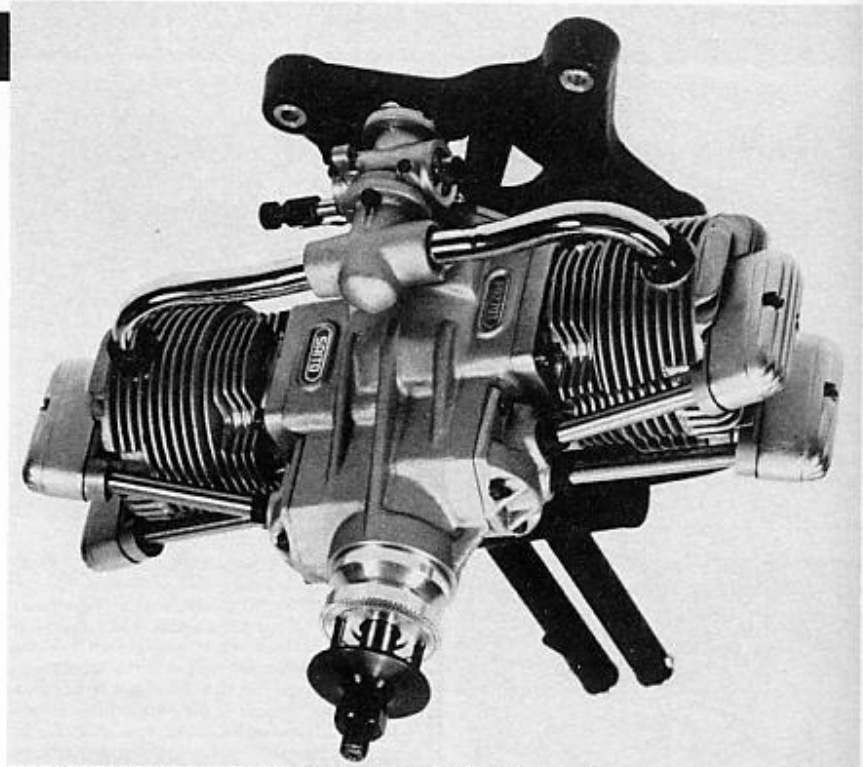
Product Report

SAITO FA-270T FOUR CYCLE TWIN

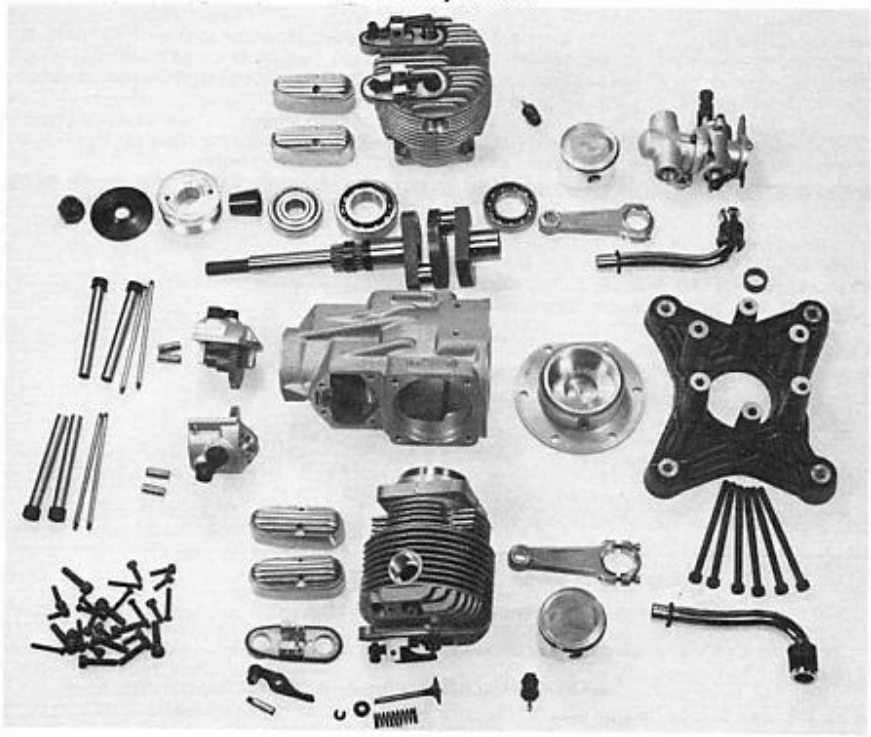
By Clarence Lee



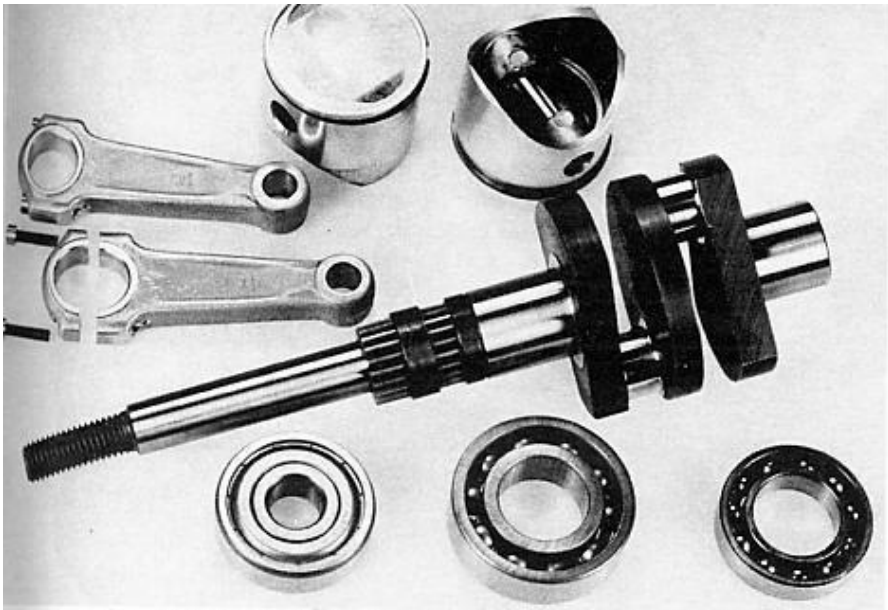
The Saito FA-270 four cycle twin is the subject of this engine review.

As I have mentioned previously in the Saito FA-120 review in the May issue, one of the nicer aspects of writing a column such as Engine Clinic is the fringe benefits that go along with the job in the form of new products, engines, etc., that the various manufacturers send in for a mention or review. However, one of the more frustrating aspects is receiving a new item or engine and not being able to give you a report for three to four months. The magazine works with a three month lead time and I cannot wait until the last day to start an engine review although it is pretty close at times. Generally, I start working on an engine review at least a month ahead of the magazine's three month lead time. Since starting these engine reviews, we have been receiving engines for review faster than we can give the reports. As a result, quite a backlog of engines is building up for future reviews. Naturally I would like to report on a newly released engine as close to its release date as possible, but with the number of new engines coming on the market lately, this is not possible. We are trying to be somewhat selective in the engines presented here, but even so, are still building up a backlog. As an example, this past month we received a new Saito FA-270T, Webra Bully 35, Webra T4-40, and Royal 40. The running tests have already been performed on these engines, as well as on the O.S. FS-61 received a few weeks previously. It will take quite a few issues of the magazine before we will be able to publish the reviews on all of these engines --- actually taking us up through the January or February 1985 issues.

Parts breakdown of the Saito FA-270 four cycle twin.



