A complete guide to

SAITO MODEL 4/STROKES

Written & illustrated by
Graham C. Rice

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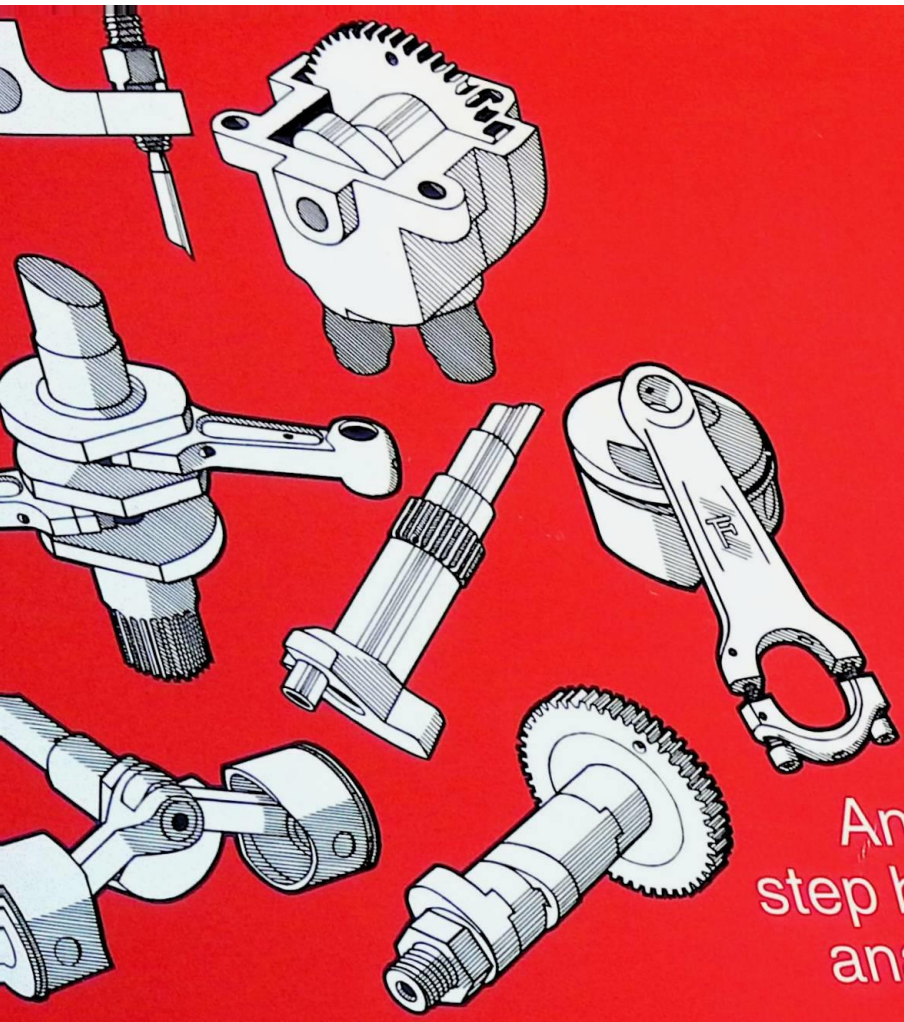

An easy to follow
step by step strip-down,
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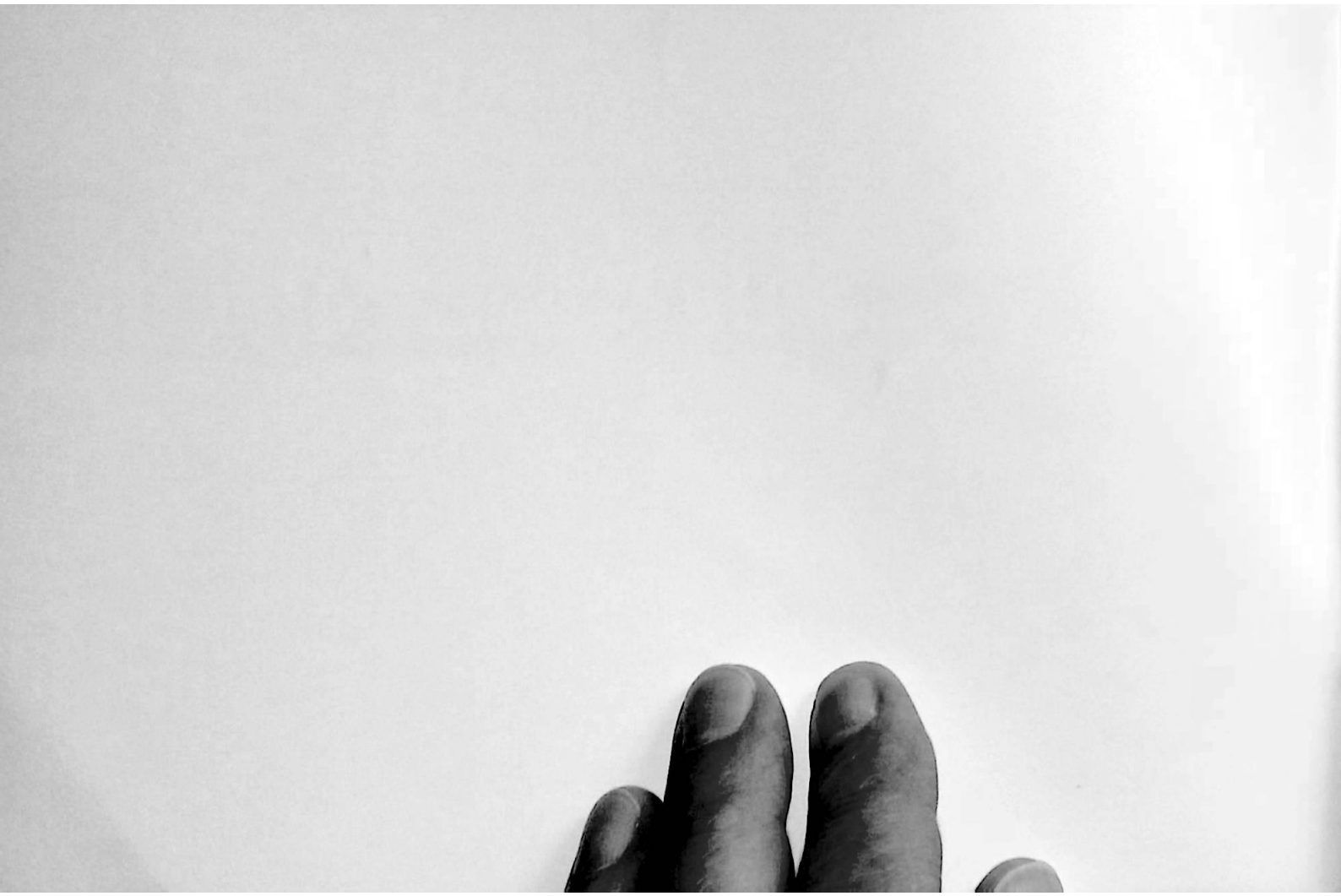

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INTRODUCTION

The Saito Company was originally founded in 1950 with the introduction of their first steam engines. The model engine enthusiasts would have to wait until 1979 before they could become excited with the Saito Company's release of their first model 4-stroke engine, the FA-30.

During 1980-81, Saito added three more engines — the FA-40 and 45, and between these two singles, in May 1981, their first twin cylinder engine — the FA-80T.

Between the years 1983 and 1985, another single cylinder — the FA-120, then their second and third twins — the FA-90T and FA-270T, and a new size of single — the FA-65. It is interesting to note that the FA-90T features a vane-type compressor and still remains a current engine with a moderate power output of 6.7 BHP per 100cc. The FA-65 single has an outstanding power output of 9.0 BHP per 100cc's. Refer to Section 10 for an explanation of Brake Horsepower per 100cc's.

In 1986, Saito released a host of 4-strokes: the FA-120S — an upgrade of the earlier model; a single cylinder — the FA-80, and the magnificent FA-325 — five cylinder radial; and in 1987, the FA-50 single, and two twin cylinder engines — the FA-130T and the FA-300T. The FA-50 was the first of the Saito engines to top the 10.0 BHP per 100cc level.

In 1988, we saw the FA-45 updated to the FA-45S and the introduction of the black finished Golden Knight engines — the FA-50 GK and the FA-80 GK.

Saito continued on in 1989 with another big production year, releasing four more engines: the FA-300T-DP, FA-120S-DP, FA-270T-DP, and the FA-130T-D. The letters "D" and "P" signify dual Glow Plugs and pump, of which there are two systems designed to control harmful blow-by gases and improve lubrication. The FA-120S-DP is an outstanding engine which tops the 11.0 BHP per 100cc level.

In 1990, another Golden Knight — the FA-65 GK, and then Saito reverted from their traditional twin Camshaft layout to produce a single Camshaft design with their FA-60T.

By 1992, we saw the introduction of the largest capacity 4-stroke single — the FA-150S at 25cc's, and then the FA-91S — producing 11.2 BHP per 100cc's, the best Saito figure to date. Finally, in August 1993, another new twin — the FA-100T.

It has been my great pleasure to be associated with the Saito Company and write about their excellent range of 4-stroke engines. I hope the hints I have collected in the following pages will add enjoyment to the operation of your favorite Saito 4-stroke.

My sincerest thanks to Ken Anderson of the Hobby Headquarters in Sydney, Australia, and to the Saito Company for their assistance during the production of this book.

Graham C. Rice

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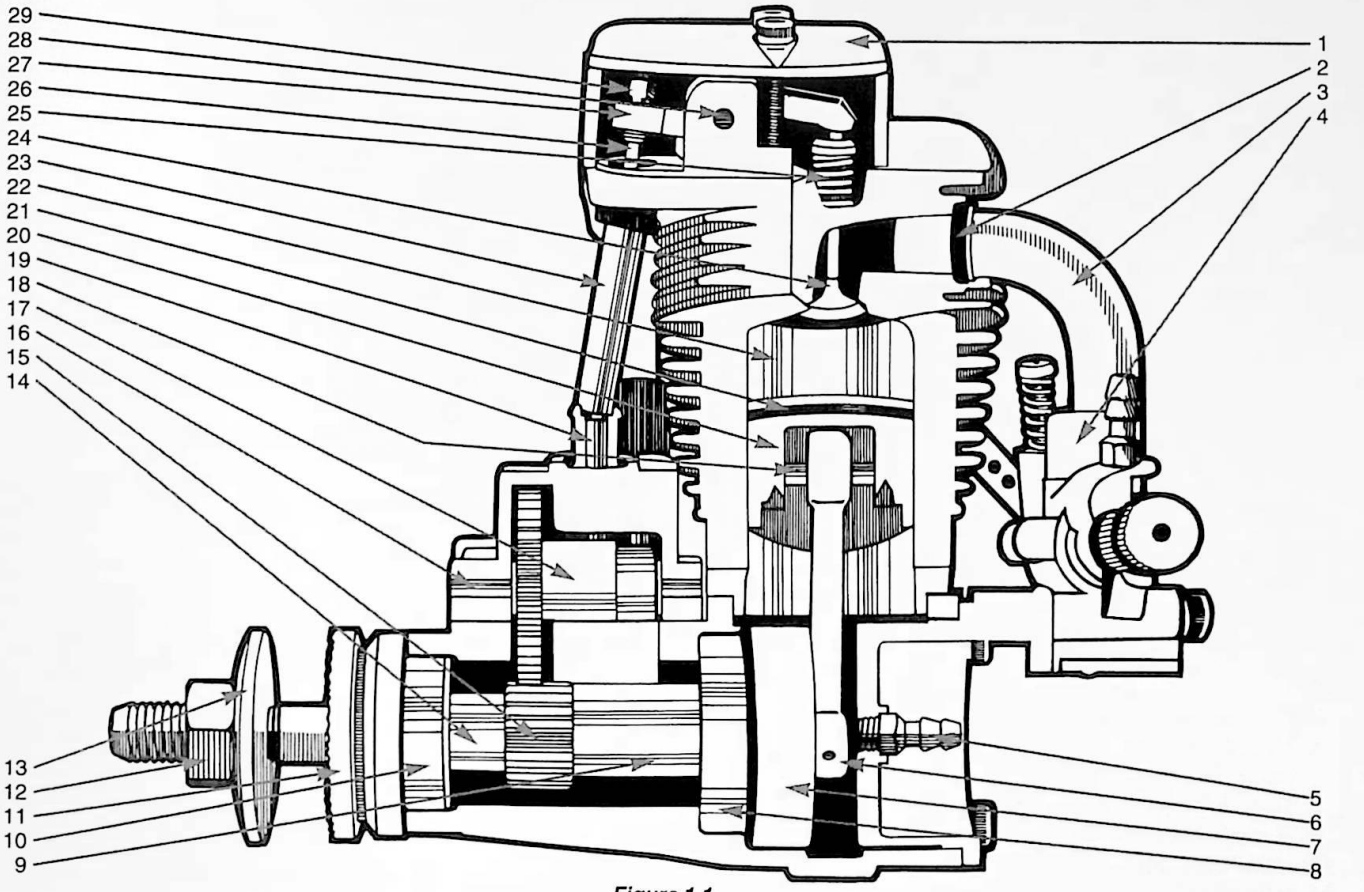
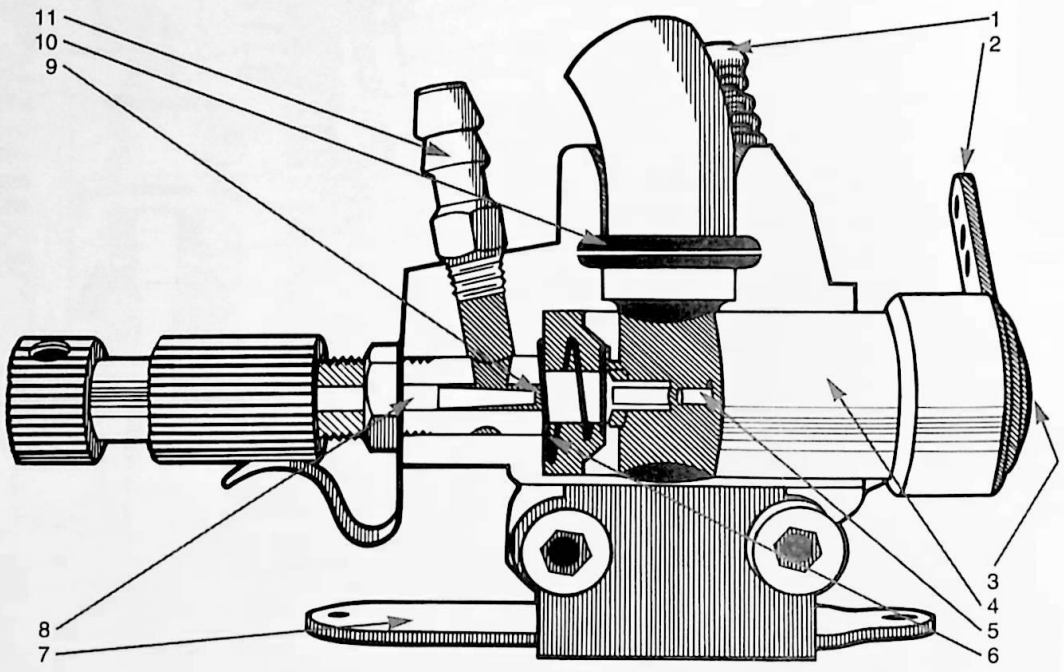


Figure 1.1

SECTION 2

Parts Of The FA-40
Special Carburetor



1. Barrel Stop Screw
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Figure 2.1

SECTION 3

What You Will Need To Get Started

Before commencing to dismantle your favorite Saito, I would like to make the following points. All Saito engines are manufactured to the highest standards of workmanship, and because of their extremely fine engineering tolerances should at all times be treated as precision instruments.

Servicing your Saito 4-stroke requires careful attention to detail, cleanliness, and a small but precise kit of tools. For those modelers attempting this for the first time, it is not difficult and I am sure the understanding you will gain from being able to dismantle and service your favorite Saito will add a new dimension to the total enjoyment of flying.

Every Saito engine is supplied with an excellent tool kit which contains almost all the tools you will need. For those who don't have the kit, you will need to obtain the following items before commencing to dismantle your single cylinder Saito 4-stroke:

A set of Allen Keys, 1.5, 2.0, 2.5, 3.0mm in size; 0.1mm thickness Feeler Gauge; a 4.0mm spanner to make Tappet adjustments; and three additional items — a pair of tweezers to assist in the removal of the "C" shaped Valve Spring Retainers; a bottle of White Spirit (cleaning solvent) to clean parts; and a small can of light machine oil, e.g., 3-In-One.

SECTION 4

The Saito Singles

Sub-sections 1-19 relate to the dismantling and assembly of the following Saito single cylinder engines.

FA-40 Special
FA-45 Special
FA-50
FA-50 Golden Knight
FA-65
FA-65 Golden Knight
FA-80
FA-80 Golden Knight
FA-91S

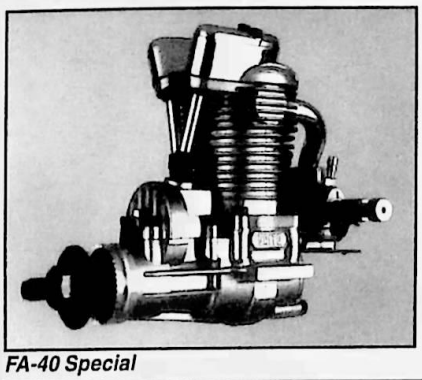
All but one of these engines are ABC (high silicon content aluminum Piston, brass Cylinder Liner plated with hard chrome), using a Piston Ring. The FA-91S is AAC (high silicon content aluminum Piston, aluminum Cylinder Liner plated with hard chrome), using a Piston Ring.

All of these engines use a 2:1 Crankshaft/Camshaft ratio, in this case being 48/24 tooth.

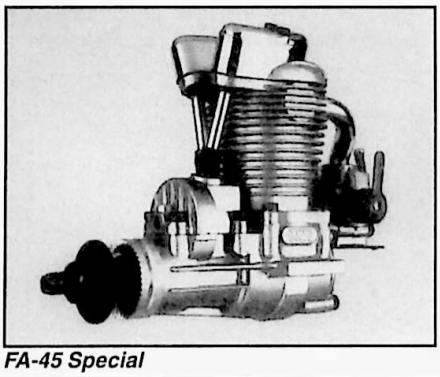
Except for the FA-91S, all the Carburetors operate on the same principle and provide a proper air/fuel metering system. They use a moving Idle Needle and as the Carburetor Barrel closes, this needle reduces the amount of fuel entering the main jet, thus keeping the air/fuel ratio balanced. The Carburetor used on the FA-91S is of the "Split" design, details of which appear in *Section 5(8)*.

All the Valve Springs are the same length with the exception of the FA-91S, and all use the "C" shaped Valve Spring Retainers.

