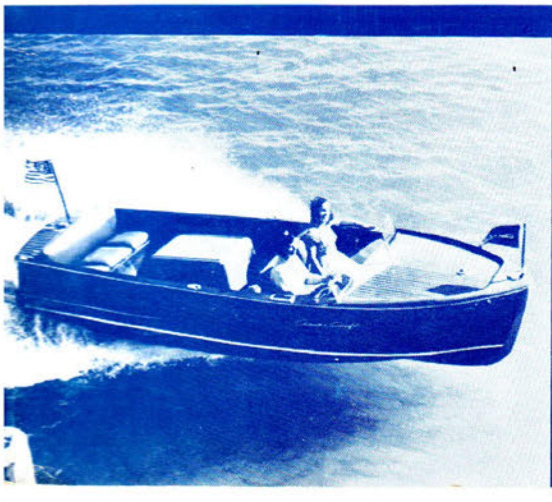
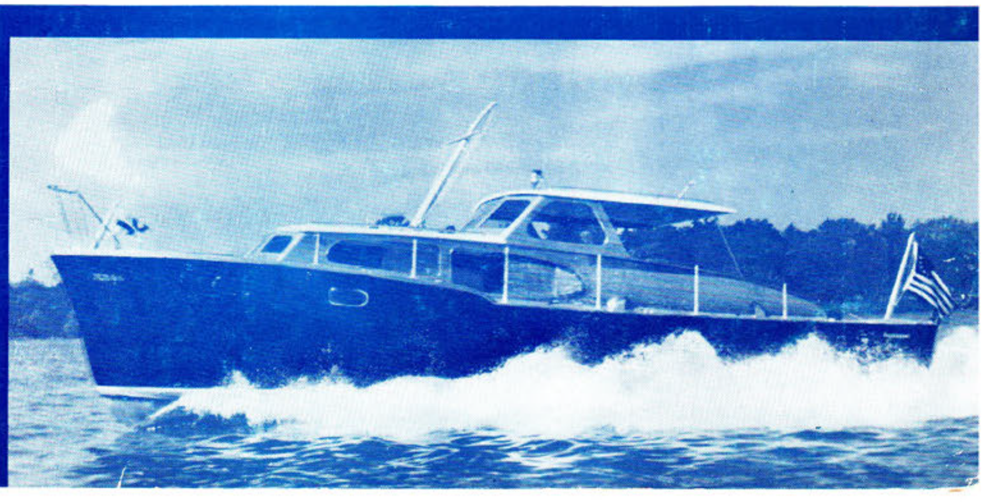
30 YEARS OF PROGRESS IN POWER BOATING

L. J. FAGEOL





THE AUTHOR

MR. L. J. (Lou) FAGEOL is President of the Twin Coach Company which controls subsidiary companies producing special purpose vehicles, small pleasure boats and trailers, automotive, marine and industrial engines and major craft subassemblies. Plants are in Kent, Ohio — Buffalo, New York — and Warsaw, Indiana. Fageol Products Company of Kent, Ohio, one of the subsidiaries, produces bus, truck, marine and industrial engines which are sold under the Fageol trade name.

Mr. Fageol is well known for his original designs, examples of which are the "Convertible" bus-truck ambulance widely used by the Armed Forces and the "Pony Express", a miniature high efficiency delivery truck employed by the U. S. Post Office Department. At the 1956 Boat Show, Fageol Products Company displayed two new marine engines. One of these, the Fageol 44 outboard motor, was personally designed by Lou Fageol. It was the first four-cylinder, four-cycle outboard of high horsepower output offered in the American market. At the present Fageol Products also offers the Fageol VIP inboard marine engine.

Lou Fageol's background in the motor boating field is almost unlimited. He has won virtually every major motor boat race in existence, not once but many times. He has won the Gold Cup, the Silver Cup, and the President's Cup. In an outstanding performance he won all three heats in the 1954 Gold Cup races at Seattle and established a new 90 mile race record. During the Gold Cup trials in 1955, he was seriously injured in a boat mishap and has retired from competition. At retirement Lou Fageol has held more competitive records in closed course hydroplane racing than any other individual. His background and experience as a boat builder, racing boat driver and marine engine manufacturer makes him eminently qualified to talk on "30 Years of Progress in Power Boating."

