

COBRA



RC HELICOPTERS

ASSEMBLY

Instruction Manual



GORHAM MODEL PRODUCTS

QUALITY, PERFORMANCE & SERVICE

INTRODUCTION

The "Cobra" RC helicopter has been designed and developed to provide the modeler with a smaller and less expensive version of the contest winning "Competitor Pro" helicopter without any sacrifice of its stability, reliability and aerobatic capability. Manufacture and supply of all the parts which make up "Cobra" has been a joint effort with the Hirobo company who also supply many of GMP's scale helicopters. Approximately 50% of the parts for "Cobra" are made in the USA and the rest are supplied by Hirobo.

The outcome of this cooperative program is a '40' sized model helicopter which provides a new standard in aerobatic capability and reliability while preserving a wide flexibility in the choice of engines and radios that can be used. High quality machined and sheet metal parts are built in with the result that your GMP "Cobra" will last for a long time. "Cobra" is a good choice for the beginner who wants to learn on a collective pitch machine.

"Cobra" is also an excellent choice for the modeler who has already learned to hover his existing helicopter and now wishes to move out into full aerobatic performance without incurring too much initial cost. At the same time, in the hands of an expert flier "Cobra" has all the aerobatic capability of its bigger brother, "Competitor". The budget priced "Cobra" also has identical construction features to "Competitor". In order to keep cost to a minimum without sacrificing any performance a few of "Cobra's" control bearing surfaces are precision bronze bushes instead of ball bearings. Even so, the "Cobra" has many more ball bearings and precision parts than other comparably priced aerobatic helicopters. "Cobra" has 31 - count the others!

The rotor head yoke is made of diecast aluminum and incorporates a small coning angle for improved stability and lower blade stresses, instead of the machined 'zero coning angle' yoke of the "Competitor Pro". "Cobra" is fully aerobatic, can perform all the FAI and AMA contest maneuvers, has full collective pitch, and a 'Bell-Hiller' mix control system plus all the latest state-of-the-art technical features.

The GMP "Cobra" can be obtained with the same uniquely designed autorotation clutch as used in "Competitor", if desired, or this can be added, inexpensively, as a low cost option later on. Note that either "Competitor" or "Cobra", when fitted with this advanced design of autorotation clutch, can be autorotated - engine off - by an average 'club' RC helicopter flier.

TECHNICAL FEATURES

Performance

The "Competitor/Cobra" range of RC helicopters was nearly one year in its testing program. During this time many control system ratios and mechanical items were changed or adjusted in order to achieve a very important feature - "balanced control". This means that the "Cobra" will 'feel' right to experienced flyers and possess that important but sometimes intangible quality that all of the finest RC helicopters must have: "it feels very 'natural' to fly".

The response of the "Cobra" is fast but very well damped. In addition, the helicopter has plenty of control "power" so that when a maneuver is commenced it can be completed without running out of control power. The "Cobra" will not surprise you with any

unusual flight characteristics. In full size aircraft design a "Cooper" rating is used by pilots to rate the handling quality of a new full size machine for the designers and engineers. If the same rating system was applied to the "Cobra" it would be awarded a very high "Cooper" rating. This means it will be liked and appreciated by the expert flyer and will be much more easily handled by the beginner learning to hover or transitioning into aerobatic flight.

Control System Quality

Because the quality of the controls of any flying machine will dictate the final performance, particular emphasis has been placed on the control system of the "Cobra". you will find many more ball and thrust bearings in the "Cobra" than in other similar RC helicopters. The purpose of this is to provide a very "tight" control system so that all inputs from the transmitter will be immediately and fully available at the control surfaces themselves. This is a prerequisite to fine quality performance in any flying machine, but especially in an RC model helicopter.

Collective Pitch and Bell/Hiller Mixing

The "Cobra" is fitted with full collective pitch on both main and tail rotor blade systems and, in addition, has a Bell/Hiller mix provided to blend "control power" with control smoothness. Note that many so-called 'collective pitch' machines do not possess Bell/Hiller mix as a standard item.

There are basically two methods of achieving collective pitch on an RC model helicopter. One method is to change the pitch of the main blades "collectively" by fitting a rod up the side or center of the main shaft and, while the rotor blades are rotating, moving the rod up or down by a lever arrangement below the main shaft. This, in turn, results in a "collective" pitch change of the main blades through the pitch angle mixing arms. This system is used on the Schluter and Kalt helicopters.

Most full size 'choppers' use the method of moving the whole swashplate up and down to achieve collective pitch changes as do the "Horizon" and Hirobo RC model helicopters. Both these methods have their advantages and disadvantages. The method selected for both the "Competitor" and "Cobra" was the moving swashplate, just like its full-size brothers. One major advantage of this method, which is not immediately obvious, is that the collective pitch 'range' can be much greater. This means that a specific level of 'dead space' or 'backlash' on the control links and servos will show up as less 'lost motion' in the rotor head. Another advantage is that the larger range fills the inverted flight needs without any modification to the standard kit. For inverted flight the swashplate must move in one direction throughout a full range for upright flight, but from the zero position through an equal negative amount for inverted flight. Consequently a total range equivalent to somewhere near 16 degrees of main blade pitch change is required. The "Cobra" control systems easily achieve this requirement.

"Cobra's" Unique Thrust Bearings

The very high centrifugal forces that exist on the bearings of both main and tail blades of RC helicopters have in the past been taken on one 'standard' ball bearing.

The 'standard' ball bearing is designed primarily for radial loads and is not optimum for use where high 'end' or 'pulling' forces are incurred. The "Cobra" main rotor blades utilize a triple bearing system with a heavy duty thrust bearing fitted into each blade holder, together with two fine quality ball bearings to take the radial loads just like the full sized choppers. In addition, the end-play can be adjusted at any time to provide a minimum of 'back-lash' utilising a double locking system. This insures fast and low friction main rotor blade rotation during flight without any lost motion. Again a prerequisite to accurate and advanced aerobatic flight.

Power Plant Versatility

Although the GMP "Cobra" has been designed to be rugged, it utilises advanced and light construction techniques so it will fly with engines ranging through 0.40 to 0.50 cu.in. (6.5 to 8cc).

If you intend to fly at high altitudes, however, remember that the power of your engine will decrease by about 3% - 4% every 1000 feet of pressure altitude above sea level. Also, 5000 feet actual altitude can become equal to 7000 - 8000 feet on a hot day. So, if you live at 5000 feet altitude, assume that you will need an engine which gives about 25% more power than would be required at sea level. Fortunately the "Cobra" is a very efficient helicopter and its flight performance at 5000 feet will not only be adequate but will be excellent with a good '45 - 50' Schneurle or P.D.P. engine.

Radio Control Installation

(Later on in this instruction manual we will provide you with detailed information on how to install your radio in the "Cobra" and set it up so that it will give you the best results.)

The GMP "Cobra" is designed for either a 4 or 5 servo installation. With the larger collective pitch helicopters it is an advantage to use 5 servos since the high forces experienced in moving the collective pitch in the helicopter are best handled by a dedicated servo, leaving another one to operate the throttle. This is by no means necessary and, provided the servos are good enough, the "Cobra", like any other helicopter of its size and type, can certainly be flown well with 4 servos. Any of the inexpensive 4 channel radios available today will usually work well. When using one of the new helicopter radios, however, 5 servos are necessary if the channel 'mixing' features inherent in these new radios are to be fully utilised.

With an advanced aerobatic helicopter such as the "Cobra" it is very important to have "tight" controls and, if you intend to participate in serious competition flying, your servos should have ball bearing outputs and a very reliable feedback potentiometer if possible. Many of the radios available today are available with these higher grade servos. This does not imply in any way that other servos will not work satisfactorily in "Cobra". We just wish to provide you with a target of what we believe are the best characteristics to aim for in your radio installation on "Cobra".

A simple 4 channel radio (bearing in mind the servo requirement) is perfectly adequate. You should also bear in mind that "Cobra" is designed for electronic mixing of the 'tail rotor' controls. This automatic tail rotor compensation for throttle/collective movements does help to smooth out 'tail twitching' following a fast throttle

application. There are now many radios available on the market which have this tail rotor mix available as a standard feature. Some of these fall into the very inexpensive range and, again providing the servos are adequate and the stick gimbal assemblies are 'tight', these will be good radios to use with your GMP "Cobra". The use of a good 'yaw' gyro is also worthy of consideration since flying can be much easier and more pleasant when using one. (The experts do!)

So bear in mind that while any radio that you have available can probably be used, consider upgrading to good ball bearing servos if you wish to obtain the very best overall performance from your machine. Also make your "Cobra" installation a 5 servo one if you want the minimum of wear on your servo system. A simple "Y" connector, available from most radio manufacturers, can enable you to use a dual servo installation with a 4 channel radio. Finally, consider using a gyro in the yaw (rudder) channel.

Rotor Blades and Autorotation (Optional)

The rotor blades of the "Cobra" have an advanced and modern semi-symmetrical section and are generally heavier than most other 40/50 model RC helicopter rotor blades available today. This factor helps in ensuring "Cobra's" superior autorotation capability. In fact, many flyers have reported the ease with which the "Cobra" can be landed after an engine failure compared with other RC helicopters fitted with so called "autorotation".

The GMP "Cobra" autorotation gear is fitted with three precision roller bearings, rather than the single one used in some 40 and 60 powered RC helicopters. Consequently, the life and reliability of this unit is very much higher than others with single bearings.

The main plastic drive gear itself is of a very sturdy construction and the tail drive gear track provides a very wide contact area because the tail drive steel pinion is an advanced design spiral hypoid bevel gear. This means less likelihood of damage to the main drive gear track. Should the gear be damaged, however, a replacement plastic part is readily available at a very low cost.

Starting System

The standard starting system of the "Cobra" is the top cone start now demanded by discriminating American modelers. It is not an extra cost accessory. This means extra expense in the design and manufacturing costs of the helicopter but the inclusion of this feature greatly eases the starting process and eliminates any problems which can arise when starting with a starting belt.

Clutch Design

The clutch is a classic one-piece design made of steel, not plastic, and provides superior and reliable performance. This unit is many times more expensive to manufacture than other plastic and two-piece metal clutches available today but it gives smoother engagement and drive performance and it virtually lasts "forever". The

clutch bell is fitted with a special lining which is factory machined to provide correct engagement and operating performance.

Engine Installation

The engine of the "Cobra" faces to the rear to permit quick glow plug changes. It is also mounted in the frames in such a way that it can be dropped out through the bottom of the helicopter without the usual problems of disassembling the cooling system of the helicopter. The headaches usually associated with 'engine change' or removal for servicing are virtually eliminated with the GMP "Cobra".

Quality Hardware

The "Cobra" uses metric nuts and bolts as do all GMP models. These are selected by nearly all the world's designers as being superior for small mechanisms, and so are rapidly becoming a world standard. The metric hardware is lighter, since it has smaller bolt heads and nuts, and its use enables the whole helicopter design to be lighter and more compact. The threads are finer and, hence, the bolt provides more tensile strength for a given diameter. 90% of the world's RC helicopters now use metric hardware. The GMP "Cobra's" metric system is a world standard one and is interchangeable with the GMP "Cricket", "Competitor" and other Japanese and European RC helicopters.

Low Aerodynamic Drag

The canopy of the "Cobra" has been designed to give very low aerodynamic drag because of its shape and small frontal profile. It is also made from a plastic thicker than most helicopters to help alleviate the vibration cracks which many times occur in canopies. Removal and replacement of "Cobra's" canopy is very easy and quick thanks to its new and unique 'one-point' attachment design.

Stabilizer "Paddle" Design

The stabilizer paddles of the "Cobra" have been designed in a unique way so that you can see how far you have screwed them on the stabilizer bars. This eliminates the annoying problem of finding that you've stripped the thread in the plastic just as you're going out to fly (or while you are flying!).

BUILDING

The "Cobra" can be built relatively fast, certainly by the expert builder. For the modeler who has not built this type of helicopter before we strongly recommend fully reading the building instructions one time at least before commencing construction. It is extremely important that all of the requirements of the designer are met in terms of adjustments of the controls and assembly of the mechanical items.

Any mistakes in setting-up the controls of a sophisticated helicopter like "Cobra" will show up much more in flight performance and reliability than with the simpler helicopter such as "Cricket", etc. So do be sure that you go through the building sequence slowly and by stages and only after you have read the full instructions at least once. The tools that you will need include:

- o a pair of scissors
- o a small screwdriver
- o the allen keys provided in the kit
- o a 7/32 nut driver (which can be purchased from your radio parts store)
- o a pair of pliers
- o a suitable socket wrench to tighten the engine nut of the engine you select

You will also need a small tube of 'Loctite', a small tube or bottle of any of the popular "10 second" Cyanoacrylate glues, some sandpaper, paint, masking and striping tape and a tube of clear silicone sealer and some epoxy glue.

Most of the construction of "Cobra" does not require any filing or fitting and so does not necessitate a work bench. However, do be sure to cover your work surface with thick paper or cloth material since the metal parts of "Cobra" can scratch polished table surfaces.

One important factor in building an RC helicopter, which cannot be stressed enough, is that all nuts (other than 'lock' nuts) and threaded devices should be assembled using BLUE 'Loctite' or equivalent, so as to make separation of these components by vibration very improbable. It is also important to note that there is a version of 'Loctite' used for assembling bearings which is usually a red color. This 'Loctite' will give a permanent assembly and, hence, you will find it difficult (if not impossible) to take your helicopter apart again so please don't use the red variety on parts which you wish to disassembly later. If you cannot locate a supply of 'Loctite' try your local auto parts store, hobby store or contact us direct. Please also note that 'Loctite' must be used sparingly - a very small amount should be applied to the threads to be secured. it works better this way. Do not use 'Loctite' on plastic parts.

In addition to 'Loctite', one of the many varieties of Cyanocrylate (instant) glue can be used for assembling your canopy and securing some items. A tube of clear silicone is also extremely useful in the assembly of the helicopter. Wherever these items ('Loctite', "Cyanoacrylate" or Silicone) are required, the text will be marked appropriately. To help in your selection of the hardware we have provided, for your convenience, a metric scale and illustrations of the various types of nuts and bolts used in the kit. Great care is taken in filling the bags with the correct quantity of parts and mistakes are rare. However, if you do find a shortage in the nuts and bolts or anything else in your kit, don't hesitate to tell your dealer or call us direct.