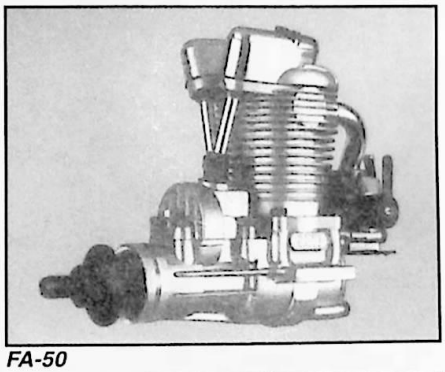
After removing the Glow Plug, refer to *Section 8* and identify your Plug Type. It is important when replacing a Glow



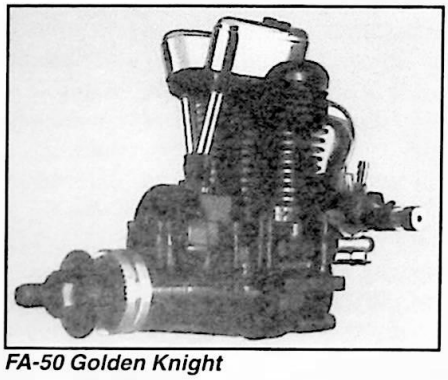
FA-40 Special



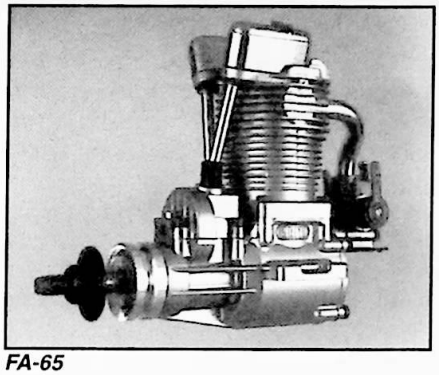
FA-45 Special



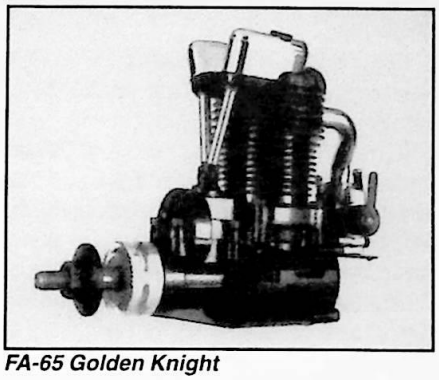
FA-50



FA-50 Golden Knight



FA-65



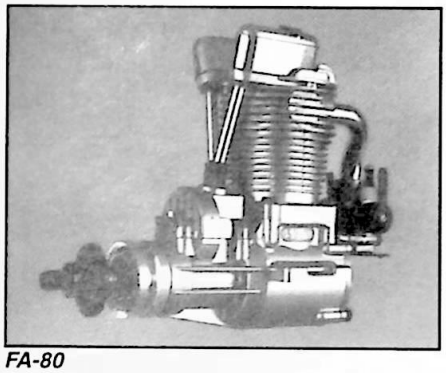
FA-65 Golden Knight

Plug that you use the correct one for your particular engine.

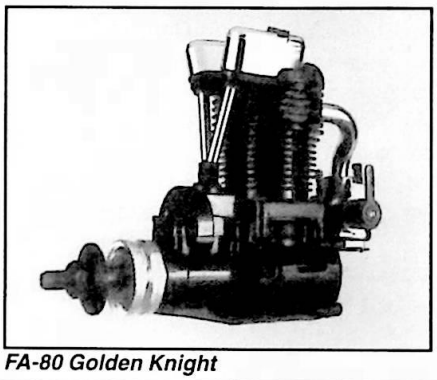
Examining the plug element and surrounding rim can provide a few hints about the running condition of your engine.

Glow Plug elements should be centered in their cavity with the top coil level with the rim of the plug. If the element has a dull look, sometimes referred to as "frosted," its future life is limited.

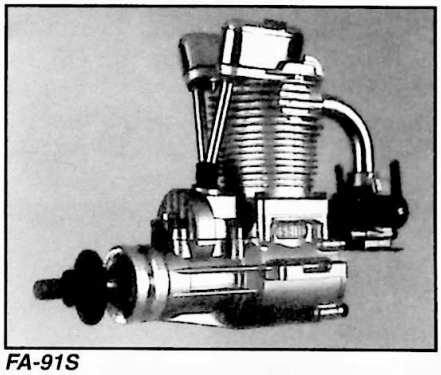
When castor oil based fuels burn, they gradually deposit carbon on the rim of the plug. If these deposits are excessive, they indicate too high an oil content and/or consistently lean



FA-80



FA-80 Golden Knight



FA-91S

needle settings.

Synthetic oils burn without leaving carbon deposits and, therefore, don't provide a guide to the running conditions of your engine.

If you are dismantling your first Saito single, you might find it helpful to refer to *Figures 1.1* and *2.1* and the list of parts for the FA-40 Special and its Carburetor at the front of this book.

(1) Dismantling Saito Singles

Using a 2.0mm Allen Key, remove the two Rocker Arm Covers taking care not to damage the Rocker Cover Gaskets.

Important: Locating The Firing Top Dead Center (TDC).

Rotate the Drive Washer on the Crankshaft and at the same time look down through the Glow Plug hole in the head and position the Piston at TDC.

Rock the Drive Washer either side of the TDC position, at the same time observing the up and down movement of the two Rocker Arms. If there is no movement of the Rocker Arms at TDC, then this is **Firing TDC**, the position we are seeking. On the other hand, if one Rocker Arm moves up at the same time as the other goes down, this also indicates TDC, but not the Firing TDC. Proceed to turn the Drive Washer one full rotation to bring the Piston to the Firing TDC position. The reason for carrying out this procedure is to position the Cam Followers at rest on the back of the Camshaft as this releases pressure on the Rocker Arms so we can dismantle them.

Using a standard slotted screwdriver, unscrew each Rocker Arm Pin to release the Rocker Arms and pull out the Pushrods. Each Pushrod has one rounded end and a 3.0mm long tapered end. The tapered end engages in the bottom of the Rocker Arm adjustment screw.

Using a 2.5mm Allen Key, loosen the two screws holding the Carburetor. Then easing it down from the Inlet Manifold, turn it slightly counterclockwise. Take care not to lose the aluminum gasket from the Cylinder end of the Manifold.

Next, remove the four screws holding the Backplate, take care when handling the gasket.

(2) The Cylinder Barrel

Using the short end of a 2.5mm Allen Key, loosen each of the four Cylinder Barrel screws, working diagonally across the Cylinder to prevent any distortion to the Barrel. Slide the Conrod from the Big End. Note the chamfer on one side of the Big End Bearing of the Conrod. This chamfer faces towards the Crankweb. There is also a small dimple mark on the chamfer side, halfway up the shaft of the Conrod which is also a guide to the correct side.

Slide out the Piston from the Cylinder Bore. Release the Conrod from the Piston by removing the Gudgeon Pin (wrist pin) with its dome-shaped Teflon End Pads.

(3) Handling Piston Rings

Piston Rings require careful handling to avoid stretching or twisting them. To remove the Ring from the Piston, press the Ring into the Ring groove on the opposite side to the Ring gap. Then using your fingernails, stretch the Ring just enough to ease it from the Ring groove *(Figure 4.1)*.

When fitting a used Ring, note the color of the staining on one side of the Ring. Place this stained side to the top of the

Piston. *See Section 6(1)* for information on how to check the Piston Ring gap.

(4) Removing The Valves

Before removing the Valves from the Cylinder, you will need to make the following two items:

A small block of wood about 10.0mm square to go inside the Cylinder Barrel and rest on the Valve head and long enough to protrude a few millimeters out the bottom of the Barrel. By sitting the end of the block on your bench, this will prevent the Valve being depressed into the Cylinder Barrel when you compress the Valve Spring.

You may also find the need for a Spring Depressor. This is a small length of brass tubing, 6.0mm in diameter with a 5.0mm deep section removed from one side which will allow the "C" shaped Valve Retainer to pass through when the spring is depressed *(Figure 4.2 and 4.3)*.

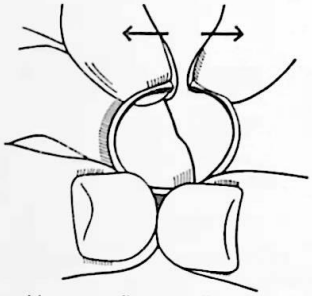
A pair of tweezers are also handy to seize the "C" clip. For further information on Valves and Valve Springs, refer to *Section 7(1)*.

(5) The Camshaft Housing

Remove the four screws which attach the Camshaft Housing to the Crankcase. Take care not to damage the gasket. Slacken, but do not remove the 1.5mm Grub Screw, slide out the Cam Gear Shaft including the two Teflon Spacer Washers. Push down the two Cam Followers from their guides. Note the Cam Followers have a rounded end which rests on the Cam Lobes and a hollow end where the Pushrod engages. Inspect the rounded ends and if these show any signs of wear, they should be replaced.

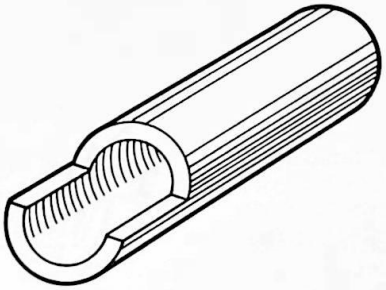
(6) Looking At The Camshaft

All Saito Camshafts for engine series FA-40, 45, 50, 65,



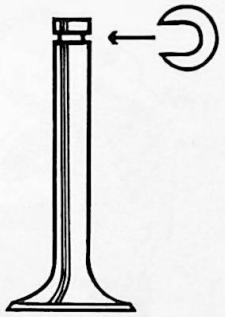
Use your fingernails to ease the Piston Ring from the Piston.

Figure 4.1



Spring Depressor made from 6mm diameter tubing with cut-out.

Figure 4.2



The "C" shaped Valve Spring Retainer.

Figure 4.3

80, and 91 have the same 48 tooth Cam Gear which represents 7.5° of movement for each tooth on the Camshaft. The Cam Lobe, furthest from the Cam Gear itself, controls the movement of the Exhaust Valve, while the inner Lobe, the Inlet Valve *(Figure 4.4)*.

The FA-120S-DP and the FA-150S Camshafts, which are much larger in dimensions, have a reduction in teeth from 48 down to 40 with each tooth representing a Camshaft movement of 9°. It will also be noted that there is a considerable change in the Exhaust Camshaft profile.

All Camshafts have a dimple timing mark on the gear face opposite the precise tooth which needs to be engaged with the Crankshaft at Top Dead Center for the engine to be correctly timed.

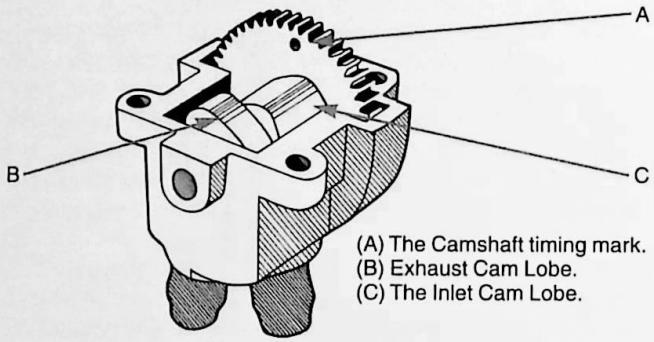
(7) Removing The Crankshaft

The Crankshaft Drive Washer is retained on the Crankshaft using a split collet system. These Drive Washers can be quite difficult to remove without the use of a Drive Washer Puller. The Saito Company doesn't provide one as an accessory, so you may have to check around to see what is commercially available.

After removing the Drive Washer, a light tap on the front of the Crankshaft with a mallet will ease the Crankshaft, and the Pinion Gear and spacer will drop out through the Camshaft Housing cavity *(Figure 4.5)*.The FA-80 and FA-80 Golden Knight engines have a much stronger system of securing the Pinion Gear, using a short pin which lays along the length of the Crankshaft, sometimes referred to as a Scotch Key.

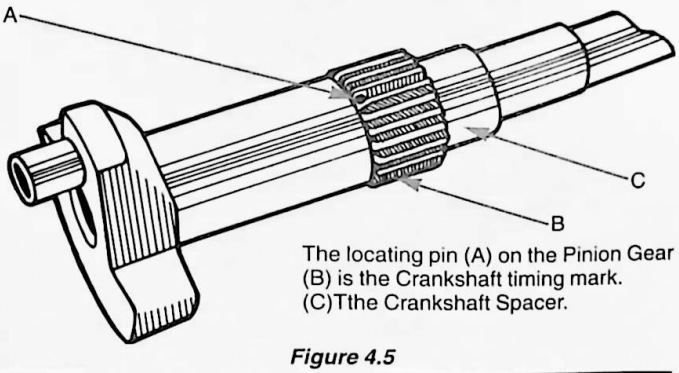
(8) Bearing Removal

In most cases, all that is necessary to remove the front and rear Bearings from the Crankcase is to heat the case in a pot



(A) The Camshaft timing mark.
(B) Exhaust Cam Lobe.
(C) The Inlet Cam Lobe.

Figure 4.4



The locating pin (A) on the Pinion Gear
(B) is the Crankshaft timing mark.
(C)Tthe Crankshaft Spacer.

Figure 4.5

of boiling water. This method is very safe because it heats the Crankcase evenly, thus removing the chance of distortion caused by localized heating. Due to the lower rate of expansion of the Saito Crankcase material, both Bearings will require a slight tap with a hammer using a piece of wood dowel as a punch.

When refitting old or new Bearings, it is a good idea to reduce the temperature of the Bearings and Crankshaft by placing them in the freezer for a short time. Fit the front Bearing into its housing first, with the rear Bearing on the Crankshaft up against the Crankweb, slide in the Crankshaft using the front Bearing to assist alignment. Place a punch down the center cavity of the Crankshaft and tap the rear Bearing to make sure it's seated in its housing correctly.

(9) Cleaning Bearings

Shape one end of a balsa wood peg, attach the Bearing and rotate it in a bowl of White Spirit. Small particles of dirt washed from the Bearing can be seen at the bottom of the bowl. Repeat the process a few times until the bowl of White Spirit remains clear *(Figure 4.6)*.

If the engine has not been used for a long period and the castor oil has solidified, soak the Bearing in pure Methanol before cleaning.

Rotate the Bearing in a Bowl of White Spirit.

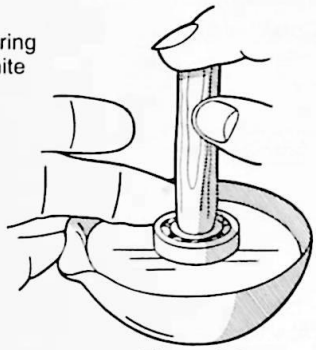


Figure 4.6

(10) Testing Bearings

After the Bearing is clean, grip the inner and the outer Rings and rock each Ring against the other to test for wear *(Figure 4.7)*. Place a drop of light machine oil on the Bearing. Rotate it and feel the smoothness. Worn Bearings feel rough and gritty and should be replaced.

(11) Assembling Saito Singles

Special Note: Oil the threads of all screws before fitting.

Grip the inner and outer Bearing Rings and rock each Ring against the other.

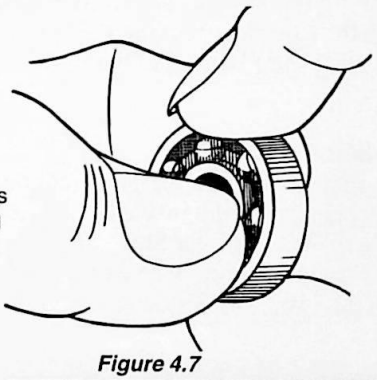


Figure 4.7

With the Crankshaft Bearings in their Housings, pass the Crankshaft through the rear Bearing then slide on the Pinion Gear and collar, making sure the slot in the Pinion Gear engages the Crankshaft alignment pin. Next, fit the Split Collet and Drive Washer, a propeller, and tighten the propeller nut. Rotate the propeller a few times to check that there is no binding of the entire assembly. If there's a tightening up of the assembly when more pressure is applied to the nut, this usually indicates the Bearings are not seated correctly in their Housings.

(12) Fitting The Valve Gear

Insert one Valve at a time into its Valve Bell, follow up with your wooden block as previously described. Depress the Valve Spring with your Spring Depressor and fit the "C" shaped Valve Retainer with your tweezers, making sure it sits down in the cavity provided.

Refit the Piston Ring as previously described, *Section 4(3);* attach the Conrod, checking the Teflon End Pads are in place, and slide the Piston into the bottom of the Cylinder Barrel.

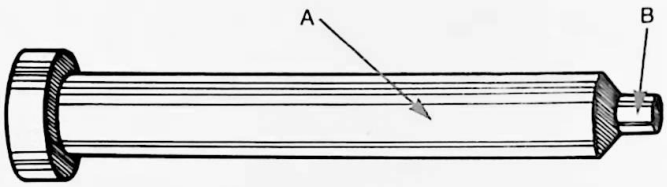
(13) Camshaft Assembly

Using a small amount of oil, stick into position one of the Teflon Spacers against the inside of the Camshaft Housing. Gently slide in the Cam Gear Shaft, and using your tweezers, position the second Spacer; don't overtighten the Grub Screw. Push down the two Cam Followers and lightly oil the entire assembly.

The next step is by far the most important in the assembly of your engine. This is the fitting of the Camshaft Housing to the Crankcase and synchronizing the timing of the engine. This involves the precise alignment of the marked tooth on the Camshaft with that of the TDC tooth on the Crankshaft. This is an extremely difficult operation because at the point when the tooth engages in the Crankshaft, you cannot see it happen!

(14) The Timing Tool

The Special Timing Tool will greatly help you with the setting of the Camshaft timing. It can be used on all the engines mentioned in the Saito singles. The tool can be made from almost any material, I have chosen to use a piece of brass, turned in the lathe with a shaft diameter of 4.0mm, the same diameter as the Cam Follower Guide. The tip of the tool is 2.0mm in diameter which fits neatly into the oil hole on the Camshaft. When this is in place, the timing mark is at the 6 o'clock position, ready to engage the correct tooth on the Crankshaft when its Crankpin is positioned at TDC *(Figure 4.8).*



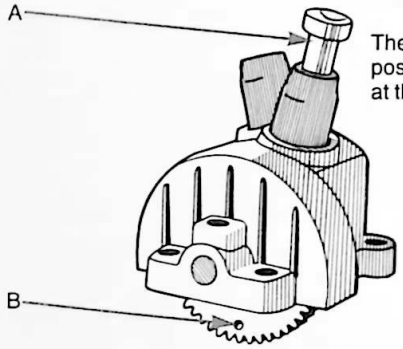
The Special Timing Tool has a 4.0mm diameter shaft (A) with a 2.0mm little end (B).