30 YEARS OF PROGRESS

IN

POWER BOATING

L. J. FAGEOL

ONCE THE PLAYTHING of relatively few people, boating has become the nation's number one recreational family sport. Countless statistics can be quoted, such as 6,000,000 pleasure craft in the United States waters, 55,000 marine radio-telephones, 331,000,000 gallons of gasoline consumed in 1956, etc. Estimates indicate that one out of every six Americans enjoyed boating during 1956.

Obviously, many factors have contributed to the fantastic rise in boating popularity. Among the foremost have been the development of high-performance, low-cost hulls that are dependable and seaworthy; reliable engines that are powerful, durable, and economical to buy and operate; and the ready availability of high-quality fuels and lubricants for use in these engines.

Just as the passenger-car manufacturers have learned much through the years from the performance of cars, engines, and fuels on the race tracks of this country, the performance available in today's marine hulls and engines can be traced to valuable experience gained in outboard and inboard racing. This doesn't mean that the engines powering today's pleasure craft are yesterday's racing engines. Or that the super-powered Allison and Rolls Royce engines in today's Gold Cup boats will be used in cruisers of the future. Or that Gold Cup speeds are needed for everyday boating.

Instead, the lessons learned have been ones proving engineering principles and design details. Whether considering either an Indianapolis "500" race or a Gold Cup race, the accent must be upon durability as well as speed. If a Gold Cup boat is to survive the punishing grind of 90 miles at speeds in excess of 100 miles per hour, the hull, engine, gearbox, fuels, lubricants, and all other parts must be of the highest quality. It is this search for the best that has resulted in many developments now available to the boating public.

The early days of power boating found boats powered by internal combustion engines far different from those we know today. In general, the engines were of large displacement, had few cylinders, turned at relatively low rpm's and burned naphtha. A search of literature reveals that these engines were not too reliable, and that the operation of these craft was considered to be somewhat dangerous. Because the history of boat racing is better documented than that of pleasure boating, it is a relatively easy thing to follow the development of both engines and boats by merely observing the chronology of events occurring in the racing boat field.

Since some of my personal later day contributions toward ever higher performance on water are recorded in the Gold Cup and Harmsworth competition records, I would like to review the progress resulting from some of these events.

1904 First Gold Cup won by the boat "STANDARD" with a best-heat speed of 23.6 mph.

1903 First Harmsworth Trophy won by England at a speed of 19.53 mph.

1913 Harmsworth Trophy won for last time by England when "MAPLE LEAF" averaged 57.45 mph.

1914 "BABY SPEED DEMON" wins Gold Cup with a best-heat speed of 50.49 mph.

1920 Gold Cup won by Gar Wood with a best-heat speed of 70.0 mph in MISS AMERICA I powered by two Liberty engines delivering 900 horsepower. After the rule change in 1922, which limited engine displacement to 625 cubic inches, Gold Cup speeds dropped. However, in 1946, Guy Lombardo won with a best-heat speed of 70.86 mph in "TEMPO VI", a 3-point-hull type boat powered by 500-horsepower Miller engines.

1920 Harmsworth Trophy taken for United States by Gar Wood at a speed of 61.51 mph. This performance foreshadowed domination by the great fleet of "MISS AMERICA's", which successfully defended the trophy through the 1933 Challenge. "MISS AMERICA X", which was powered by four Packard engines developing 6,000 horsepower, attained a speed of 86.93 mph for a 40 nautical-mile heat.

1949 With the change to a 3-point-type hull, 1500 horsepower won the 1949 Harmsworth for Stan Dollar's "SKIP-A-LONG" at a speed of 94.28 mph.

1950 The great "SLO-MO-SHUN IV" successfully defended the Harmsworth Trophy with the first 100-mile-per-hour average ever recorded for the 40 nautical-mile heat. As the driver, it gives me pleasure to state that this achievement still stands in the record book, along with several others which have defied the present-day group of challengers for some time.

1956 In concluding with competitive racing, it is interesting to note that "MISS THRIFTWAY", 1956 winner of the Gold Cup, exceeded 100 miles per hour for the entire 90-mile race.