Trying to decide which engine to run each month is always a rough decision, but the job was a little easier this month. I have always had a "thing" for twin cylinder engines since back in the old spark ignition days following WW II. I have also developed a considerable interest in



The heart of Saito FA-270 is the beautiful double crankshaft which is supported by three massive ball bearings. Note the massive connecting rods.

the four stroke engines — the four strokes being "fun" engines to run and test. So the subject of our engine review for this month will be the newly released Saito 270T — a twin cylinder, four stroke twin which nicely covers both areas of my interest.

Although this is not the first four stroke twin to be produced by Saito Seisakusho, Ltd. in Japan (they previously produced the Saito FA-80T and Saito FA-90T), it is the first true alternate firing twin to be marketed by Saito. Whereas the FA-80T and FA-90T used a common crankpin and had a rather unorthodox firing sequence with one cylinder firing, the crankshaft rotating 180° and the other cylinder firing, and then the crankshaft rotating 540° (a turn and a half) and the sequence repeating, the new FA-270T has a double throw crankshaft and firing impulses 360° apart. That is, it has a firing impulse for every rotation of the crankshaft. Those who have run other alternate firing four stroke twins such as the Kavan FK-50 and O.S. Gemini know the neat realistic sound the engines have. More like a real aircraft engine than a model engine. The firing impulse every rotation of the crankshaft, rather than one firing impulse every other rotation as in a single cylinder four stroke engine, results in considerably higher low speed torque also being developed. The Saito FA-270T is a real powerhouse. Of course, it is also a **big** engine with an actual displacement of 2.75 cu. in. and the largest model engine I have run. Only the Kavan FK-50 is a slightly larger four stroke twin with a displacement of 3 cu. in.

