, cooled, and returned to circuit. (Illustration courtesy Power Magazine.)



Construction of a typical hydraulic torque converter: P is impeller, T_1, T_2, and T_3 are runner vanes, and F and F_1 are the fixed vanes. (Illustration courtesy Power Magazine.)

velop torque in proportion to the square of the speed of the driven member and the fifth power of the diameter.

HYDRAULIC COUPLINGS

The hydraulic coupling is the simpler of the two hydro-kinetic drives. It consists essentially of two identical opposed vaned members, so that either half can be used as the driving or driven member. In certain adaptations of the hydraulic coupling, added features are incorporated to alter this arrangement slightly, but the basic principle remains. The two opposed members being identical, one would expect to find the character of power transmitted identical with the power driving the coupling, and this is the case, except for friction losses. In the traction or sealed type of coupling, the simplest and most common hydraulic coupling, the output speed is only about three per cent less than the input speed, and the output torque is always equal to the input torque.

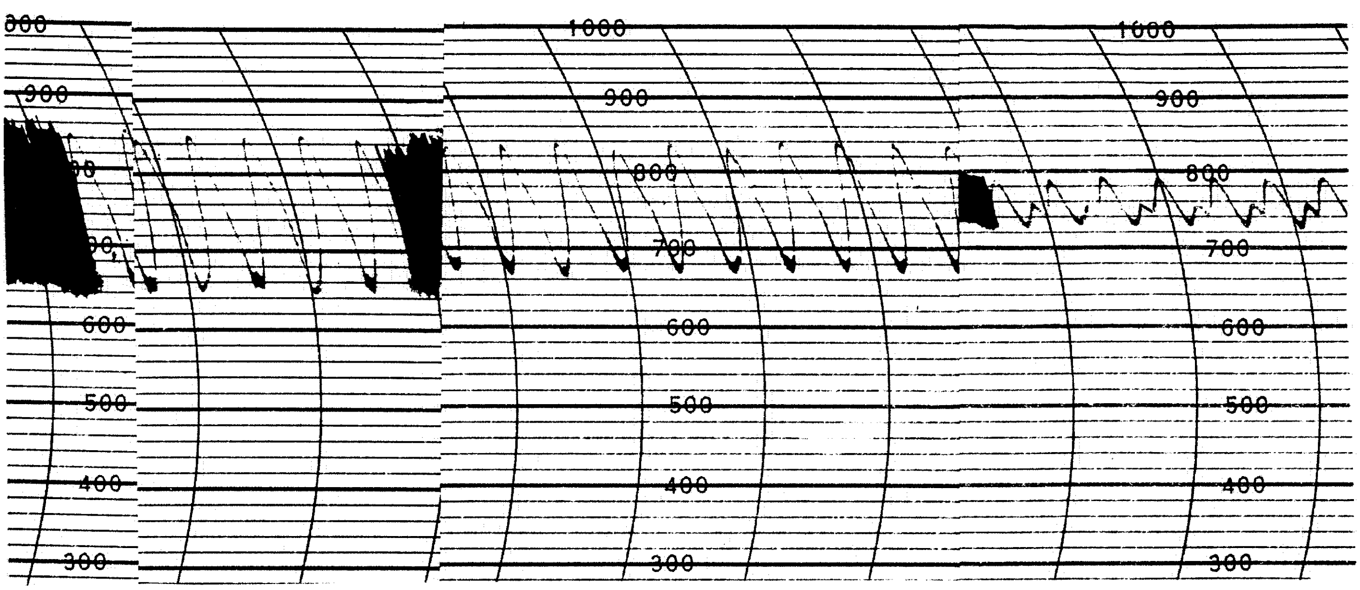
In addition to the simple traction or sealed coupling, one may obtain scoop tube or variable speed couplings, ring type couplings, dumping couplings, and clutch type couplings. These have all been developed to meet certain requirements, but they are basically the same as the traction coupling. Perhaps the most interesting of these special couplings is the scoop tube coupling, which allows the operator to control the volume of fluid in the coupling. This controls the amount of slip for any given output speed and torque requirement. In addition the scoop tube coupling allows the fluid to be constantly removed from the circuit, cooled, and reintroduced into the circuit.

APPLICATIONS OF HYDRAULIC COUPLINGS

The hydraulic coupling is essentially a constant-speed, constant-torque hydraulic unit, and as such it should be used on drives requiring this type of power. It is also an efficient drive, and one need not be concerned with loss in power through this type of unit. The passenger automobile is one of the outstanding successful applications of hydraulic units, since it has a relatively constant-speed, constant-torque drive after the unit gains speed and is one in which economy of operation is a prime factor.

One of the best industrial applications for hydraulic couplings is that between the internal combustion engine and the propeller shaft on moderate-sized power boats. The coupling absorbs engine vibrations and provides a very smooth drive. In new developments for fishing boats hydraulic couplings are being incorporated into multiple-engine drives to compound the power of two engines into a single propeller shaft. This drive has the added advantages of balancing the power of the two engines and protecting the compounding drive equipment. It is interesting to note that the original development of hydraulic drives was made in connection with ship propeller drives incorporating up to 20,000 horsepower, and now the drives are being developed for fishing boats having requirements of approximately 300 horsepower.

Couplings are also useful in connection with electric motors which must be started under load. The fact that



Engine speed variation, hydraulic coupling on engine: 22.4 strokes per minute; left, 105-115 pound pressure; center, 132 pound pressure; right, 200 pound pressure.

the coupling transmits torque in proportion to the square of the speed allows the electric motor to gain speed under light torque. With this type of drive, standard push-button controls and standard electric motors can be successfully used to start heavy loads. The load is also started much more smoothly than with special high-starting-torque electric motors. Electric motor drives of this nature are in operation on grease mixers, belt conveyors, ball mills, and many similar types of machinery where the unit must start under full load.

Consistent reports of reduced maintenance of equipment are received from operators using drives incorporating hydraulic couplings. One of the most interesting came from a major contractor operating heavy dirt-moving equipment. One set of earth movers was capable of transporting 13 yards of material per load and another set was capable of transporting only five yards. Both were of a similar nature and both working on the same job, and both employed the same mechanical transmission in the drive. The 13-yard unit included a hydraulic coupling and the five-yard unit had a conventional drive. In almost a year's operation, only two repair jobs were required for the transmissions in the large units equipped with hydraulic couplings, while there was an average of one a week on the smaller units which were not protected by hydraulic couplings, despite the fact that the smaller units were loaded much lighter.