Figure 4.8

(15) Setting The Timing

With the Cam Followers removed, place the Special Timing Tool down the Inlet Cam Follower Guide, i.e., the left-hand guide as viewed from the rear of the engine. Turn the Camshaft until the small end of the Timing Tool engages in the oil hole of the Camshaft *(Figure 4.9)*.

Position the Crankpin on the Crankshaft at TDC, stick the Cam Housing Gasket in place using a little oil. Lower the Housing into place while at the same time holding the Crankshaft from moving. Once the teeth are engaged, finger tighten the four Cam Housing screws. Do not remove the Timing Tool just yet. By rocking the Crankshaft very slightly sideways and watching the Crankpin positioned at TDC, you will be able to feel a sight slackness of one engaged tooth. As the Timing Tool is still in place, you will know the Camshaft timing is correct. Remove the Timing Tool and tighten the four Housing screws. Oil the Cam Followers and slide them into their guides.



The Special Timing Tool in position (A), the timing mark at the 6 o'clock position (B).

Figure 4.9

(16) The Cylinder Barrel

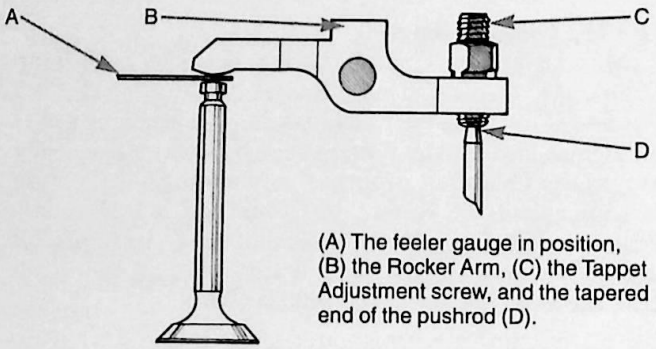
Making sure the Conrod chamfer is placed against the Crankweb, fit the Cylinder Barrel, positioning the two Pushrod Covers into their rubber seals. After applying a little oil, tighten the Cylinder Barrel screws by working diagonally across the Cylinder, progressively adding a little more tension each time. Rotate the Crankshaft to feel for any Piston binding. Complete by tightening the screws firmly, but don't overtighten them. Add a few drops of oil on the Big End, and attach the Backplate with its Gasket.

(17) The Rocker Arms

Insert the Pushrods with the 3.0mm long tapered end towards the Rocker Arms. Place a finger on the top of each Pushrod and rotate the Crankshaft to the Firing TDC position, where there is no movement felt in the Pushrods. Now we can attach the Rocker Arms, but first we need to look closely and observe the different adjustment lengths of the Tappet adjustment screws. Although the Pushrods are the same length, the starting positions on the Camshaft Housing are different. Now we can attach the Rocker Arms and secure the screws.

(18) Tappet Adjustment

Our final job is to set the correct Tappet gap using the Feeler Gauge supplied with the engine. If the gauge fits loosely, then the Tappet gap is too great and needs to be adjusted. For those modelers who don't have an original gauge, the Tappet gap should be between 0.03mm (.001") and 0.10mm (.004") and make sure to tighten the Lock Nut securely *(Figure 4.10)*.



(A) The feeler gauge in position, (B) the Rocker Arm, (C) the Tappet Adjustment screw, and the tapered end of the pushrod (D).

Figure 4.10

(19) The Final Check

Before fitting the Rocker Arm Covers, carry out the following visual check: As we are still at the Firing TDC position, when we rock the Drive Washer backwards and forwards both sides of TDC, there should be no movement of the Rockers. Now, rotate the Drive Washer 360° to the Non-Firing TDC and carry out a timing test. If the timing is correct, the Exhaust Rocker Arm will rise by the same amount as the Inlet Rocker Arm will descend. If this is correct, oil the complete assembly, seat the Rocker Arm Cover Gaskets with a little oil, and replace the Rocker Covers.

SECTION 5

The Big Singles

Sections 1 to 12 relate to the dismantling and assembly of the FA-120S, FA-120S-DP, and the FA-150S.

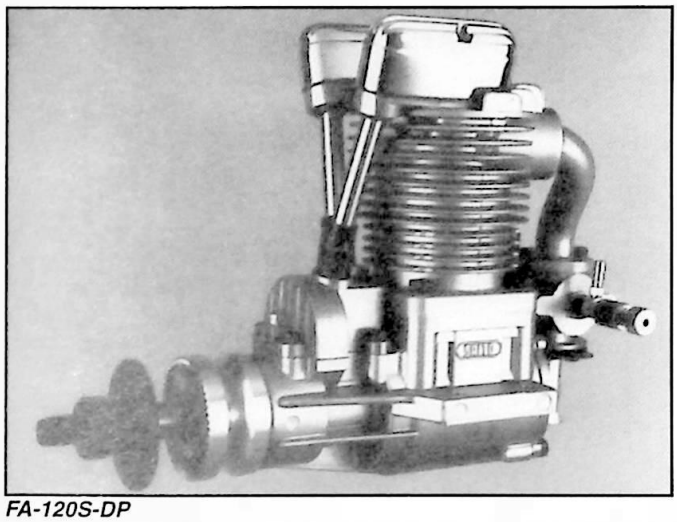
These three engines are AAC (high silicon content aluminum Piston, aluminum Cylinder Liner, hard chrome plated) and use a Piston Ring. They have a 2:1 Crankshaft/Camshaft gear ratio with a reduction in the number of gear teeth, 40/20.

The Carburetors fitted to these engines together with the FA-91S, employ a more precise fuel metering system to control the amount of idle fuel by using a tapered slot which I will refer to later on as a "Split."

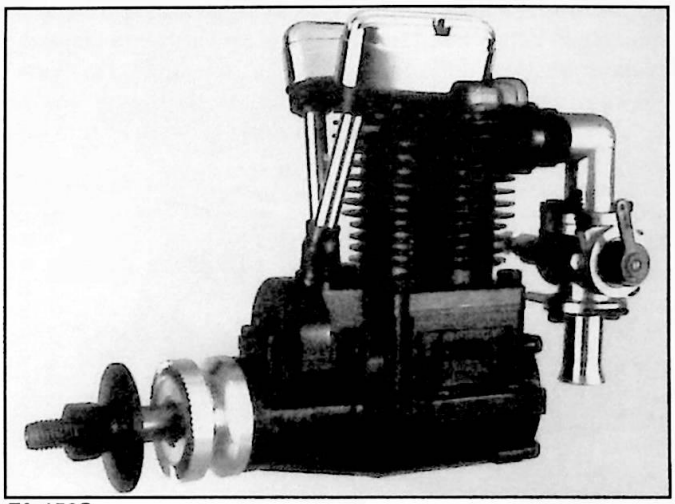
The FA-120S-DP has twin Glow Plugs in each cylinder and a fuel pump system designed to control blow-by gases and improve fuel economy.

Because they are fitted with much larger Valves, these engines require much larger Valve Springs and Saito has opted for the Split Collet system for Valve retention.

Note: Although this section applies in detail to the FA-120S-DP, it also equally applies to the FA-120S and the FA-150S.



FA-120S-DP



FA-150S

(1) Dismantling The FA-120S-DP

After removing the Glow Plugs, refer to *Section 8* and identify your Plug Type. It is important when replacing the Glow Plugs that you use the correct one for this particular engine.

Using a 1.5mm Allen Key, remove the two Rocker Covers. Rotate the Crankshaft Drive Washer to the Firing TDC position as previously described in *Section 4(1)*. Before unscrewing the Rocker Arm Pins, we need to make two observations: (1) Each Rocker Arm has one sheet metal spacer fitted to the inside lug of the left and right Rocker Arm Bracket. (2) Feel with the fingers the Tappet gap of each valve by depressing the Valves in turn. As a rough guide, the movement should feel about the same. If this is so, now look at the Tappet Adjustment Screw and Lock Nut on each Valve and you will see these are set at different lengths. As both the Pushrods are the same length, it is due to their different starting positions on the Camshaft Housing. If you don't wish to adjust the Tappets when you reassemble your engine, you will need to mark the Rocker Arms left and right *(Figure 5.1)*.

Now remove the Rocker Arms and pull out the Pushrods. Unless you wish, it is not necessary for the strip-down to remove the Rocker Arm Brackets. We will leave the dismantling of the Valves until later.

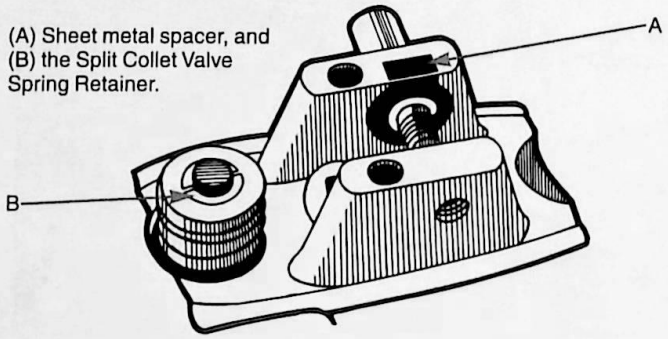


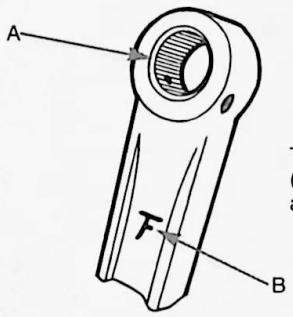
Figure 5.1

(2) Carburetor And Backplate

Remove the two upper Backplate screws which release the Carburetor from the Backplate, and pull out the Inlet Manifold which is positioned in the Cylinder Barrel by two "O" Rings. Complete the removal of the Backplate, taking note of the internal cut-away on the upper side needed to clear the Piston skirt at BDC.

(3) Piston And Conrod Assembly

Note the "F" marking on the Conrod which signifies the



The Big End chamfer (A) on the same side as the "F" mark (B).

Figure 5.2

"Front" and is on the same side of the Conrod as the Big End chamfer. This side is positioned towards the Crankweb when we assemble the engine *(Figure 5.2).*

For the correct method to remove the Piston Ring and how to test for the correct Piston Ring gap, refer to *Section 6(1)* and see *Figure 4.1.* The Gudgeon Pin is an easy sliding fit in the Piston with its pair of dome-shaped Teflon End Pads.

(4) The Camshaft Housing

After removing the four screws holding the Camshaft Housing, use a 1.5mm Allen Key to loosen (but don't remove) the Grub Screw on the Housing. This will then release the Cam Gear Shaft which needs to be pushed out from the rear of the Housing because of a very small "O" Ring on the front end *(Figure 5.3).* Watch for the two Cam Gear Shaft spacers on the inside of the Housing.

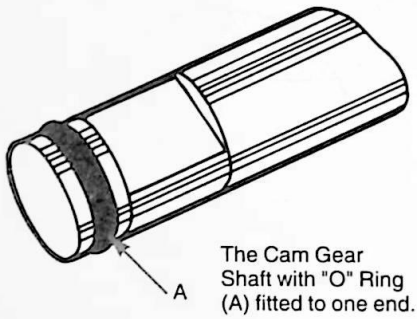
Push down from the top to remove the Cam Followers. You will notice these have enlarged heads which means they will have to be inserted into their guides first, when we refit the Camshaft later on *(Figure 5.4).*

(5) The Camshaft

The FA-120S and the FA-150S use a much wider toothed gear on these larger engines, and a tooth reduction from 48 teeth down to 40. Note the timing mark on the face of the gear is positioned in the middle of the Exhaust and Inlet Cam Lobes, and it is the tooth opposite this mark which has to engage the Crankshaft Pinion Gear when the Crankshaft is at TDC *(Figure 5.5).*

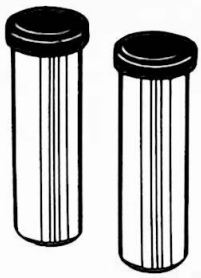
(6) The Crankshaft

For all the small engines, Saito uses a separate Crankshaft Pinion Gear located with an alignment pin. For the FA-120S and the FA-150S, the Pinion Gear has been cut integrally on



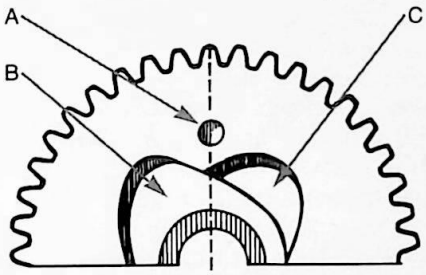
The Cam Gear Shaft with "O" Ring (A) fitted to one end.

Figure 5.3



Cam Followers are first inserted into their guides before assembling the Crankshaft.

Figure 5.4



Note the timing mark (A) is positioned between the Exhaust (B) and the Inlet (C) Cam Lobes.

Figure 5.5

the Crankshaft for greater strength *(Figure 5.6).*

You will require a Drive Washer puller to dismantle the Split Collet system used on all Saitos. Tap out the Crankshaft using a mallet, and then see *Section 4(8)* for information regarding removal and refitting the Bearings.

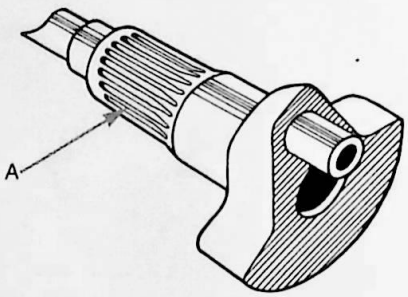
(7) Releasing The Valves

On the FA-120S and the FA-150S, the "C" shaped Valve Retainers have been replaced by the Split Collet system, *(Figure 5.7).* To prevent the Valves from depressing into the Cylinder Barrel when dismantling them, you will need a wood dowel about 12.0mm round and just long enough to protrude below the bottom of the Barrel. With the dowel in place, compress the Valve Spring, and using a pair of tweezers, gently pick out the Split Collets. For the correct Valve Spring lengths refer to *Section 7.*

(8) The Carburetor

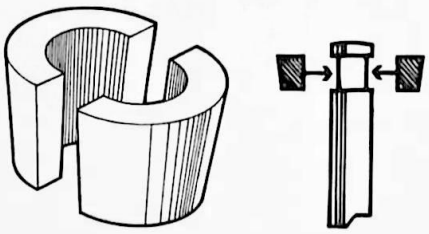
As large choke Carburetors are needed for these big engines, Saito has opted for a more precise method of metering the fuel during idle conditions. As the Carburetor Barrel rotates and gradually closes off the main air supply, it moves inward, taking with it a brass sleeve which gradually closes an elongated slot (I will call the "Split"), so reducing the amount of fuel available to match the reduction in air.

When the Barrel is fully open and we look down the Carburetor from the Inlet Manifold side, we can see the "Split." This can be set visually by using the Idle Adjustment Screw so that the end of the brass tube is centered exactly in the middle of the "Split" *(Figure 5.8).* This will give you a good starting point when setting the idle; however, it must be remembered that this method is affected by the viscosity of the fuel being used. Synthetic oil users may find it necessary to close the "Split" slightly more to compensate for the thinner oil.



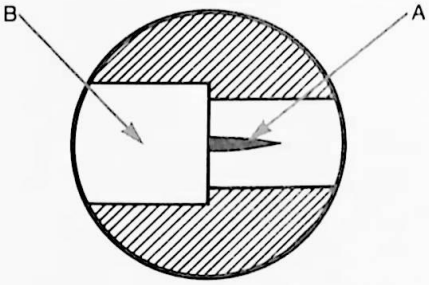
The FA-120S, FA-150S have a Pinion Gear (A) integrally cut on the Crankshaft.

Figure 5.6



The Split Collet system and assembly.

Figure 5.7



(A) The fuel entry "Split," (B) the brass idle sleeve control.

Figure 5.8

(9) The Pump

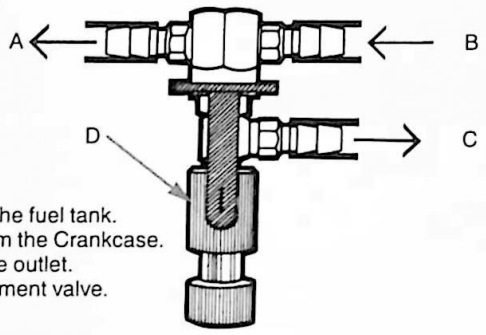
The FA-120S is fitted with a fuel pump system to produce fine vapor particles which results in improved combustion efficiency and better fuel consumption.

The pump features an air injection method which helps eliminate back pressure in the Crankcase so reducing the Blow-by gas density, which Saito says, helps to reduce Bearing corrosion *(Figure 5.9)*.

(10) Assembling The Camshaft Housing

Special Note: Oil the threads of all screws before fitting.

With the Crankshaft assembly in place and the Drive Washer in position, proceed to assemble the Camshaft Housing. First place the Cam Followers into the Housing from the inside. Feed the plain end of the Cam Gear Shaft through the Housing, positioning the two Spacer Washers, one on either side of the Camshaft. Don't overtighten the Grub Screw and be sure to oil the entire assembly. Apply oil to the Camshaft Housing Gasket and lay it in position on the Crankcase.



(A) Air pressure to the fuel tank.
(B) Air pressure from the Crankcase.
(C) Excess pressure outlet.
(D) Pressure adjustment valve.

Figure 5.9

(11) Setting The Timing

As there is no timing mark on the Crankshaft, position the Crankshaft Big End at TDC. Because the Cam Followers are already in place, we don't have any means of holding the Camshaft from moving (utilizing our special Timing Tool) as previously described. However, because of the much larger teeth on the Camshaft Gear and the matching Crankshaft spline, by pressing on the inlet Cam Follower with a probe, we can apply just enough pressure on the Camshaft to prevent it moving, while we engage it with the Crankshaft. Tighten the four Housing screws.

(12) The Cylinder Barrel

With the Valves fitted to the Cylinder Barrel, slide the Piston into the Cylinder Bore, watching for those Teflon End Pads. Connect the Conrod with the "F" mark towards the Crankweb. Carefully tighten the four Cylinder Barrel screws, working diagonally across the Cylinder, tightening each one a little at a time. Turn the Crankshaft over to make sure the entire assembly feels nice and free. Slide the Pushrod Covers with their rubber grommets attached through the Rocker Arm Brackets and down into the Cam Follower Guides.

Fit the Pushrods with the tapered end towards the Rocker Arm's end and set the Crankshaft at the Firing TDC position. To check TDC, press down with two fingers on the Pushrods, move the Crankshaft slightly and feel there is no movement

in the rods. If there is movement, then rotate the Crankshaft 360° before moving on to the next step.

Assemble the Rocker Arms, and position the two sheet metal spacers, one on each inner side of the Rocker Arm supports.

Move the Crankshaft 360° to the Non-Firing TDC and rock the Crankshaft ever so slightly either side of TDC, watch for the equal up and down movement of the Rocker Arms. If these move the same amount, but in the opposite direction, the engine's timing is correct.