As previously noted, there is a close correlation between the developments resulting from better performance on the race course and what becomes available for the boating public. Improvements in lubricants, fuels, hulls, and engine designs have all carried over from racing into everyday use. Lubricants are able to stand higher temperatures and provide better lubrication. Fuels are able to satisfy higher output engines. Engine designs having such features as high compression ratio, high rotative speed, better breathing, and more horsepower per cubic inch all contribute to more efficient and safer power boating. The close cooperation between boat builders, engine manufacturers, and gasoline refiners has been essential to achieve the present high standards.

Hull Design

In all forms of racing, the vehicle is just as important as the engine. Improvements in hull design were necessary to handle the more powerful racing engines. These improvements have been translated into the power boats in common use today, and modern engines could not be successfully applied without proper hull design.

Hull design not only affects the power required to drive a boat at a given speed with the power available but also affects the maneuverability and seaworthiness of a boat. In the early 1900's there appeared in the boating field the V-bottom hull which had the ability to plane over the surface of the water, in contrast to the plowing action of the conventional round-bottom displacement hull. First used in small racing craft, the planing hulls later found their way into small recreational boat construction, and eventually into the large cruisers. Thirty years ago many builders of such craft were in the throes of evaluating the relative merits of the two hull designs, and the resulting controversy still exists to some extent.

As was recognized many years ago, the planing hull has decided advantages insofar as speed is concerned when boats are called on to move faster than about 10 miles per hour. From 0 to 10 miles per hour approximately equal performance will be obtained from the various hull shapes for the same power output. However, when the boat speed exceeds 10 miles per hour, the planing hull gives a much greater return for the power applied, as compared with the displacement hull. Naturally, at very high speeds something more complicated than the simple V-type planing hull is required. The 3-point hydroplane is an example of hull design for high-speed operation.

The round-bottom hull and the V-bottom hull are not the only types that have been investigated. The inverted V-bottom hull, which was used on at least one boat make built some years ago, had advantages in shallow-draft operation and in the return of speed for power applied. This hull design was very popular with both law-enforcement agencies and lawbreakers during the prohibition era. The primary reason why the inverted V-bottom is not more popular today is that it tends to make a boat somewhat harder to maneuver as compared to the other hull types. Also, the construction of the bottom more or less dictated the general shape of the boat, and apparently the public did not care for the result.

A development that has recently achieved some prominence in the boating journals, both here and in foreign countries, is the hydrofoil. This idea is not new. In fact, Alexander Graham Bell of telephone fame first equipped a boat with hydrofoils in 1919. The 60-foot hull, which was supported by three sets of hydrofoils and powered by two Liberty engines driving air propellers, achieved speeds exceeding 70 miles per hour, a remarkable feat for those days. The advantages of the hydrofoil are quite well known in that considerable speed can be obtained for the power expended. However, hydrofoil-equipped boats are somewhat difficult to maneuver when planing on the hydrofoils, and the public may not readily accept the appearance of craft equipped with this device.

Engines

Marine engines also have undergone a lengthy period of development, during which various engine designs have been tried and either accepted or discarded. Early inboard gasoline engines were generally of low power output and had relatively few cylinders when used in recreational craft other than racing. The types of engines used in inboard powered craft have passed through several stages of evolution. In early days many of the engines were of the overhead-valve, inline design. This was followed by a period during which the L-head design became popular due to its lower silhouette. As more people embraced boating as a means of recreation, many smaller craft were built, and the space taken up by the power plant became more important.

Recently, still another era in engine design has been evident. As in the passenger-car and truck fields, there is a definite trend toward the application of higher horsepower engines in the marine field. Concurrently, another type of inboard engine is becoming more popular, particularly in the larger horsepower categories. This, of course, is the overhead-valve V-8 engine of compact design. Today, practically every manufacturer of inboard marine engines either produces or is experimenting with engines of the overhead-valve V-8 configuration. Lightweight, smooth operating, and economical, these engines have been readily accepted by the boating public. It appears, however, that the L-head engine will retain its popularity for low-horsepower applications, say less than 150 horsepower, where the engine is mounted in a conventional manner.

New methods of applying marine power to hulls are continually being tried or retried. A recent development is the installation of a small overhead-valve marine engine, which develops a high 0.8 horsepower per cubic inch, in a vertical position near the stern, with the power transmitted down through the hull by an outboard-motor-type lower unit. With this type of installation, it has been demonstrated that boat performance is better than would be expected from the power rating of the engine. This installation also eliminates the admidships obstructions that normally occur with conventional inboard installations.