Hydraulic couplings with built-in friction clutches are now being used in power shovels and on engines supplying power to oil-well pumping units. Both of these operations are carried on with the engines working at relative constant speeds, but the horsepower requirements vary rapidly. The coupling reduces the peak load on the engine by smoothing out the power requirements. The recording tachometer and vacuum gauge readings taken on an experimental oil-well pumping installation show how the coupling smooths out the load on the engine when pumping conditions remain as nearly constant as possible. Without the coupling the engine speed varied from approximately 600 *rpm* to 900 *rpm* on every stroke of the unit. This variation was reduced to less than half that obtained with the standard drive after the hydraulic coupling had been installed on the engine. A similar reduction of the intake manifold pressure variation was observed. The clutch type of coupling allows the operator to disconnect the engine from the driven members when necessary, but allows him to remain in hydraulic drive at all times while operating.

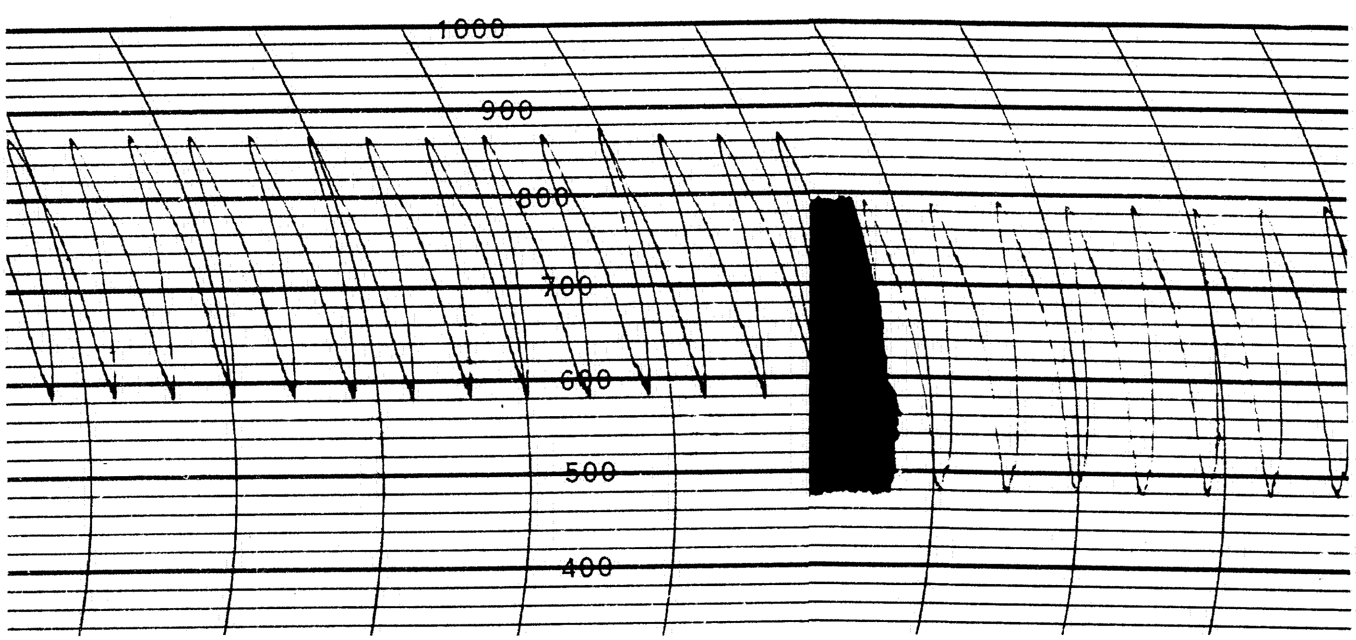
The scoop tube, or variable speed, hydraulic coupling has the added advantage of controlling the speed of the output shaft by regulating the amount of fluid in the coupling. In this type of coupling an adjustable tube extends into the hydraulic circuit and drains the fluid down to any desired level, thus allowing the coupling to slip. The amount of fluid and the degree of slip control the output speed of the coupling. It is apparent that the efficiency of the scoop tube coupling is inversely proportional to the slip.

Scoop tube couplings are used to advantage in driving slush pumps in drilling oil wells. It is sometimes advantageous to hold a constant pressure on the drilling fluid, even when there is no circulation of fluid. This is done with the scoop tube coupling by adjusting the tube to give the desired driving torque at the rated speed of the prime mover. As the scoop control coupling has provisions for cooling the coupling fluid, this condition of full slip in the coupling can be maintained for an extended period without overheating the coupling.

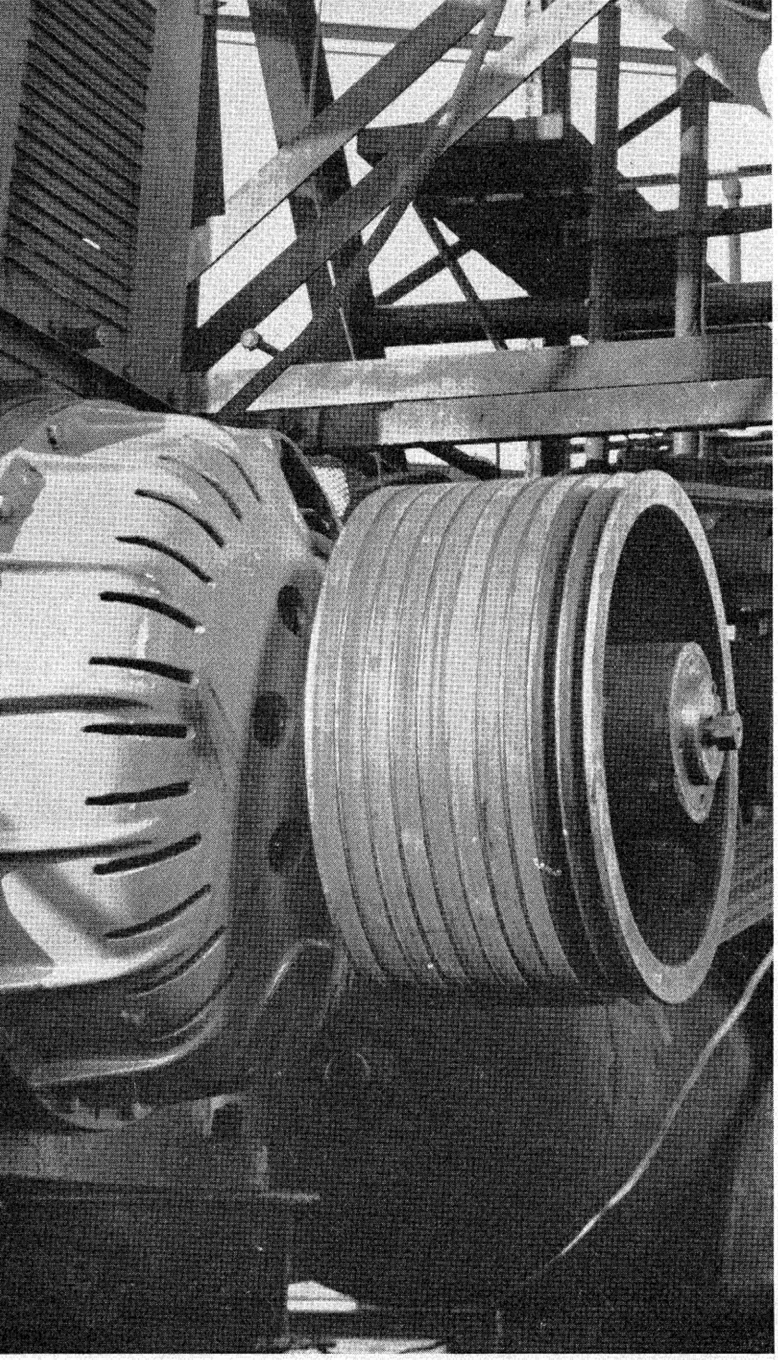
Variable speed couplings are also used in the automatic control of superchargers on airplanes. In this case the reduction in air pressure, as the plane gains altitude, operates a diaphragm which introduces fluid into the coupling. The higher the plane goes, the more fluid is introduced into the coupling and the more the coupling output speed increases. This increase in fluid and output speed is regulated so that the output speed of the coupling, and, in turn, the speed of the supercharger, will be correct for any given altitude.