Don't forget to build under a good light. Build slowly and please, please, read all the instructions very carefully. They have been written with a lot of care to try and cover every point. Even so, your comments on how we can improve our instructions are always welcome. We will continue to upgrade and try to make the "Cobra" instructions the finest available in the industry. Good luck in your building.

BUILDING AND ASSEMBLY INSTRUCTIONS

Before commencing assembly of your "Cobra", open the Hardware bag (nuts and screws,

etc.) and put the contents in a plastic bowl, tub or similar container. All of the hardware needed for building your helicopter is in this bag. Be careful to select the right screws, nuts, etc., that each step calls for. Read the manual and look at the sketches. Refer to hardware information chart and metric scale on page 34.

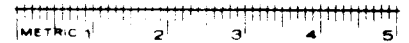
STEP 1 Transverse Lever Assembly - see Figure 1

From bag #5, take the following:

- 2 #482 Pitch Levers
- 1 #479 Pitch Shaft "A"
- 1 #480 Pitch Shaft "B"

From the hardware dish, take the following:

- 2 #211 5mm balls
- 4 #241 2mm nuts
- 2 #270 2.6mm x 8mm skt. hd. screws*
- 2 #269 2mm x 12mm skt. hd. screws
- 2 #276 3mm flat washers



* These are a special screw size used in this assembly only. Make sure that you select the right ones.

- A. Fasten Pitch Shafts #479 and #480 on to Pitch Levers #482 (both pitch levers are the same) using skt. hd. screw #270 and washers #276. USE LOCKTITE.
- B. Fasten Pitch Levers #482 together using skt. hd. screws #269 through 5mm ball #211 and two nuts #241. USE LOCKTITE.
- C. Set Transverse Lever assembly and the remainder of bag #5 aside at this time.

NOTE: IT IS IMPORTANT TO TORQUE ALL NUTS AND SCREWS WELL IN THIS ASSEMBLY.

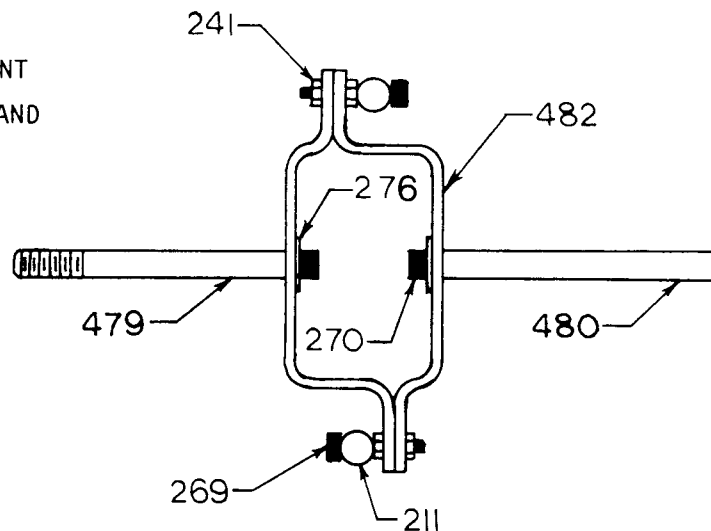


Figure 1
TRANSVERSE LEVER ASSEMBLY

STEP 2 ENGINE ASSEMBLY - see Figure 2

- ✓ You will need an engine of your choice to proceed with this step. The GMP "Cobra" model will fly with any good 0.40, 0.45 or 0.50 Schneurle or P.D.P. engine.
- ✓ With a new, non-ringed engine, it is advisable to have at least half an hour of bench running. This will help you to familiarize yourself with the carburettor settings.

From Bag #3, remove the following:

- ✓ 1 #423 Engine Mounting Block and Cross Piece
- ✓ 1 #429A Tapered Collet
- ✓ 1 #830 Flywheel
- ✓ 1 #438 Clutch Bell Assembly
- ✓ 1 #428 Fan
- 1 #841 Clutch Assembly

From the hardware dish, take the following:

- ✓ 6 #235 3mm x 12mm skt. hd. screws

- ✓ A. Remove prop nut and washer from your engine.
- ✓ B. Remove 'prop' drive backplate washer and tapered drive collet from engine. Please proceed cautiously so not to damage engine. Seek advice if in doubt.
- ✓ C. Install Tapered Collet #429A from kit on engine. The tapered collet in the kit MUST be used since it is matched exactly to "Cobra's" cooling fan hub.

This collet will fit on all OS Max engines. Some engines, such as Webra and HP, may need a spacer behind the collet to properly locate the cooling fan onto the engine shaft. Other engines, such as the HB, with a smaller output shaft than the OS, use Tapered Collet #429B.

Contact your dealer or one of our service centers if you are unable to make or find the proper spacer or if you need advice.

- ✓ D. Place Fan #428 on engine shaft, locating it firmly onto the Tapered Collet #429A. Make sure that there is no grit, oil or grease between the mating surfaces.
- ✓ E. Place Flywheel #830 on engine shaft.
- ✓ F. Fasten assembly securely with the engine nut. This nut must be very tight so that a slippage does not occur if the engine 'backfires'. However, do NOT use Loctite because it will make removal, if required later, extremely difficult. One method used to ensure a well tightened nut is for one person to hold the cooling fan by wrapping a heavy cloth or towel around it and use both hands to grip the fan. The other person then 'torques' up the nut as tightly as possible. Do not try to hold the fan unit in a vice - it will almost certainly damage or break it.
- ✓ G. Fasten Clutch Assembly #841 to flywheel using two skt. hd. screws #235. Be sure, when it is tightened down, that it is straight and runs true. If it

does not, repeat Steps 'E' and 'F' and try again. USE LOCKTITE.

- ✓ H. Install engine cross pieces (2) between engine blocks and fasten to engine using 4 sct. hd. screws #235. For shorter engines like the OS, the position on the blocks should give maximum height to the engine when mounted in the helicopter. With longer engines the blocks can be reversed to accommodate the extra length and mount the engine lower within the frames.
- ✓ K. Place the Clutch Bell Assembly #438 on the clutch shaft. Check that the clutch bell spins freely.
- ✓ L. At closed throttle, position carburettor throttle arm on engine as shown. Check that the carburettor barrel completely closes off the air to the engine at low throttle position. If it does not, adjust the mechanical set screw stop until the barrel can (just) be completely closed by rotation of the throttle arm. This adjustment is particularly important in an RC model helicopter so that the engine can be stopped remotely. Set engine assembly aside.

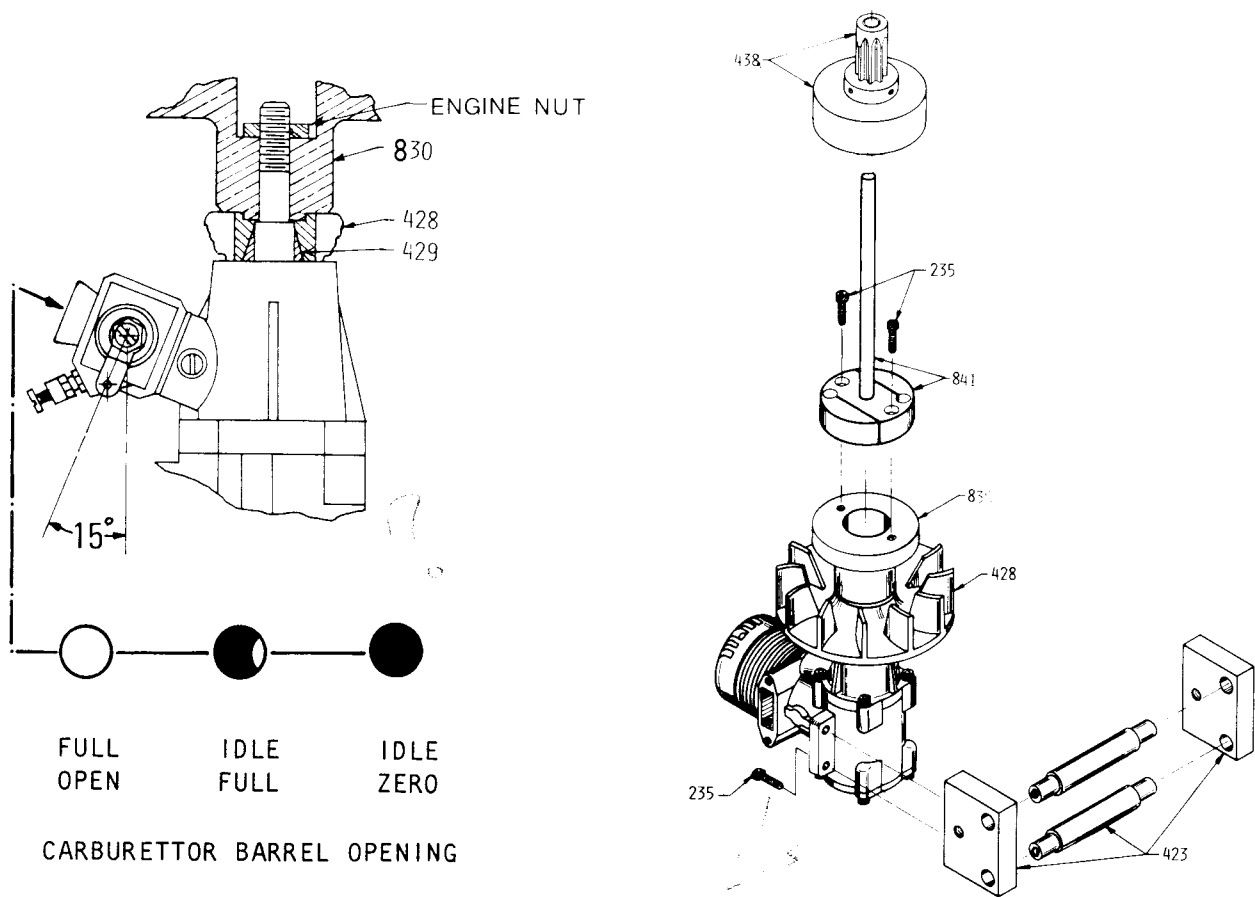


Figure 2
ENGINE ASSEMBLY

STEP 3 MAIN FRAME ASSEMBLY - see Figure 3

From the kit box, take the following:

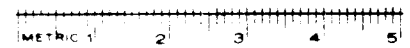
- ✓ 1 #806 Right Side Frame
- ✓ 1 #807 Left Side Frame

From Bag #2, take the following:

- ✓ 1 #810 Front Frame Plate
- ✓ 2 #411 Servo Mount Stay
- ✓ 1 #408 Front Stay Right
- ✓ 1 #409 Front Stay Left
- ✓ 1 #811 Canopy Mounting Post

From the hardware dish, take the following:

- ✓ 14 #223 3mm x 10mm pan hd. screws
- ✓ 14 #243 3mm locking nuts



- ✓ A. Fasten Front Stay Right #408 to Right Side Frame #806 using two pan hd. screws #223 and two locking nuts #243. Check that everything is square. Tighten securely. See Figure 3.
- ✓ B. Repeat (A) using Front Stay #409 and Left Side Frame #807.

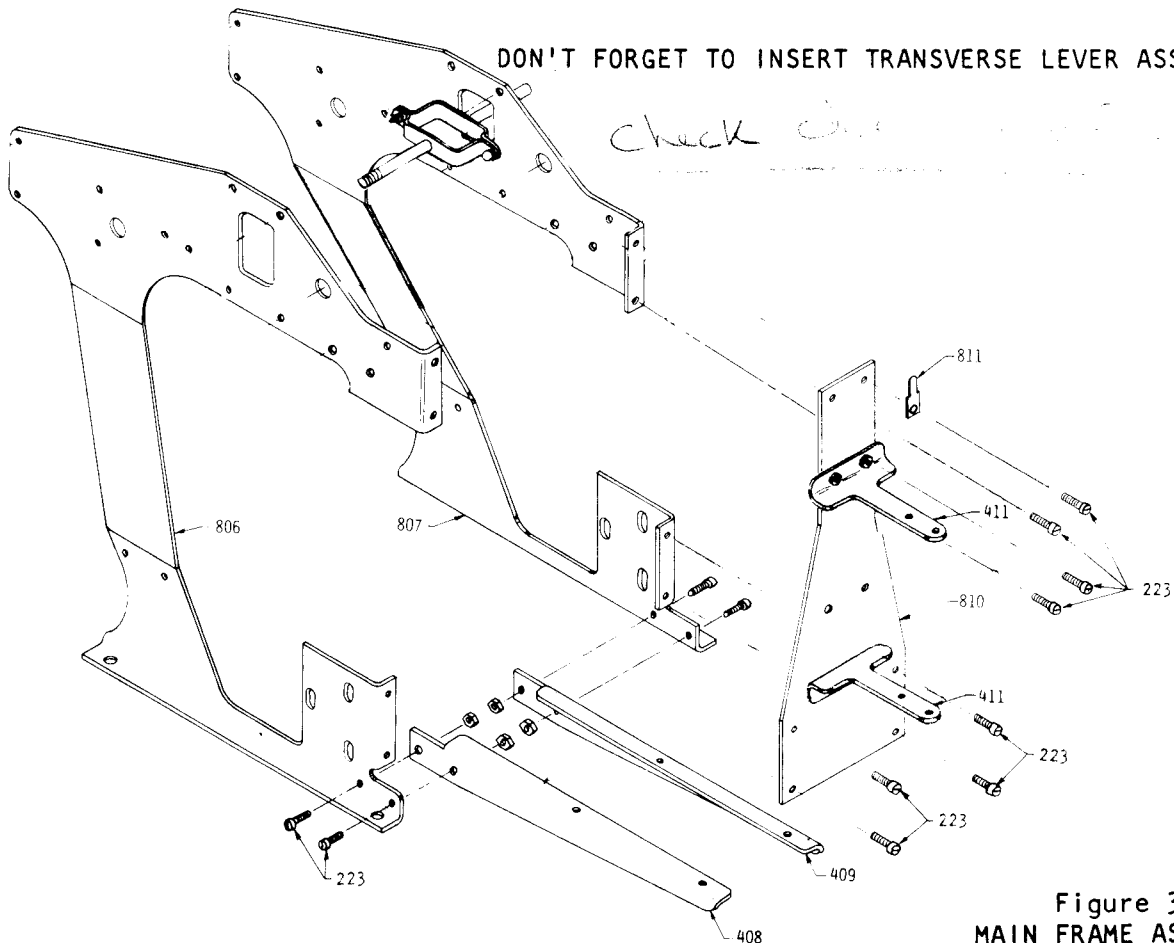


Figure 3
MAIN FRAME ASSEMBLY

- C. Fasten Front Frame Plate #810, Canopy Mounting Post #811 and Top Servo Mount Stay #411 to left and right frame assemblies using eight pan hd. screws #223 and eight locking nuts #243. Assemble, but do not fully tighten nuts at this stage. See Figure 3.
- ✓ D. Place Transverse Lever Assembly from STEP 1 between side frames, arms extending through rectangular holes in upper part of side frames. Threaded pitch shaft should be on the right (starboard) side of the helicopter. See Figure 3.
- ✓ E. Tighten all screws and nuts while holding main frames together as much as possible and checking, on a flat surface, that the whole assembly is square.
- ✓ F. Fasten Lower Servo Mount Stay #411 to Front Plate #810 as shown in Figure 3.