Fit the Backplate, watch for the cut-out, then assemble the Inlet Manifold and the Carburetor. Adjust the Tappets, if need be, put a few drops of oil on the Rocker Arms and a few drops into the Cylinder to complete the assembly.

SECTION 6

Piston Rings And Lubrication

The fuel/oil mixture enters the combustion chamber via the poppet valves. On the fourth upward stroke, some of the semi-compressed mixture is blown past the Piston Ring. The oil content of the blown-by gases acts as a top up to the existing oil in the Crankcase which lubricates the Crankshaft Bearings, Big End, and Camshaft Assembly.

If there's not the right Piston Ring gap, or any malfunction to the Piston Ring due to varnish build-up, the lower working parts of the engine will not receive sufficient oil replacement, this will lead to accelerated engine wear.

ENGINE	INCHES	MM
FA-40 Special	.008	0.2
FA-45 Special	.008	0.2
FA-50, GK	.008	0.2
FA-65, GK	.008	0.2
FA-80, GK	.008	0.2
FA-91S	.012	0.3
FA-120S-DP	.008	0.2
FA-150S	.012	0.3
FA-60T	.005	0.127
FA-90T	.006	0.152
FA-100T	.008	0.2
FA-130T	.008	0.2
FA-300T	.0095	0.24
FA-300T-D	.0095	0.24
FA-325R-D	.008	0.2
GK — Golden Knight		

Although castor based fuels have proven the best overall lubrication for poppet valve 4-strokes, they do in time build up a tar layer on Piston Rings. In the early stages, these layers can be seen as harmless black specks on the running surface of the Piston Ring; but after a couple of years of constant use, they will spread to form horizontally tiered layers of tar. When this happens, engine torque will suddenly drop. This loss of power becomes most evident at take-offs when the engine is asked to deliver maximum torque. I have found many modelers do not list Ring failure as a possible cause, but are continually searching for the problem in the area of fuel tanks and Carburetors.

The correct Piston Ring gap is vital to the engine's performance. The Piston's first job is to seal the Bore during the

(A) The Piston Ring positioned in the Cylinder Barrel, (B) the Feeler Gauge.

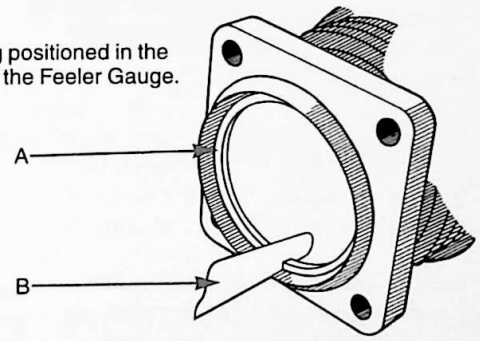


Figure 6.1

power stroke, with enough Piston Ring gap to expand and contract during wide temperature changes, and its second job is to control the amount of oil needed to lubricate the working parts in the Crankcase.

Don't attempt to fit a Piston Ring by feeding the end into the Ring groove in the Piston and screwing it in. Piston Rings which are made from relatively soft cast iron can easily acquire a twist and this will produce an uneven seal during operation.

(1) Checking The Piston Ring Gap

Place the Piston Ring squarely into the bottom of the Cylinder Bore and, using a Feeler Gauge, measure the gap *(Figure 6.1)*. The table lists the Piston Ring gaps used in Saito 4-stroke engines.

SECTION 7

Valve Spring Tension

Before dismantling the Valves from the Cylinder Barrel, press down each Valve in the Head and feel for the differences in Valve Spring tension between the two Valve Springs. Small differences in Valve Spring tension can be felt through the fingers. If one Valve Spring feels it has lost some tension, the chances are it has become shorter! Over-revving a 4-stroke will shorten a Valve Spring which reduces Valve Spring tension, increasing the likelihood of Valve float or bounce. With one exception, I don't think it is likely you could shorten a spring on an FA-150S!

ENGINE	VALVE SPRING LENGTH INC. VSK	VALVE SPRING RETAINER
FA-40 Special	15 mm	"C" clip
FA-45 Special	15 mm	"C" clip
FA-50, GK	15 mm	"C" clip
FA-65, GK	15 mm	"C" clip
FA-80, GK	15 mm	"C" clip
FA-91S	16.5 mm	"C" clip
FA-120S	18.5 mm	Split collet
FA-120S-DP	18.5 mm	Split collet
FA-150S	18.5 mm	Split collet
FA-60T	15.0 mm	"C" clip
FA-90T	14.3 mm	"C" clip
FA-100T	15.0 mm	"C" clip
FA-130T	16.5 mm	"C" clip
FA-300T	18.5 mm	Split collet
FA-300T-TDP	18.5 mm	Split collet
FA-325R-D	15.0 mm	"C" clip

Check the table for your particular engine. Valve Spring lengths include in the measurement, the Valve Spring Keeper.

Problems relating to shortened Valve Springs can be avoided by using the recommended diameter and pitch propellers suggested by Saito. Use a tachometer to check ground revs and allow 10% extra for the engine unloading in the air. In power dives, always throttle back the Carburetor to prevent the engine over-revving.

After dismantling the Valves, a careful inspection needs to be carried out on the "C" shaped Valve Spring Retainers. Ridges will appear when these become worn and the wear can be quite advanced if a Valve Spring has been shortened. If in any doubt, fit a new set because a broken "C" clip will cause the Valve to drop into the Cylinder which may cost you a new Cylinder Head!

(1) Valves And Valve Seats

I would not recommend the practice of lapping Valves to improve Valve seal. The removal of all traces of lapping compound from impregnating the bronze Valve seats permanently, is quite difficult.

Providing the Valve seats are not scratched, Valves will bed down into their bronze seats with running. I have found, simply rotating the Valve head to a new position sometimes works.

SECTION 8

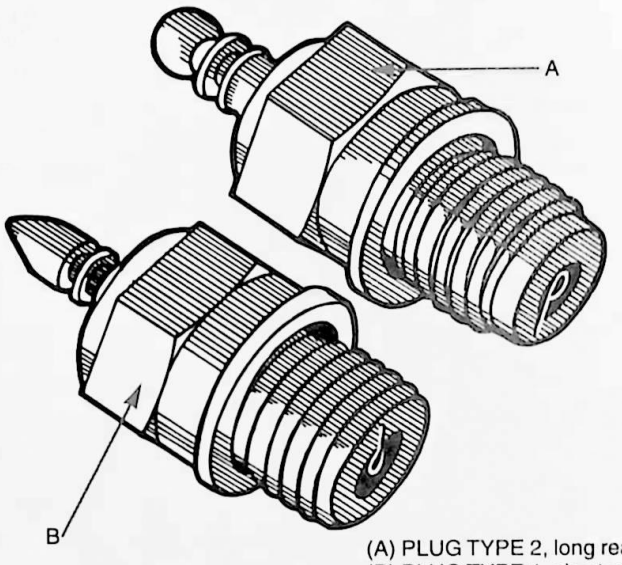
Saito Glow Plugs

The complete range of Saito engines come fitted with either one or the other of two Glow Plugs. As only one of these is specifically listed by name, (P2); I will refer to each as Plug Type 1 and Plug Type 2 *(Figure 8.1)*.

Plug Type 1 has a 3/16" or 4.76mm screw thread length, after we deduct the Gasket thickness. Its wire element is 0.14mm in diameter, wound in a coil 1.2mm in diameter, and this sits in a cavity, 2.85mm in diameter.

Plug Type 2 has a 1/4" or 6.35mm screw thread length, also minus the Gasket thickness. Its wire element is 0.175mm in diameter, wound in a coil 1.5mm in diameter, and this sits in a cavity, 2.35mm in diameter.

	ENGINE	SCREW LENGTH IN MM	CAVITY DIA. IN MM	ELEMENT DIA. IN MM	COIL DIA. IN MM
Plug Type 1	FA-40 S FA-45 S FA-50, GK	4.76	2.85	0.14	1.2
Plug Type 2	FA-65, GK	6.35	2.35	0.175	1.5
Plug Type 1	FA-80, GK FA-91S	4.76	2.85	0.14	1.2
Plug Type 2	FA-120S FA-120S-DP FA-150S	6.35	2.35	0.175	1.5
Plug Type 1	FA-60T FA-90T	4.76	2.85	0.14	1.2
Plug Type 2	FA-100T FA-130T-D FA-300T FA-300T-TDP	6.35	2.35	0.175	1.5
Plug Type 1	FA-325R-D	4.76	2.85	0.14	1.2
GK — Golden Knight					



(A) PLUG TYPE 2, long reach.
(B) PLUG TYPE 1, short reach.

Figure 8.1

All these figures may seem a bit technical but, if Plug Type 1 were to be considered a medium heat range Glow Plug, then by comparison, Plug Type 2, allowing for its larger coil diameter, would seem to me to be a different heat rating when we take into account its thicker element and smaller cavity.

If you glance at the chart, the interesting part of the analysis is the use of Plug Type 1, a short reach Glow Plug for the 40's and 50's; Plug Type 2, a long reach Glow Plug for the 65's; and then back to short reach for the 80's and the 91! This fact may not be known to Saito owners and it would be important for them to know exactly which Plug Type had been fitted originally to their engines by Saito, when new. With differences in screw thread length and heat rating, selecting a short reach Glow Plug when it should be long or vice versa, will have a considerable effect on performance.

SECTION 9

The Importance Of The Choke/Bore Ratio

In order for a Carburetor to function efficiently, it requires a high velocity of air to flow through the Choke. This movement of air, caused by the displacement of the Piston, lowers the atmospheric pressure in the Choke. The incoming fuel, which is at atmospheric pressure, flows into the Choke to balance up the difference in pressure.

Leaving aside the control of the needle Valve, there are two factors which control the fuel flow into the Choke, the engine rpm, and more importantly, the Choke/Bore Ratio.

If this Choke/Bore Ratio is too low, air supply will be restricted and the engine will not reach its full potential. On the other hand, if the Choke/Bore Ratio is too high, poor air/fuel mixing will occur which results in the Carburetor lacking response and subsequently poor engine tune.

To calculate the Choke/Bore Ratio and express it as a percentage, divide the Choke area by the Bore area and multiply the result by 100.

The table lists the Choke/Bore Ratios as a percentage, for Saito engines.

ENGINE	BORE IN MM	CHOKE IN MM	CHOKE/BORE %
FA-40 Special	21.0	5.7	7.4
FA-45 Special	22.4	5.7	6.5
FA-50, GK	23.4	6.2	7.0
FA-65, GK	24.8	6.2	6.3
FA-80, GK	27.0	7.0	6.7
FA-91S	28.2	8.0	8.1
FA-120S	32.0	9.4	8.6
FA-150S	34.0	10.0	8.6
FA-60T	20.0	5.15	6.6
FA-90T	22.4	6.0	7.2
FA-100T	23.4	6.0	6.6
FA-130T-D	24.8	5.5	4.9
FA-300T	34.0	9.4	7.6
FA-325R-D	24.8	6.2	6.3
Choke percentages include the area of the jet system.			

SECTION 10

Brake Horsepower Per 100cc

If we wish to compare the brake horsepower of a group of model engines of different capacities like Saito, it is necessary to bring these capacities to a common denominator. I have chosen 100cc for this, as the range of Saito are below this figure.

Let us divide 100 by the engine's particular capacity (6.5cc for an FA-40), then multiply the result by the BHP figure for the FA-40, 0.55. The result is 8.5 and this is expressed as 8.5 BHP/100cc.

Engine designers consider very carefully all the possible combinations of Bore/Stroke Ratios of the engine they are designing. There are many factors including torque, the rpm, valve sizes, engine balance, and cylinder wear which are influenced by this ratio.

The Bore/Stroke Ratio is simply arrived at by dividing the diameter of the Bore by the diameter of the Stroke.

ENGINE	CAP IN CC	BORE MM	STROKE MM	BORE/STROKE RATIO	BHP	BHP/100 CC
FA-40 Spec.	6.5	21.0	19.0	1.11:1	0.55	8.5
FA-45 Spec.	7.5	22.4	19.0	1.18:1	0.7	9.3
FA-50, GK	8.2	23.4	19.0	1.23:1	0.85	10.4
FA-65, GK	10.6	24.8	22.0	1.13:1	0.95	9.0
FA-80, GK	13.1	27.0	22.8	1.18:1	1.3	9.9
FA-91S	15.2	28.2	24.0	1.18:1	1.7	11.2
FA-120S	20.0	32.0	24.8	1.29:1	1.8	9.0
FA-120S-DP	20.0	32.0	24.8	1.29:1	2.2	11.0
FA-150S	25.0	34.0	27.6	1.23:1	2.5	10.0
FA-60T	10.0	20.0	16.0	1.25:1	0.9	9.0
FA-90T	15.0	22.4	19.0	1.18:1	1.0	6.7
FA-100T	16.4	23.4	19.0	1.23:1	1.4*	8.5
FA-130T-D	21.2	24.8	22.0	1.13:1	1.9	9.0
FA-300T	50.0	34.0	28.0	1.21:1	4.7	9.4
FA-300T-DP	50.0	34.0	28.0	1.21:1	4.8	9.6
FA-325R-D	53.0	24.8	22.0	1.13:1	3.8	7.2

*Estimated figure

SECTION 11

Cylinder Head Efficiency

The design of the Cylinder Head has more bearing on the performance of a 4-stroke than any other component in the entire engine. There isn't any way that a high horsepower output can be achieved if the air/fuel mixture can't flow cleanly into the Cylinder Head and then be burned efficiently.

Selecting the correct Inlet and Exhaust Valve dimensions, Manifold contours and Cam lift is vital to controlling the velocity of the mixture in the Head.

Because of the slow burning characteristics of Methanol, it is very important that our 4-strokes have properly designed "Squish Band" areas which concentrate the mixture around the area of the Glow Plug during ignition.

When we are in possession of the following factors: engine capacity, the rpm at full throttle, and the fuel consumption per minute at those revolutions, we are able to make some simple comments regarding Cylinder Head efficiency.

As an example, let us consider the Saito FA-45 Special, which has a capacity of 7.5cc and consumes 14cc of fuel per minute at a full throttle speed of 10,500 rpm. This represents 0.23cc of fuel consumed per second for every 44 engine inductions.

By multiplying the 44 inductions by the capacity of the engine, in this case 7.5cc, we can see the engine intakes 330cc of air/fuel mixture per second.

If we then divide the fuel consumed every second, which is 0.23cc, by the total air/fuel mixture per second (330), we arrive at a fuel/air fuel mixture per second ratio of .00070:1.

Squish Bands: Squish Bands in a Cylinder Head come into play by reducing the air space around the edges of the Head as the Piston moves to TDC and force the fuel mixture to be concentrated towards the Glow Plug. Squish Bands also increase turbulence which makes the mixture burn faster so that more heat goes into the expansion and less into raising the temperature of the engine.

ENGINE	CAPACITY IN CC	BHP/100 CC	FUEL CONSUMPTION PER MINUTE	FUEL CONSUMPTION PER SECOND	FULL THROTTLE RPM	INDUCTIONS PER SECOND	CC OF AIR/FUEL MIXTURE PER SECOND	FUEL/AIR FUEL MIXTURE RATIO
1	2	3	4	5	6	7	8	9
FA-40 Spec.	6.5	8.5	13	0.22	10500	44	286	.00077
FA-45 Spec.	7.5	9.3	14	0.23	10500	44	330	.00070
FA-50, GK	8.2	10.4	18	0.3	10500	44	361	.00083
FA-65, GK	10.6	9.0	24	0.4	10500	44	466	.00086
FA-80, GK	13.1	9.9	30	0.5	10500	44	576	.00087
FA-91S	15.2	11.2	37	0.62	10500	44	669	.00093
FA-120S	20.0	11.0	40	0.67	10500	44	880	.00076
FA-150S	25.0	10.0	50	0.83	9500	40	1000	.00083
FA-60T	10.0	9.0	13	0.22	9000	38	380	.00058
FA-90T	15.0	6.7	14	0.23	9000	38	570	.00040
FA-100T	16.4	8.5	14	0.23	9500	40	656	.00035
FA-130T	21.2	9.0	30	0.3	9500	40	848	.00035
FA-300T	50.0	9.4	70	1.17	7500	31	1550	.00075
FA-300T-TDP	50.0	9.6	80	1.33	7500	31	1550	.00086
FA-325R-D	53.0	7.2	75	1.25	7000	29	1537	.00081

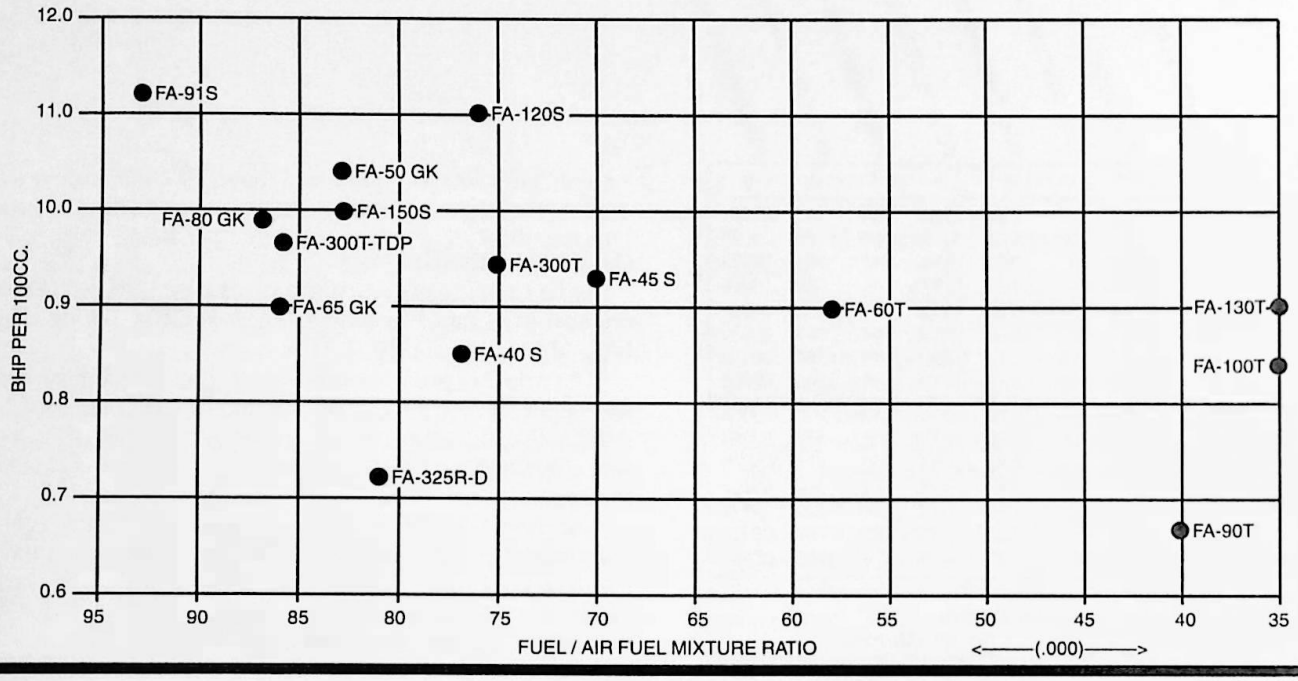
GK — Golden Knight
Fuel contains synthetic oil and 10% Nitro Methane.
FA-300T-TDP consumption test was using 15% Nitro Methane.

