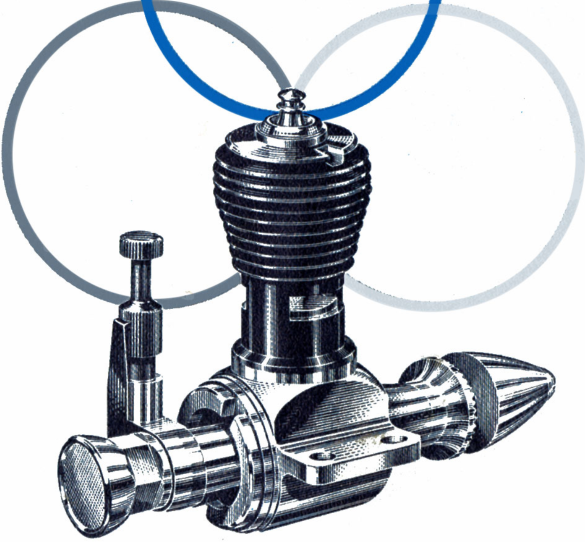
HOW TO GET THE BEST PERFORMANCE FROM YOUR MODEL ENGINE



L. M. COX MANUFACTURING CO., INC.
SANTA ANA, CALIFORNIA

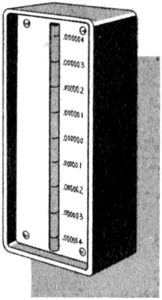
PREFACE

Your model engine is the finest piece of internal combustion machinery that is being produced today. Compared to full scale engines it runs faster, tolerances are closer, and in many cases the basic material are of finer quality.

For example, a full scale reciprocating-type aircraft engine normally runs at 2,500 to 3,000 revolutions per minute. A model engine mounted in a miniature replica of the same plane operates, as you know, at 12,000 to 19,000 R.P.M. This means that the piston goes up and down over 300 times every single second!

Consider another comparison. The tolerances allowed in a full scale engine may be .003 to .004 (three to four thousands) of an inch, which is a pretty small space! Nevertheless, a model engine with such "wide" tolerances would be useless. Thimble-Drome engines, the performance champions of their class, are manufactured to tolerances less than *20 millions of an inch*. The Thimble-Drome Tem-Trol process of precision manufacturing is the most accurate known in the engine manufacturing industry today.

It is this intrinsic quality and extreme precision of model engines that enable them to develop so much power with so little displacement and to withstand the terrific heat and high speeds at which model engines operate.



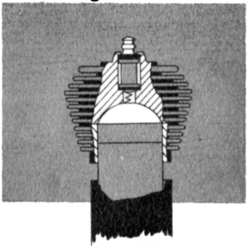
Precision air gages are required for measuring to accuracies beyond 1/10,000th of an inch.

THE INTERNAL COMBUSTION ENGINE

Few inventions, of course, in the short space of a single generation have affected such marked changes in human life as the internal combustion engine. Not only has it revolutionized transportation as used in automobiles, busses and trucks, but it has made airplanes a reality, and has created important and far- reaching changes in industrial, agricultural and even domestic life.

Basically, an internal combustion engine is one in which energy is directly translated into mechanical power by causing a controlled explosion to take place above the piston. The pressure of the explosion accelerates the piston downward. The piston is linked to a crankshaft by means of a connecting rod, thus the linear motion of the piston is converted to rotary crankshaft motion. In the case of a model airplane engine, the propeller is fastened directly to the end of the crankshaft and revolves at the same speed as the crankshaft.

The question is often asked "How can fuel be admitted, volatilized, exploded, discharged, and then a new fuel charge admitted at a rate of 200 or 300 times per second?" To better understand the operation of a small engine, let us closely examine the cycle of a typical two - cycle model engine; a Thimble-Drome .049 Babe Bee, for example.



Spherical or "domed" combustion chamber extracts fullest power from each fuel-air charge.

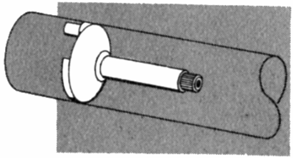
As the piston moves upward from the bottom of its stroke or "bottom dead center," a reduced pressure is created within the crankcase. This reduced pressure or "suction" causes the thin reed valve at the rear of the crankcase to open and admit outside air. However, before this air can get into the crankcase, it must pass through a precisely tapered venturi tube. Inside the venturi tube there are very small holes or slots through which metered flue is drawn. The metering is accomplished by use of a finely threaded needle valve. (The venturi and needle valve constitute the carburetor). As the fuel passes down the venturi, it vaporizes and thoroughly mixes with the air to create a gaseous fuel-air charge which enters the crankcase.