The trend to overhead-valve engines of either inline or V-8 design can be readily explained. In order to obtain additional power from engines of the same relative size, or to make available the same amount of power from a smaller package, the horsepower per cubic inch of piston displacement must be increased. There are several ways to accomplish this, and most of them have been thoroughly explored in the passenger-car field. Improving the breathing system of the engine is one method of increasing the horsepower per cubic inch. This can be accomplished by enlarging the manifold passages, by increasing the breathing capacity of the carburetor system, by using larger valves, and by raising the valve higher off its seat. The ultimate goal is to supply more and more air to the engine at the high rotative speeds that modern engines employ. Another approach is to raise the compression ratio of the engine in order to extract more power from the fuel-air mixture as it burns in the cylinder. Better breathing and higher compression ratios, as well as higher engine speeds, are being employed in modern marine engines.

Thirty years ago the horsepower per cubic inch available from popular marine engines used in recreational inboard power boats, other than those employed for racing, varied from a low of approximately 0.14 to a high of about 0.35. By comparison, the values for comparable 1956 engines ranged from about 0.39 to a high of over 0.6 horsepower per cubic inch. Marine engines featuring a number of the developments that have appeared on the higher-horsepower passenger-car engines develop 0.66 horsepower per cubic inch or better.

Similarly, in the late 1920's the compression ratios used in most inboard engines other than racing engines ranged from 4 to 5-to-1. In contrast, almost all current engines employ compression ratios in excess of 6.5 to 1, and many have compression ratios of 8 to 1 or higher. Nine-to-one compression ratios are used in some models of various manufacturers, and probably will be widely used in the near future. It is anticipated that engines having the higher compression ratios will have to be of overhead-valve design in order to fully utilize these higher ratios, since the L-head design does not permit both high compression ratios and good breathing in the same engine.

Thirty years ago most marine engines were rated at speeds in the range of 2,000 to 3,000 rpm. Today, most have rated speeds in the 3,000 to 4,000 rpm range. At first glance, it may appear that these higher speeds would adversely affect engine durability. It seems reasonable to expect that higher rpm's would produce higher piston speeds, and therefore shorten engine life. However, the engine designers overcame this problem by shortening the piston stroke so that piston speeds are well below the critical limit. As a result, modern engines employing higher rotative speeds have proved to be very durable.

Some historical comparisons will help to demonstrate the advancements in marine engines. For example, thirty years ago three popular engine models developed 41, 43, and 61 horsepower at an average cost of $11.4 per horsepower. Today, three popular engine models of the same make develop 70, 100, and 135 horsepower at an average cost of $11.3 per horsepower. In other words, today's horsepower costs no more despite the fact that the value of the dollar has declined markedly during the past 30 years.

Still another comparison can be made between two eight-cylinder engines of nearly equal displacement. The 1927 engine developed 132 horsepower as compared to today's 215 horsepower, weighed 1100 pounds versus 640 pounds, and was 59 inches long as compared to 36½ inches. It is interesting to note that the early engine weighed 12.5 pounds per horsepower developed, while the modern engine weighs only 3 pounds per horsepower. This certainly is a tribute to the design and manufacturing skills of engine manufacturers.

All manufacturers of marine engines recognize that the modern inboard engine operates under severe loading conditions, and that developments perfected for other heavy-duty applications fit well into the marine engine picture. Modern marine engines feature such heavy-duty components as chrome-plated top piston rings, hard-faced valves of high-quality steel, sodium-cooled valves, and valve rotators. Cylinder blocks proven in other types of service are the type most widely used in marine engines. Practically all inboard marine engines are constructed around engine designs proven in passenger car, truck, bus or commercial service.

One field of marine power that has not been touched on as yet is the outboard motor. The growth of this means of propelling a boat has bordered on the fantastic. For example, in 1927 the total sales of outboard motors was in the neighborhood of 20,000 units. In 1956, over 640,000 outboard motors were produced and sold. During the same span, the horsepower of the average outboard motor rose from under 3 in 1927 to 14.2 in 1956. Outboards developing 60 horsepower are currently available, and larger ones are under development. Every outboard manufacturer recognizes that people are interested in performance in their boats as well as in their passenger cars.