(1) Reading The Graph

As an example, let us make a comparison between the fuel consumption and brake horsepower per 100cc of the FA-300T and the FA-300T-TDP.

The relative positions of the two engines on the graph shows that the FA-300T-TDP has only a small increase of 0.2 BHP/100cc, but its economy suffers greatly even though the fuel consumption figure includes the use of 5% more Nitro Methane.

The FA-300T-TDP has twin Carburetors assisted by a pump and the fuel mixture is ignited by dual Glow Plugs; it could be suggested, as the Cylinder Head designs of the two engines are the same, then the efficiency at which these are burning the fuel should be the same.


12.0
11.0
10.0
0.9
0.8
0.7
0.6
BHP PER 100CC.
FA-91S
FA-120S
FA-50 GK
FA-80 GK
FA-150S
FA-300T-TDP
FA-300T
FA-45 S
FA-65 GK
FA-60T
FA-130T
FA-40 S
FA-100T
FA-325R-D
FA-90T
95
90
85
80
75
70
65
60
55
50
45
40
35
FUEL / AIR FUEL MIXTURE RATIO
<———(.000)———>

SECTION 12

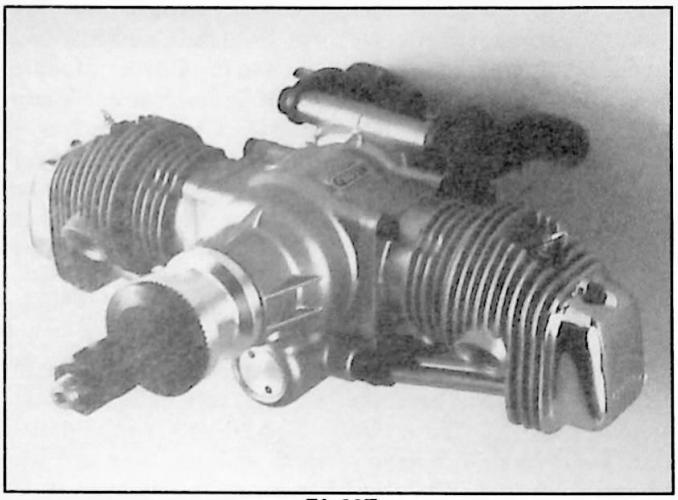
The FA-60T

(1) Dismantling The FA-60T

Before we can dismantle the FA-60T, we first need to remove the four 3.0mm screws which secure the two engine mounting brackets and the Choke Valve Bar.

(2) The Inlet Manifolds And Carburetor

Using the 10.0mm spanner provided in the tool kit, ease the two Inlet Manifold nuts and the two 2.5mm screws at the rear of the Carburetor to release the two Inlet Manifolds and the Carburetor from the engine. Ease out the two aluminum Inlet Manifold Gaskets from the Cylinder Heads. If, for any reason, you need to remove the Inlet Manifolds from the Carburetor, you will observe that they are different lengths and will require marking, left and right.



FA-60T

(3) The Glow Plugs

Next remove the two Glow Plugs, *Refer to Section (8)*, and identify your engine's Plug Type. It is important when replacing Glow Plugs, that you use the correct type for the FA-60T.

Examination of the two plug elements and the surrounding rim can provide a few hints to the running condition of your engine. Both plug elements should be centered in their cavities and the top coil level with the rim of the plug. Different levels of carbon deposited on the Glow Plugs indicate which Cylinder is running richer than the other. A "Wet" carbon look around the rim may indicate a Glow Plug not performing at its best.

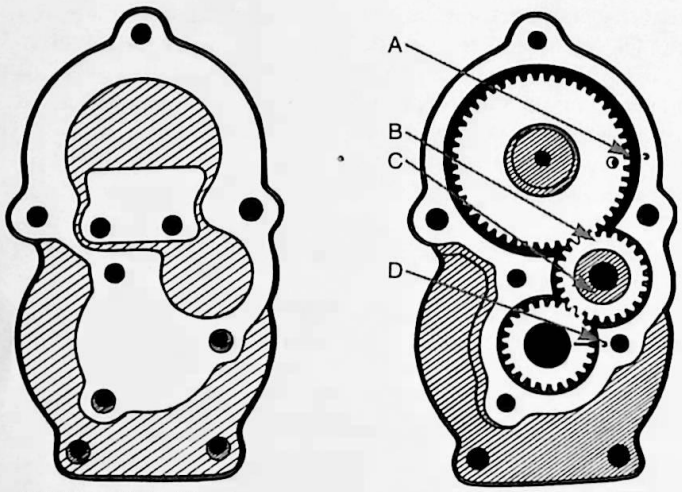
Synthetic oils burn without leaving noticeable carbon deposits and are, therefore, not a guide to the running condition of your twin.

Using a 2.0mm Allen Key, remove the two Rocker Covers and their Gaskets, carefully noting the direction of the Saito name on the Covers. Replacing the Covers the wrong way around will cause the Tappet Adjustment Screws to strike the inside of the Rocker Covers. The Rocker Cover Gaskets are slightly tapered and fit only one way; the wide end towards the Glow Plug.

(4) The Rocker Arms

Rotate the Drive Washer and at the same time look down one of the Glow Plug holes, move the Piston to TDC. Rock the Drive Washer backwards and forwards very slightly and observe the movement of the Rocker Arms on both Cylinders. The pair of Rocker Arms which do not move tells us that this Cylinder is at Firing Top Dead Center. Proceed to remove the Rockers from this Cylinder by easing the Spring Retainers and loosening the 1.5mm Grub Screw. Slide out the Rocker Arm Shaft, taking a careful note of the four spacers and their positions and thicknesses. If you don't wish to readjust the Tappets after the assembly, then the Rocker Arms will require labeling, left and right. Slide out the two Pushrods taking note that one end has a 3.0mm tapered end which engages in the Rocker Arm Adjustment Screw.

Now rotate the Crankshaft 360° to bring the other Cylinder to the Firing TDC and remove its Rocker Assembly and Pushrods.



REAR COVER (A) outer

REAR COVER (B)

(A) Camshaft timing marks, (B) Idler Gear,
(C) Teflon Space Washer and (D) Crankshaft timing marks.

Figure 12.1

(5) The Rear Covers (A), (B)

Remove all nine screws which attach the two Rear Covers designated by Saito as Rear Cover (A) the outer cover, and Rear Cover (B), which is attached directly to the Crankcase. Carefully ease the two Covers away from the Crankcase and the Camshaft will come out attached to the Covers. Handle the Gaskets with care and watch for the Teflon Spacer Washer in front of the Idler Gear. If you find the Camshaft is firmly attached to its Bearing in the Rear Cover (A), ease the Cover away from the Bearing using a pair of slot screwdrivers, one on each side of the Bearing. It is best to note now, the various timing marks on the Crankshaft, Camshaft, and Rear Cover (B) and to refer to *Figure 12.1.*

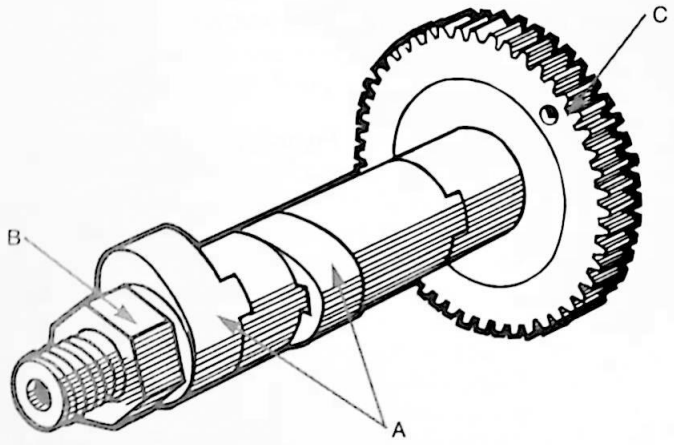
(6) The Camshaft

The Camshaft Gear has 48 teeth and because of the use of an Idler Gear, this means the Camshaft rotates in the same direction as the Crankshaft. The Idler Gear and the Crankshaft Gear both have 24 teeth and the Camshaft 48, giving a drive ratio of 2:1. Looking end-on at the Camshaft, if

we align the timing mark on the Gear Face with the Exhaust and Inlet Cam Lobes, we will see that instead of the Camshaft timing mark falling right between the Inlet and the Exhaust Cam Lobes, it is approximately one tooth or 7.5° to the right; all this meaning that (at the Firing TDC position), the Rocker's Arms will not be level, *Figure 12.2.*

(7) The Cylinder Barrels

Using a shortened end of a 2.5mm Allen Key, loosen each of the four Cylinder Barrel Screws, working diagonally across the Cylinder to prevent distortion to the Barrel. First



(A) Cam Lobes are keyed into place on the Camshaft and retained by nut (B). The timing mark is (C).

Figure 12.2

the left Cylinder, then the right, and make a small identification mark for later on so that these will not be reversed during assembly. Slide out the Cam Followers and check their running surfaces for wear.

(8) Removing The Valves

To remove the Valves, refer to *Section 4(4)* and *Section 7* on the importance of Valve Spring Tension.

(9) The Pistons

Next remove both Pistons from their Conrods by pushing out the Gudgeon Pins. Note with care, the Teflon End Pads and the way they are shaped. For information regarding removal and testing of Piston Rings, refer to *Section 6*, Piston Rings and Lubrication.

(10) The Conrods

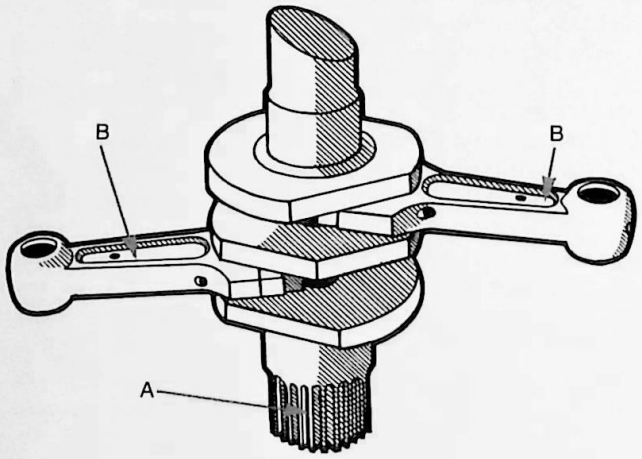
By entering the opposite Barrel cavity, gently unscrew the Conrod Studs using a 2.0mm Allen Key. Gradually withdraw the upper section of the Conrod away from the screws until it is free. Make a mark on the Conrod and its matching Cylinder side and take careful note of the following. There is a dimple mark on the shaft of both Conrods and both dimple marks should be assembled facing forward. Each Conrod half has a matching mark on the end near the Studs. Do not reverse these halves or swap them to the other Conrod, as they are preassembled before being machined at Saito to match them perfectly *(Figure 12.3).*

(11) Assembling The FA-60T

Special Note: Oil all screw threads before assembling the FA-60T.

After the Crankshaft is in place, assemble the two Conrods on their Big Ends. Refer closely to *Figure 12.3*. It is very important you take a little extra time with this part of the assembly and observe the matching marks on each Conrod half and the dimple mark showing the direction the Conrod has to be assembled on the Big End.

I have found it a little easier if you stand the Crankshaft on its end and work sideways with your Allen Key through the opposite Cylinder Barrel hole. **Do not overtighten the studs.** After assembling each Conrod, oil the Big End and test to feel there is no binding. If there is, go back and recheck all the matching marks.



(A) Pinion spline, matching dimple marks (B) face forward.

Figure 12.3

(12) Piston And Cylinder Barrel

Fit the Cam Followers, first making sure they are not protruding into the Camshaft Housing. With the Valves assembled in the Heads, fit one Piston at a time to its Conrod, watch for the Teflon End Pads and lower the Cylinder Barrel and Pushrod Covers into place. After oiling the screws, secure the Cylinder Barrel by progressively tightening the screws working diagonally across the Cylinder to prevent distortion. Move to the other Cylinder and complete the assembly.

(13) The Timing

For this procedure, refer to *Figure 12.1*, Rear Cover (B). Using a little oil, attach the matching Gasket to the Rear Cover (B) and secure the Cover to the Crankcase with two screws at the top that hold the Choke Valve Assembly and one screw at the bottom. Next, check to see the Teflon Space Washer is in place on the Idler Gear, then synchronize the Crankshaft Pinion's timing mark to the timing mark on the Rear Cover (B). Be careful not to allow the Crankshaft to move. Then, insert the Camshaft, aligning its timing mark with the timing mark also on Cover (B).

Apply oil to the Cam Gear Assembly and the Rear Bearing in the Rear Cover (A), oil the Gasket and complete the timing by securing Rear Cover (A).

(14) The Rocker Arms

On this engine, the Rocker Arms are a little tricky to assemble. Using your tweezers, assemble the Rocker Arm Shaft with the two thick washers on the inside of the Rocker Arms. Center the Rocker Arm Shaft and don't overtighten the Grub Screw. Feed on the thin washers on the outside and then clip on the Retainers. Finally, loosen the Grub Screw and allow the Rocker Arm Shaft to self-align, then retighten it.

(15) The Final Check For The FA-60T

Stage 1. Set the Piston in the left Cylinder to the Firing TDC position, i.e., the position when by rocking the Crankshaft Drive Washer at TDC, the Rocker Arms do not move. Using a marker pen, make a mark on the Drive Washer and adjacent Crankcase. Using your Feeler Gauge, adjust the Tappets.

Rotate the Drive Washer 360°.

Stage 2. Still on the left Cylinder, rock the Drive Washer and observe the position of the Rocker Arms. Note that the Exhaust Rocker Arm is slightly raised at TDC.

Stage 3. Without moving the Drive Washer, adjust the Tappets on the right Cylinder.

Rotate the Drive Washer 360°.

Stage 4. On the right Cylinder, rock the Drive Washer and observe the position of the Rocker Arms. The Exhaust Rocker Arm is slightly raised at TDC.

If Stage 2 or 4 are not as described, you will need to check the timing on the Camshaft Timing Gears, otherwise the final check is completed *(Figure 12.4)*.

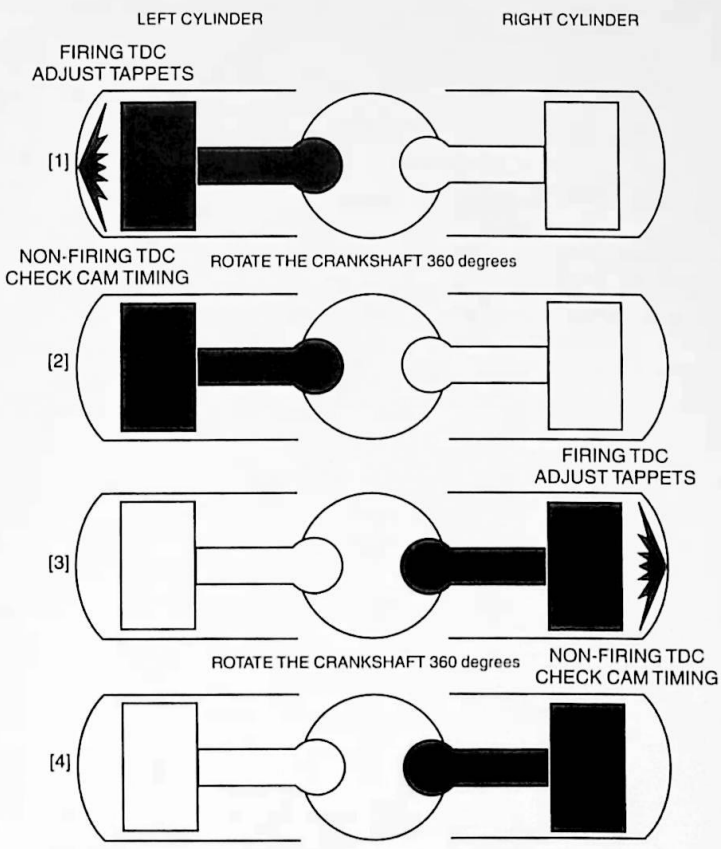


Figure 12.4

SECTION 13

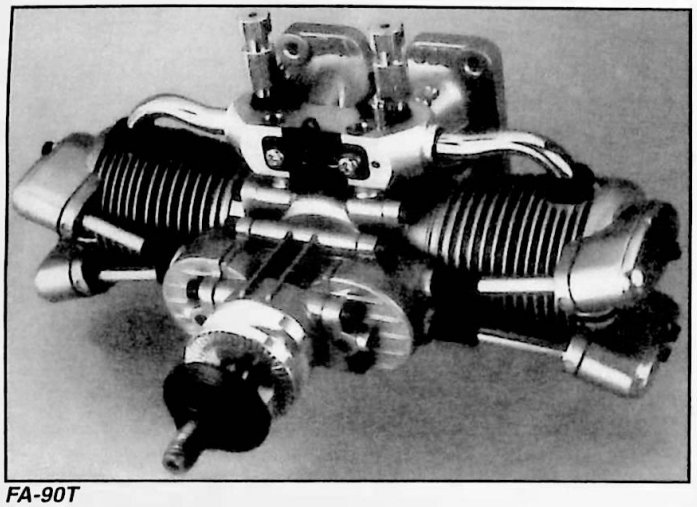
The FA-90T

The FA-90T Mark II flat twin ABC is unique in the fact that like full-size radial engines, it has a single throw Crankshaft, that is to say both Conrods are connected to a single Crankpin or Big End *(Figure 13.1)*. This engine utilizes a Vane Type Air Pump to help control harmful blow-by gases and improve lubrication. For optimum air/fuel mixing, it has twin air bleed type Carburetors which can be individually adjusted to their respective Cylinder.

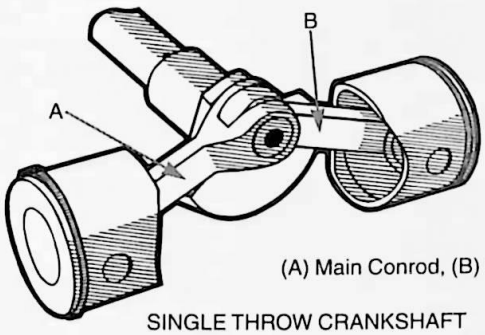
(1) To Dismantle

Using a 2.5mm Allen Key, release the two screws holding the Carburetor to the Crankcase, and at the same time release the Inlet Manifold retaining nuts. Watch for a Manifold Gasket in each Cylinder Head. Next, using a 3.0mm Allen Key, remove the Vane Pump Housing. Ease the Housing away from the Crankcase, disengaging the Drive Pin connected to the Big End. Unfortunately, if the Housing has been in place for some time, you will probably need a spare Gasket which is listed as a Crankcase Gasket, part number 31. We will examine the Vane Pump in detail a little later on.