The Saito FA-270T uses the same cylinder/piston assemblies as the Saito FA-120 single cylinder engine. These have a bore of 32mm (1.260"). However, the Saito FA-270T has had the stroke increased from the singles 24.8mm (.976") to 28mm (1.102") for a displacement of 45cc or 2.75 cu. in. This increase in stroke also contributes to the engine's high torque output. Whereas the single cylinder Saito FA-120 was of considerably "overbore" design, the FA-270T is closer to "square" but still of overbore design. That is, the bore is larger than the stroke.

Although the FA-270T cylinder would appear to be the same as used on the previous single cylinder FA-120, design changes have been made in order to use the cylinder on the FA-270T. The original FA-120 cylinder had both the intake and exhaust openings on the back sides of the cylinder. On the new cylinder, these have been positioned directly on each side. An additional boss on the left rear is left undrilled on the twin but drilled to accept the intake tube on the single cylinder engine with the side boss, in turn, left undrilled. Both the single and twin uses the side exhaust exit. The original cylinders had a pressed-in chrome plated steel sleeve. I have had reports and examined one FA-120 in which the cylinder had slipped out of place when the engine got hot. The latest cylinders used on both the single and twins have a threaded steel sleeve to correct this problem. Less than 100 FA-120s were sold before the problem was corrected. The early engines had an A or B stamped on the top of the right hand mounting lug. Engines with C or D cylinders as well as the twins have the new threaded sleeves. Saito is repairing these early engines at no charge if returned to either

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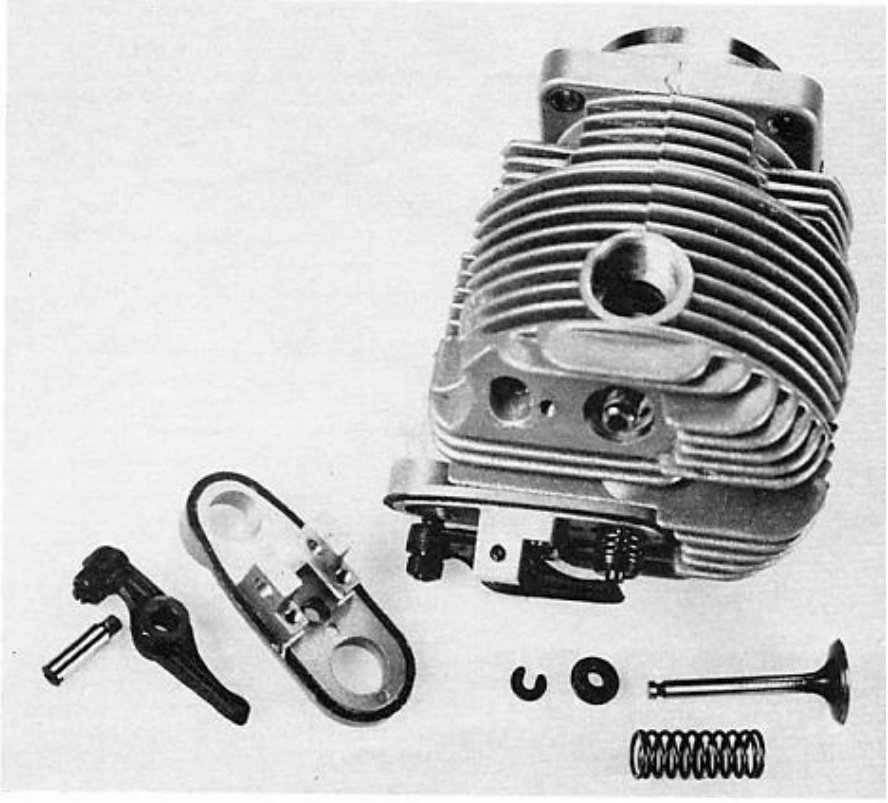
Valve and rocker arm details are shown.



Hobby Shack or Tower Hobbies, who are the U.S. importers of the Saito line of engines.