The outboard motor has followed the same trend as the inboard engine in that higher horsepower per cubic inch is being sought at all times. The experience gained in other fields of gasoline engines has been investigated by the outboard manufacturers in order to overcome certain problems associated with advancements in power output. Greater horsepower per cubic inch of outboard motors has been achieved by higher rotative speeds, better breathing, and higher compression ratios. The use of higher compression ratios in larger engines became feasible with the advent of electric starters, which are almost mandatory for the larger outboard motors.

Gasolines

The development of modern high-output gasoline engines could not have taken place without the parallel development of better quality gasolines. The petroleum and engine industries have made progress by maintaining close cooperation. Engines have been built to take advantage of the best available fuels, while fuels have been refined that will satisfy available engines. As a result, the higher output marine engine of today is well suited to take advantage of the quality available in modern marine gasolines.

What should boat owners and operators look for in the gasolines they use in their engines? The most important characteristics of marine gasolines are stability, antiknock quality, and volatility. In other words, the gasoline should resist the formation of gum, burn without knocking in the engine, and evaporate readily for quick starting and rapid engine warm-up without inducing vapor lock.

The stability of gasolines has been of primary concern to boat operators for many years. Gum formation, which causes such ailments as sticking valves and clogged fuel lines and carburetors, occurs due to the oxidation of unsaturated hydrocarbons in the gasoline. The rate at which gum forms in gasoline is dependent not only on the amount of unsaturated hydrocarbons in the gasoline but also on how thoroughly the gasoline is exposed to air, on the surrounding temperature, and on the presence of catalysts, such as copper, which accelerate gum formation.

Broadly speaking, gasolines for marine use can be classified as marine white or automotive type. As recently as 20 years ago, marine engines were fueled almost exclusively with marine white gasolines. These gasolines, which consisted of straightrun stock, were largely composed of saturated hydrocarbons distilled directly from crude oils, and usually had excellent inherent resistance to oxidation for fairly long periods of storage.

Leaded fuels were shunned because they exhibited poor storage stability in the copper tanks generally used at that time. Old timers in the boating field will remember that a popular misconception was that the tetraethyllead employed in the fuel caused the gum formation. This misconception stemmed from the fact that thermal-cracked gasoline and tetraethyllead were introduced almost simultaneously into gasoline blends about 30 years ago. Since the early thermal-cracked stocks contained unsaturated hydrocarbons which were not stabilized by oxidation inhibitors, these gasolines were relatively unstable. Actually, as has been proved since then, tetraethyllead and the dyes used to identify leaded gasolines do not promote or oppose the formation of gum in gasolines.

Undoubtedly, some of the early criticisms of tetraethyllead in terms of gum formation occurred because the gum found in engines was colored with the red identifying dye of leaded gasolines. Practically speaking, this dye is a safety advantage in that it provides telltale evidence of gasoline leaks or careless handling of gasolines, such as spillage on decks or hulls.

Today, the gasoline-for-marine-use picture has changed as a result of several factors. The use of copper for marine fuel tanks has practically disappeared due to its undesirable effect on gum formation and its high material cost. Instead, hot-dip galvanized steel has been employed for almost all the fuel tanks made during the past 15 years for use with inboard marine engines, and terne plate and aluminum are used for outboard-motor tanks. These materials satisfactorily resist corrosion, and have little or no effect on gum formation. At the same time, modern automotive gasolines are produced by refining methods which have resulted in a reduction of those unstable hydrocarbons which have poor resistance to oxidation. Those hydrocarbons with low oxidation resistance that still occur in automotive gasolines are effectively stabilized by the use of antioxidants and metal deactivators. As a result, automotive gasolines have been used in most marine engines for many years with excellent results.

A fairly recent development, which reflects the tremendously increased marine-fuel market since World War II, has been the introduction by some refiners of high-octane automotive-type gasolines especially prepared for marine use. These gasolines combine the high octane number and desirable qualities of automotive-type gasolines with additional antioxidants to effectively inhibit gum formations during extremely severe storage conditions.