LIMITATIONS OF HYDRAULIC COUPLINGS

Hydraulic couplings are best fitted for those drives in which the prime mover is operating at a uniform speed over long periods of time and where the output speed and torque are fairly constant. Couplings are not



Engine speed variation, friction clutch on engine: 120-143 pound pressure; left, 22.2 strokes per minute; right, 19.4 strokes per minute.



Hydraulic coupling installed on oil-well pumping engine reduces variations in engine speed and impact loads on sucker rods.

suitable for operating at various input speeds or on loads where the torque requirements change rapidly. An examination of the typical performance curve of a hydraulic coupling driven by an electric motor shows that the coupling output speed stalls under full torque at about three quarters normal prime mover speed. This prevents using the coupling at reduced prime mover speeds.

HYDRAULIC TORQUE CONVERTERS

Hydraulic torque converters consist of three basic members. The impeller, or pump, provides a means of imparting kinetic energy to the fluid as in the coupling, but in this case the pump is so designed that it will operate in one direction only. The turbine consists of several sets of blades which absorb the energy of the fluid. Between each set of turbine blades is a set of reaction blades which are stationary and which redirect the flow of fluid from one set of turbine blades to the next. The reaction blades and turbine blades are very similar in appearance to the blades in a conventional steam turbine and the impeller has the appearance of a simple centrifugal pump. The torque converter is not reversible, nor can the driven or turbine blade be used as driving members.

The output and input members of a torque converter are very different in appearance, and the output and input speeds and torques are also very different. The output speed of the torque converter varies from full engine speed at zero torque to zero speed at five times engine torque. Thus we can see that the converter runs at zero efficiency both at stalled output speed and when the output speed equals the speed of the prime mover. The hydraulic torque converter is a very successful hydraulic transmission between these two limits. One of the first reactions to the converter is the loss of from 15 to 30 per cent of developed horsepower when working in the recommended speed limits of the hydraulic unit. The converter efficiency does not tell the entire story in this case, as it is the work done in a day's time that counts, not the fuel consumption nor efficiency.

One of the outstanding cases of torque converters working at almost zero efficiency and getting a job done that could not be done in any other way came just after December 7, 1941. Pearl Harbor was lined with ships lying in the mud on their sides, and a means had to be found to right them. Six Wheels, Inc., in Los Angeles, built six heavy-duty winches including twin disc torque converters in the drive. These were shipped to Pearl Harbor and rigged up with the necessary blocks to pull the ships upright. For hours the converter shafts were almost stalled with the engines running at full speed and developing full horsepower. Each time a fraction of an inch was gained on the hoist drum the converter held it and a continuous pull was maintained on each hoist drum all of the time. The ships were righted and the torque converters, working much of the time at zero efficiency, get much of the credit for doing the job. No other known drive would keep the high torque on the drum drive hour after hour without rest.

APPLICATIONS OF TORQUE CONVERTERS

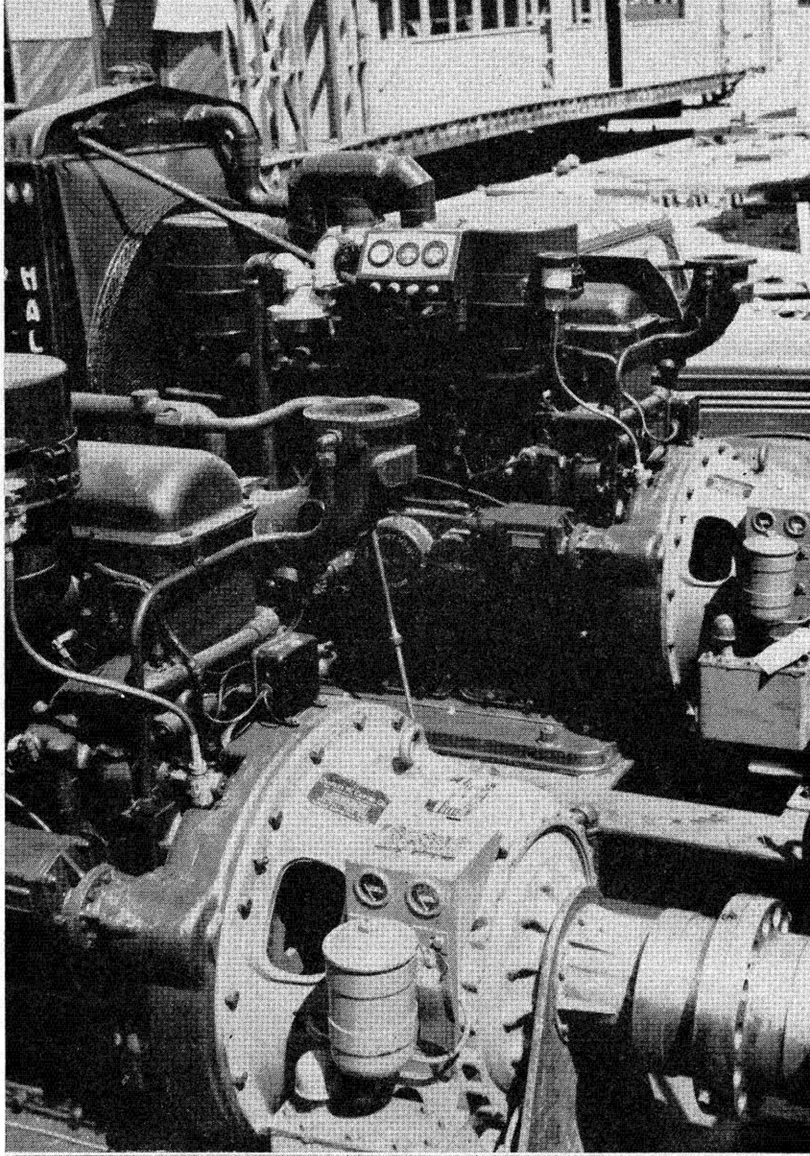
The torque converter is essentially a hydraulic transmission capable of developing torques varying from full prime-mover torque at about three-quarters speed to five times prime-mover torque at stalled output speed. A drive of this type is very useful in any operation requiring repeated changes in torque requirements, as it automatically selects the proper output torque and output speed for any load within its working limits. Hoists of all natures are the most logical application for torque converters, but study reveals many other suitable applications.