The cylinder and head is a one piece aluminum pressure die-cast unit with removable rocker arm assemblies. A slight change in the design of the rocker arm has been made in that the early FA-120s had rocker arms machined from steel with an access hole drilled through the arm for removal of the retaining screw. The latest rocker arms are a steel forging without the access hole. It is now necessary to remove the pivot shaft and rocker arm in order to get to the screw holding the rocker arm support casting to the head.

Another small change is the elimination of the pressed-in bronze valve seat and guide that also formed the valve pocket. The latest cylinders now use only a bronze valve guide with the valve seat being machined in the aluminum casting. This is more than likely being done to simplify production rather than having any effect on engine performance.

The combustion chamber shape remains the same being basically a shallow hemispherical shape partially filled in on either side for a flat "squish" area. The measured combustion chamber volume was 2.9cc, the same as the single cylinder FA-120. However, with the increase in the length of the stroke and resulting increase in displacement from 1.217 cu. in. to 1.374 cu. in. for a single cylinder, the compression ratio now computes to be 8.77-1. Although somewhat higher than the single cylinder 120's 7.9-1, there was no indication of detonation even when setting the mixture extremely lean with the larger size propellers. Saito's combustion chamber shape evidently allows the use of a fairly high compression ratio for an engine of this displacement size. I have run quite a few four stroke engines with lower compression ratios that still had a tendency to detonate when set too lean with the larger size propellers.

The piston is machined from a high silicon aluminum die-casting and has the unusual feature of a .045" wide ring or band around the outer top edge. Whereas this band was only .010" high on the early 120s, it is .025" high on the twin. As explained in a previous Engine Clinic column, the purpose of this raised band is to give a machined finish to the top edge of the piston without taking a full length machine cut across the top of the piston, possibly exposing any air pockets that may have been formed during the casting process. I still can't help but wonder if this treatment to the top of the piston is not providing some help in eliminating detonation and contributing to the engine's extremely good idle and acceleration characteristics. Possibly the top of the piston shape in conjunction with the combustion chamber shape works together as a very beneficial combination. For compression seal, the engine uses a very narrow .038" wide single expansion type ring unpinned. That is, the ring is free to

rotate on the piston.

The FA-270 uses a .275" diameter hardened and finish ground tubular wrist pin. Whereas in the 120 this was retained by two wire clips, the 270 piston has been step drilled on one side forming a shoulder. The wrist pin can only be inserted from one side and butts against the shoulder. A thick floating Teflon wrist pin pad is then used on the insertion side to prevent the wrist pin from scoring the cylinder wall. Floating meaning that the Teflon pad does not have a shank that fits into the hollow wrist pin. When disassembling or assembling the engine, care must be taken to not have the wrist pin pad slip out of place.

The one piece double throw crankshaft is machined from bar stock steel, hardened, and given a finish grind on the bearing surfaces. The crankshaft is supported by three ball bearings. The front bearing being of the double shielded type with an o.d. of 30mm (1.181") and i.d. of 10mm (.394"), the center bearing having an o.d. of 30mm and i.d. of 17mm (.669") and the rear bearing really a monster with an o.d. of 35mm (1.378") and i.d. of 17mm. The front and rear bearings handle the main support of the shaft and are of considerably heavier design construction than the center bearing which acts more as a center support. Pressed onto the shaft and pinned to prevent movement are two narrow spur gears that, in turn, mesh with mating spur gears that are machined as part of the twin camshafts.

The connecting rods follow full size automotive / aircraft practice in that the crankshaft end splits and the lower cap is retained by two bolts. In the case of the Saito, there are two cap screws. This is a very desirable feature in that the rods can be easily replaced if needed. Quite often manufacturers of twin cylinder engines will use a pressed together type of crankshaft design with the connecting rods being assembled on the crank throws and then the individual crankshaft pieces pressed together. Once assembled as a unit, the connecting rods cannot be changed other than by the factory. The connecting rods are machined from aluminum forgings and have bronze bushings at both the wrist pin and crankpin ends. Oil holes have been drilled in both the bottom of the cap as well as one through the upper top side to provide adequate lubrication.

Unlike the cylinders which are a pressure die casting, the crankcase is

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an aluminum sand casting. A sand casting actually is considerably stronger than a die casting. I imagine the reason for the sand cast crankcase, however, is due to the FA-270 being a low production quantity engine and the number of engines being produced not justifying the cost for permanent dies for pressure die casting. Pressure die casting dies are very expensive.