After the piston reaches the top of its stroke, there is no longer a reduced pressure in the crankcase and the reed valve closes. Now the piston begins its downward acceleration from the explosion of the previous charge. The fresh fuel-air charge is trapped in the crankcase and is actually compressed as the piston continues downward. Just before the piston reaches bottom dead center, by-pass grooves, cut in the cylinder wall, are uncovered by the top edge of the piston and allow the compressed crankcase charge to "squirt" up into the combustion chamber. Almost simultaneously the piston also opens up the exhaust ports which allow the spent gases to discharge. In addition, the fresh charge rushing up into the combustion chamber helps scavenge the spent gases. Momentum of the flywheel or propeller carries the crankshaft around and the piston begins moving upward once again, closing off the by-passes and exhaust ports, thus compressing the new charge trapped above it. As this charge is compressed, extreme pressures and temperatures are created and, when the piston reaches the top of its stroke, the charge explodes spontaneously, thereby driving the piston downward again, to repeat the cycle. When a Thimble-Drome Babe Bee is running at 15,000 R.P.M., this cycle occurs 250 times every second! Such speed is practically incomprehensible, but for an engine to run smoothly, every phase of the cycle must occur perfectly.

In a very short time, the temperature within the cylinder has risen to a high degree, and obviously this heat must be dissipated. The cooling or heat dissipation process is accomplished by cylinder and head fins. The area of these fins is carefully worked out to provide optimum cooling for normal continuous operation conditions.

When one considers the speeds, temperatures and stresses that model engines must endure, it becomes apparent that the utmost precision of parts is essential. The three "working" parts of a Thimble-Drome Babe Bee engine are outstanding examples. The piston, shaped like an inverted steel can about ½ inch high, and 3/8 inch in diameter, goes through twelve separate operations including machining, plating, carburizing, burnishing, grinding, lapping and spinning, in the process of manufacturing. The results is a micro-finished piston which is accurate in size within a millionths of an inch.

The connecting rod, machined from a 1/4 inch diameter bar of special steel, is about 7/8 of an inch long and tapered somewhat like a baseball bat. Here again, precise tolerances are maintained, and every Thimble-Drome connecting rod is electronically inspected for size and out-of-roundness. The smooth ball-shaped bearing at the top end of the rod perfectly matches the spherical socket in the piston, while the other end of the rod is drilled, chamfered, and accurately reamed to fit the crankpin on the crankshaft.



Maximum crankshaft strength is achieved by machining in one piece from solid steel bar.

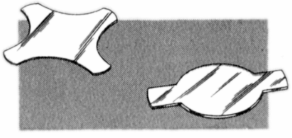
The crankshaft is also machined from a solid piece of special steel bar stock. On one end it contains an eccentrically shaped counterbalance and crankpin, while the other end is splined for the propeller drive plate and internally threaded for the propeller screw. After machining, the entire crankshaft is case hardened and the main bearings and thrust bearing are carefully ground to a super smooth finish.

Typical of Thimble-Drome's advanced engineering is the clean one-piece cylinder head which has long been an outstanding feature of all Thimble-Drome engines. The smooth hemispherical combustion chamber derived from such construction plays a vital role in assuring peak combustion efficiency and top R.P.M. Indeed the hemispherical combustion chamber used in Thimble-Drome engines is very similar to that used in many large automotive and aircraft engines.

The above information, purposely stated in non-technical language, is brief and somewhat oversimplified, but it will help most modelers gain a better understanding of the operation and construction of model internal combustion engines. To the engineering trained modeler there is little here that is new; to the inexperienced modeler these facts are an introduction to an extremely interesting subject.

GETTING AQUAINTED WITH YOUR ENGINE

You have undoubtedly stood in front of a full size engine and marveled at the mechanism you were looking at. As the foregoing discussion indicates, your model engine, part for part, is even more amazing and, in may ways, more durable. Quality materials have been used throughout. The crankcase, for example, is machined from a specially extruded aluminum alloy which has outstanding bearing properties. Probably the most critical and difficult part of the engine to produce is the valving; the part you hear least about. Thimble-Drome engines use very delicate copper alloy reed valves, which respond unerringly to the speed of the engine.