STEP 4 ENGINE AND MAIN DRIVE INSTALLATION - see Figure 4

From Bag #3, take the following:

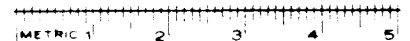
- ✓ 1 #815 Main Shaft
- ✓ 2 #424 Bearing Block and Bearing
- 1 #427 10 x 15 x 3.5mm Collar
- 1 #416 Main Gear

From Bag #6, take the following:

- ✓ 1 #413 Steel Main Shaft Collar

From the hardware dish, take the following:

- ✓ 6 #274 4 x 10mm skt. hd. screws
- ✓ 6 #261 4mm flat washers (Large)
- ✓ 8 #231 3 x 10mm skt. hd. screws
- ✓ 1 #233 3 x 25mm skt. hd. screws
- 2 #252 4 x 4mm set screws
- 1 #243 3mm lock nut
- 10 #276 3mm flat washers



- ✓ A. Place the engine assembly into the frame.
- ✓ B. Fasten engine assembly between frames using six 4 x 10mm skt. hd.screws #274 and six heavy 4mm flat washers #261. FINGER TIGHTEN ONLY.
- ✓ C. Before installing Bearing Block Assembly #424, lubricate bearings with good grade of light bearing grease or a 140 weight oil.
- ✓ D. Fasten top Main Shaft Bearing Block #424 between frames in uppermost holes with open side of bearing up, using four 3 x 10mm skt. hd. screws #231, with a 3mm Washer #276 under each screw head. DO NOT TIGHTEN.
- ✓ E. Fasten bottom Main Shaft Bearing Block #424 between frames in lower holes

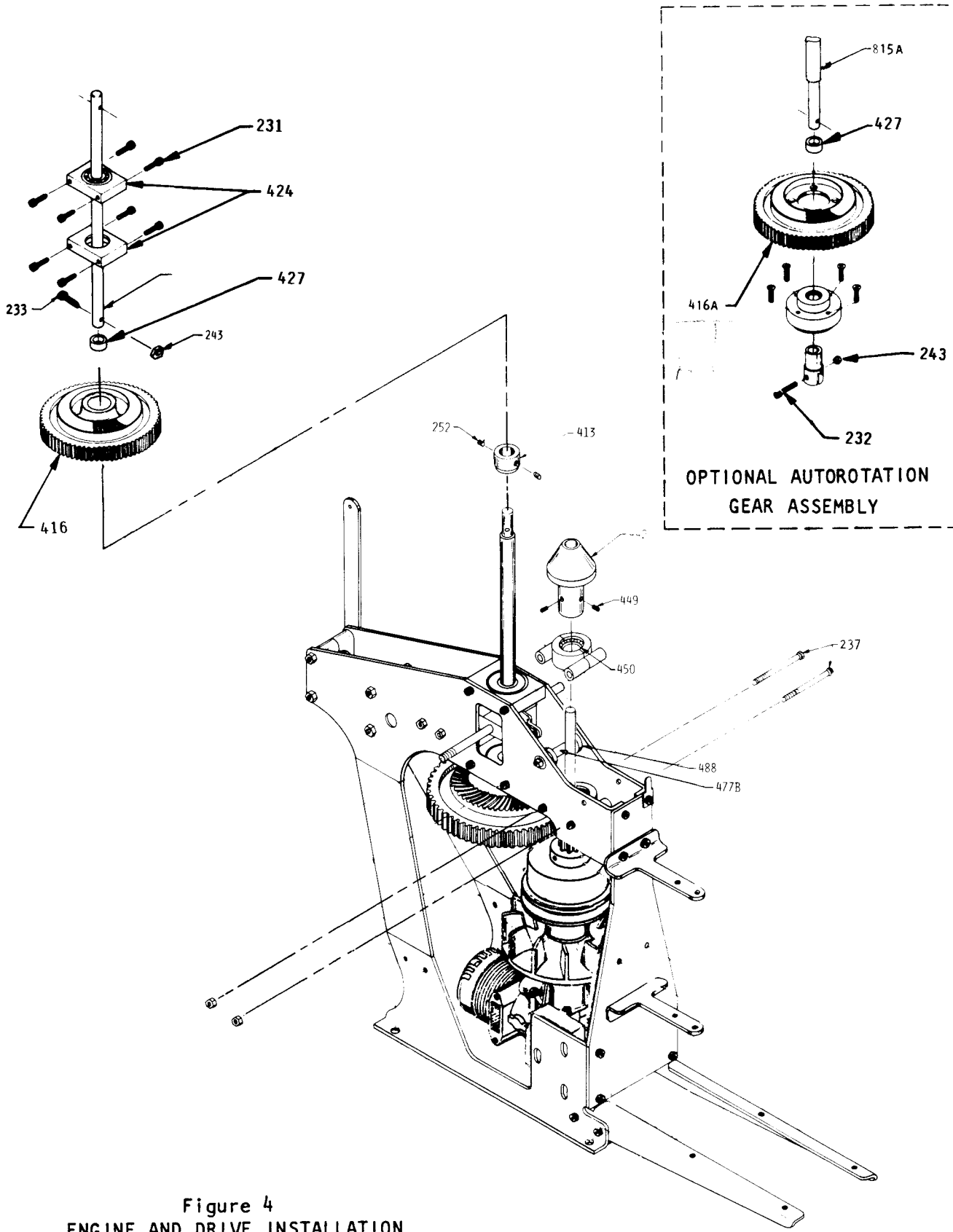


Figure 4
ENGINE AND DRIVE INSTALLATION

with open side of bearing down, using four 3 x 10mm skt. hd. screws #231 with a 3mm Washer #276 under each screw head. DO NOT TIGHTEN.

- ✓ F. Slip Main Shaft #815 down through bearing blocks and center of transverse lever to insure proper alignment of bearings. Some oil on shaft may help. Tighten all eight screws securely. USE LOCKTITE.
- ✓ G. Raise the main shaft far enough to allow the fitting of the Brass Collar #427, followed by the Main Gear #416 onto the lower end of the main shaft. Collar should be on top of the gear.
- ✓ H. Fasten gear to main shaft with 3 x 25mm skt. hd. screw #233 and a 3mm lock nut #243 with a 3mm washer #276 under the screw head and nut. Tighten firmly but don't over torque.
- ✓ J. Place Main Shaft Collar #413 on main shaft and secure with two 4 x 4mm skt. hd. set screws #252 while pulling up on main shaft and pushing down on the collar. USE LOCKTITE. There should be zero up-and-down play on the main shaft after this step.

STEP 4A ENGINE AND MAIN DRIVE INSTALLATION - continued - see Figure 4

From Bag #3, take the following:

- ✓ 1 #442 Starting Cone

From Bag #4, take the following:

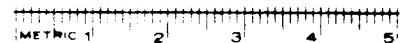
- ✓ 1 #450 Bearing
- ✓ 2 #451 Plastic Bearing Holders

From Bag #5, take the following:

- ✓ 2 #488 Collective Lever Shaft Collars
- ✓ 1 #477B Collective Lever Shaft
- ✓ 2 #487 Plain Bearing

From the hardware dish, take the following:

- ✓ 2 #237 3 x 35mm Skt. hd. screws
- ✓ 2 #243 3mm lock nuts
- ✓ 4 #287 3 x 3mm set screws
- ✓ 4 #276 3mm flat washers



- ✓ A. Fit the Bearing #450 between two plastic Bearing Holders #451.

- ✓ B. Lubricate bearing with a good grade of light bearing grease of a 140 weight oil.
- ✓ C. Place bearing assembly, with raised portion up, on clutch shaft. See drawing.
- ✓ D. Fasten bearing assembly in place between the main frames with two 3 x 35mm skt. hd. screws #237 and two 3mm lock nuts #243. Fit one 3mm flat washer #276 under each screw head and under each 3mm lock nut.
- ✓ E. Before tightening clutch shaft bearing assembly, adjust gear mesh by placing a piece of typing paper between gears then tighten all four bearing block screws and all six motor mount screws securely. Remove paper by turning gears. Gears should mesh and rotate smoothly. If there is any eccentricity then the notepaper check should be repeated with the gear meshing at their tightest point.
- ✓ F. Using epoxy glue (preferably 30 minute type), glue the two Bearings #487 into the holes on the side frames with flange of bearing on the inside. Make sure there is no grease or oil on the surfaces to be glued. See drawing. Do not wait for glue to dry but immediately fit Collective Lever Shaft #477B through both bearings with Collective Lever Shaft Collars #488 between bearings. Slide collars against bearing flange and fasten with a 3 x 3mm set screw #287.
- ✓ G. Check that Collective Lever Shaft #477B rotates freely. If not, adjust Collars #488 until it does. Lubricate bearings with a light oil.
- ✓ H. Mount Starting Cone #442 on clutch shaft and secure with two 3 x 3mm skt. hd. set screws #287. The starting cone should just rest on top of bearing. Tighten well. USE LOCKTITE.

STEP 5 COOLING SYSTEM - see Figure 5

From the Fan Shroud bag, take the following:

- ✓ 1 #557S Split Fan Shroud
- ✓ 1 #557S-1 Shroud Mounting Bracket
- ✓ 7 #266 #4 x 3/8 wood screws

- ✓ A. Fit the two Cooling Shroud Halves #557S between the main frames and around the fan. The two bosses on the sides of the shroud may have to be trimmed so it can fit between the frames.
- ✓ B. Fasten the two shroud halves together with five #4 x 3/8" Wood Screws #266. The front lower screw goes through the left half, then through the mounting bracket and into the right side. A new hole will have to be drilled in the bracket so that the fan shroud touches the front frame.
- ✓ C. Attach the Mounting Bracket #557S-1 to the front frame, using a 3 x 10mm skt. hd. screw and a 3mm lock nut. a 1/8" dia. hole will have to be drilled in the front frame.
- ✓ D. Attach the cooling shroud to the main frame using two #4 x 3/8 wood screws #266.

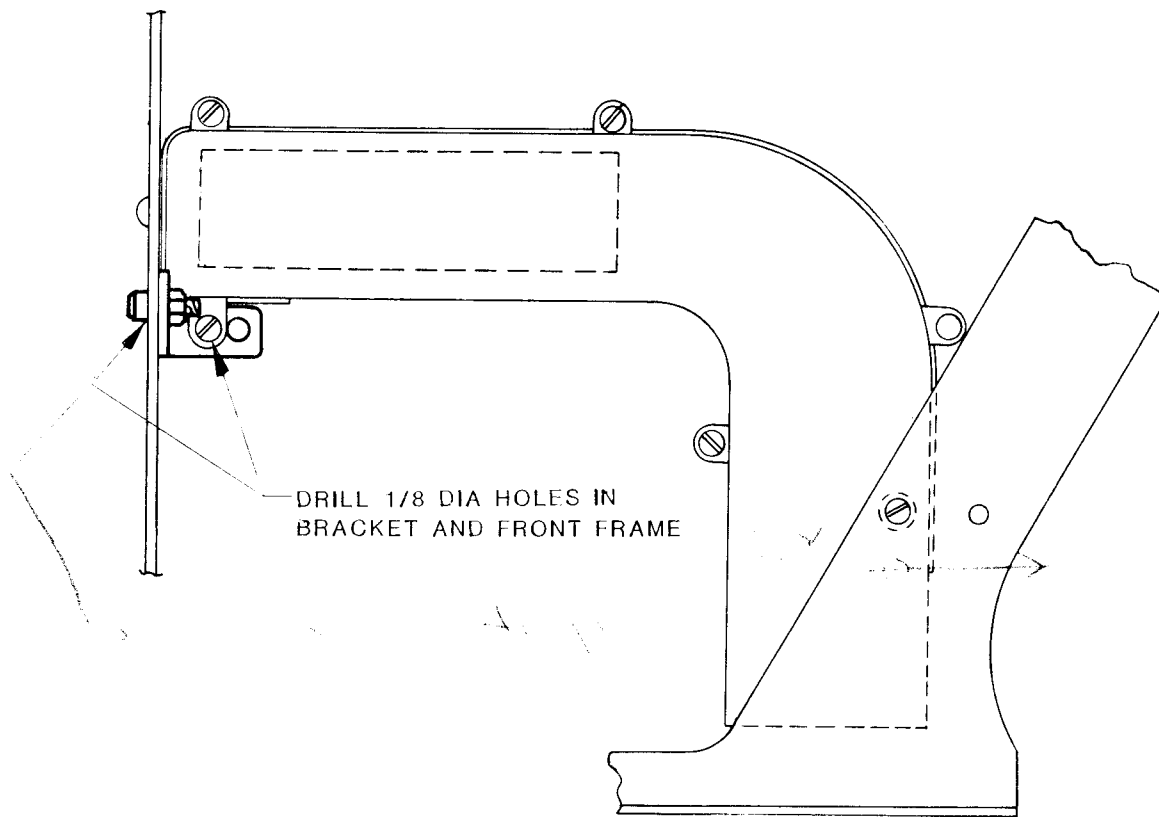


Figure 5
COOLING SHROUD DETAIL

STEP 6 COLLECTIVE MECHANISM ASSEMBLY - See Figure 6.