The crankcase is a one piece unit to which mount the two cylinders, the two camshaft support housings, and the back cover. Both the camshaft housings and the back cover also being sand castings. The back cover supports the rear ball bearing and the crankcase is machined for the front and center bearings. The overall finish is very good for a sand casting and is given a glass bead blast finish.

The twin camshafts are actually composed of two pieces. A spur gear and lobe plus a separate second lobe pressed onto a bronze bushing that, in turn, rides on a hardened steel shaft pressed into the aluminum housing. The two lobes are keyed together to prevent any possible changing of position and resulting change in valve timing. The cam lobes, in turn, drive hardened steel cam followers that then actuate the valve rocker arms using tubular stainless steel pushrods with hardened steel end pieces. The tubular steel pushrods cut down on valve train weight, something very important for high rpm four stroke operation. The lighter the valve train, the higher the operating range of the engine. This is probably also the reason for Saito changing from machined rocker arms to forged rocker arms; a considerable savings in size and weight coming about here.

Unlike the two individual carburetors mounted in a single body used on the FA-80 and FA-90 twins, the FA-270 uses a single carburetor. The FA-270 carburetor is basically the same carburetor as used on the FA-120 single cylinder engine. We went into considerable detail on the workings of the FA-120 carburetor in the March issue so we will not go into that again. Minor changes now include a full length spray bar with a slit cut across the bottom for fuel mixture entry into the air stream. The older carburetor had a tube extending half way into the venturi. The older carburetor had an aluminum rotating barrel and brass end cap that held the fuel inlet/needle valve assembly. The new carburetor still has the aluminum rotating barrel but it has been given a gold anodized finish. The brass end cap has been replaced with an aluminum end cap also given a gold anodized finish — the gold anodize giving one an impression that the parts are made of brass. I believe that Saito pulled a little "sneaky" here. However, the aluminum parts do save weight and the anodize finish does have slightly better wear qualities over plain alumimum. In fact, there are forms of hard anodizing that have very good wear qualities but the gold anodized used by Saito is strictly appearance anodizing. Slight modification has also been made to the metering groove in the end cap. The carburetor still features an air bleed for final idle mixture adjustment and no idle speed stop screw. Idle speed has to be set with the transmitter. With an otherwise extremely good carburetor, I do not know why Saito omits the positive idle speed stop. A screw is used to retain the rotating barrel in the housing and this could easily be modified into an idle speed adjustment.

The carburetor features a sliding choke plate that can be actuated from outside the aircraft with a wire extension that Saito provides. One does have to be careful not to leave the choke in the closed position when starting the engine, otherwise a hydraulic lock could easily occur — especially if using an electric starter.

The Saito FA-270 aluminum prop drive washer has two approximately 1/8" dia. steel roll pins pressed into it to prevent propeller slippage. Also a very nice feature that Saito uses is a tapered hole in the prop washer that matches a taper on the back side of the prop nut. The back of the prop nut has four slots so that when tightened it is very positive locking. This prop nut feature, in itself, almost assures that the prop will never come off if the engine backfires when starting or in the air. Those with sharp eyesight will notice that I have removed the two roll pins in the disassembled parts picture. This was done mainly because I have to use the test propellers on a variety of engines and the back of the propellers would end up looking like swiss cheese if drilled for all the various spacing patterns that the different engine manufacturers use for their prop retaining pins. However, I have been receiving and hearing of a lot of instances where

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these retaining pins have caused propellers to shatter when the engine backfired. A lot of this prop shattering is due to drilling the holes in the propeller vertically with the grain. This is just asking for splitting of the prop. If the retaining pins are used, they should be drilled 90° to the propeller grain; that is, horizontally if the prop is held vertically. This can often place the prop in a bad position for hand starting. The Saito uses a collet type holding collar so the pins can be placed in any position you want. I recommend doing this if you do want to drill the propeller for the retaining pins. I do not really feel that they are necessary, however — especially with the locking nut system used by Saito. Have any of you guys ever thought about using a double locking nut on the end of the shaft? That is, the regular nut and a secondary jam nut. Or a regular nut and secondary spinner nut. Naturally this pertains to engines using nuts for holding the propeller — not multiple bolts, etc.