Two types of copper alloy reed valves, most delicate parts in Thimble-Drome engines.

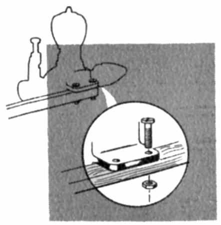
The modeler who understands the extreme precision and quality—as well as the operation—of his engine, will regularly g et better performance from it because he will be more inclined to treat it like the precision piece of machinery it is.

The following information will help you get the best satisfaction from your model engine, and add to the hours of pleasure you can derive from properly maintaining your engine. Most of the information applies to all sizes of glow plug engines, and all of it specifically applies to Thimble-Drome engines.

INSTALLING YOUR ENGINE

By following a few simple rules when installing your model engine, many common difficulties can be avoided.

Bolt your engine securely in place. If your engine mounts directly on a firewall, or on wooden motor bearers, make certain all surfaces are well coated with hot fuel proof paint. Engines that are loose and sloppy mounted usually cause trouble.



Avoid damage or accidents by bolting engine securely in place before running.

If your engine is enclosed inside a cowl, or within the body of a car or boat, make provisions for cooling the cylinder and head. There *must* be a movement of air past the cylinder and head to maintain normal operation. Without adequate cooling, any engine will quickly overheat and likely seize or "freeze up". Overheating also greatly shortens the life of the glow head.

The carburetor air intake, on the rear of Thimble-Drome engines, must be unrestricted and open to fresh air. If your engine is cowled, be sure the exhaust is not contaminating the carburetor air. On most Thimble-Drome airplanes, air is taken in through a hole in the firewall; thereby preventing engine exhaust from mixing with the carburetor air. This is an ideal arrangement, and can be employed on most home-built planes as well.

INITIAL RUN

Some engines will need breaking in. Always do this according to the instructions furnished by the manufacturer, for he knows best what is required. A few engines will need considerable break-in running.

Thimble-Drome engines, however, require virtually no break-in running. They thrive on high speed operation and are capable of high speeds on the very first run. They will improve after a couple of hours use, but are ready to go just as you buy them. It is not wise to "lug" or overload an engine during the first thirty minutes of running.

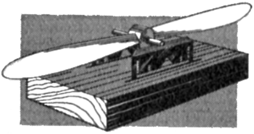
Thimble-Drome fuel should always be used in Thimble-Drome engines because their high precision demands a clean fuel.

When a new Thimble-Drome engine gets tight during the first few runs, it is not frozen up. A new engine will sometimes tighten up a few times, especially after slow runs. This is more likely to happen, and will occur more often, to an engine that is properly fitted and has smooth wearing surfaces. Do not run it tight. This is caused by a shellac-like deposit on the cylinder wall. Refer to the section of this booklet entitled "Trouble Shooting," for instructions to remedy this condition.

It is wise to check the screws, glow plug, etc., on a new engine to see that they are tight. Snug them up firmly, but do not overtighten.

PROPELLERS

If you are interested in optimum performance, you must be "propeller conscious." Always use a good grade wooden or nylon propeller such as Thimble-Drome Dubl-Tuf Nylon Propellers. Plastic propellers, other than nylon, are dangerous and should be avoided. Select a propeller of the correct diameter and pitch for the performance you desire. Usually a little experimenting is required before the optimum diameter and pitch is found.



Check your propeller for balance by making your own propeller test stand.

Always check a new propeller for balance. Perfect balance is very essential for good performance. To balance a propeller, sand off any rough spots, particularly along edges. Fit a drill or shaft through the hole and rest the shaft on razor blades set in wooden blocks as shown in Fig. 2. Sand the heavy blade until the propeller will balance in a horizontal plane. Care must be exercised to do the sanding without spoiling the airfoil characteristics.

If you scrape or nick the propeller blade tips during use, replace the propeller, or sand the damaged tips smooth, and re-balance. The inefficiency of a propeller with ragged tips is quite surprising! Wise contest fliers usually have a stock of perfect propellers in their flight kit for immediate use.

FUELS

Fuels with doubtful additives, invariably prove to be most expensive in the final analysis. There are several good clean-burning fuels available. Thimble-Drome fuel, one of the finest, is widely known for its deposit free performance and dependability.