From Bag #5, take the following:

- ✓ 1 #471 Collective Pitch Lever A
- ✓ 1 #472 Collective Pitch Lever B

- ✓ 2 #486 6mm Plain Bearing
- ✓ 2 #481 Brass Pitch Collars
- ✓ 1 #483 Aluminum Spacer
- ✓ 1 #476 Plastic Roll Lever
- ✓ 1 #475 Pitch Torque Lever

From the hardware dish, take the following:

- ✓ 2 #258 3 x 6mm skt. hd. screws
- ✓ 2 #276 3mm flat washers
- ✓ 1 #278 4 x 8 x 0.5mm flat washer
- ✓ 1 #275 4mm Lock nut
- ✓ 4 #211 5mm balls
- ✓ 4 #221 2 x 10mm pan hd. screws
- ✓ 4 #241 2mm nuts
- ✓ 2 #288 4 x 6mm set screws
- ✓ 4 #262 2mm flat washers

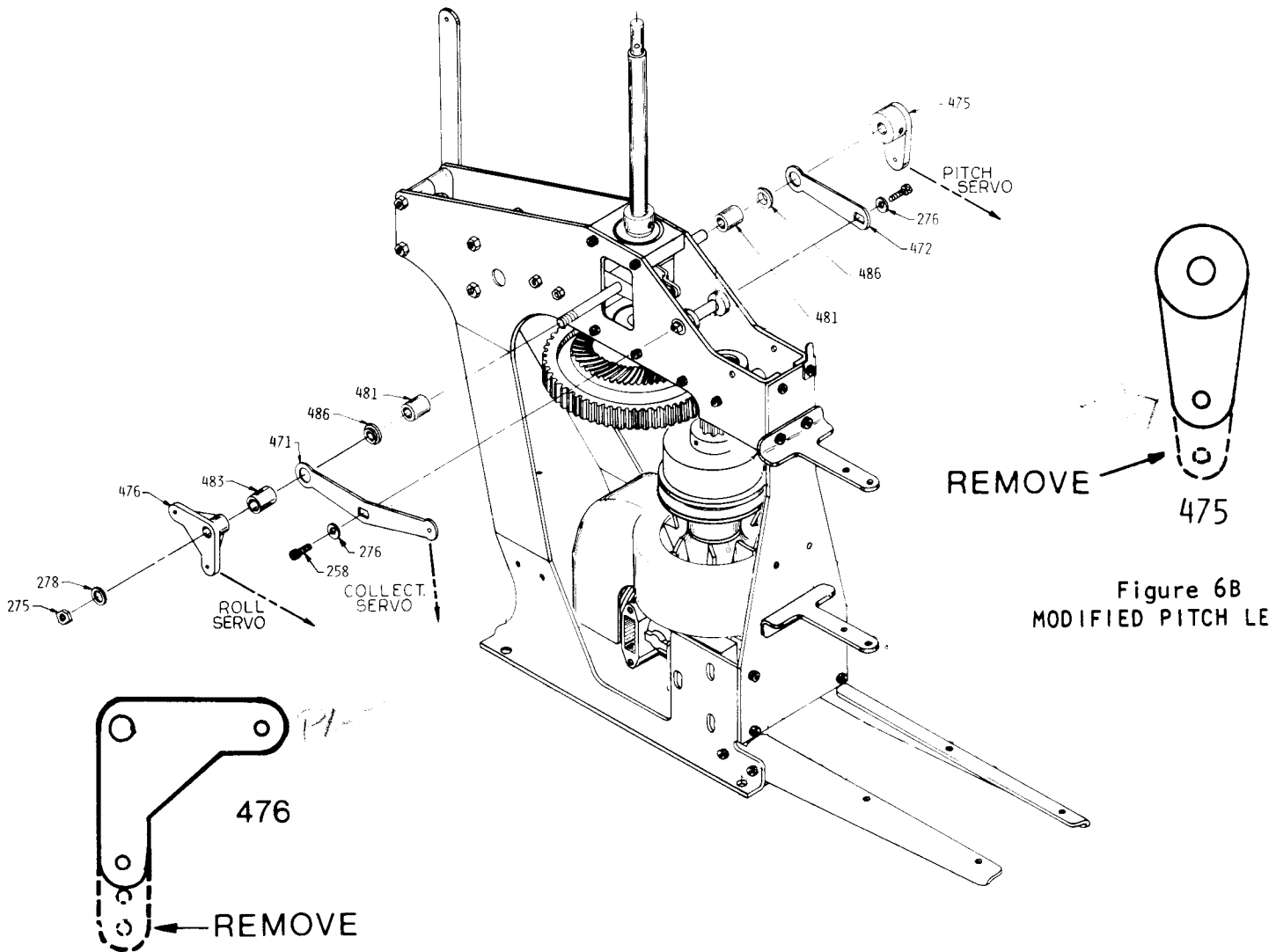
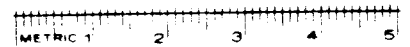


Figure 6A
MODIFIED ROLL LEVER

Figure 6
COLLECTIVE AND CYCLIC CONTROL MECHANISM ASSEMBLY

Figure 6B
MODIFIED PITCH LE

- ✓ A. Epoxy one Bearing #486 into each Collective Pitch Lever 'A' & 'B' #471 and #472. Bearing must be on inside towards frame. See sketch. Do not forget to thoroughly degrease and clean surfaces of bearing and lever so that the epoxy will hold properly.
- ✓ B. Place Brass Pitch Collars #481 onto each Transverse Pitch Shaft #479 and #480. Make sure that small shoulders of collars face outwards.
- ✓ C. Fit Collective Pitch Lever B (short) #472 on to the left transverse pitch shaft, and Collective Pitch Lever A (long) #471 on to the right transverse pitch shaft. Note that the curve or set of the long lever must be upwards, not downward (see exploded view). Fasten both collective pitch levers to Collective Lever Shaft #477B using two 3 x 6mm skt. hd. screws #258 and two 3mm flat washers #276. USE LOCKTITE.
- ✓ D. On the right side; place the Aluminum Spacer #483 onto the Transverse Pitch Shaft #479.
- ✓ E. Take the plastic Roll Lever #476 (figure 6A) and remove (cut) the section which contains the second and third holes from long leg (lever will now have only one hole on this leg). Place plastic roll lever on collective transverse shaft followed by the 4mm flat washer #278 and 4mm lock nut #275. Tighten nut so that roll lever can move freely, but with very little end play.
- ✓ F. Remove the lower hole and surrounding material from end of Pitch Torque Lever #475 (see Figure 6B).
- ✓ G. On left side, fasten Pitch Lever #475 to pitch shaft with two 4 x 6mm skt. hd. set screws #288. Pitch lever must be perpendicular to transverse mechanism. USE LOCKTITE.
- ✓ H. Fasten the four 5mm balls #211 using 2 x 10mm pan head screws #247, 2mm nuts #241 and 2mm flat washers #262 in the following locations (see Figure 6 for details):

2 balls on plastic Roll Lever #476 in the outermost holes
 1 ball on Pitch Torque Lever #475 - USE LOCKTITE
 1 ball on Collective Lever #471 - USE LOCKTITE

The balls on the roll lever should both face inward. DO NOT USE LOCKTITE. USE SUPER GLUE ON NUT AFTER ASSEMBLING.

The ball on the pitch torque lever should face outwards - away from the hub.

The ball on the collective lever should face outwards.

STEP 7 TAIL GEAR DRIVE ASSEMBLY - see Figure 7

From Bag #4, take the following:

- ✓4 #455 Tail Boom Mounts
- ✓1 #444 Tail Gear Drive Assembly

✓2 #452 Bearing Holders

From Bag #2, take the following:

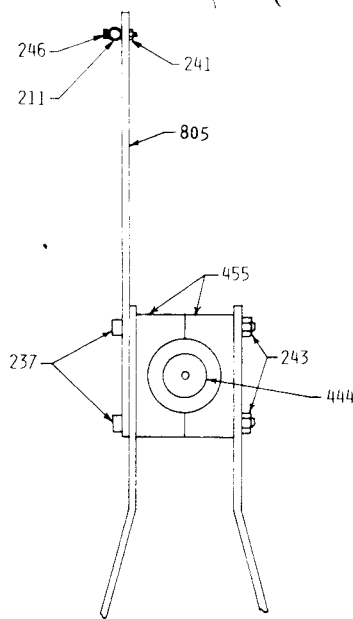
✓1 #805 Radius Arm Stay

From the Hardware dish, take the following:

- ✓6 #237 3 x 35mm skt. hd. screws
- ✓6 #243 3mm lock nuts
- ✓4 #276 3mm flat washers



- ✓A. Install plastic Tail Boom Mounts #455 between side frames using four 3 x 35mm skt. hd. screws #237 and four 3mm lock nuts #243. Radius Arm Stay #805 must be retained on the left side of the helicopter by these same screws. DO NOT TIGHTEN.
- ✓B. Mount Tail Gear Drive Assembly #444 between two plastic Bearing Holders #452.
- ✓C. Fasten the whole unit in position between side frames with two 3 x 35mm skt. hd. screws #237 and two 3mm lock nuts #243. Fit one 3mm flat washer #276 under each screw head and under each 3mm lock nut. Set gear mesh as close as possible without binding. Also check, by viewing from the rear through the Tail Boom Mounts #455 that the tail drive gear coupler is centered in the tail tube. Tighten nuts securely but do not overtorque.



REAR VIEW OF
SIDE FRAMES

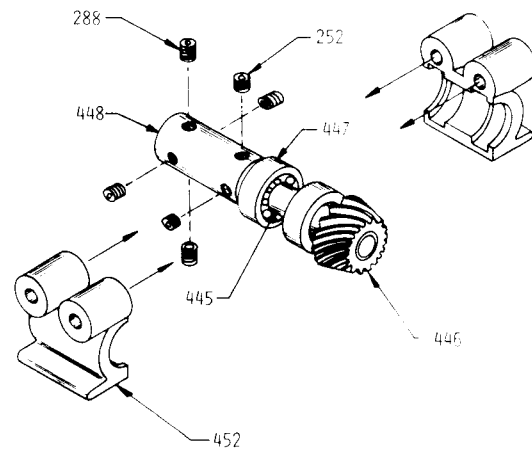


Figure 7
TAIL GEAR DRIVE ASSEMBLY

✓STEP 8 LANDING GEAR ASSEMBLY - see Figure 8

✓From Bag #1, take all contents:

- ✓ 2 #101 Skids
- ✓ 2 #802 Struts
- ✓ 4 #110 Skid Clamps

From the hardware dish, take the following:

- ✓ 4 #223 3 x 10mm pan hd. screws
- ✓ 4 #231 3 x 10mm skt. hd. screws
- ✓ 8 #243 3mm lock nuts



- A. Fasten Landing Struts #802 to side frames using four 3 x 10mm pan hd. screws #223 and four 3mm lock nuts #243. Tighten securely.
- B. Slide two skid clamps #110 over each skid #101.
- C. Fasten skids to struts with four 3 x 10mm skt. hd. screws #231 and four 3mm lock nuts #243. Rear of skids should extend 2 1/4 inches from the rear edge of the rear skid clamp.

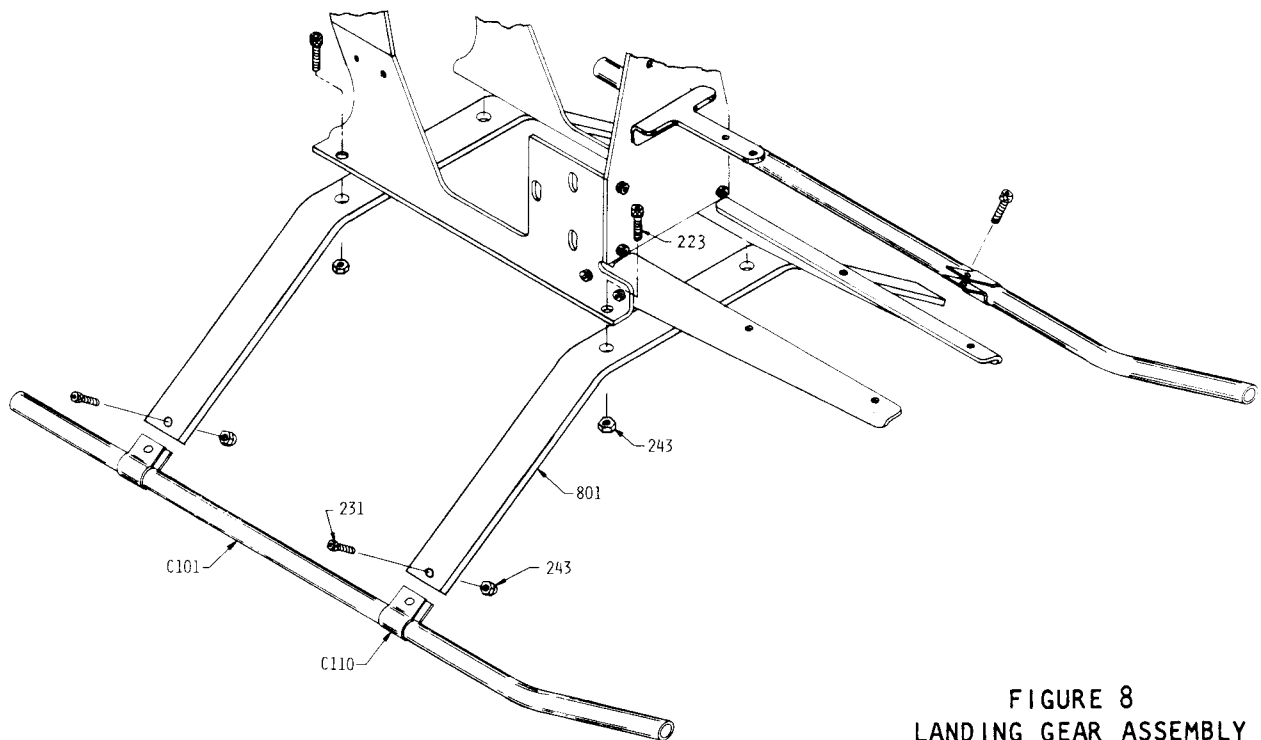


FIGURE 8
LANDING GEAR ASSEMBLY

STEP 9 - SWASHPLATE ASSEMBLY - see Figure 9

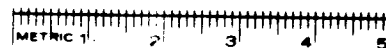
From Bag #6, take the following:

- ✓ 1 #509 Mast Lock
- ✓ 1 #510 Pivot Arm
- ✓ 1 #511 Control Arm
- ✓ 2 #512 Radius Arms
- ✓ 2 #513 Brass Collars

- ✓ 1 #656 Swashplate Assembly
- ✓ 2 #566 2 x 11.8 Needle Pins
- ✓ 4 #545 Pivot Bolt 'D' (short)
- ✓ 4 #546 Pivot Bolt 'E' (long)

From the hardware dish, take the following:

- ✓ 1 #211 5mm ball
- ✓ 1 #241 2mm nut
- ✓ 1 #242 3mm nut
- ✓ 2 #245 2 x 6mm pan head screws
- ✓ 1 #246 2 x 8mm pan head screw
- ✓ 1 #249 2 x 16mm pan head screw
- ✓ 1 #223 3 x 10mm pan head screw
- ✓ 4 #262 2mm flat washers



- A. Screw four Pivot Bolts 'E' (long) #546 into the upper ring of the Swashplate #656. USE LOCTITE.
- B. Screw four Pivot Bolts 'D' (Short) #545 into the lower ring of the swashplate. USE LOCTITE.
- C. Lubricate the swashplate assembly from the underside with a small amount of light oil.
- ✓ D. Place the Mast Lock #509 inside the Pivot Arm #510. Insert the Brass Collars #513 into the Pivot Arm #510. Fasten with a 2 x 16mm pan head screw #249 and 2mm nut #241. Fit one 2mm flat washer #262 under each screw head and nut. USE LOCTITE.
- ✓ E. Spread the legs of the Control Arm #511 and place over the Pivot Arm #510. Fasten with two 2 x 6mm pan head screws #245 and 2mm flat washers #262.
- F. Attach the two Radius Arms #512 to the Pivot Arm #510 and the Control Arm #511 as shown in the drawing using two Needle Pins #566. The needle pins are pressed in and need no further fixing if fitted properly. Check that the whole assembly can move freely.
- ✓ G. Attach a 5mm Steel Ball #211 to the Control Arm #511 using a 2 x 8mm pan head screw #246.

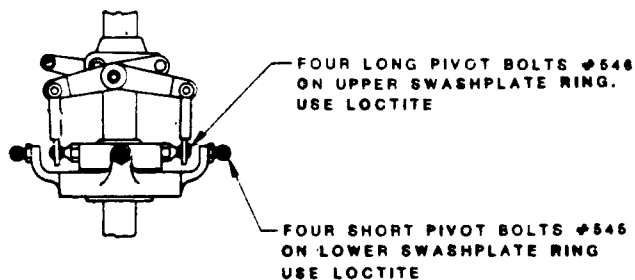
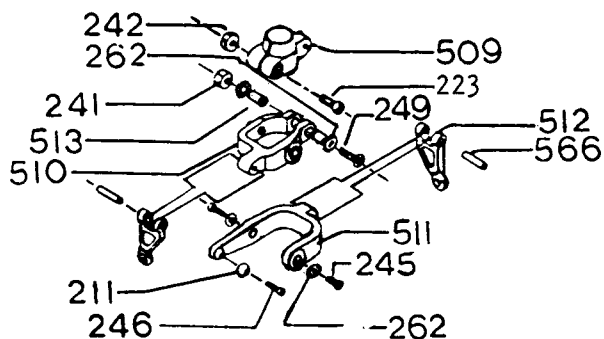


Figure 9
SWASHPLATE AND WASHOUT CONTROL ASSEMBLY

- H. Attach the radius arms on the washout control assembly to the balls on the upper swashplate ring.
- J. Slide the whole assembly over the main shaft and fasten with a 3 x 10mm pan head screw #223 and 3mm nut #242. DO NOT USE LOCTITE.

STEP 10 COVERING AND BALANCING OF MAIN ROTOR BLADES - see Figure 10

From the box take the following:

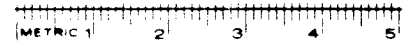
- ✓ Main Rotor Blades and Covering

From Bag #7 take the following:

- ✓ 2 #531 Plastic Blade Ends
- 1 Yoke/Blade Holder Unit (factory assembled)

From the hardware dish, take the following:

- ✓ 2 #234 3 x 20mm skt. hd. screws
- 2 #240 4 x 30mm skt. hd. screws
- 2 #243 3mm lock nuts
- 2 #275 4mm lock nuts



- ✓ A. The rotor blades provided in the "Cobra" kit are a standard large size and must be cut to length depending on engine used.

For 0.40 - 0.45 engines, each blade length should be 21 1/8 inches. This will result in a total rotor span of 48 1/2 inches.

For 0.50 engines, each blade length should be 21 3/8 inches. This will result in a total rotor span of 49 inches.

- ✓ Cut the blades squarely using a razor saw or small hand or power saw and sand the tip smooth. Do not make a mistake and cut the end with the holes in it. Make sure that both blades are exactly the same length.

- ✓ B. Lightly sand the leading edge of the blades to remove any sharp edges.

- ✓ C. Reinforce root end of main rotor blades (ends with holes). First sand the top and bottom surfaces where the plastic blade ends are fitted but remove only enough wood to make up for the increase in thickness added by the reinforcing material. If you do not do this the blade end can finish up too thick to fit properly into the plastic blade ends, thus overstressing them. One method to reinforce the blade ends is to take some light weight 3/4 oz. fiberglass cloth and wrap one layer around the first 3 inches of the blade, top and bottom. Attach the cloth to the blades by saturating it with instant or cyanoacrylate glue. When dry trim and sand the reinforced end. You must use very thin cloth or the plastic blade ends to be fitted in the next step will be overstressed when fitted onto the blades.

- ✓ D. Fasten plastic Blade Ends #531 onto blades with 30 minute epoxy glue and secure with one 3 x 20mm skt. hd. screw #234 and a 3mm lock nut #243. Make sure that both holes in the blade end are aligned with the appropriate holes in the rotor blade before the glue sets.
- ✓ E. Covering the blades: The blades should be covered with the vinyl film provided in the kit or you can go down to your hobby shop or hardware store and choose the color and texture of your choice. Please, however, do cover the blades because this adds considerably to the 'along the grain' strength. It is recommended that you do not operate the helicopter without blade covering. Before applying the vinyl it is advisable to lightly spray fuel-proof paint on the first three or four inches of the blades at the blade holder end and the outer tip of blade to keep fuel from soaking into the wood. To cover the blades, strip the paper backing from the vinyl covering and hold one blade up with your finger and thumb in front of you, with the trailing edge to the right and the plastic hub blade end at the bottom. Now, with the sticky part of the covering facing away from you, overlap the trailing edge of the blade facing you by about 1/2 inch, attaching it at the top or end of the blade first and then carefully let the blade covering stick to the trailing edge underneath until you have the full length fully covered with 1/2 inch of covering. Smooth down carefully with the fingers and then you can take the blade horizontally in your hand and fold the covering over the top surface of the blade, making sure there is a sharp crease at the trailing edge. If handled gently and carefully, covering a blade is very easy. It can be made difficult if the covering is pulled hard in some places and not in others. So be very careful to just gently smooth the covering over the blade rather than pulling it too tightly.

After the top surface is covered, the covering can be wrapped around the leading edge carefully and pulled underneath the blade again until it overlaps the first 1/2 inch seam that we made at the very beginning. Smooth out all wrinkles and bubbles before pressing the covering down hard.

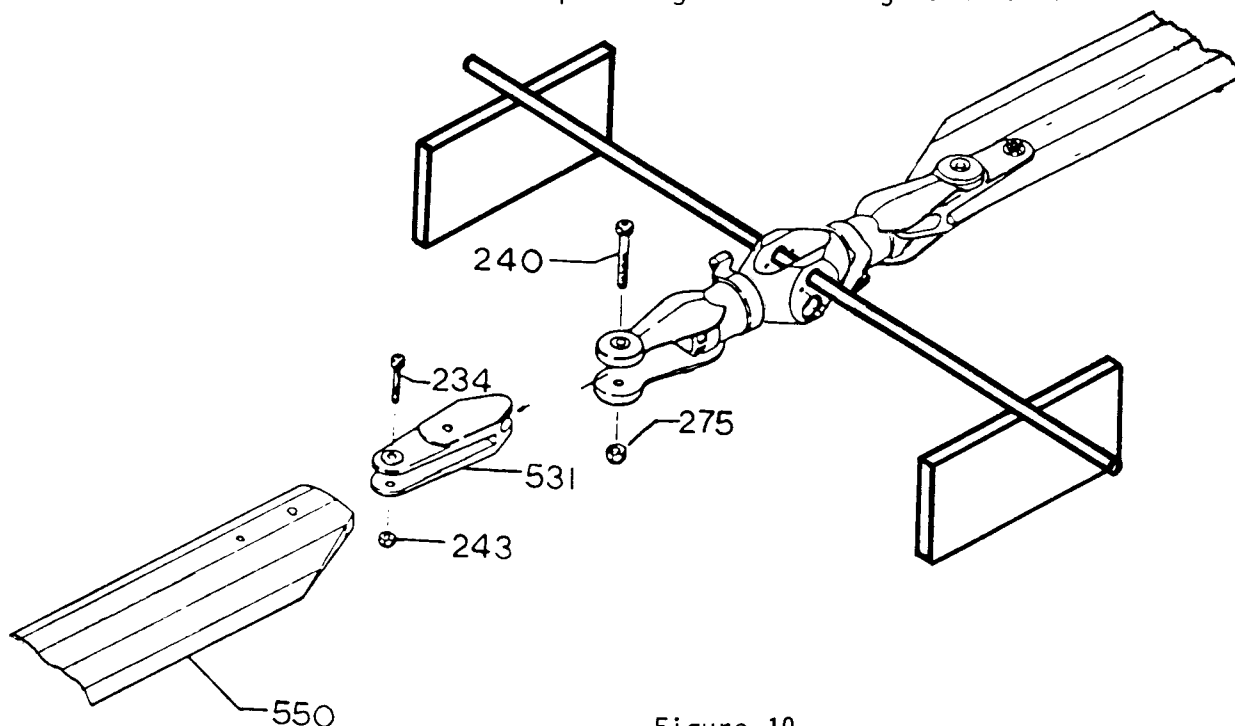


Figure 10
BALANCING MAIN BLADE ASSEMBLY

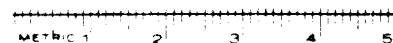
- ✓ F. Mount both blades to the factory assembled yoke/blade holder unit using 4 x 30mm skt.hd. screws #240 and 4mm lock nuts #275.
- ✓ G. To balance head, first make sure blades are parallel to the head. Place a suitable round axle through either large set of holes in the head and suspend in a "Hi-Point" balancer or other suitable balancer. A round tube or pencil and two straight edges of metal or ply will also do the job. (See Figure 10.)
- ✓ H. Cut some 1 inch wide by 5 inch long pieces of colored vinyl film or Monokote Trim and wrap the outer end of the lightest blade at the tip. Repeat again if necessary until blades are balanced. Set head and blade assembly aside.

STEP 11 ROTOR HEAD ASSEMBLY - see Exploded View

From Bag #7, take the following:

- | | |
|------------------------------|--|
| ✓ 1 #530C Rotor Hub | ✓ 2 #566 2x11.8mm Needle Pins |
| ✓ 1 #533 Seesaw Pivot Arm | ✓ 2 #535 Mixing Arm Holders |
| ✓ 2 #532 Flybar Paddles | ✓ 2 #534 Seesaw Bearing Holders |
| ✓ 1 #567 3x15.8mm Needle Pin | ✓ 2 #538 Plastic Dust Caps |
| ✓ 2 #541 Needle Bearing | ✓ 2 #548 Flanged Ball Bearings |
| ✓ 1 #543 Damper Rubber | ✓ 1 #565 4x29.8mm Needle Bearing |
| ✓ 2 #549 Pivot Bolts | ✓ 1 #539 Yoke Damper Collar (A) |
| ✓ 2 #536 Mixng Arms | ✓ 1 #540 Yoke Damper Collar (B) (threaded) |
| ✓ 2 #542 Flybars | ✓ 2 #537 Gimbal Shaft Bearing |
| ✓ 1 #520 Seesaw | |

From the hardware dish, take the following:



- | | |
|--------------------------|--------------------------------|
| ✓ 1 #211 5mm ball | ✓ 1 #233 3x25mm skt. hd. screw |
| ✓ 4 #241 2mm nuts | ✓ 2 #278 4mm flat washers |
| ✓ 1 #252 4x4mm set screw | ✓ 1 #246 2x8mm pan hd. screw |
| ✓ 5 #288 4x6mm set screw | ✓ 4 #245 2x6mm pan hd. screw |
| ✓ 2 #275 4mm lock nut | ✓ 4 #248 2x14mm pan hd. screw |

Note: as you proceed through these steps make sure that all parts move freely but without any excessive play.

- ✓ A. Remove grease or oil from the two Gimbal Shaft Bearings #537. Glue the bearings, flanges to the inside, into the holes using a slow setting epoxy. **(DON'T STOP - GO TO NEXT STEP BEFORE EPOXY SETS.)**
- ✓ B. Slide the 3mm Needle Pin #567 through bushings with Seesaw Pivot Arm #533 in place while epoxy is curing.
- ✓ C. Secure the needle pin in place with 4 x 4mm set screw #252 in top of seesaw pivot arm. USE LOCKTITE.
- ✓ D. Lubricate Damper Rubber #543 and insert into large hole in Rotor Hub #530C. (Note: use Vaseline or any vegetable based grease for this step but don't

overlook it since an unlubricated rubber bush can lead to severe vibrations in your helicopter.)