Remove the two Glow Plugs. Refer to *Section 8* and identify your Plug Type. It is important when replacing Glow Plugs that you use the correct type fitted by Saito for the FA-90T. Next, remove the four Rocker Covers and their Gaskets.



FA-90T



(A) Main Conrod, (B) Linked Conrod.

SINGLE THROW CRANKSHAFT

Figure 13.1

(2) The Rocker Arms

While watching the Big End on the Crankshaft, rotate the Drive Washer to position one of the Pistons at TDC. By rocking the Drive Washer slightly and watching the Rocker Arms, you will be able to tell if this Piston is at the Firing TDC position, or not (i.e., the Rocker Arms will not move). All four Rocker Arms are best removed when their Cam Followers are on the back of the Camshaft, i.e., not in the raised position. Pull out the four Pushrods. Note each has a 3.0mm tapered end which engages in the Rocker Arm Adjustment Screw.

Press down each of the Valve Springs and feel the tension. The Valve Springs fitted to this engine are much softer than other springs, and can be confirmed by checking their length listed in the Table *(Section 7)*.

(3) Cylinder Barrels And Pistons

Using the shortened end of a 2.5mm Allen Key, loosen each of the four Cylinder Barrel screws, working diagonally across the Cylinder to prevent distortion of the Barrel. Make your own identification mark on one of the Barrels, matching Piston and Conrod so that these matching parts are reassembled as they were originally. Also mark each Conrod on the Crankweb side to prevent these from being reversed. You can now disconnect the Conrods from the Big End.

(4) Piston Rings

Piston Rings require careful handling to avoid stretching or twisting them. Refer to *Section 4(3)*, Handling Piston Rings; and *Section 6*, Piston Rings and Lubrication.

(5) Removing The Valves

To release the Valves and for the testing of Valve Springs, refer to *Section 4(4)* and *Section 7*, Valve Spring Tension.

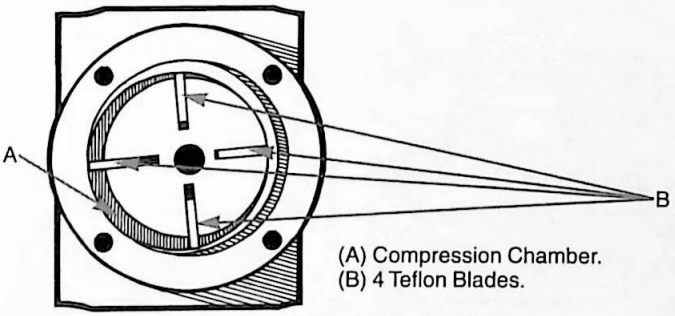
(6) The Crankshaft

Using a commercially made Bearing Puller, remove the Drive Washer and the Tapered Collet. Tapping out the Crankshaft with a hammer, you will notice how the Crankshaft Pinion Gear and Spacer are trapped between the front and rear Bearings. If you have no need to replace the Bearings, they can be left there, as you would need to remove the front Bearing to get them out.

(7) The Vane Type Compressor

Remove the four 2.5mm screws which holds the cover hatch on the Vane Pump. Take note of a pair of circular alignment marks, one on the cover plate and the other on the Housing.

The Vane Pump consists of a rotor driven by the Big End on the Crankshaft *(Figure 13.2)*. As the rotor spins, the four Teflon sealing blades are held against the walls of the chamber by centrifugal force, constantly adjusting them-



(A) Compression Chamber.
(B) 4 Teflon Blades.

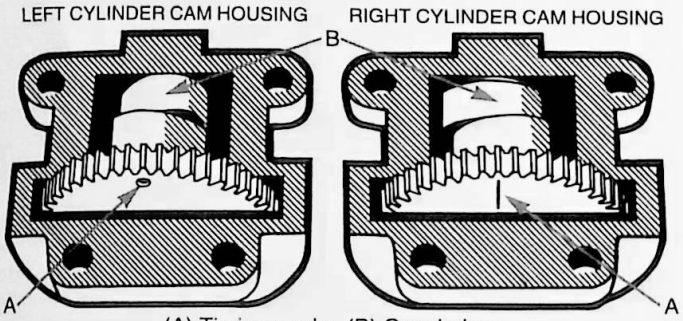
VANE TYPE COMPRESSOR
Figure 13.2

selves to follow the contours of the chamber. Air is drawn into the pump through the nipple on the rear cover. This Vane Type Compressor is a very important part of this engine. At all times, the nipple must have access to a supply of clean air and never allowed to become blocked .

(8) The Camshafts

Before removing the four 2.5mm screws holding each of the Camshaft Housings, mark one of the Housings and its specific side. At a first sight, the Camshafts may look the same, but they are quite different, as one is specifically designed for the left Cylinder operation and the other, for the right.

When facing the engine from the front, the Camshaft for the right Cylinder has a scratch mark on the rear face of the gear opposite the correct tooth which has to engage the Crankshaft when it's at TDC. Ignore the dimple timing mark completely. The Camshaft for the left-hand side uses the conventional dimple mark for its alignment with the Crankshaft *(Figure 13.3).*



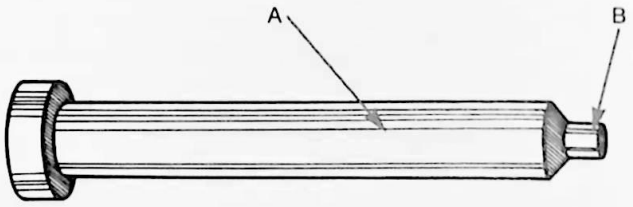
(A) Timing marks, (B) Cam Lobes.

Figure 13.3

(9) The Timing of the FA-90T

Because of the differences in the configuration of the Camshafts used on the left and right Cylinders, the timing cannot be successfully carried out without the use of the Special Timing Tool. Refer to *Section 4(14)* and *Figure 13.4.*

As the Timing Tool is inserted into the left-hand Cam Follower Guide, we will need to remove the Cam Followers from the two Housings. Without dismantling the Camshafts, if we simply hold a Housing upside down and give it a quick flick with the wrist, the Cam Followers will be out in a jiffy. If for some reason they are too tight in their guides, then you will have to remove the Cam Gear Shaft. Watch for the two Teflon Spacers on the shaft and don't overtighten the Grub Screw.



The Special Timing Tool has a 4.0mm diameter shaft (A), with a 2.0mm little end (B).

Figure 13.4

If the Bearings require replacing, be sure to place the Pinion Gear and Spacer facing in the correct direction to engage the Crankshaft Alignment Pin, before fitting the front Bearing.

(10) Assembly Of The FA-90T

Special Note: Oil all screw threads before assembly. Reassemble the Crankshaft engaging the Pinion Gear slot on the Alignment Pin. Fit the Drive Washer and a propeller, and tighten the propeller nut. If the entire assembly binds up, then the Bearings have not been seated in their Housings correctly. If there is only a slight feeling of tightness, place a punch down the central cavity of the Crankshaft and give it a light tap with a hammer.

(11) Setting The Timing

I cannot stress strongly enough the importance of understanding this next phase to getting the timing correct.

Saito's method of using a separate Camshaft assembly to actuate the Valves on each Cylinder (in all but one of their twin cylinder engines) means that great care must be taken to ensure each Camshaft tooth timing mark is correctly engaged with the Crankshaft when its Crankpin is positioned at TDC.

The Special Timing Tool is designed to remove the guesswork from this operation *(Figure 13.4)*.

LEFT CYLINDER	RIGHT CYLINDER
(*)	(*)
(*)	(A)
(*)	(R)
(A)	(*)
(R)	(*)
(A)	(A)
(R)	(R)
(A)	(R)
(R)	(A)

Legend: (*) correct
(A) advanced one tooth
(R) retarded one tooth

(12) The Special Timing Tool

First identify the top of the Crankcase and, with the front of the engine pointing towards you, decide which is the left and right side. We will assemble the right side Camshaft Housing first. This is the Housing which contains the Camshaft which has a "scratch mark" opposite the timing tooth *(Figure 13.3)*. Insert the Special Timing Tool into the left-hand Cam Follower Guide (the Exhaust Valve Side), and engage the oil hole on the Camshaft *(Figure 4.9)*. Oil the Housing Gasket and place it in position. Holding the Crankshaft Big End at TDC, place the Camshaft Housing into position, tighten the four screws but **do not** remove the Timing Tool. With the Timing Tool still in position, when you rock the Drive Washer slightly, you will feel a slight slackness in the tooth, but the Big End will still be firmly at TDC. You then know that you have successfully engaged the correct tooth, now remove the Timing Tool.

Rotate the Crankshaft 180°, oil the other Gasket and place the Timing Tool into the left-hand Cam Follower Guide (Inlet Valve Side) and, holding the Crankshaft at TDC, fit the second Housing. Carry out the same test as performed on the first Cylinder. You have successfully completed the timing.

Before fitting the Cylinder Barrels, be sure to fit the Cam Followers in their Guides.

(13) The Cylinder Barrels

Remove the Pistons from the "Y" shaped Conrod and the linked Conrod before you fit the Conrods to the Big End. After the Conrods are attached, reassemble both Pistons, taking care to fit the Teflon End Pads correctly.

Following the assembly marks you established during the dismantling (with the Valves in place in the Cylinder Heads), assemble each Cylinder Barrel with their Pushrod Covers. After applying a little oil, tighten the Barrel screws, working diagonally across the Cylinder, progressively adding a little more tension each time. Rotate the Crankshaft to make sure the Piston is not binding in the Cylinder.

(14) The Tappets

Move the Crankshaft to the Firing TDC position and fit the Rocker Arms. While in that position, adjust the Tappet gaps with your Feeler Gauge. Move the Crankshaft to the opposite Cylinder's Firing TDC and fit its Rocker Arms and adjust the Tappets.

(15) The Vane Pump

Using a little oil, stick the Vane Pump Gasket to the Pump Backplate mount. Engage the Vane Pump Drive Pin into the Big End. To test if this is properly located, remove the Air Inlet Nipple on the Backplate to see if the rotor is revolving when the Crankshaft is moved.

After carrying out the final check, oil the Rocker Arms, replace the Rocker Arm Covers and Gaskets, and don't forget a few drops of oil down the Glow Plug holes before replacing the Glow Plugs.

(16) The Final Check For The FA-90T

Stage 1. Position the Piston in the left Cylinder at the

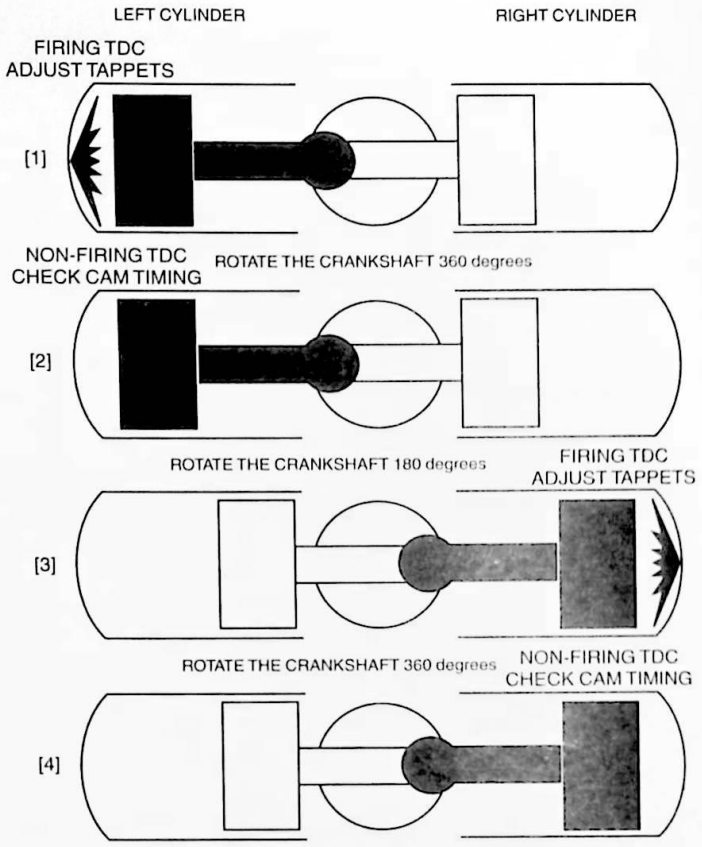


Figure 13.5

Firing TDC, i.e., the position when by rocking the Crankshaft Drive Washer at TDC, the Rocker Arms do not move. Using a marker pen, make a mark on the Drive Washer and adjacent Crankcase. Using your Feeler Gauge, adjust the Tappets.

Rotate the Drive Washer 360°.

Stage 2. Still on the left Cylinder, rock the Drive Washer and observe the position of the Rocker Arms, they should be level at TDC.

Rotate the Drive Washer 180°.

Stage 3. Adjust the Tappets on the right Cylinder.

Rotate the Drive Washer 360°.

Stage 4. On the right Cylinder, rock the Drive Washer and observe the position of the Rocker Arms, they should be level at TDC.

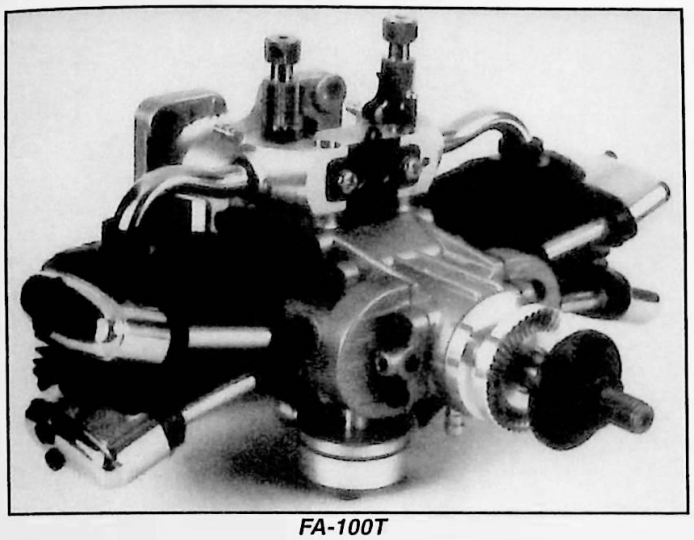
If Stages 2 and 4 are not as described, you will need to check the Camshaft Timing Gears, otherwise the final check is completed *(Figure 13.5)*.

SECTION 14

The FA-100T

Released in August 1993, the FA-100T is the very latest addition to the FA series of engines from Saito. Following the same design established by the FA-90T and the FA-130T, this engine utilizes the single throw Crankshaft design similar to full-size radial engines, that is to say, both Conrods are connected to a single Crankpin or Big End.

This engine is fitted with twin Carburetors, each able to regulate the air/fuel mixture to its respective Cylinder. Each Carburetor has a 6.0mm diameter Choke with the Throttle Lever from each Carburetor linked together.



FA-100T

This engine is fitted with a Diaphragm Air Pump actuated by the left-hand Inlet Cam Lobe and is designed to control the level of harmful blow-by gases and improve the overall engine lubrication.

(1) To Dismantle

Remove the two Glow Plugs. Refer to *Section 8* and identify your Plug Type. It is important when replacing Glow Plugs for you to use the correct type intended for the FA-100T. Next, remove the four Rocker Covers and their Gaskets.

After disconnecting the hose from the Diaphragm Pump to the Backplate, remove the four 3.0mm screws attaching the engine Backplate. Watch for the Teflon Spacer Washer fitted to the Big End of the Crankshaft. Next, ease the two Inlet Manifold Nuts and the 2.5mm screws attaching the twin Carburetors, watching for the Inlet Manifold Gaskets within the Cylinder Heads.

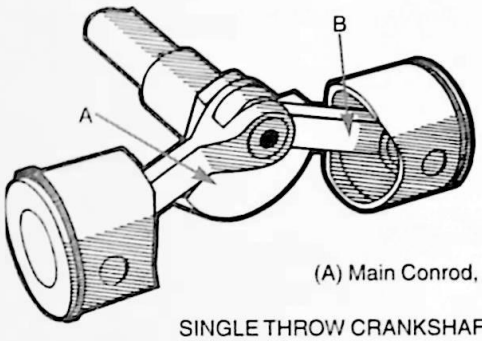
(2) The Rocker Arms

Rotate the Drive Washer to position one of the Pistons at TDC. By rocking the Drive Washer slightly and watching the Rocker Arms, you will be able to tell if this Piston is at the Firing TDC position, or not; i.e., the Rocker Arms will not

move. All Rocker Arms are best removed when their Cam Followers are at this position, on the back of the Camshaft. Remove the Rocker Arms, then pull out the four Pushrods. Note each has a 3.0mm tapered end which engages in the Rocker Arm Adjustment screw.

(3) Cylinder Barrels And Pistons

Using the shortened end of a 2.5mm Allen Key, loosen each of the four Cylinder Barrel screws, working diagonally across the Cylinder to prevent distortion of the Barrel. Make your own identification mark on one of the Barrels, the matching Piston, and the Conrod so that these matching parts are reassembled as they were originally. Also, mark each Conrod on the Crankweb side to prevent these from being reversed. You can now disconnect the Conrods from the Big End *(Figure 14.1)*.



(A) Main Conrod, (B) Linked Conrod.

SINGLE THROW CRANKSHAFT

Figure 14.1

(4) Piston Rings

Piston Rings require careful handling to avoid stretching or twisting — *Section 4(3)* Handling Piston Rings; and *Section 6*, Piston Rings and Lubrication. To remove the Valves, see *Section 7*, Valve Spring Tension.

(5) The Diaphragm Air Pump

Looking from the front of the engine, the Diaphragm Pump is attached to the Camshaft Housing on the left Cylinder. The pump is a very simple design and consists of a rubberized diaphragm with a central pushrod approximately 18mm in length which sits above the Inlet Cam Lobe and receives a passing flick from it which activates the diaphragm. Clean air is drawn into the upper chamber of the pump by the action of the diaphragm which is then relayed to the Crankcase *(Figure 14.2)*.

(A) Air Inlet Filter.
(B) Compression Chamber.
(C) Return Spring.
(D) Diaphragm.
(E) Diaphragm Pushrod.