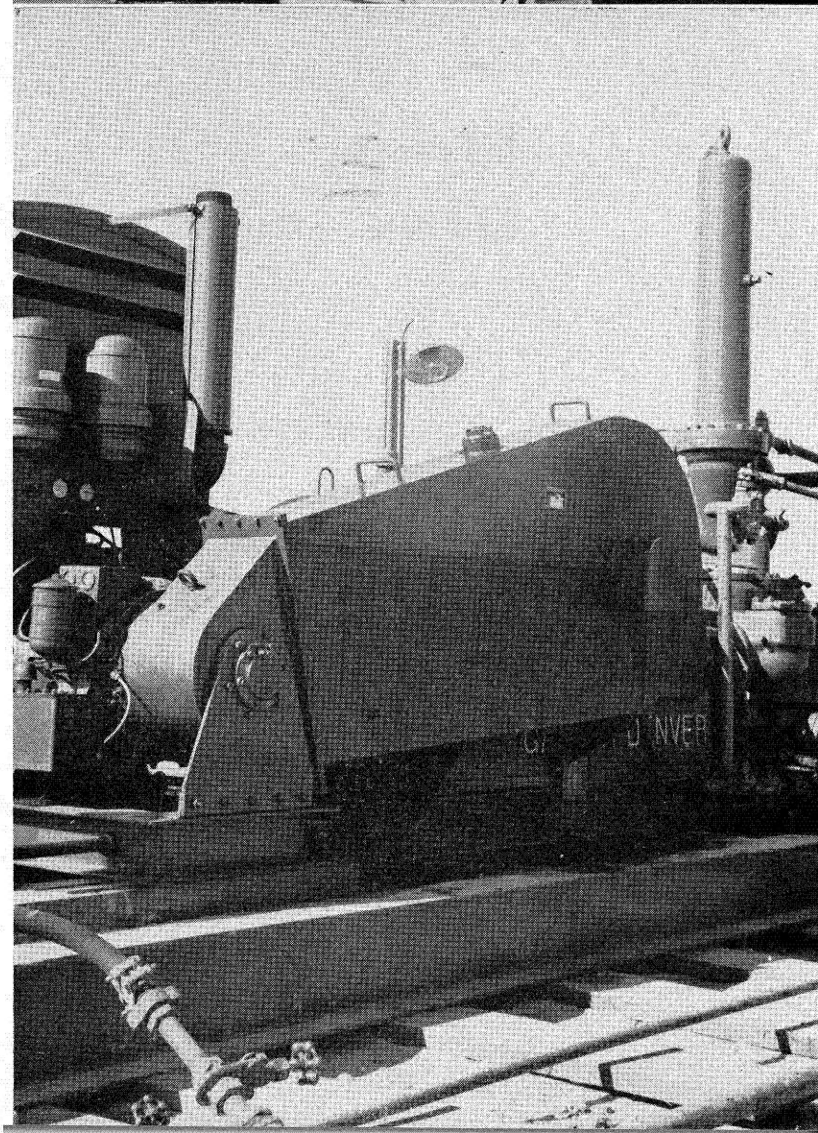
One of the early commercial applications of torque converters in large numbers was made in the logging industry of Washington, Oregon, and northern California. Internal combustion engines were replacing steam donkey engines on the hoists, but the gear transmissions fell far short of steam engine operation. Torque converters were installed on several hoists; they provided hoisting characteristics which did some things it was not possible to do with steam and they allowed loggers to use economical internal combustion engines in place of steam donkey engines. Each section of log to be moved would vary in weight and the hydraulic torque converter automatically selected the maximum speed at which any given log could be moved or hoisted. In yarder hoists the units driving through torque converters are able to hoist the logs at full throttle, hold them suspended at an even elevation while swinging them over the truck bed with the engines at partial throttle, and then lower them against the torque converter as the engine throttle is closed a little more. In this entire operation it is not necessary to touch a single clutch or brake lever from the time the log is hoisted until it is in position on the truck bed. All movements—hoisting, holding, and lowering—are done by control through the engine throttle only. In addition it has been found that many more logs can be loaded each day with converter-equipped units, and wire line and chokers give materially greater life.

Another early commercial application of torque converters was that made to oil-field hoisting equipment, or drawworks. The torque converter proved in the oil fields, as in the logging industry, that it would do more work in a day than similar units not provided with this hydraulic drive. It also proved that over-all maintenance on the rigs was greatly reduced through the protection of the hydraulic drive. The torque converter has its best opportunity to show its advantage in pulling the drill pipe from the hole, as each stand of pipe pulled reduces the weight of the remaining pipe to be hoisted. Time studies taken on rigs equipped with torque converters show that hoisting time is reduced as each stand of pipe is removed, and this is not true on rigs powered with internal combustion engines not equipped with torque converters.

The oil-field operators are also using torque converters to provide smooth power to small independent rotary table drives. These remove much of the impact loads and shock from the drill pipe and have proved their advantage in fields where they are suitable. Three interesting pump drives are now being developed in the oil field, including torque converters in the drive. This drive has often been questioned for torque converter application because of the continuous operation with maximum horsepower requirements and the possibility of damage to the pump when the stalled converter develops five times normal torque. Two of the pump drives are very special and are ideally suited for torque converter drives. One is an oil-well cementing pump used where the initial requirements on each job are to provide high-volume, low-pressure fluid. When all cement has been placed, it is necessary to build up and hold very high pressure against the cement until it has set. The other drive is used on an oil-well clean-out pump where the operator desires very high starting pressures to break circulation in the well and then wants to increase the volume rapidly as the pressure required to circulate reduces. Torque converters provide the required power and output torque to perform these jobs with the greatest assurance of successful operation.