- ✓ F. Place one flanged Ball Bearing #548 onto each threaded stub of Seesaw Pivot Arm #533, flanges facing in.
- ✓ G. Thread onto the same seesaw pivot arm threads two plastic Mixing Arm Holders #535, tighten against bearings and position them both to be parallel to rotor hub and in line with each other (see explodview of rotor head).
- ✓ H. Fit two Mixing Arms #536 into the plastic Mixing Arm Holders #535 using the two 2 x 11.8mm Needle Pins #566.
- ✓ J. Carefully coat the outside rims of the two Ball Bearings #548 with a small amount of SILICONE.
- ✓ K. Place rotor head assembly into cradles of Seesaw #520 and secure with Seesaw Bearing Holders #534 and four 2 x 14mm pan head screws #248 and four 2mm nuts #241. The bearing holders will be on the underside and the seesaw on top - see exploded view of rotor head. USE LOCKTITE..
- ✓ L. Fasten a 5mm Ball #211 to side of seesaw with a 2 x 8mm pan head screw #246. USE LOCKTITE.
- ✓ M. Press two Needle Bearings #541 into Rotor Head Yoke #522 until just flush with inside surface of yoke. They must not project beyond the inside surface.
- ✓ N. Place rotor hub assembly into yoke, and slide a 4 x 29.8mm Needle Pin #565 through bearing and hub, placing a 4mm flat washer #278 on either side of hub as the pin goes through to space it equally between the yoke (see exploded view of rotor head).
- ✓ O. Secure needle pin with 4 x 6mm set screw #288 through side of rotor hub. Do not overlook this step. USE LOCKTITE.
- ✓ P. Lubricate Needle Bearings #541 with a heavy weight oil or light grease. Place two plastic Dust Caps #538 over needle bearings. Fasten with four 2 x 6mm pan head screws #245. USE LOCKTITE.
- ✓ Q. Place Yoke Damper Collars #539 and #540 into Yoke #522. Secure with 3 x 25mm skt. hd. screw #233. One of the Damper Collars, #540, is threaded and will act as a nut. USE LOCKTITE.
- ✓ R. Screw two Pivot Bolts #549 onto Blade Holder #521 as per drawing. Make sure that they are torqued down firmly but remember that the blade holders are made of aluminum so be careful not to 'strip' the threads in the blade holder. **USE RED LOCKTITE.** Be sure to rotate the blade holders so that each pivot bolt faces the direction of rotation of the head - see Exploded View. Install the two Flybars #542 into Seesaw #520. The end with the short threads goes into the seesaw. Secure with 4mm lock nut #275 from inside of seesaw. Nut must be threaded all the way on. Pull both flybars out so that nut rests firmly against the seesaw and then secure with four 4 x 6mm set screws #288. USE LOCKTITE.

✓ S. Screw Flybar Paddles #532 onto flybars until the flybar screw threads just protrude into the square opening in the paddles. Flybar paddles have carefully tapered unthreaded holes that will allow them to tap themselves as they are threaded on. They should be set so as to be parallel to the seesaw and with the leading edge facing the direction of rotation (clockwise when viewed from the top).

✓ T. Balance the flybar by removing the main rotor blades temporarily. (note which side each blade comes from so that it can be replaced on the same side.) Now adjust the position of the paddles until the flybar assembly is equal weight on each side. If you prefer you can fit one wheel collar on each flybar and slide these collars in or out to achieve a good balance of the flybar unit. Replace the main rotor blades. Torque the 4mm nuts so that the blades will be "friction tight" and will not "flop" around when the helicopter is tilted slightly.

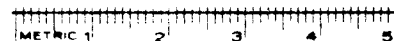
STEP 12 TAIL ROTOR GEAR BOX ASSEMBLY - see Exploded View

From bag #4 take the following:

✓ 1 #863	Tail Rotor Assembly	✓ 1 #462	Tail Rotor Hub
✓ 1 #465	Tail Rotor Pitch Plate	✓ 1 #453	Tail Gearbox Mount
✓ 2 #456	Tail Rotor Pitch Hinge	✓ 2 #457	Thrust Bearing Set
✓ 1 #163F	7x7mm Brass Collar	✓ 2 #459	Ball Bearing
✓ 4 #164CP	Tail Blade Holder	✓ 2 #461	2x8.8mm Needle Pin
✓ 1 #448	Drive Coupler 'A'		

From the hardware dish, take the following:

✓ 2 #211	5mm ball	✓ 4 #241	2mm nut
✓ 6 #221	2x10mm pan hd. screw	✓ 2 #276	3mm flat washer
✓ 2 #251	3x5mm set screw	✓ 2 #570	ball link
✓ 2 #287	3x3mm set screw	✓ 2 #259	3mm lock nut (red)
✓ 2 #252	4x4mm set screw		



✓ A. Slide Drive Coupler 'A' #448 onto the input shaft of the Tail Rotor Assembly #863 and fasten with two 4x4mm set screws #252. USE LOCKTITE

✓ B. Grip the Tail Rotor Assembly #863 in a vice or pliers by the Tail Drive Coupler #448, which is already attached.

✓ C. Insert Brass Collar #163F over the threaded end of the gearbox output shaft. Make sure there is no grease or oil on the shaft or on the threaded hole in the Tail Rotor Hub #462.

✓ D. Thread Tail Rotor Hub #462 onto gearbox output shaft. **Threads are left handed.** That is, you tighten up by twisting in an anti-clockwise direction. Tighten securely. USE LOCKTITE.

✓ E. Assemble tail rotor blade bearings onto each of the threaded studs of the tail rotor hub in the following sequence:

Thrust Bearing Washer (groove out)	
Thrust Bearing	#457
Thrust Bearing Washer (groove in)	
3mm Flat Washer	#276
Ball Bearing	#459
3mm Lock Nut	#259

Note: ✓ The two 3mm lock nuts are a special length so that they fit the inside of the plastic blade holders without fouling. If you use any other type of lock nut you may have to relieve the inside of the blade holders a little but be very careful so as not to reduce their strength.

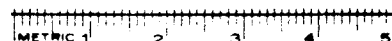
- ✓ F. Lubricate the bearings with light grease or 140 weight oil.
- ✓ G. Fasten plastic Blade Holders #164CP around bearing assemblies using four 2 x 10mm pan head screws #221 and four 2mm nuts #241. NOTE: each pair will include one holder with ball link holder projection. USE LOCKTITE on the 2mm nuts - not on the plastic. Check that the blade holders rotate freely without any binding after tightening screws.
- ✓ H. Attach two 5mm Balls #211 to blade holder assemblies with two 2 x 10mm pan head screws #221.
- ✓ J. Pin two Pitch Hinges #456 into ends of Pitch Plate #167CP using two 2 x 8.8mm needle pins #461.
- ✓ K. Thread two Ball Links #570 all the way onto Pitch Hinges #456.
- ✓ L. Thread two 3 x 3mm set screws #287 into the pitch plate collar.
- ✓ M. Fit the pitch plate assembly onto the pitch rod and tighten the set screws. USE LOCTITE.
- ✓ N. Snap ball links on pitch plate assembly onto the 5mm balls on the blade holders. Balls must be on the leading edge as unit rotates in clockwise direction, viewed from the blade side.
- ✓ O. Fasten Tail Gearbox Mount #453 to gearbox assembly with two 3 x 5mm set screws #251. Webs on mount should be horizontal. USE LOCKTITE.

STEP 13 COVERING AND BALANCING THE TAIL ROTOR BLADES

Take the Tail Rotor Blades from the kit box.

From the hardware dish, take the following:

- ✓ 2 #243 3mm lock nuts
- ✓ 2 #232 3x16mm skt. hd. screws



- A. Cut both tail blades to the following lengths, as you did for the main rotor blades in Step 10A:
 - 40 - 45 engine: 4 1/4 inches (10.25" dia.)
 - 50 engine: 4 3/8 inches (10.5" dia.)
- B. Proceed with sanding, painting and covering the tail rotor blades the same as you did in STEP 10 for the main rotor blades. It is not necessary to cover the roots with fiberglass cloth but a light soaking with cyanocrylate glue around the hub hole and the tips will help to extend the life of the blades.
- C. Cover the blades with vinyl film or Monocote Trim. As with the main blades, do not use them uncovered.
- D. To balance the tail rotor blades, use a "Hi-Point" balancer or use a metal rod which is a stiff push fit through the mounting holes and check the balance by resting the ends of this rod on two thin edges just as you did with the main rotor blades. Adjustment can be made by adding more covering to the lighter blade or by drilling 1/16" dia. holes in the end of the heavier blade.
- E. Mount the blades on the tail rotor assembly so that when the blades turn clockwise (viewed from the left hand side of the model) the leading, or rounded, edge rotates ahead and the surface towards you is the rounded one.

STEP 14 TAIL BOOM ASSEMBLY - see Figure 11

From the wood parts bag #8 take the following:

3 Wood Disks

From the box take the following:

- 1 #854 1/8 inch Tail Drive Tube (brass)
- 1 #553 Tail Drive Wire
- 1 #852 Tail Boom
- 1 #582 Tail Strut Kit

From Bag #4 take the following:

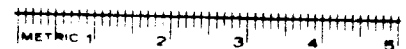
- 1 #454 Tail Gearbox Clamp - "hose clamp"

From Bag #5, take the following:

- 1 #485 Frame Pillar

From the hardware dish, take the following:

- 8 #288 4 x 6mm set screw



- A. Drill a 1/8 inch hole in the center of the three wood disks from Bag #8 of plywood parts. Check that each disk will fit easily, but not loosely, into the tail tube; if not, sand the diameter down a little.

- ✓ B. Slide the three wood disks over brass tube, placing one in the center and the other two approximately 3 inches from each end. Cement in place using a 5 minute epoxy or use cyanoacrylate glue and baking soda to create a filet.
- ✓ C. When the glue is dry, put some silicone on the outside of the disks and slide brass tube assembly into the tail boom. Center it in the tail boom and let the silicone dry. Epoxy may be used in place of silicone or you may just drop a small amount of cyanoacrylate glue down the tube and onto the disk edges after the assembly is in place.
- ✓ D. Insert tail boom between tail boom mounts, in frame of helicopter, so that front of boom protrudes about 1/16" in front of front tail boom mount.
- ✓ E. Install 1/16" Tail Drive Wire #553 into Gearbox Coupler #448 on tail rotor assembly, and fasten with four 4 x 6mm set screws #288. So as not to bend wire when tightening set screws, use the following sequence: turn in one set screw until it contacts wire. Turn in opposite set screw securely. Tighten first set screw securely. Tighten both sets of screws this way. USE LOCKTITE.
- ✓ F. Slide Tail Boom Clamp #454 over tail boom.
- ✓ G. Insert tail drive wire with tail rotor box attached through tail boom tube and into front drive coupler. Check wire for proper length and cut if necessary. Remove wire and lubricate with light grease or medium weight oil before final insertion.
- ✓ H. Re-insert the tail drive wire and fasten front of wire into front drive coupler. Tighten securely using same technique as sub-step (E). USE LOCKTITE.
- ✓ J. With a twisting motion, pull the tail boom rearward just a little to relieve any compression of the tail gearbox input shaft due to the fitting of the tail drive wire. Then position the gearbox horizontally and pointed to the left side of the helicopter.

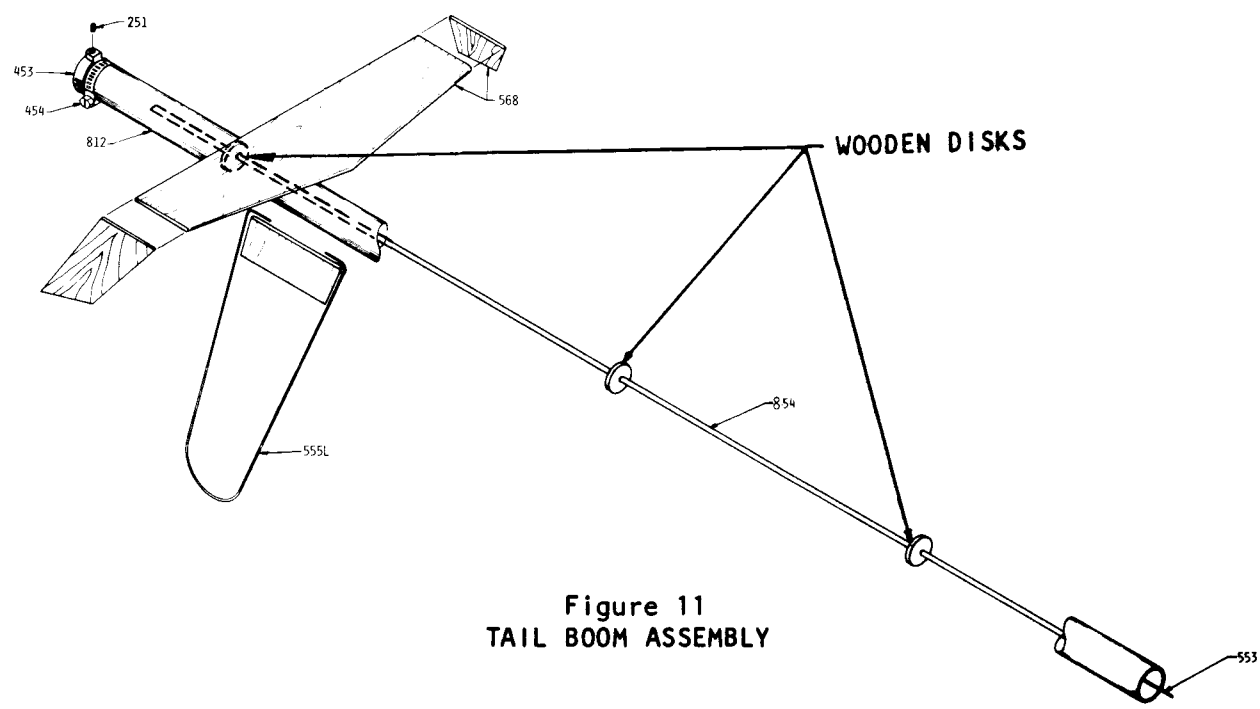


Figure 11
TAIL BOOM ASSEMBLY

- K. Tighten the four nuts and socket head screws that go through side frames and tail boom mounts.
- L. Tighten well the screw of the tail boom clamp to secure the tail gearbox in place.
- M. Attach the two Tail Struts #586 to the main frame behind the cooling shroud. Use two 3 x 10mm socket head screws #231 and one grommet cut in half. The screw fits through the strut, then one grommet half, then through the main frame and screws into the end of the Frame Pillar #485.
- N. Fit the Tail Strut Clip #583 over the tail boom. Insert two grommets into the holes of the strut clip. Attach the tail struts to the strut clip with a 3 x 16mm socket head screw #232 and a 3mm lock nut #243. The struts fit on the outside of the grommets.