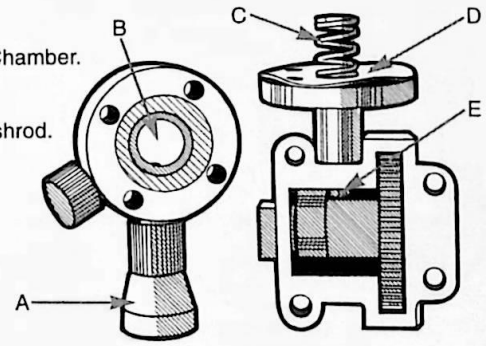


Figure 14.2

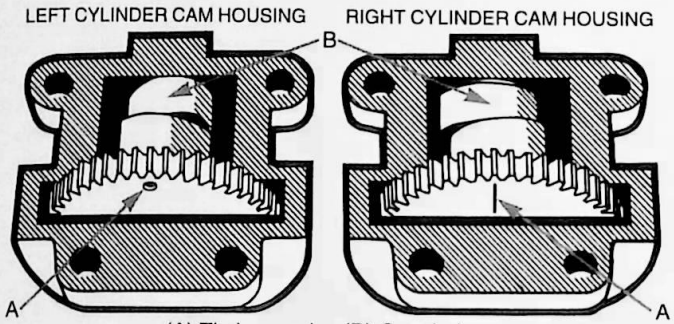
(6) Camshaft Housings

As we will be setting up the Cam timing later using the Special Timing Tool, we will need to remove the four Cam Followers from their Guides. Dismantle the Housings from the Crankcase, and holding each upside down, give them a quick flick of the wrist and the Cam Followers will be out in a jiffy. If for any reason they are too tight, you will have to remove the Camshaft first; if so, watch for the Teflon Spacer Washers.

(7) Assembly Of The FA-100T

Special Note: Oil all screw threads before fitting.

If the Crankshaft Bearing has been removed for any reason, attach the Tapered Collet, the Drive Washer, and a propeller with a nut. If there is any binding in the entire assembly, the Bearings are not seated correctly in their Housings. If there is only a very slight feeling of tightness, place a punch of the right diameter into the Crankshaft's central cavity and give it a light tap with a hammer. Don't proceed to the next stage while there is any binding in the Crankshaft assembly.



(A) Timing marks, (B) Cam Lobes.

Figure 14.3

(8) Setting The Timing

Follow carefully *Section 13(11,12)*, Setting the Timing and the Special Timing Tool; *Section 13(13,14)*, the Cylinder Barrels and the Tappets; and *Figure 14.3*.

(9) The Final Check For The FA-100T

Stage 1. Position the Piston in the left Cylinder at the Firing TDC, i.e., the position when by rocking the Crankshaft Drive Washer at TDC, the Rocker Arms do not move. Using a marker pen, make a mark on the Drive Washer and adjacent Crankcase. Using your Feeler Gauge, adjust the Tappets.

Rotate the Drive Washer 360°.

Stage 2. Still on the left Cylinder, rock the Drive Washer and observe the position of the Rocker Arms, they should be level at TDC.

Rotate the Drive Washer 180°.

Stage 3. Adjust the Tappets on the right Cylinder.

Rotate the Drive Washer 360°.

Stage 4. On the right Cylinder, rock the Drive Washer and observe the position of the Rocker Arms, they should be level at TDC.

If Stages 2 or 4 are not as described, you will need to check the Camshaft Timing Gears, otherwise the final check is completed *(Figure 14.4)*.

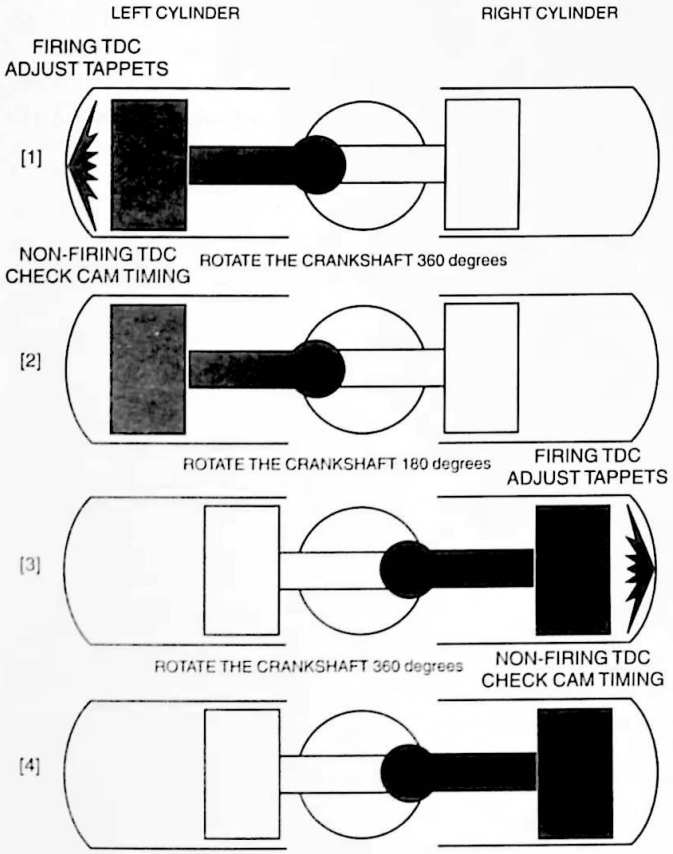

LEFT CYLINDER
RIGHT CYLINDER
FIRING TDC
ADJUST TAPPETS
[1]
NON-FIRING TDC
CHECK CAM TIMING
ROTATE THE CRANKSHAFT 360 degrees
[2]
ROTATE THE CRANKSHAFT 180 degrees
FIRING TDC
ADJUST TAPPETS
[3]
ROTATE THE CRANKSHAFT 360 degrees
NON-FIRING TDC
CHECK CAM TIMING
[4]

Figure 14.4

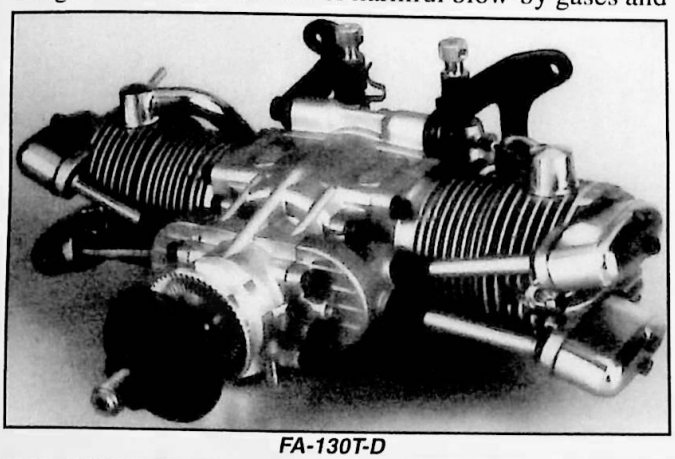
SECTION 15

The FA-130T-D Flat Twin

The FA-130T-D, like the FA-90T and the FA-100T has a single throw Crankshaft like full-size radial engines; this is to say, both Conrods are connected to a single Crankpin or Big End.

This engine is fitted with twin Carburetors, each able to regulate the air/fuel mixture to its respective Cylinder. Each Carburetor has a 5.5mm diameter Choke and utilizes the "Split" method to more precisely control the metering of the fuel. The Throttle levers of the two Carburetors are linked together with a Ball Joint Arm.

The engine is fitted with a Diaphragm Air Pump designed to control the level of harmful blow-by gases and improve overall lubrication. Each Cylinder is fitted with dual Glow Plugs.



FA-130T-D

(1) To Dismantle

First we need to remove the two Engine Mounting Arms with a 3.0mm Allen Key, before we can detach each Carburetor with its Inlet Manifold. The Manifolds are a snug fit into the Cylinder Barrel and are sealed with an "O" Ring. The black plate between the two Carburetor intakes is to prevent one Carburetor's airflow upsetting the other Carburetor.

Remove the Carburetor Mount from the Backplate and the piece of hose which connects the Diaphragm Pump to the Backplate.

Next, remove the Glow Plugs. Refer to *Section 8* to identify your Plug Type for this engine. Remove the four screws which secure the Rear Coverplate and slide it out.

(2) The Rocker Arms

Remove the four Rocker Arm Covers and their Gaskets. While watching the Big End on the Crankshaft, rotate the Drive Washer to bring one of the Pistons to TDC. By rocking the Drive Washer slightly and watching the Rocker Arms, you will be able to tell if this Piston is at Firing TDC, i.e., the Rocker Arms will not move. All four Rocker Arms are best removed when their Cam Followers are on the back of their respective Camshafts, i.e., not in a raised position.

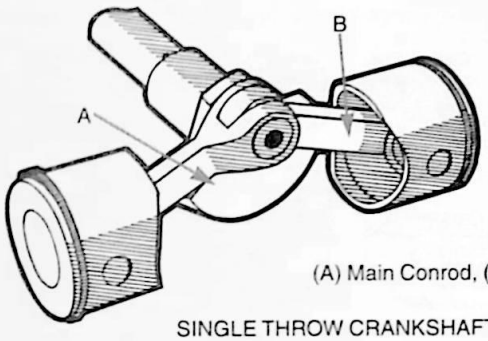
If you don't wish to adjust the Tappets after you assemble the engine, you will need to mark each Rocker Arm for later identification.

(3) The Cylinder Barrels

Using the short end of a 2.5mm Allen Key, loosen in turn the four Cylinder Barrel screws, working diagonally across the Cylinder to reduce the chances of Cylinder distortion. Note that these Barrel screws have Washers. Ease one of the Cylinder Barrels from its Piston and place an identification mark on the rim of the Barrel Mount, the Cylinder Barrel itself, the Piston and the Conrod on that particular side of the engine. Now dismantle both Pistons from their Conrods and watch carefully for the pair of Teflon End Pads on the Gudgeon Pin *(Figure 15.1)*.

(4) Piston Rings

Piston Rings require careful handling to avoid the chance of stretching or twisting them. Refer to *Section 4(3)*, Handling Piston Rings; and *Section 6*, Piston Rings and Lubrication.



(A) Main Conrod, (B) Linked Conrod.

SINGLE THROW CRANKSHAFT

Figure 15.1

(5) Removing The Valves

Refer to *Section 7*, Valve Spring Tension.

(6) The Diaphragm Air Pump

Looking from the front of the engine, the Diaphragm Pump is attached to the Camshaft Housing on the left Cylinder. The pump is a very simple design and consists of a rubberized diaphragm with a central Pushrod approximately 18mm in length which sits above the Inlet Cam Lobe and receives a passing flick from it which activates the diaphragm. Clean air is drawn into the upper chamber of the pump by the action of the diaphragm which is then relayed to the Crankcase *(Figure 15.2)*.

(7) The Camshaft Housings

When removing the Camshaft Housings, care should be taken handling the gaskets. A different gasket material has been used on the Saito FA-130T than that on their other

(A) Air Inlet Filter.
(B) Compression Chamber.
(C) Return Spring.
(D) Diaphragm.
(E) Diaphragm Pushrod.

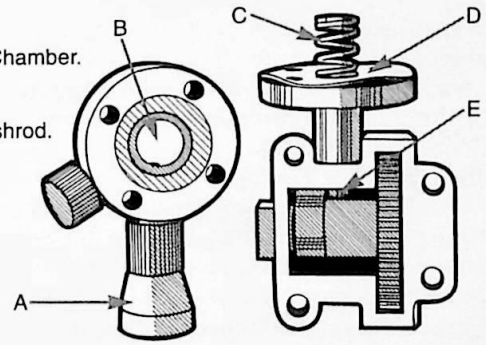


Figure 15.2

gines. As we will be setting up the Cam timing later using e Special Timing Tool, we will need to remove the four am Followers from their Guides.

Without dismantling the Camshafts from their Housings, f we simply hold the Housing upside down and give it a quick flick of the wrist, the Cam Followers will be out in a jiffy. If for any reason they are too tight in their Guides, then you will have to remove the Cam Gear Shaft, watch for the two Teflon Spacers on the shaft.

The Crankshaft Pinion Gear has been cut integrally on the Crankshaft. Refer to *Section 5(6)*, the Crankshaft.

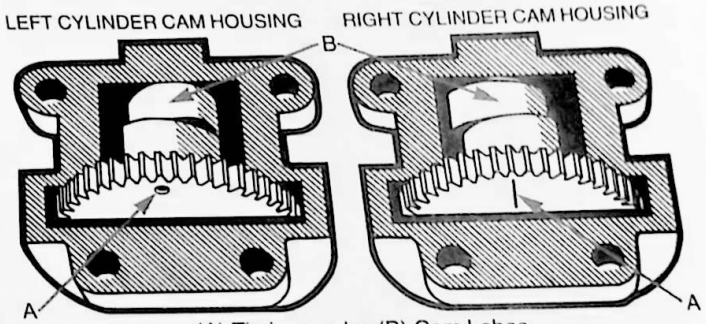
(8)Assembly Of The FA-130T-D

Special Note: Oil all screw threads before fitting.

If the Crankshaft Bearings have been removed for any reason, attach the Drive Washer and Tapered Collet, and a propeller and nut. As you tighten the nut, if there is any binding in the entire assembly, it will become evident. This will be due to the Bearings not being seated correctly in their Housings. If there is only a slight feeling of tightness, place a punch of the right diameter into the Crankshaft cavity and give it a light tap with a hammer. Don't proceed to the next stage while there is any binding in the Crankshaft assembly.

(9) Setting The Timing

Follow carefully the instructions in *Section 13(9)*, The Timing of the FA-90T; *Section 13(11)*, Setting The Timing; *Section 13(12)*, The Special Timing Tool. To complete the assembly, refer to *Section 13(13)*, The Cylinder Barrels; *Section 13(14)*, The Tappets; and *Figure 15.3*.



(A) Timing marks, (B) Cam Lobes.

Figure 15.3

0) The Final Check For The FA-130T-D

Stage 1. On the left Cylinder, set the Piston at the Firing TDC position, i.e., the position when by rocking the Crankshaft Drive Washer at TDC, the Rocker Arms do not move. Using a marker pen, make a mark on the Drive Washer and adjacent Crankcase. Using your Feeler Gauge, adjust the Tappets.

Rotate the Drive Washer 360°.

Stage 2. Still on the left Cylinder, rock the Drive Washer and observe the position of the Rocker Arms, they should be level at TDC.

Rotate the Drive Washer 180°.

Stage 3. Adjust the Tappets on the right Cylinder.

Rotate the Drive Washer 360°.

Stage 4. On the right Cylinder, rock the Drive Washer and observe the position of the Rocker Arms, they should be level at TDC.

If Stages 2 and 4 are not as described, you will need to check the Camshaft Timing Gears, otherwise the final check is completed *(Figure 15.4)*.

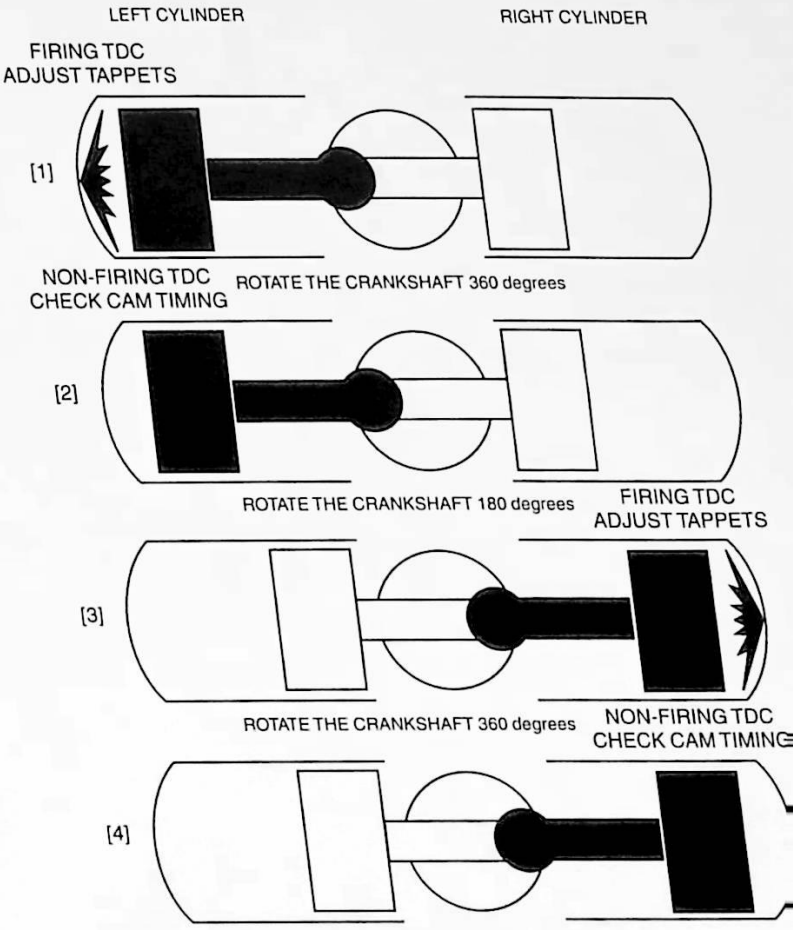


Figure 15.4

SECTION 16

The Big Twins

The FA-300T and the FA-300T-TDP.

The Big Twins are both AAC engines (high silicon content aluminum Piston, aluminum Cylinder Liner, hard chrome plated), and use a Piston Ring for compression. They have a 2:1 Crankshaft/Camshaft ratio of 40/20 teeth.

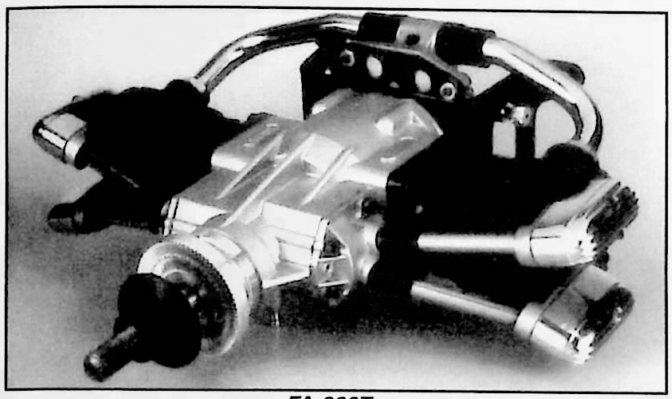
The FA-300T-TDP is fitted with twin 9.4mm diameter Choke Carburetors, each being able to be adjusted to its respective Cylinder. These Carburetors use the more precise "Split" system of metering fuel. The FA-300T has only a single Carburetor.

The FA-300T-TDP has twin Glow Plugs to each Cylinder and a fuel pump system designed to control harmful blow-by gases for improved lubrication and fuel economy *(Figure 5.9)*. The Valve Springs in these two engines are naturally much larger and use the Split Collet system of Valve retention.