The late war was responsible for two interesting applications of torque converters. Many of the landing craft were equipped with torque converter drives in their anchor winches. These landing craft drop their anchor several hundred feet before they run up onto the beach. When they have unloaded, the throttle on the anchor winch engine is opened and the drive through the converter puts a strain on the anchor line. This





AT TOP: Hydraulic torque converters on oil-well drilling unit improve hoisting performance and reduce maintenance cost. AT BOTTOM: Duplex reciprocating pump driven through torque converter insures maximum pressure and volume under all conditions. (See also cover illustration caption, page 1.)

strain is greatest at stalled speeds, but is substantial up to a speed equal to the reverse speed of the craft. The hydraulic torque converter insures maximum pull on the anchor line at all times and also sufficient speed on the spooling drum to make sure that all slack is taken up as the boat is floated by the combination of the anchor line pull and action of the waves.

Many of the army tractors used in transporting moderate field pieces included torque converters in their drive. The latest of these units are powered by two 215-horsepower engines, each equipped with its own torque converter. It has been proved that the smooth flow of power to the tractor treads has allowed the converter-equipped tractors to move equipment in areas where other units cannot travel. The army tractors are an outgrowth of early developments of Allis-Chalmers with converter-equipped industrial tractors, and Allis-Chalmers is again in production of these units in limited numbers.

City buses, heavy-duty short-haul trucks, and rail cars show other interesting applications of torque converters to mobile equipment. Many of the newer buses in Los Angeles are now equipped with torque converter drives. They can be identified by their rapid acceleration and even engine speed. No change in exhaust sound can be detected as the buses pick up speed, since they do not shift gears and the engines maintain maximum speed at all times. The loss of efficiency at high road speeds limits the use of torque converters, but this is not a problem on city buses in view of the number of stops and starts they make and the short distances they travel at high speeds. Rail cars present a different problem. They require high starting torque and smooth application of power to the wheels in starting the trains, but they also require full power and speed between stops. Special direct-drive converters are used for drives on buses and rail cars so the operator can shift from converter drive to direct drive when the high starting torque is not required.

Many other suitable applications will no doubt be developed for torque converters. At the present time plans are being made for off-the-highway trucks with a gross load of 300,000 pounds, powered by two 200-horsepower engines driving through torque converters. Fishing boats are also using converters to provide a constant strain on the lines used in recovering their heavy nets. The Navy uses torque converters on submarine net hoists guarding one southern California harbor.

LIMITATIONS OF TORQUE CONVERTERS

Care must be used in selecting the ratio of all drives in connection with torque converters in order that they may do most of the work in the efficient range of the converter. The high torque developed in the output shaft also places added loads on all conventional gear trains installed in many pieces of machinery. The loss of an average of 25 per cent of power through the converter makes this type of drive undesirable in those units operating at their maximum horsepower capacity and relative uniform loads for long periods of time.

SUMMARY OF HYDRO-KINETIC DRIVES

Both hydraulic couplings and hydraulic torque converters require relative high input speeds in order to operate to their best advantage. Industrial internal combustion engines operating at 1400 *rpm* and greater rates are very suitable for use with the present hydraulic drives. Both drives provide smooth starting of loads, prevent overloading and stalling the prime mover, and absorb much of the torsional vibration of the engines. Couplings are suitable on constant-speed, constant-torque drives where efficiency in excess of 95 per cent is desired. Torque converters are adaptable to those operations in which the prime mover will be operated at various speeds and loads, and where the output speed and torque varies with successive operations.

There are many applications in which couplings and converters are not suitable, and many more suitable applications will be developed as more experience is gained with these drives. Each new development will require careful study of the operations to be performed and careful engineering to select proper speed and torque requirements.

POSITIVE HYDRAULIC DRIVES

In addition to the hydro-kinetic units which have been described, there are several fine positive hydraulic drive units in widespread use in industry. These units are often built into various machine tools and generally develop but a low horsepower. In this type of drive a hydraulic pump provides a flow of fluid at the required pressure and volume for the drive. The fluid is carried through suitable lines to the positive-driven hydraulic motor. In most types of positive-drive units either the pump or the motor has a variable volume control to regulate the speed of the driven unit. One of the manufacturers of positive hydraulic drives very aptly compares his unit with an electric generator and an electric motor. The hydraulic pump generates hydraulic power which can be transported reasonable distances and around obstructions to the hydraulic motor, just as electricity can be carried over wires. The power developed depends upon the volume and pressure of the fluid, just as electric power depends upon the voltage and current.

Positive hydraulic drives have three outstanding characteristics. The hydraulic motors can be reversed very easily, a wide range of motor speeds can be obtained, and the hydraulic power can easily be transported reasonable distances through suitable pipes. The hydraulic fluid is in a closed circuit so that it is used repeatedly.

The positive hydraulic drive units do not have the ability to absorb shock loads which is so characteristic of the hydro-kinetic drives.

ESSENTIAL OILS

(Continued from Page 9)

for plant life and as if, because of the nature of the oils, the plant reacted by walling them off, as is also the case when intradermal oil injections are made in animals.

The question has repeatedly come up as to what function the oils could have in plants, and many guesses have been made, such as the attraction of insects for pollination, protection against snails or other enemies, sealing of wounds, varnish against excessive evaporation, etc. The experimental evidence for these opinions is not very strong: it rests on a few individual experiments which do not allow generalization.

The interesting field of the biochemistry of the oils, which also includes our perception of these as odors and flavors, is still practically a closed book. Our chief interest up to the present has been to enrich our statistical knowledge, mostly in view of commercial advantages. A diversion of this interest to the underlying biochemical principles will undoubtedly be of benefit to all concerned.

C.I.T. NEWS

ADMINISTRATIVE REORGANIZATION

THE retirement of Dr. R. A. Millikan was announced, together with other administrative changes, in the August issue of *Engineering and Science*. The Board of Trustees has anounced new appointments which will be of interest to the alumni.

Professor E. C. Watson has been appointed Dean of the Faculty, a position which has not heretofore existed at the Institute. Professor W. V. Houston has been appointed chairman of the Division of Physics, Mathematics and Electrical Engineering. This position was formerly held by Professor R. A. Millikan.

Professor F. C. Lindvall has been appointed chairman of the Division of Civil and Mechanical Engineering and Aeronautics. This position was formerly occupied by Dean Franklin Thomas, who remains as head of the Civil Engineering Department and Dean of Upper Classmen.