Always use a strainer in your fuel equipment. Thimble-Drome furnishes a strainer of 100 mesh stainless steel which snaps into the fuel can spout. This keeps dirt out of the can and any foreign matter in the can from get-

Always strain fuel when filling tank or priming engine. Strainer caps are available.

ting into the engine fuel tank. When fueling small engines, this is especially important, as very tiny particles can plug the carburetor jets. For easy starting and peak power use new, fresh fuel. Fuel that has stood around for several months improperly cupped will weaken, and result in sub-standard performance.

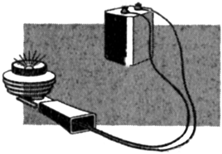
BATTERIES AND GLOW HEADS

Probably more engine starting tribulations can be directly traced to weak ignition glow than all other causes combined. There are several factors that contribute to this.

Firstly, for easy starting, you must have a good battery. Use a 1 ½ -volt dry cell battery #6, a hobby battery, or equivalent. Make certain it is usable before starting out. Check it with a tester or a good glow plug. If the glow plug filament gets bright red very quickly, the battery is suitable. If the battery is not good, you will save time by getting a new battery before attempting to start your engine.

Use short battery wires to connect your glow plug clip to the battery. Long thin wires cause too much voltage drop. Wires 18 inch in length are about right.

A good glow plug clip is important. Be sure wire connections are properly made. Solder connections where indicated. Twisted, unsoldered connections are always a source of trouble.

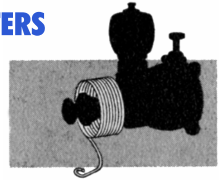


For proper starting the glow plug should glow bright red when battery is connected.

If your glow plug does not light up at all, and you know your battery and connections are good, it is possible that the plug is burned out. Like light bulbs, glow plugs do burn out occasionally, and are not guaranteed. Most modelers keep spare glow plugs on hand at all times. Remember, for an engine to start quickly and easily, the glow plug must glow bright red when the battery is connected.

STARTERS

Some engines now come equipped with spring starters. Spring starters are a real aid to starting and should always be used, especially on Thimble-Drome engines. When you get accustomed to using a spring starter, you will never use another method of cranking. If you have previous experience in running model en-



Spring starters are a real aid in starting the engine and should always be used.

gines, and have never used a Thimble-Drome spring starter, you will undoubtedly be prejudiced against it. Give it a fair trial and you will be convinced. A spring starter turns the propeller over with plenty of snap, and always starts the engine in the correct direction. Spring starters also help prevent bruised fingers.

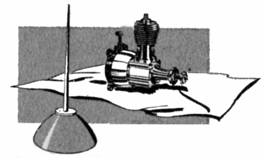
ENGINE CARE

All manufacturers provide an Instruction Sheet with specific guidance for the care and operation of the engine in question. Do not throw away this folder— read it and follow it, if you own a Thimble-Drome engine, here are some special suggestions and instructions, some of which apply to the car of any engine:

After the last run, oil the engine with a light oil (SAE 10 or "3 in 1" is good) and wrap it with cloth, or otherwise protect it.

Always empty the tank on the last run by running the engine until it quits. Never put the engine away with fuel in it.

If dirt enters the engine from a "crack up" or other cause, clean it thoroughly before running the engine again. Take the engine apart, wash it out, oil it, and carefully re-assemble. Running before properly cleaning the engine will cause a grinding action and severe wear during the first 2 or 3 minutes of running.



After the last run, oil the engine with a light oil and protect from dust or dirt.

Should your engine inadvertently become submerged in water, which happens occasionally with sea planes or boats, take it apart and wash and oil it immediately. This is especially important if the water happens to be salt water. Salt water will ruin an engine in a few hours of not cleaned out.

TROUBLE SHOOTING

There are many reasons why model engines frequently malfunction. Virtually all of these reasons are quite simple. Most alert modelers can quickly identify the trouble, make necessary adjustments or repairs, and have their engines running again with minimum delay.

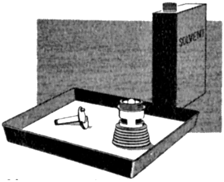
The following tips will help you pinpoint troubles and keep "down time" to a minimum.

Engine refuses to fire: Check for weak or dead battery, bad wire connections, or burned out glow plug.