STEP 15 TAIL FIN ASSEMBLY - see Figure 11A

From the Tail Fin Plywood Sheet take the following:

- ✓ 1 Horizontal Fin
- ✓ 1 Small Vertical Fin
- ✓ 2 Tiplets

From the box take the following:

- ✓ 1 #555L 15 inch Tail Skid Wire

- A. Cut a groove into the leading, trailing and top edges of the vertical fin, as shown in Figure 11A. Bend 1/16 x 15 inch wire #555L to proper shape and epoxy in place. See Figure 11A.
- B. Remove 3/4 inch from each end of horizontal fin. Measure in 3 1/2 inches from right side on bottom of horizontal fin and make a line perpendicular to the trailing edge. Epoxy the vertical fin assembly to the horizontal fin on this line. Bevel the ends of the horizontal fin so the tiplets are at an angle of approximately 30 degrees when glued in place.
- C. When epoxy is dry, sand and paint or cover with Monokote trim or other plastic covering.
- D. Fit the fin assembly onto the tail boom so that trailing edge of horizontal fin is 5 inches from end of tail boom tube. Use a generous amount of silicone so that filets are formed as shown in Figure 11A.

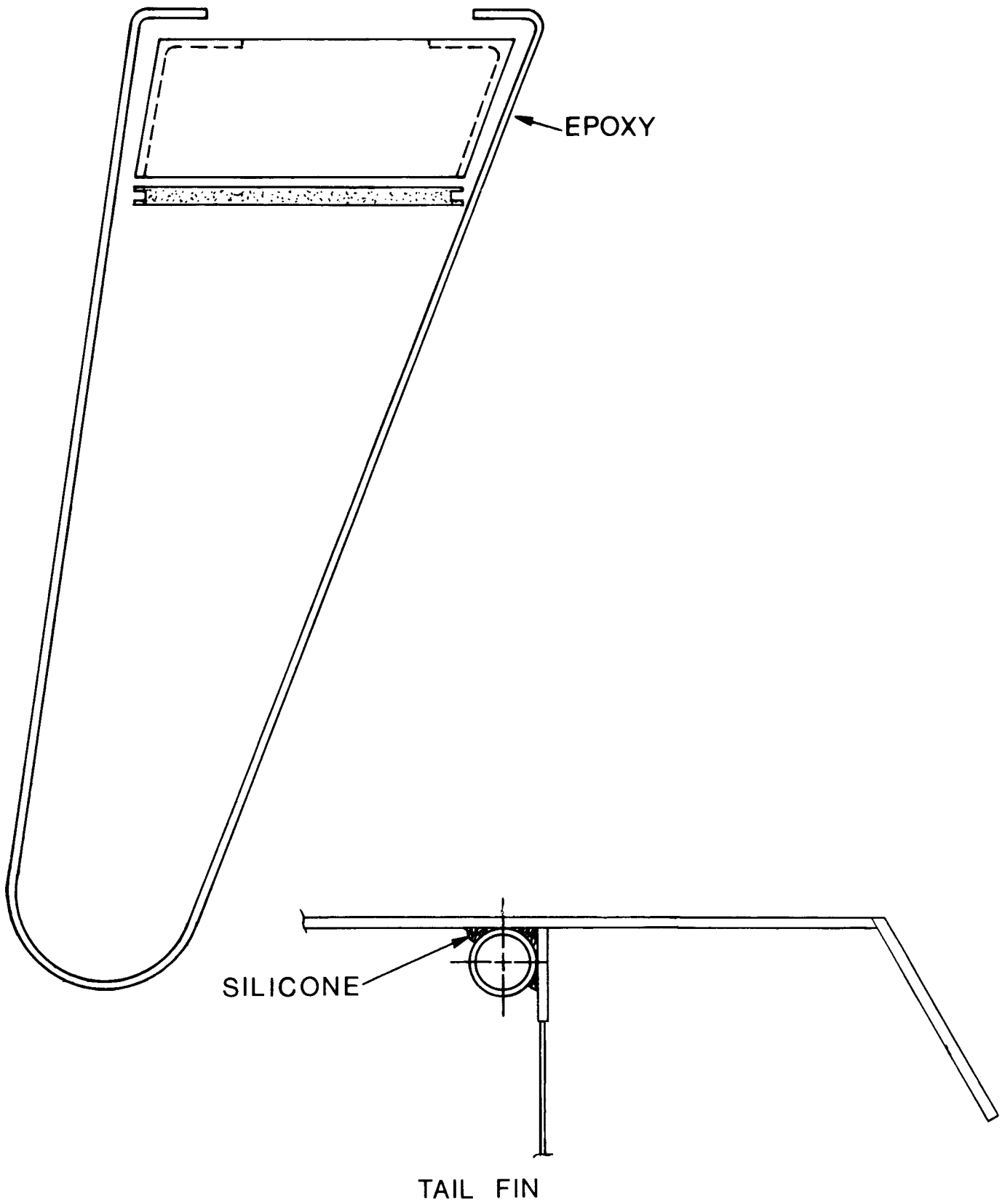


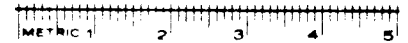
Figure 11A
TAIL SKID AND FIN

STEP 16 SERVO TRAY ASSEMBLY - see Figure 12

From the box, take the Servo Tray Plywood Sheet

From the Hardware dish, take the following:

- ✓ 4 #268 #4 x 1/2" wood screws
- ✓ 4 #223 3 x 10mm pan hd. screws
- ✓ 4 #243 3mm lock nuts



- ✓ A. Laminate two horizontal servo trays (3 holes) together with epoxy or white glue. Do the same to the vertical servo trays (1 hole).
- ✓ B. The pre-cut holes will allow the mounting of most standard servos. Check that your servos will fit these holes. If necessary enlarge or alter them to fit.
- ✓ C. Cut the vertical servo tray to be 2 8/10 inches long. (See Exploded View.)
- ✓ D. Glue the vertical tray perpendicular to the horizontal tray centered between the two rear servo holes and flush with rear edge. Use epoxy. Let dry.
- ✓ E. Fit servo tray assembly between servo mount stays on helicopter frame.

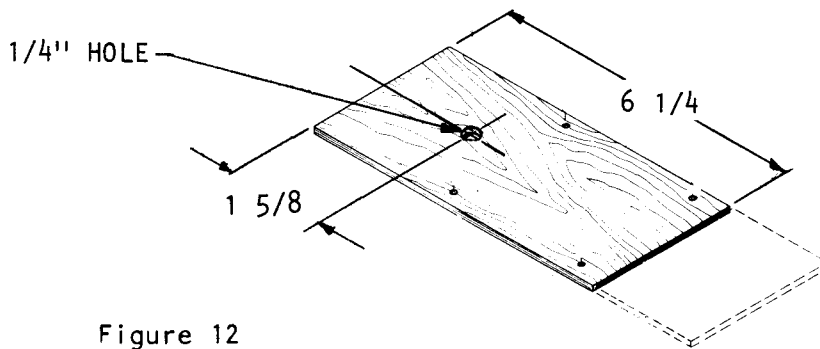
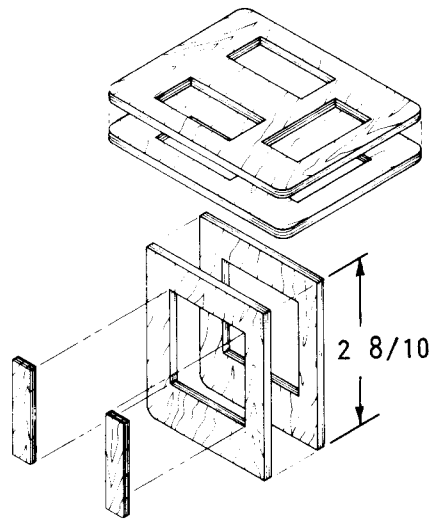


Figure 12
RADIO TRAY ASSEMBLY

- ✓ F. Fasten servo tray assembly to servo mount stays using four #4 x 1/2" wood screws #268. Be sure unit is straight in vertical and horizontal planes. It is advisable to drill 1/16 inch dia. pilot holes to avoid splitting the wood.
- ✓ G. Glue the two servo mount spacers to the vertical servo tray on the right side next to the servo openings. This is done to elevate these servos.
- ✓ H. Shorten the plywood floor to 6 1/4 inches.
- ✓ J. Fit the 6 1/4 x 2 7/8 x 1/8 inch plywood floor to the front stays on the helicopter and drill four 1/8 inch holes to match the mounting holes in the horizontal aluminum stays. Drill 1/4 inch dia. access hole as shown in Figure 12.
- ✓ K. Remove servo trays and floor and paint or fuel proof. We use Pactra black color spray dope.
- L. Remount servo tray assembly and mount plywood floor using four 3 x 10mm pan hd. screws #223 and four 3mm lock nuts #243.

STEP 17 CANOPY INSTALLATION NOTE: SEE PAGE 48 FOR DRAWING

From the box take the following:

- ✓ 1 pr #860 Canopy

From the hardware dish take the following:

- ✓ 1 #572 Rubber Grommet

- ✓ A. Cut out canopy halves leaving 3/8 inch edge on the outside of canopy and 3/16 inch flange on back. Scissors work best.
- ✓ B. Clamp canopy halves squarely together using clamps or clothes pins. Spring clamps work best. Cement halves together with a cyanoacrylate glue. Allow to dry thoroughly.
- ✓ C. Trim the canopy outside edge to 1/8 inch. Remove a piece 3/16 x 2 3/4" wide from the bottom rear edge so the canopy will fit around the front of the side frames. Notch the top of the canopy to clear the collective arms and the starting cone.
- ✓ D. Glue the 3/8" x 3/8" x 2 1/4" wood block to the inside of the canopy, 5 inches from the rear edge. The block should fit between the flanges of the front angles.
- ✓ E. Drill a 1/4 inch hole in the top of the canopy at the location of the canopy mounting post.
- ✓ F. Mask and paint canopy as desired. Polyurathane or epoxy paints work best. Be sure to degrease the canopy thoroughly before painting. You can wash it in

✓ warm soapy water, rinse and dry. If a tinted window is wanted, soak in "Rit" or other hot water dye before masking and painting.

G. Insert rubber grommet into the 1/4 inch hole in the canopy.

✓ H. The protection on the bottom of the canopy is for optional mounting of a whip antenna. Drill a hole in the front face of the projection large enough for the antenna base can be attached with silicone or epoxy.

STEP 18 FUEL TANK ASSEMBLY - see Figure 13

✓ Take the Fuel Tank from the kit box.

✓ Also, from your local hobby shop, obtain 1 foot of medium size fuel tubing.

✓ A. Remove contents of fuel tank.

✓ B. Lay tank on its side on wood floor with cap facing the rear left side.

✓ C. Insert two aluminum tubes into cap. The long one is for the vent and should be bent so that it touches the top inside of tank when cap is in place. To the short tube on the inside of cap connect a 3 inch piece of the silicon fuel line. Connect the clunk to other end. Make sure that the clunk falls onto the floor of the tank by its own weight. If it does not, you need to use a more pliable fuel tubing.

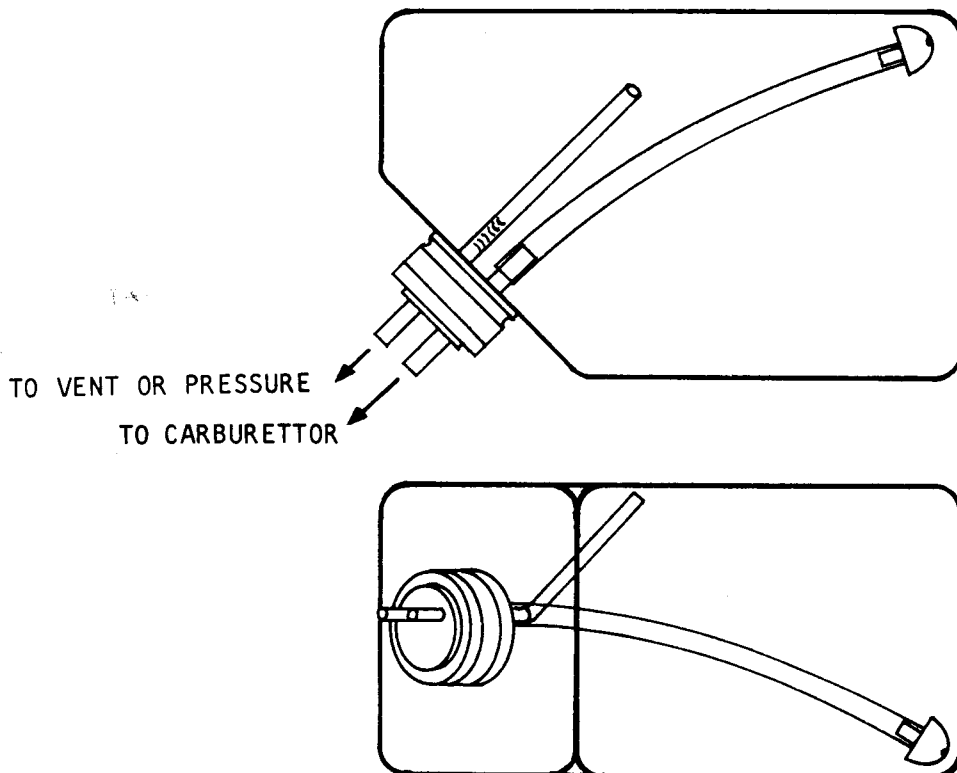









Figure 13
FUEL TANK #559

- ✓ D. Insert cap and tubes into tank.
- ✓ E. Fit the tank under the vertical servo tray.

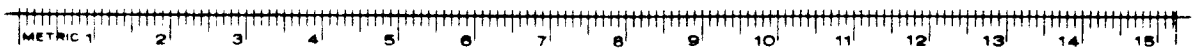
STEP 10 ✓ MUFFLER

Install a muffler of your choice. Our favorite is the "MAC'S" Heli-Ball, available at your local hobby store. It provides a quiet exhaust with minimum loss of power. However, tuned pipes can be used, too, and GMP also stocks a special quiet muffler which works well. Use silicone between the muffler and engine and also on the muffler mounting screws.