Professor J. E. Wallace Sterling, who is a member of the newly formed executive committee, has been appointed Edward S. Harkness Professor of History and Government. This professorship was formerly held by Professor William B. Munro, who has retired, becoming a member of the Board of Trustees and Treasurer of the Institute.

Harry J. Bauer, member of the Board of Trustees, has been appointed a member of the Observatory Council.

The Board of Trustees has transferred the Department of Meteorology to the Division of the Geological Sciences.

These actions were made effective September 15, 1945.

On November 10 it was announced that two engineers whose scientific skill aided materially in winning the war on opposite sides of the world have returned to civil life by joining the faculty at California Institute of Technology.

Lieutenant-Colonel Arthur P. Banta, who won high praise as an army sanitary engineer in the Pacific, rejoined the staff as associate professor of sanitary engineering, after a four-year military leave of absence.

Dr. George W. Housner, advisor of generals on aerial gunnery and bombing tactics in Africa and Italy, joined the faculty for the first time as assistant professor of applied mechanics.

As chief of the Army's War Planning Section, with headquarters at Honolulu, Colonel Banta had charge of design, construction, and initial operation of water supply and sewerage systems in the Pacific theater.

Author of numerous articles on sewage disposal systems, Colonel Banta was graduated in 1926 from Stanford University with an A.B. degree, and from California Institute of Technology in 1928 with a Master of Science degree in civil engineering. He is married and lives at 159 Sierra View Road.

A structural engineer here before the war, Dr. Housner became chief analyst of the First Operations Analysis Section, 15th Air Force, in 1943. In that capacity he advised high-ranking officers on bombing weights necessary for certain operations, with reference to different terrain conditions, and on other problems.

Working under his direction was a consulting body of 20 physicists, mathematicians, and electronics engineers. Major-General N. F. Twining, commanding officer of the 15th Air Force, commended him highly for "employing innumerable innovations in operational procedure and technique."

Unmarried, he lives with his family in Flintridge. He is a graduate of University of Michigan, with a B.S. degree in 1931, and of California Institute of Technology, with a Ph.D. received in 1941. An expert in engineering seismology, he has written numerous articles on earthquakes and their effect on structures.

ATHLETICS

By H. Z. MUSSELMAN,
Director of Physical Education

Bouncing back after an early season slump, Caltech's football team won the last three games on the schedule to finish the season with a record of four wins and two losses.

Coach Pete Brown's lads turned in a neat game in trouncing U. C. L. A. Junior Varsity, 6-0. Outplaying the heavier and favored Bruins, Tech drove for its touchdown in the fourth quarter with fullback Dutch Schimenz leading the sustained march and bucking over for the touchdown.

The best game of the season was the 32-20 triumph over San Diego State. With halfbacks Jerry Wozniak and Lloyd Chamberlain skirting the ends, and fullbacks Dutch Schimenz and Mort Powell tearing the line to shreds, the Beaver offense rolled up a total of 383 yards from scrimmage. The Tech line, consisting of Hubert Clark and Don Hibbard ends, Bill Libbey and Dennis Long tackles, Milt Strauss and Norman Lee guards, and John Gerpheide center, consistently outplayed the heavy State line and opened up holes which sprung the backs loose for long gains. In the second quarter Schimenz broke loose for a 55-yard run, and later in the quarter scored after a 45-yard run. In the final period Mort Powell raced 65 yards to produce the final Tech marker.

In the final game, Tech experienced little difficulty in administering a 19-0 defeat to Occidental, subduing the Tigers for the second time of the season. With Schimenz, Powell, Wozniak, and Root again spearheading the attack, the Engineers registered 317 yards from scrimmage while holding the Bengals to 61 yards.

The season's results:

Caltech	— 7	Redlands	13
	— 20	Occidental	0
	— 6	Cal Poly	7
	— 6	U. C. L. A. JV's	0
	— 32	San Diego State	20
	— 19	Occidental	0
	90		40

At the opening of the new semester, Coach Carl Shy was greeted with a record turnout of basketball men, but found only three lettermen—Jerry Schneider center, Stuart Bates forward, and Dennis Ahern guard—returning from last year's team. However, much material should be uncovered from the 240 V-5 trainees and the 75 civilian frosh who are just entering the Institute this semester.

With all the Southern Conference schools being represented by teams for the first time since 1943, "home and home" games have been scheduled with Occidental, Pomona, Whittier, and Redlands. Additional contests will be scheduled with U. S. C., U. C. L. A., Pepperdine, and various service units. All home games will again be played at the Pasadena Armory.

The schedule:

Sat. Dec. 1	Whittier	at	Caltech
Fri. Dec. 7	Occidental	at	Caltech
Fri. Dec. 14	Caltech	at	Redlands
Fri. Dec. 21	Caltech	at	U. C. L. A.
Sat. Jan. 5	Caltech	at	Whittier
Fri. Jan. 11	Redlands	at	Caltech
Sat. Jan. 12	Caltech	at	Pepperdine
Sat. Jan. 18	Caltech	at	Pomona
Fri. Jan. 25	Caltech	at	Occidental
Sat. Jan. 26	Pepperdine	at	Caltech
Sat. Feb. 2	Pomona	at	Caltech

The Institute has just announced the appointment of Mason Anderson to the physical education staff. Anderson was stationed at the Institute as a chief specialist in the Navy V-12 unit from May, 1944, to June, 1945, and coached the 1944 football team which produced such an enviable record. Prior to entering the service, Anderson coached the high school teams at Trinidad, Colorado, Raton, New Mexico, and Colorado Springs, Colorado, to several championships. Having recently received his discharge from the Navy, Anderson took up his duties at the Institute at the opening of the semester on October 29 and at present will supervise the physical education and intramural program and assist Coach Shy in coaching basketball.

OCTOBER ALUMNI MEETING

By W. H. SIMPSON

THE October meeting of the Alumni Association was a dinner meeting held at the University Club in Los Angeles with Al Knight, class of 1922, as host. In the absence of Charley Varney, the meeting was ably presided over by Allen Laws '26, vice-president of the Association. There were 68 people for dinner, including three members of the faculty and about six guests, which made a fairly good turnout.

The speaker was H. W. Hitchcock, chief engineer of the Southern California Telephone Co. Mr. Hitchcock had recently returned to the United States after spending a year in the battle areas of Europe in the capacity of a director of communications. His job was to supply communication facilities for all the armed forces and hospitals. These facilities included telephone, telegraph (for coded messages), and manually operated radio networks.

Of the many problems encountered in the tremendous job of maintaining communications, two seemed to stand out as the toughest. For one thing, the field wires were necessarily strung along the side of roads because the fields had not been cleared of land mines. Mr. Hitchcock said the Germans had placed literally millions of mines in very effective locations, doing the damage they were intended to do in a very efficient manner. If it had been possible to string wires across country the work would have been made much easier.