Although the stability of gasoline has been of prime importance to the boat operator for many years, it is only fairly recently that the antiknock quality of the gasoline has become equally important. As previously noted, the trend throughout the years has been to more powerful and more efficient engines, which develop more power per cubic inch of piston displacement. Much of these increases in power and efficiency has resulted from increased compression ratios. This means that higher octane gasolines must be used in order to avoid knocking and thus such troubles as blown cylinder head gaskets, burned and cracked pistons, and broken piston rings. If the octane number of a gasoline is too low, the octane-number requirement of the engine can be reduced by retarding the ignition timing, but then a loss of power and efficiency must be accepted.

Knock-free operation is even more important in marine engines than it is in passenger cars. This stems from the differences in engine operation. In passenger cars, the most critical operating condition from the standpoint of octane-number requirement is full-throttle acceleration at low and medium engine speeds. Thus, if a gasoline is incapable of completely satisfying the engine during these conditions, the resulting knock will occur only momentarily.

On the other hand, the boat's propeller prevents full-throttle loading of a marine engine at low and medium speeds, since the propeller permits the engine to speed up as soon as the throttle is opened. Therefore, the highest octane number requirement occurs when the engine is operating at or near its rated speed. Unlike passenger-car engines, marine engines often operate for long periods of time at high speeds and loads. When this occurs, use of a gasoline with too low an octane number will result in continuous knocking which, while often unheard due to wind and wave noise, causes the engine to overheat in the combustion areas with resultant damage to engine parts.

Since marine use eliminates the low-speed requirement associated with passenger cars, marine engines tend to have lower octane-number requirements than comparable passenger car engines. Recently, however, the trend to higher horsepower and higher compression ratios in passenger car engines has been also evident in inboard marine engines. As a result, manufacturers of most inboard marine engines now specify a Motor octane number of 80 or above, and some future engines may require premium gasolines. Motor octane number is the more important rating for marine engines because their maximum octane requirements occur at high speeds.

Automotive-type gasolines have only a slight variation in antiknock quality as compared with marine white gasolines. The maximum difference between regular-grade gasolines sold by reputable manufacturers in a given area is currently about five Motor octane numbers, and the national weighted average in December, 1956 was 84.0 Motor octane number. On the other hand, a recent survey of marine white gasolines revealed that, although many of these gasolines have sufficient antiknock quality to satisfy modern marine engines, the Motor ratings of some were as low as 61 octane number. Since there is no convenient way to determine the octane rating of marine fuels, it appears that the wisest choice would be to purchase either regular or premium grades of automotive-type fuels, or to be certain that the marine white fuel purchased is sufficiently high in octane rating by reputation. It is interesting to note that almost all manufacturers of both inboard and outboard engines are now employing automotive gasolines in their engine development programs.

The volatility of gasolines or their tendency to vaporize is important because it directly affects the performance characteristics of an engine, such as ease of starting, warm-up, and acceleration. Gasoline is composed of hundreds of hydrocarbons, each of which boils at a different temperature. Therefore, the volatility of gasoline as a whole is determined by its hydrocarbon composition.

Practically speaking, the most widely employed standards for determining the acceptability of gasoline volatilitywise are the temperatures at which 10 per cent, 50 per cent, and 90 per cent of the gasoline is evaporated. In general, the lower the 10 per cent point, the easier an engine can be started. However, if the 10 per cent point is too low, sufficient vapor may be formed in the fuel system to stop the flow of gasoline. This phenomenon is known as vapor lock.

The 50 per cent point affects the ability of an engine's intake system to supply the proper mixture of gasoline and air to the engine's cylinders during warm-up. The 90 per cent point indicates the portion of high-boiling components in the gasoline. If the 90 per cent point is too high, the heavy ends of the gasoline will not vaporize within the combustion chamber. As a result, these liquid drops tend to pass into the crankcase and dilute the lubricating oil.

Modern gasolines are carefully tailored to meet the volatility requirements of today's engines; and oil companies adjust the volatility of their gasolines according to the season and geographical areas. Therefore, the distillation curves of gasolines produced by reputable refiners and sold in a given area are remarkably similar.

Lubrication

During the period when more efficient, more durable, and more powerful engines and the fuels required by these engines were being developed, the development of lubricants was also keeping pace. The modern lubricant is as necessary to successful operation of a modern high output engine as is the fuel. Modern oils contain additives designed to prevent oil oxidation and lacquering, to prevent foaming of the oil under severe operating conditions, and to keep the engine clean. These lubricating oils have been proven in many other services, as well as in marine operation. Marine engine manufacturers have evaluated these oils in their engines and made available recommendations concerning the type oil to be used.