Engine starts, slows down and stops with excess fuel at the exhaust ports: The mixture is too rich. Close the needle valve. Flip propeller till engine starts and burns out excess fuel. Open needle valve and re-start.

Holding an inverted engine sideways helps prevent flooding when priming and starting.

Engine starts with a burst of power and dies: The mixture is too lean, not getting fuel. Open needle valve another one-half turn. If trouble persists, open the needle valve and cover intake while turning the propeller over once. This "choking" will pull the castor oil residue from the previous usage out of the carburetor jets. Be careful not to flood the engine while doing this. If the engine still will not run, you may have a clogged fuel passage. Disassemble tank or carburetor and probe a fine wire through passages to dislodge foreign particles. Wash parts in fuel or solvent and reassemble.



Always wash parts in a clean pan with clean fuel or solvent.

Engine pops and fires repeatedly, but will not continue to run: With Thimble-Drome engine this is a characteristic of dirt under the reed valve. To remedy, disassemble tank or carburetor from crank case and carefully unsnap reed retainer wire and remove the reed. Wash all parts in fuel or solvent. Replace reed, making certain the same side is out. When properly assembled, the reed is free to turn underneath the retainer wire.

SERVICING YOUR ENGINE

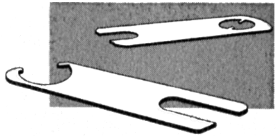
A model engine that is treated properly will run many hours without requiring any more service than an occasional cleaning or glow plug replacement.. However, should you damage your engine through carelessness, or a crackup, you can repair the engine yourself.

Most modelers are mechanically minded and want to service their own engines. All engine manufacturers make replacement parts available, and many hobby shops maintain a stock of parts. This is particularly true with Thimble-Drome engines.

Before attempting to disassemble any engine, make sure you have the proper tools. Like all Thimble-Drome engines, most engines require special spanner wrenches for removing heads and cylinders. Hobby shops have these wrenches in stock. Never attempt to remove a cylinder or head by gripping it with pliers. Irreparable damage may be done.

Allow an engine to cool before removing cylinder head so it will loosen easier. Too much force against the exhaust ports to keep the cylinder from turning will force the cylinder out of round or even turn a burr into the bore. A new cylinder is usually required to remedy such damage.

Reed valves, found in Thimble-Drome engines, are processed with special dies to produce clean burr-free parts that will not leak. The material is a very hard, yet flexible, copper alloy. The reed must always be handled with extreme care to keep from bending. Reassemble the reed exactly as it was before, with the same side down.



Always use the right wrench for the particular part.

As stated, a new engine will sometimes tighten up a few times, especially after slow runs. This will occur more often, to an engine that is properly fitted, with properly smooth wearing surfaces. Do not run the engine tight. The trouble is caused from a shellac-like deposit on the cylinder wall. Screw the head off. Remove the cylinder and scour the inside cylinder wall with a bit of fine or medium steel wool. Wash, oil and replace. The engine will then turn over freely and run good. Never use sandpaper, emery cloth, abrasives of any kind, or scrapers. Such methods will ruin the cylinder. Steel wool will not harm the cylinder. Certain kinds of weather, especially warm humid (sticky) weather will cause excessive shellacing in a new cylinder. There is no known way to eliminate this nuisance and the smoother the fit, the more susceptible is the engine to this trouble.

Erratic operation or rapid drop from peak power soon after starting may be caused by an unbalanced propeller, or a shellaced cylinder (See preceding paragraph). A loose needle valve will also cause erratic operation and usually can be corrected by replacing the needle valve spring with a new one or stretching the old spring slightly to increase its pressure.

Incorrect head compression, usually low, may also cause a loss of power. Try removing a head gasket. If this does not smooth out operation noticeably, replace the gasket.

Insufficient cooling may cause an engine to “sag out” after reaching peak power. Make sure there is an unrestricted flow of air across cylinder and glow head fins.

When rebuilding a model engine, never force parts together. If parts do not seem to fit, usually something is out of alignment and forcing will only damage the parts. Use light oil when reassembling, be reasonably careful, and you should have very little difficulty.

Never overtighten nuts, screws or other threaded parts when reassembling. Just snug them up firmly, then stop. Overtightening will result in stripped threads and distorted parts.

L. M. COX MANUFACTURING CO., INC.
P. O. BOX 476 Santa Ana, California

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