The second problem was an outcome of the first. Because of the fact that wires were strung along roads, communications were continually interrupted by war vehicles of various sorts, breaking the wires when they accidentally left the road. In most cases where the distance between repeater stations was not too great, when a break occurred, a complete new line would be strung between stations rather than take the time to hunt for the interference. As a result of this, the trees, hedgerows, poles, etc., were festooned with miles of wires of various sizes and purposes, making it almost impossible to identify any one line.

Mr. Hitchcock paid high tribute to the men in the armed forces who through their ingenuity were able to erect and maintain communication facilities under very trying conditions.

DECEMBER ALUMNI MEETING

On December 13, members of the Alumni Association will enjoy a dinner meeting at the University Club in Los Angeles. Mr. R. G. Kenyon, vice president of the Southern California Edison Company, will talk on Labor-Management Relations. Announcements will be in the mail a week or so prior to the date of this meeting.

The January meeting will be held on the 17th of the month with dinner at the University Club. Mr. Verne Orr, Vice President, Chrysler Pacific Corp., will be the speaker of the evening.

The annual dance will be held in February.

MAJOR EDWIN R. KENNEDY RECEIVES CITATION

Major Edwin R. Kennedy, Air Force, was awarded the Legion of Merit in July by the Commanding General, United States Forces, China Theater, at the Edgewood Arsenal, where he is presently stationed. The citation reads as follows:

"Major Edwin R. Kennedy, O 339 409, Air Corps, is awarded the Legion of Merit for exceptionally meritorious conduct in the performance of outstanding service from 21 May 1944 to 26 January 1945 as technician in charge of producing a gasoline substitute for motor vehicle use in China. Adequate quantities of motor vehicle gasoline could not be brought over the 'Hump' owing to limited air tonnage allotments, and Major Kennedy was brought to China to develop a local product for use as a substitute. After conducting a large number of tests of various fuels, he selected alcohol as the best substitute available in sufficient quantities in China. Although blends of more than ten per cent alcohol and ninety per cent gasoline never before had been used successfully with standard gasoline engines, he succeeded in obtaining efficient operation with blends of seventy-five per cent alcohol and twenty-five per cent gasoline with only minor modifications of government vehicles. The use of this blend resulted in a monthly saving of more than 1,800 tons of air freight, which permitted greater quantities of other vital material to be brought to China and directly increased the scope of combat operations in that theater, which reflects great credit upon Major Kennedy and upon the American military service."

PERSONALS

Ex. 1923

LIEUTENANT-COLONEL VERNON JAEGER, 91st "Powder River" Division chaplain, arrived in the States on September 11 with elements of his division, veterans of the Italian campaign. Going overseas in April, 1944, Chaplain Jaeger served with the Fir Tree Division throughout the Italian campaign. He won the Bronze Star Medal for meritorious service in support of combat operations in May, 1945. In civilian life, Chaplain Jaeger was pastor of the First Baptist Church, Port Townsend, Wash. His family now lives in Pasadena, Calif.

1927

THOMAS L. GOTTIER holds the position of chief television engineer for the Raytheon Manufacturing Co. of New York, N. Y.

RICHARD DODGE has moved to southern California with his family.

1929

LIEUTENANT-COMMANDER FRANK W. THOMPSON has returned to the

States from duty in the Pacific area aboard the U.S.S. California, where he took part in the invasions of Saipan, Tinian, Guam, Leyte Gulf, and Lingayen Gulf. Commander Thompson is now stationed at Kaiser Shipyards in Richmond, Calif.

1932

PAUL ARNERICH is a service engineer for Douglas Aircraft at Santa Monica, Calif.

1933

ALVIN J. SMITH is employed by the Pacific Enterprise Products Co. of Los Angeles as an electrical engineer.

1936

VERNE L. PEUGH visited at the Institute last month. Verne is chief engineer for Winston Bros. Co., constructors and engineers of Minneapolis, Minn.

SIDNEY SCHAFER works for Pan American Production Co., Houston, Tex., as chief geologist and geophysicist.

1937

V. C. KELLEY is on the staff of the geology department at the University of New Mexico, in Albuquerque, and spends his field seasons with the metals section of the U.S.G.S., largely in Colorado.

VICTOR H. CHURCH is an instructor in the geology department at Utah State University, Logan, Ut.

1938

LIEUTENANT (j.g.) JOHN R. BAKER is stationed at the Naval Air Technical Training Center in Memphis, Tenn. He was formerly at the Aviation Supply Office in Philadelphia for 20 months.

HERBERT ELLIS, who has been with the Engineering and Transition Office of the O.S.R.D. in Washington, D. C., visited the Institute in September and expects to move his family to southern California and resume residence in La Canada.

MICHEL AMBROFF is doing consulting work as a technical design coordinator.

DONALD D. DAVIDSON and Miss Corinne Nelms were married on October 6 at Long Beach, Calif.

1939

WILLIAM M. NORTON is a member of the purchasing director's staff of the Consolidated Vultee Aircraft Corp., San Diego, Calif.

CAPTAIN LLOYD ZUMWALT is in residence at Oak Ridge, Tenn., and works for the Manhattan District, U. S. Engineers.

Ex. '39

TECHNICAL SERGEANT JOHN BILLHEIMER is employed by the U. S. Engineers, Manhattan District, and also lives at Oak Ridge, Tenn.

1940

ENSIGN CYDNOR BIDDISON, who received his commission last October, has recently been assigned as assistant navigator on a newly commissioned refrigerator store ship of the Navy.

LIEUTENANT RUSSELL DOOLITTLE, U.S.N.R., is now serving his second tour of duty in the Pacific area.

1941

QUENTIN ELLIOTT was married to Miss Dolores Benedict of Denison, Tex., on July 19. Quentin is now with the department of chemical engineering at the Naval Ordnance Test Station, Inyokern, Calif.

GEORGE H. BRAMHALL and Miss Elizabeth Irene Bird were married in a formal wedding September 16 at Schenectady, N. Y.

WILTON A. STEWART announces the arrival of David Michael on September 5.

LLOYD A. LEWIS is a petroleum geologist with the Shell Co., alternating between Alberta and the Ventura Basin.

LOUIS S. STIVERS, JR., is an aeronautical engineer for the National Advisory Committee for Aeronautics at Langley Field, Va.

FREDERICK W. THIELE is working as a research staff member at the Institute, under Dr. Carl Anderson.

1942

LIEUTENANT (j.g.) TOM ELLIOTT, after serving 18 months in aviation maintenance at the Naval Air Station at Honolulu, visited in southern California before reporting to his new station at Seattle.