It is just as important to change oil at proper intervals as it is to select the right oil for use in the engine. It is true that oils never wear out. However, if an oil is doing the job it should, it becomes contaminated and cannot perform its job efficiently. The drain interval depends a great deal on the engine design and the operating conditions. Each engine manufacturer supplies detailed information regarding oil drain intervals, and it is strongly recommended that his advice be carefully followed. Marine engines fitted with oil filters should have the filter changed at the recommended intervals to insure the best in performance, economy, and durability from the engine.

Engine lubrication is not the only application where improved petroleum products are needed. Modern gear lubricants containing extreme pressure agents have made possible the transmission of more power through gear boxes. The correct lubricant must be used at all points of friction for the best engine performance.

As is well known, the lubrication of two-cycle outboard motors is accomplished by mixing lubricating oil with the gasoline. All outboard manufacturers have specific recommendations for the type of lubricating oil to be used in their engines. Petroleum marketers have developed special lubricants for two-cycle outboard motors, and their recommendations closely match those of the outboard manufacturers. Following either recommendation is a wise course.

Maintenance

Most prospective boat purchasers devote hours to carefully weighing the relative merits of hulls, engines, and associated equipment. Unfortunately, many boat owners fail to apply the same interest to maintenance. In considering the maintenance needs of the engine, they forget or never did know that marine operation is heavy-duty operation, and is comparable to that of engines in bus or truck service. As a result, even the best designed marine engine will fail to give satisfactory service if it is not properly maintained.

A false economy is to consider price rather than cost per hour of operation. It is inevitable that certain parts of the engine will wear out or no longer perform their assigned duty. The life of engine parts can be extended at a minimum cost by careful attention to routine maintenance, such as lubricating oil changes, lubrication and greasing of working parts, and regular inspections and adjustments. Every marine-engine manufacturer has a definite list of recommendations covering periodic maintenance on his particular engine.

Eventually, of course, every engine requires an overhaul. When this occurs, it pays to use the very best of parts. For example, it has been demonstrated that the proper application of such engine components as chrome-plated piston rings, pistons with groove inserts, hard-faced or sodium-cooled exhaust valves with rotators, inlet valves made of exhaust valve steels, and bearings of materials capable of carrying higher loads with less fatigue have provided such an extension in service life that the ultimate cost per hour of operation has been reduced despite their higher initial selling price.

A case in point involves war surplus marine engines that were bought for private use after World War II. Since it was recognized that the life of these engines would be short in combat duty, most of these engines were designed for limited life, thereby reducing the need for critical materials. As a result, civilian buyers found to their dismay that service life was short, and costly and time-consuming overhauls were frequent.

In general, boat owners have not been sold on the necessity for preventive maintenance, and too little information has been disseminated on how to plan a maintenance program. As a result, most marine engines fail to come anywhere close to achieving life between overhauls equivalent to the 100,000 miles that are now common in fleets of buses and trucks where preventive maintenance is rigidly observed. Fleet owners recognize that such maintenance pays off in terms of reliability, performance, and economy of operation.

* * * * *

Three-way cooperation between boat manufacturers, engine builders, and gasoline refiners has resulted in steady and sometimes dramatic progress during the past 30 years. Today, hulls that are fast, seaworthy, and maneuverable are being offered at prices well within the range of the average pocketbook; the efficiency and durability of modern engines represents a standard almost undreamed of 30 years ago, and high-quality fuels and lubricants are available in abundant quantity throughout the country.

The full potential of the efforts of manufacturers and refiners cannot be realized, however, unless the boat owner recognizes his responsibility. That is the necessity for properly servicing and maintaining his boat.

Printed in U.S.A.

BYNUM TURNER (TEXAS)
Mac Murdoch (Massachusetts)
Bill Rusher (Long Island)
Don Chapman (California)
Don Flynn (Rhode Island)
Marshall McDorman (Baltimore Md)
Bob Hogan — (Kaintucky)
Al Haudmf (Illinois)
Bob Wells (Pgh)
John Schaefer (NY-Del-La)
Dan Guy — (Detroit-Ohio Texas)