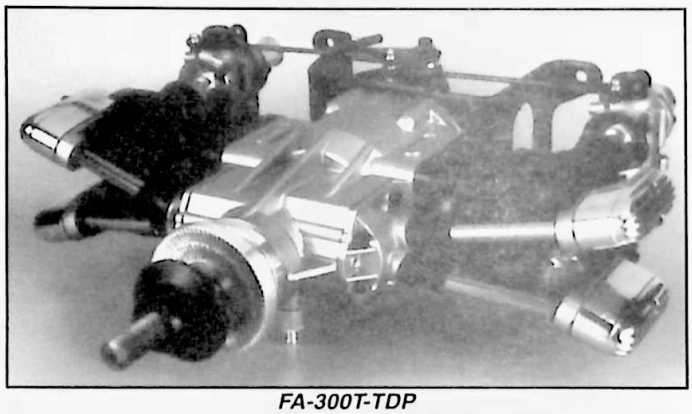
(1) To Dismantle The FA-300T

First remove one of the Glow Plugs from each Cylinder Head. Refer to *Section 8* and identify your engine's Plug Type. It is important when replacing Glow Plugs that you use the correct Plug Type for the FA-300T.

Dismantle the Carburetor from the Inlet Manifold flange using a 2.5mm Allen Key. Note the long and short screws. Loosen the two Inlet Manifold Nuts and with a 3.0mm Allen Key, remove the two screws attaching the black Carburetor Mounting Plate to the engine mounts. Carefully remove the



FA-300T



FA-300T-TDP

two Inlet Manifold Gaskets from inside the Heads. Next, dismantle the 3.0mm screws which attach the engine Mounting Plates to the Rear Cover. Note: The yellow headed screw on the left is much shorter than the other three screws. This prevents it from protruding inside, into the Cylinder Barrel flange.

Although the Rear Cover is loose, it cannot be removed at this stage because it contains in its Housing the rear Crankshaft Bearing. This Bearing is a press fit on the rear of the Crankshaft. Later on, we will remove the Drive Washer and Split Collet and the Crankshaft will slide out with the Rear Cover attached.

(2) The Rocker Arms

Before dismantling the Rocker Arms, be sure to move the Crankshaft to the Firing TDC position. Refer to *Figure 16.1* regarding the correct position for the sheet metal Spacers. Remove the Rocker Arms; it is not necessary to dismantle the two Rocker Arm Brackets.

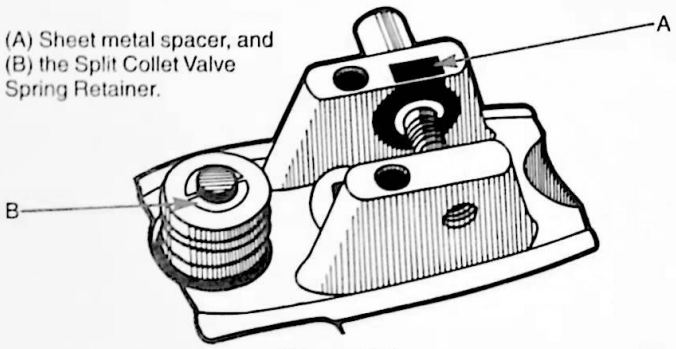


Figure 16.1

(3) The Cylinders

Using the short end of a 3.0mm Allen Key, ease the eight screws which secure the Cylinder Barrels to the Crankcase. Slide the Barrels off the Pistons. At this stage we need to mark a Barrel, Piston, Conrod, and the top of the Crankcase on either the left or right-hand side of the engine for identification when we are assembling. Complete the dismantling of the other Cylinder Barrel.

Refer to *Section 7*; Valve Spring Tension and *Section 5(7)*, Releasing the Valves.

Next remove the Pistons, watch for the Teflon End Pads and, using a 2.0mm Allen Key, carefully unscrew the Big End Studs on each Conrod. I have found it easier to place the Crankcase on its Rear Cover Plate and work sideways with your Allen Key, gradually withdrawing the Conrod away from the Studs as they are unscrewed.

As we have already marked one of the Conrods, we know

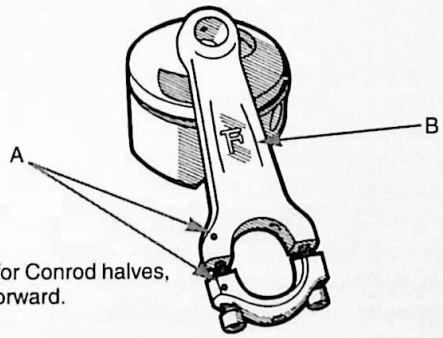


Figure 16.2

which Cylinder this is matched to; it's only necessary to take note of the "F" mark which indicates this side faces to the front of the engine when assembled, and the two circular register marks for matching the Conrod halves *(Figure 16.2)*.

(4) The Camshaft Housings

Before removing either of the Camshaft Housings, we need to make two marks, one on the outside of one of the Cam Housings and the other nearby on the Crankcase itself. This is because the two Camshafts are very different from each other as regards to their Cam Lobes and timing marks. As a safeguard, if you feel uncertain of the correct assembly of the Cam Housings, you will be able to refer to your marks to prevent the Housings being installed on the wrong side.

To examine the running surfaces of the Cam Followers for wear, it is not necessary to remove them from the Camshaft Housing. Because of their enlarged heads and their need to be prefitted to the Housing before the Camshaft, we are unable to use the Special Timing Tool for this engine.

(5) The Crankshaft

Using a Puller, remove the Drive Washer and its tapered Collet. The Crankshaft will now tap out, taking with it the Rear Cover Plate.

(6) Assembly Of The FA-300T

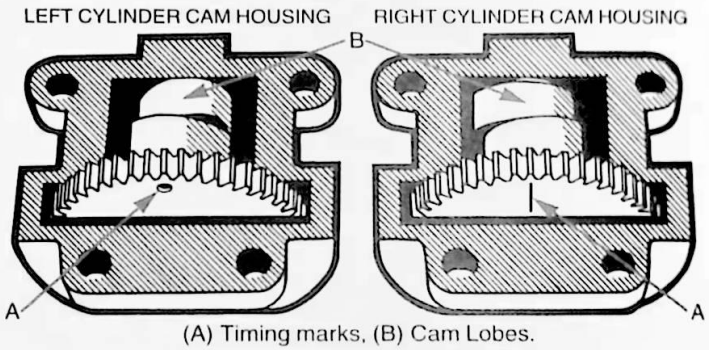
Fit the two Conrods according to your identification marks and face the "F" mark towards the front of the Crankshaft. Don't overtighten the Studs, apply plenty of oil to the Bearing surfaces and check each Conrod to feel that there is no binding.

(7) The Timing

Refer to your identification marks made on the Camshaft Housing and Crankcase and observe the two different timing marks on the face of the Cam Gears. With the engine Crankshaft facing towards you, first fit the Camshaft with the timing mark "scratch" to the right-hand Cylinder. Position the tooth opposite the "scratch" at 6 o'clock and without moving the Crankshaft, very carefully engage it on the Crankshaft Spline with the Big End at TDC. Fit the Housing screws. **Do not move the Crankshaft** and fit the left Camshaft Housing and secure the screws *(Figure 16.3)*.

(8) The Cylinder Barrels

Complete the assembly of one Barrel at a time. Because of the size and tension of the Piston Ring fitted to an engine of this capacity, you will find it a little easier to first fit the Piston into the bottom of the Cylinder Barrel, leaving most of



(A) Timing marks, (B) Cam Lobes.

Figure 16.3

the Piston protruding from the Barrel to let you to fit the Gudgeon Pin and the Teflon End Pads.

At this stage, only finger tighten the eight Cylinder Barrel screws, and fit the Pushrod Covers with their rubber grommets into place. We can finally tighten the Cylinder Barrel screws, working diagonally across the Cylinder, gradually tensioning the screws.

(9) The Rocker Arms

After fitting the Pushrods, position one of the Cylinders at Firing TDC and assemble the Rocker Arms, fitting the sheet metal Spacer on the inside of the Rocker Mount *(Figure 16.1)*. If the Tappets need adjusting on this Cylinder, now is the time to do it.

Assemble the rest of the engine, the Engine Mounts first, making sure to position the yellow headed screw to the left and center. Inlet Manifolds and Gaskets next and finally the Carburetor. Oil the Rocker Arms and the Pistons.

(10) The Final Check For The FA-300T

Stage 1. Set the Piston in the left Cylinder at the Firing TDC position, i.e., the position when by rocking the Crankshaft Drive Washer at TDC, the Rocker Arms do not move. Using a marker pen, make a mark on the Drive Washer and adjacent Crankcase. Using your Feeler Gauge, adjust the Tappets.

Rotate the Drive Washer 360°.

Stage 2. Still on the left Cylinder, rock the Drive Washer and observe position of the Rocker Arms, they should be level at TDC.

Stage 3. Without moving the Drive Washer, adjust the

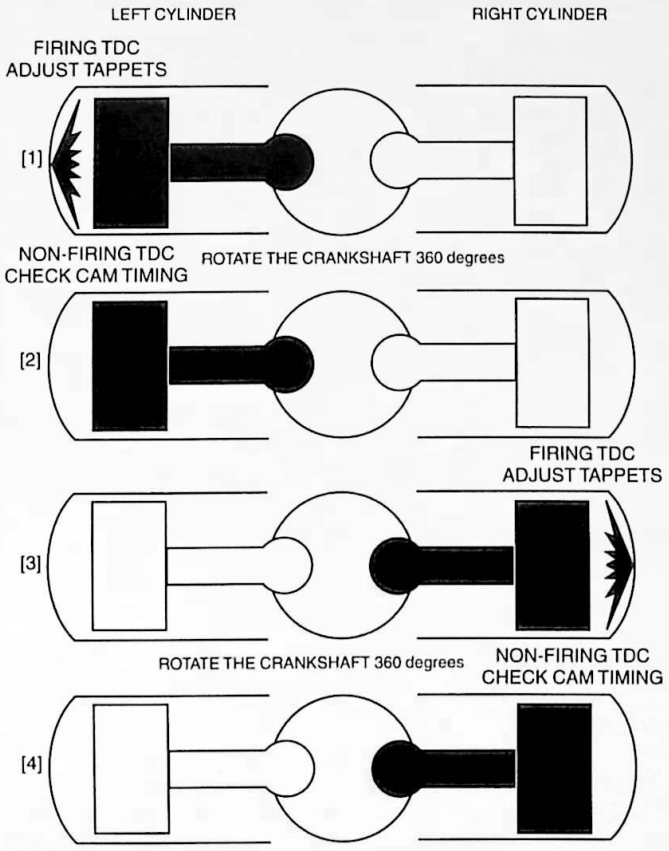


Figure 16.4

Tappets on the right Cylinder.

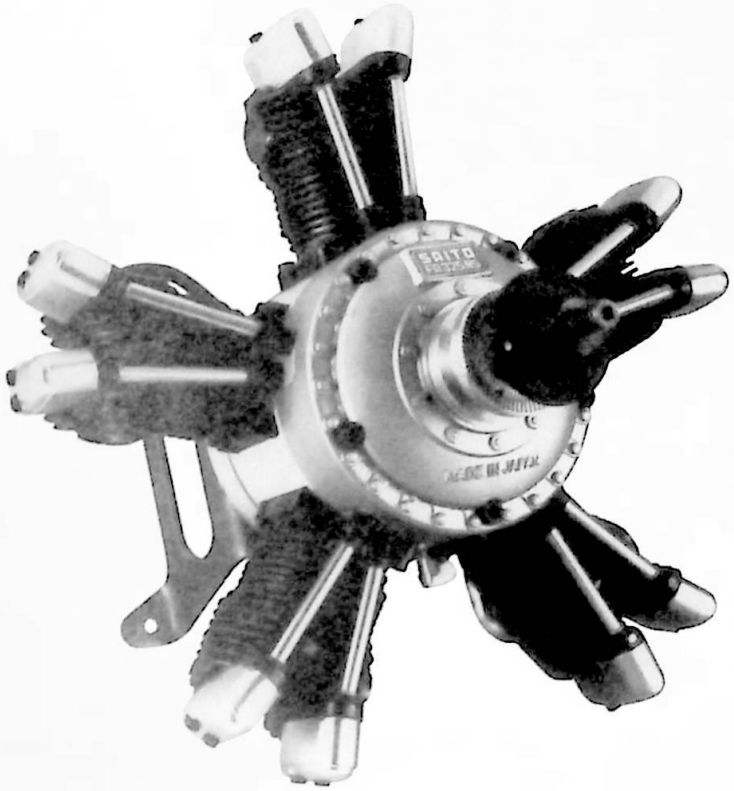
Rotate the Drive Washer 360°.

Stage 4. On the right Cylinder, rock the Drive Washer and observe the position of the Rocker Arms, they should be level at TDC.

If Stages 2 and 4 are not as described, you will need to check the Camshaft Timing Gears, otherwise the final check is completed *(Figure 16.4)*.

SECTION 17

The FA-325R 5 Cylinder Radial



FA-325 R5-D

To provide a complete description on how to dismantle and rebuild the FA-325R, goes beyond the intentions of this book.

This engine requires specialized jigs and tools found only at the Saito factory to complete such a project. To completely dismantle this engine could invalidate your warranty with Saito.

However, for all those modelers interested in this remarkable engine, I will endeavor to describe its internal mechanism and how it all operates.

I will begin with the twin Ball Bearing Crankshaft. As with all Saito 4-strokes, it has a Pinion Gear located on the Crankshaft. Arranged in a circular configuration and driven by the Crankshaft Pinion, is a set of five Idler Gears, referred to by Saito as Counter Gears. These Idler Gears together with the five Camshafts are mounted between two plates referred to in the instructions as Cam Gear Base A and B. This entire mechanism is located within the Front Housing of the Radial.

Turning our attention now to the reciprocating parts of the engine, the number one Cylinder's main Conrod is attached to the Big End of the Crankshaft in the conventional manner, but the difference is, that at the bottom and on both sides of the main Conrod are very substantial flanges to which the four Linked Conrods are attached with Link Pins.

The Pistons are made from high silicon content aluminum with a Piston Ring for compression. These run in a Cylinder Liner of brass that is hard chrome plated.

On the induction side, uniform mixing of the fuel and air, considered to be the most difficult to accomplish in a radial

engine, has been achieved by an Impeller, built into the rear of the Crankcase and driven by the Crankshaft. Fuel is induced from a single Carburetor and drawn into a special chamber where the Impeller maintains enough manifold pressure to allow the engine to idle at revolutions as low as 1700 per minute.

Looking from the back of the engine, with the Crankshaft rotation now clockwise, the firing order of the Cylinders is 1-3-5-2-4.

When starting the radial, fuel is not induced into the engine by choking the Carburetor, as this would flood the two bottom Cylinders, numbers 3 and 4; but is primed with a syringe directly into the Manifolds of Cylinders, 2 and 5.

The Saito FA-325R is designed for 1/4 scale aircraft and will operate between 1700 and 7500 revolutions per minute swinging a 20 x 8 propeller. The engine will consume 75cc of castor based fuel per minute containing 10% Nitro Methane.

(1) The Timing

Looking from the back of the engine, the clockwise firing order of each Cylinder is 1-3-5-2-4. When the Piston in the number one Cylinder is at the Firing TDC position, the Piston in the number two Cylinder is moving upwards and is 72° of Crankshaft rotation from the Non-Firing TDC position.

The Piston in Cylinder number three is also moving up the Bore, but still requires 144° of rotation to bring it to the Firing TDC position.

The Piston in Cylinder number four is 216° from its Non-Firing TDC position and still moving downwards in the

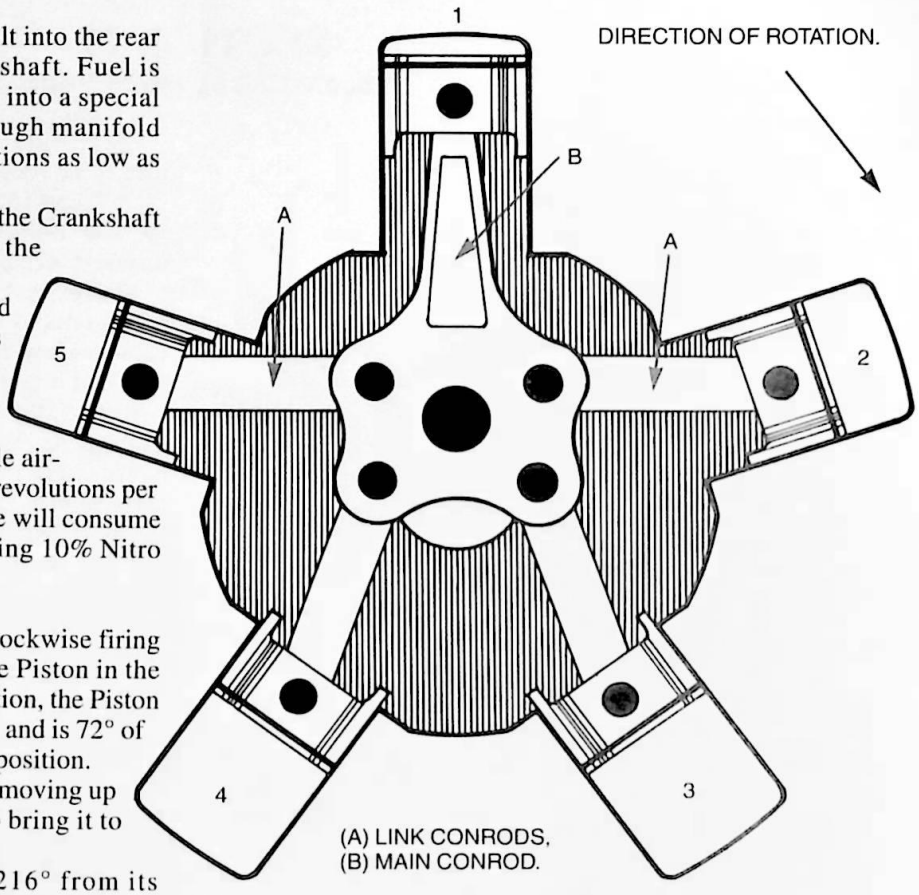


Figure 17.1

bore. Finally, the Piston in the number five Cylinder is also descending at this point and is 288° from its Firing TDC position.

At the completion of the first 360° of Crankshaft rotation, Cylinders 1-3-5 have passed through their Firing TDC positions and the Piston in Cylinder number one is now at the Non-Firing TDC position. The next 72° , Cylinder number two will fire and Cylinder number four at the 216° mark, to complete the cycle.

When adjusting the Tappets on the Radial, place the Piston in number one Cylinder at the Firing TDC position, adjust its Tappets then rotate the engine Drive Washer past Cylinder number two to Cylinder number three and set its Tappets; pass through four and set the Tappets in Cylinder five; pass through one and set two; pass through three and finally set Cylinder number four *(Figure 17.1)*.

The FA-325R, 5 Cylinder radial is a unique model engine which combines the dynamics of flying with realistic sound. It represents the painstaking research efforts at Saito, who are undisputedly world leaders in model 4-stroke engine design. Standing at the head of the Saito Company's superlative range of some 18 engines, it represents the Jewel in the Crown.