LIEUTENANT AL LANDAU is company commander with an ordnance evacuation outfit in Germany. Al is the only officer in his company and is extremely busy. Because of the nature of his work and lack of "points," Al doesn't expect to get home before June or July of next year.

LIEUTENANT J. F. McCLAIN, who is stationed at the Naval Repair Base at San Diego, visited the Institute in September. Lieutenant McClain is planning to return to the Institute at termination of service.

LAWRENCE W. SMITH is working as an engineer in design and construction of butane-propane pumps in South Pasadena, Calif. Lawrence is married and has a son, born in November of last year.

ENSIGN JOSEPH FRANZINI visited friends at the Institute in September during his leave, after which he was going out to sea again on transport duty.

ALVIN R. PIATT has been discharged from the Navy and has moved to southern California from Washington, D. C., where he was an officer in the Naval Research Laboratory.

1943

LIEUTENANT (j.g.) ROLAND S. SAYE, who has been with Mine Assembly Ordnance at Yorktown, Pa., is now assigned to a unit to go overseas with a light-duty garage for overhauling light-duty stock.

PETER DEHLINGER is working as a geophysicist in the Los Angeles office of the Shell Oil Co. His second child, Peter, was born in November, 1944.

EDWARD A. WHEELER announces the arrival of a daughter, Beth, born on May 22.

LIEUTENANT (j.g.) RALPH WILLITS spent 19 months in the southwest Pacific area with Motor Torpedo Boat Squadron 11 as a radar officer. During his leave last month, Lieutenant Willits visited friends at the Institute. He was to report to a P.T. training center at Melville, R. I.

LIEUTENANT (j.g.) MITCHELL DAZEY, while on a 30-day leave, visited at the Institute last month. Lieutenant Dazey was at Espiritu Santo for 15 months in aviation ordnance, two months in Pearl Harbor, and had a six weeks trip to Guam, Ulithi and Eniwetok. At the end of his leave, he was going to a mine depot station at Yorktown, Va.

LIEUTENANT (j.g.) EARLE R. ATKINS, JR., and Miss Myrtle L. Brockman of Long Beach, Calif., were married on the evening of September 8. Jack French '43 was best man. The Atkinses plan to live at Yorktown, Va., where Earle will be stationed at the mine depot.

1944

ENSIGN KENNETH ROSS DE REMER, U.S.N.R., is engaged in radio, radar, and sonar work aboard the U.S.S. Biloxi.

ENSIGN JOHN J. GARLAND, after completing his destroyer training program at Norfolk, Va., was assigned to the U.S.S. Mayo, which left August 1 for the Pacific area.

FRANK C. SMITH is an aviation radio technician, second class, now stationed at San Clemente Island, Calif. Frank had preradio training in Chicago, radio at the University of Houston, and a radar course at Corpus Christi, Tex. Frank was meeting his old friends at the Institute last month.

ENRIQUE SILGADO, after completing two years of graduate work in geophysics under the auspices of the Institute of International Education, returned by plane to his home in Lima in September, 1944.

ENSIGN NEVILLE LONG is stationed at Guam as adjutant with the 76th N.C.B. and hopes to see Tech men as they pass through.

LIEUTENANT FRED MORRIS, who has been specializing in high-frequency and radar at Fort Monmouth, was home in southern California on a 20-day leave in September.

WILLIAM W. OLENBUSH is a graduate student at the University of Michigan, specializing in chemical and metallurgical engineering.

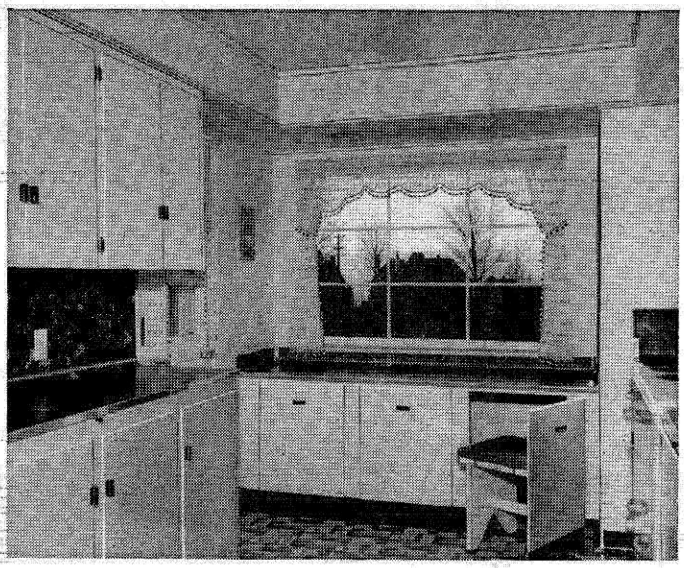
1945

GEORGE FEIN was married to Miss Marjorie Frances Goodman on September 1 at San Francisco, Calif. They are making their home in Pasadena, Calif.

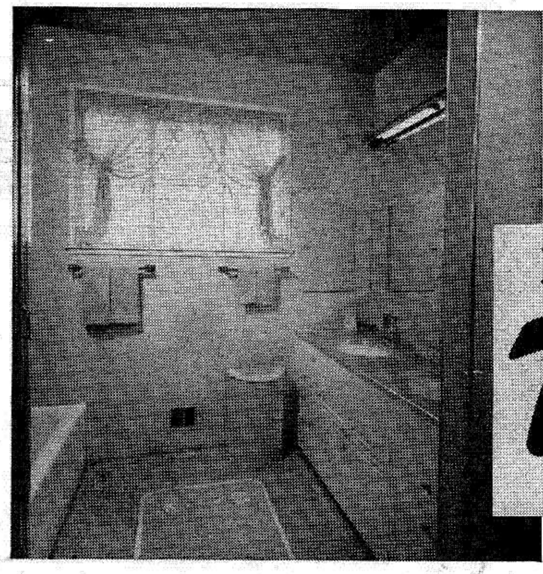
Ex. '45

LIEUTENANT GENE FISHER, who has been flying in a combat carrier squadron all over Burma and China, expects to return to the States soon on leave and possibly receive discharge. Gene, who made his "T" in cross-country in 1942, recently found an opportunity to continue his distance running when in track meet he qualified, with 11 other men, out of a field of 90, for the finals and placed fifth. Gene has two Distinguished Flying Crosses, four Air Medals, and three battle stars to his credit.

In the kitchen, DFPA "Plypanel" is used for smooth, firm, sturdy flush doors and other built-in detail and cabinet work.



For a firm, smooth surface under a linoleum floor, use ¼" or 3/8" Plywall over a Plyscord subfloor. Sound 1 Side Plypanel is used under drainboard and counter linoleum.



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