With the technicalities out of the way let's get on with the performance. Saito recommends fuel containing 5%-10% nitromethane and castor oil lubrication. No mention is made of the castor oil percentage. Straight synthetic oil is not recommended. If synthetic oil is used it should be mixed at a ratio of 70% synthetic and 30% castor. Rust in four stroke engines is a big problem and the use of synthetic oils only adds to the problem. Of course a lot depends on the synthetic oil. Going along with the manufacturer's recommendations, we mixed up a fuel containing 10% nitromethane and 15% castor oil. After break-in, the castor oil content could probably be reduced to 12%. Frankly, with the amount of fuel a 2.75 cu. in. engine consumes and the resulting oil that accumulates on the aircraft, I would prefer synthetic oil myself with possibly the addition of 2%-3% castor. Castor oil can make quite a mess on an aircraft as most of you well know. However, bear in mind that if you do depart from the manufacturer's oil recommendations and experience engine damage due to rust or lack of lubrication, do not expect free repair under warranty.

The engine was given our standard 30 minute break-in period which is not enough to consider an engine fully broken-in, but sufficient for comparative power tests. All engines tested are being given the same break-in procedure. The temperature the day of testing was 67°F., the relative humidity 60%, and the barometric pressure 29.89 inches of mercury. The manufacturer's recommended propeller sizes for the engine are 20/8 and 20/10. We also ran the engine with an 18/8 and 18/10. The following rpm figures were recorded.

18/8 Zinger — 8,800
18/10 Zinger — 7,800
20/8 Zinger — 7,800
20/10 Zinger — 6,800

The engine was extremely smooth which is to be expected of an alternate firing twin. The vibration level was lower than many two stroke .40 size engines I have run. The lower rpm range also being a contributing factor here. There was no tendency to detonate even when set too lean with the larger prop sizes. The idle and acceleration were exceptional. With the 20/8 and 20/10 propellers, the engine could be idled indefinitely at 1250 rpm and, upon snapping open the throttle, accelerate to full throttle with no hesitation. The engine could be idled as low as 1000 rpm but was becoming marginal. At no time was there any tendency for one of the cylinders to cut out. In fact, I could not get one to cut out even when idling the engine excessively rich at below normal idle speed. A really beautiful running engine and the sound is something you have to hear to appreciate. More like a full size aircraft engine than a model engine. It would seem more appropriate to refer to the engine as a miniature aircraft engine rather than a model engine.

The engine comes equipped with a small expansion chamber type muffler with two long extension tubes to carry oil residue from the exhaust outside the cowl. A fitting is attached for pressurizing the fuel tank and another fitting connects to the crankcase vent. In the line leading from the crankcase vent to the muffler fitting is a breather nipple that prevents the excess oil that normally blows out of the crankcase vent from doing so. This seems to work very well as no oil accumulation occurred on the test stand other than that from the exhaust. Two restrictors are fitted in the ends of the exhaust tube extensions to evidently increase back pressure in the muffler in order to pressurize the fuel tank. The manufacturer warns not to remove these. Naturally being curious as to what effect removing the restrictors would have on engine performance, they were removed. There was no change in the rpm of the engine and only the sound level was a little higher.

Hand starting was very easy providing Saito's instructions are followed. That is, with the throttle fully open, choke the engine until it is good and wet. Saito says until fuel runs out the exhaust pipe, but this is almost too much choke. Reduce the throttle setting to just slightly above idle speed and be sure to open the choke. Connect the starting battery and flip the engine backwards. It will kick and take off running in the correct direction. We tried starting the engine both with the backward flip and by flipping in the normal running direction. Five out of six times the engine would take off running when flipped in the normal direction. Occasionally it would spit and kick backwards but a second flip would have it running. Starting was very easy due to the large propeller size and only pulling against one cylinder for starting. That is, you are using a propeller size for a 2.75 cu. in. engine but pulling against a 1.37 cu. in. cylinder for starting. This gives a nice soft feel similar to starting a .40 size engine with a .60 size propeller.

The throttle position is a little critical when starting in that if it is open too far you will get a lot of kicking back and blowing of fuel out of the carburetor air bleed. The throttle being opened just slightly above idle speed is very important and as long as this is followed you will encounter no starting problems, providing the engine has the proper amount of choke/prime.

Being a 2.75 cu. in. engine and operating on glow fuel, you can expect high fuel consumption in the neighborhood of two ounces per minute. This engine would be ideally suited for a spark ignition conversion unit such as the C.H. Electronics unit. Gasoline operation would increase the fuel economy and cut fuel costs considerably.

For you fellows into giant scale aircraft who want a scale appearing and sounding engine for your aircraft, you could not ask for a better suited engine than the Saito FA-270T. □