Hardware Information Chart

Description	Qty/Kit	GMP#	
3x6mm Skt Hd Screw	2	258	 Skt Hd Scrw
3x10mm Skt Hd Screw	14	231	
3x12mm Skt Hd Screw	6	235	
3x16mm Skt Hd Screw	2	232	
3x20mm Skt Hd Screw	3	234	 Pan Hd Scrw
3x25mm Skt Hd Screw	2	233	
3x35mm Skt Hd Screw	8	237	
4x30mm Skt Hd Screw	2	240	
2x6mm Pan Hd Screw	6	245	 W/Scr w
2x8mm Pan Hd Screw	2	246	
2x10mm Pan Hd Screw	16	247	
2x14mm Pan Hd Screw	4	248	
2x16mm Pan Hd Screw	1	249	
3x10mm Pan Hd Screw	24	223	 Nut
#4 x 1/4" Wood Screw	3	267	
#4 x 1/2" Wood Screw	4	268	
2x12mm Skt Hd Screw	2	269	
2.6x8mm Skt Hd Screw	2	270	
4x10mm Skt Hd Screw	6	274	 Lk Nut
2mm Nut	23	241	
3mm Nut	1	242	
3mm Lk Nut	41	243	
3mm Lk Nut (Special)	2	259	
4mm Lk Nut	5	275	 Flt Wshr
3mm Flt Washer	24	276	
2mm Flt Washer	12	262	
4x8x0.5mm Flt Washer	3	278	
4x10x0.9 Flt Washer	6	261	
3x3mm Set Screw	6	287	
3x5mm Set Screw	2	251	
4x4mm Set Screw	5	252	 Set Scrw
4x6mm Set Screw	15	288	
4x15mm Skt Hd Screw	4	239	

METRIC CHECK SCALE IN MILLIMETERS



CONTROLS INSTALLATION AND SET-UP - see Figure 14

We will install and hook-up every control arrangement and servo separately. The push rod lengths will be given - then the overall length with ball links or clevises (measured from center to center of the balls or clevis pins) will be given in parenthesis like this: 2x110mm (120mm). The control rods from servos to controls may vary in length because of variations in individual servo sizes and may need to be varied from the suggested dimensions given. Cut equal amounts from each end of the control rod and deburr the ends thoroughly or your ball link or clevis may not be secured properly onto the rod ends.

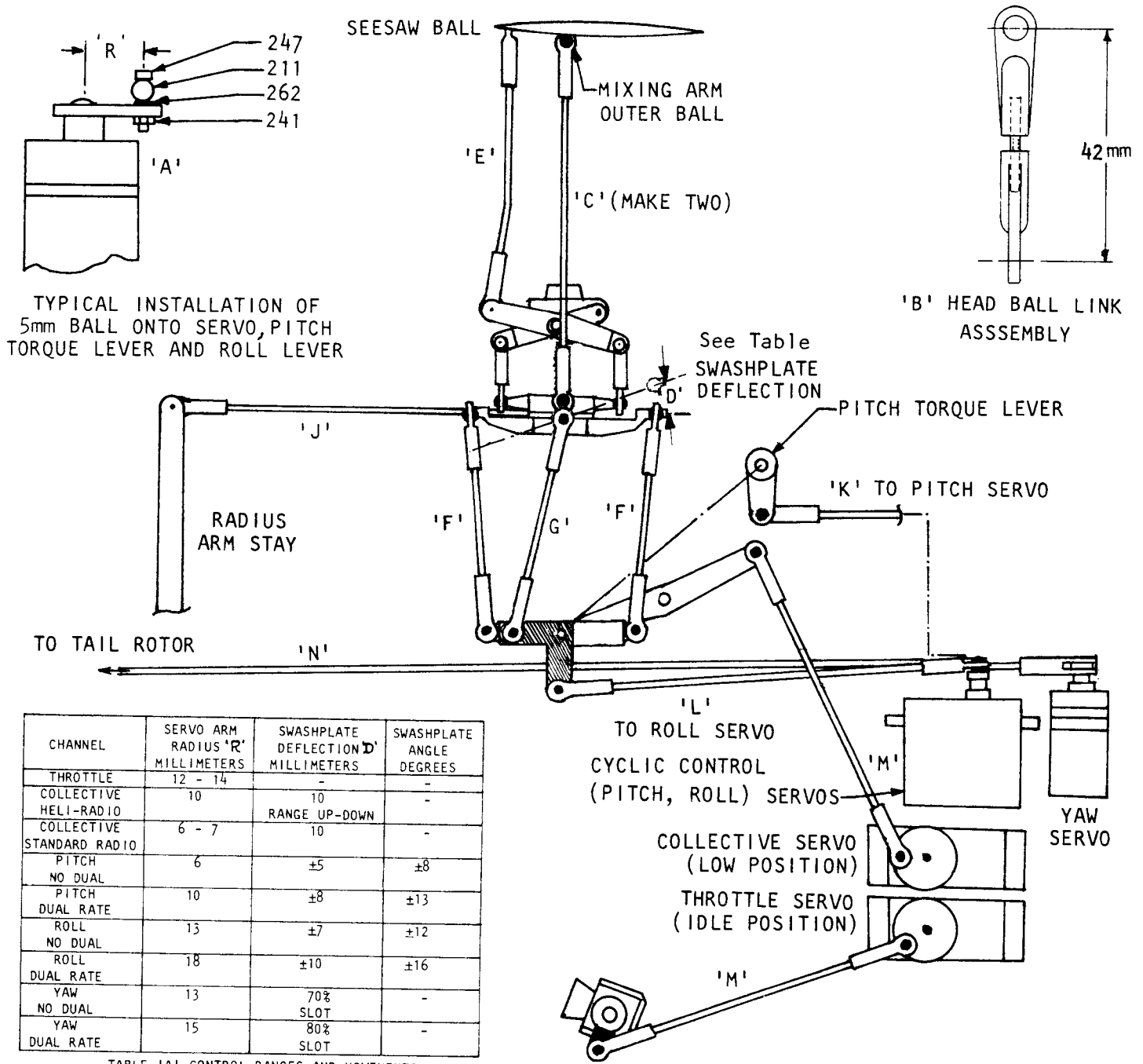


Figure 14
CONTROL RODS INSTALLATION

Bag #9 contains all of the links, clevises and ball links needed for the control system. Take out the following parts:

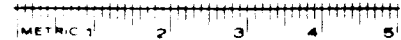
- ✓ 30 #570 Ball Links
- ✓ 2 #571 2x16mm Control Rod
- ✓ 3 #227 2x30mm Control Rod
- ✓ 1 #574 2x55mm Control Rod
- ✓ 1 #219 2x70mm Control Rod
- ✓ 3 #874 2x80mm Control Rod
- ✓ 3 #576 2x100mm Control Rod
- ✓ 5 #211 5mm Ball
- 2 #579 Control Rod End
- 2 #581 Clevis
- 1 #580 Metal Clip

From the kit box, take the following:

- 1 #556 Control Wire
- 1 #558 Control Wire Tube

From the hardware dish, take the following:

- ✓ 1 #223 3 x 10mm pan hd. screw
- ✓ 1 #234 3 x 20mm skt. hd. screw
- ✓ 2 #243 3mm lock nut



Note: See Figure 14 for each individual control rod connection. Each rod is marked with a letter corresponding to the appropriate steps below. For example, Step 'B' will refer to the installation of control rod marked 'B'.

First, fit the rotor head assembly to the top of the main shaft and secure it with the 3 x 20mm skt. hd. screw #234 and the 3mm lock nut #243. Tighten well. Now carry out the following steps:

- A. Fit a 5mm ball onto each of the output arms of the pitch (elevator), roll (aileron) and throttle and collective servo (if used). If only one servo is used for throttle (collective) then two 5mm balls will be fitted to a servo wheel as shown in Figure 16. Table 'A' in Figure 14 suggests the radius at which the ball should be fitted onto each servo arm and illustrates a typical installation for your guidance.

Use of the radius dimensions given will result in approximately the correct amount of swashplate cyclic and collective movements. However, this in turn depends upon a servo rotation of plus or minus 45 degrees. If this rotation angle varies, then the radius dimension may have to be varied to suit. Note that we have suggested a shorter radius if your radio does not have dual rate available in pitch and roll.

The swashplate deflections shown in the table will provide a good aerobatic capability for the average flier and are intended as a starting point. However, each flier may feel more comfortable, and give a better performance, with a higher or lower ratio than those recommended. In this event the servo arm length may be changed to suit.

- ✓ B. Cut about 3mm from the ends of four ball links #570 as shown in Figure 14. Take the two 2 x 16mm (42mm) threaded rods. Screw one of these ball joints onto the end of each of the two threaded rods. Make sure that the rod enters each ball joint equally to a depth of at least 6mm. The distance between the centers of the two balls, if fitted to the ball links, should be 36mm as an initial adjustment. The ball joint ends should be rotated to be at right angles to each other. These two units are fitted between the inside balls of the blade mixing arms and the pivot bolts of the main blade arms. Since these ball links are subject to high flight loads, please make them up very carefully.
- ✓ C. Take the two 2 x 80 mm (105mm) threaded rods and fit a ball joint at each end, again with the thread entering the ball joint at least 6mm. Both of these rods must always be the same length between the ball joint holes and when any adjustment is made to these particular links it must be made equally. The lower end of each rod is fitted to the 'closest in' 5mm ball on the swashplate upper level and the upper end to the outside ball of the mixing arm in the rotor head.
- D. Rotate the washout mast lock on the main mast until the slit in the Plastic Mast Lock #509 is directly underneath the 5mm ball fitted onto the outside of the flybar seesaw. The distance between the top of the washout mast lock and the underside of the rotor hub should be set initially to about 10mm. This distance may need to be readjusted during final set-up. Tighten the bolt in the washout mast lock to secure the unit to the main mast.
- ✓ E. Take a 2 x 55mm (80mm) rod and fit it with two ball joints in the same fashion as the others. Feed this control rod through the slot in the rotor head so that one ball joint can be clipped to the side ball of the seesaw and the other ball joint to the top ball of the washout unit. You will have to bend this rod slightly so that it does not interfere with the sides of the rotor yoke, whatever angle the rotor yoke is tilted to. Look at the photos and exploded views to see how this link is fitted. The final length of this rod is adjusted to ensure that the paddles are parallel with the swashplate at all times.
- ✓ F. Make up two 2 x 30mm (56mm) control rods with a ball link at each end. These rods are connected between the fore and aft balls of the lower part of the swashplate to the two balls on the rocker arm assembly of the pitch control lever (inside the main frames).
- ✓ G. Make up one 2 x 30mm (60mm) control rod with a ball link at each end. Connect this rod between the ball on the right hand side of the swashplate and the shorter horizontal arm of the aileron "L" lever (situated on the right hand side of the model).
- ✓ H. Take a 5mm ball and fit it, by means of a 2 x 10mm screw and a 2mm nut, to the hole in the top of the radius arm stay. The ball should face outwards to the left hand side of the model. USE LOCKTITE.
- ✓ J. Make up one 2 x 100mm (125mm) control rod and fit it with a ball joint at each end. This control rod is fitted between the ball on the top of the radius arm stay and the ball on the left hand side of the swashplate.

- K. Make up two 2x100mm (125mm) control rods fitted with a ball link on each end. Connect one rod between the pitch (elevator) servo and the Cyclic Pitch Lever #475 on the left hand side of the model. This rod should be adjusted so that the transverse lever is horizontal when the servo is in its neutral position.
- L. Connect the second 2x100mm control rod between the Roll Lever #476 and the roll (aileron) servo. The length of the rod should be adjusted so that the roll lever vertical arm is vertical when the servo is in its neutral position.
- M. Make up one 2x70mm (93mm) control rod fitted with a ball link at each end. Use this to connect the collective pitch servo arm to the end of the collective main lever. Keep this control a straight run. Trim upper servo mount if necessary.
- N. Make up the tail rotor control rod from the 38" Control Wire #556 provided in the kit. Solder two Threaded Couplings #579 onto each end of the wire after sliding Tail Rotor Control Tube #558 onto the wire. Please note that these joints must be made very carefully so that a failure due to vibration or loads between servo and control is extremely unlikely. For this reason a good silver solder should be used and both parts thoroughly cleaned prior to soldering. If you have any doubt about your ability to make a good soldered joint in this step, please consult an experienced friend or your local hobby store for advice. Attach a nylon clevis #581 to each end of the threaded coupling. The total length of the finished control rod should initially be 35 1/4", measured from clevis pin to clevis pin. Fasten the tube to the left side of your model by means of Clip #580 secured into an unused hole in the side frame using the 3x10mm pan head screw #223 and a 3mm locking nut #243. To ensure rigidity of control use either cable ties or vinyl tape every 5" or 6" to hold the assembly to the tail boom.
- O. Throttle rod 2x80mm (100mm) servo to throttle arm.

Now that we have connected all the control rods we will start the initial set-up of our tail rotor controls.

Tail Rotor Control Set-Up - see Figure 15

The following text illustrates and describes how to set up your tail rotor controls. Remember that there will always be a mechanical limit on the total travel or movement on the tail control and it is the center of this maximum movement which you should take as a datum when you center the control adjustments. So here are the steps which should be made in sequence:

- A. Set the rudder servo arm at neutral position and, at this setting, the control rod from the rudder servo to the tail control lever should be adjusted in LENGTH until the PIN in the gearbox SLOT is CENTERED (see position 'A' in Figure 15).
- B. NOW, DON'T TOUCH (A) again and do the following: adjust the LENGTH of the rudder SERVO ARM (the distance from the pivot to the point where the tail wire is fixed) so that, with full left to right rudder stick movement (including the additional movement added by the trim lever also), the pin moves NEARLY (say 80%) the full amount of the movement that the slot will permit (see positions 'B' and 'C' in Figure 15).

- C. NOW, DON'T TOUCH the adjustments made in (A) or (B) again. Set the collars which position the pitch control plate on the pitch control wire so that, with FULL LEFT stick on the transmitter, the flat surface of the tail blades are approximately parallel to the line of flight (see position 'B' in Figure 15).

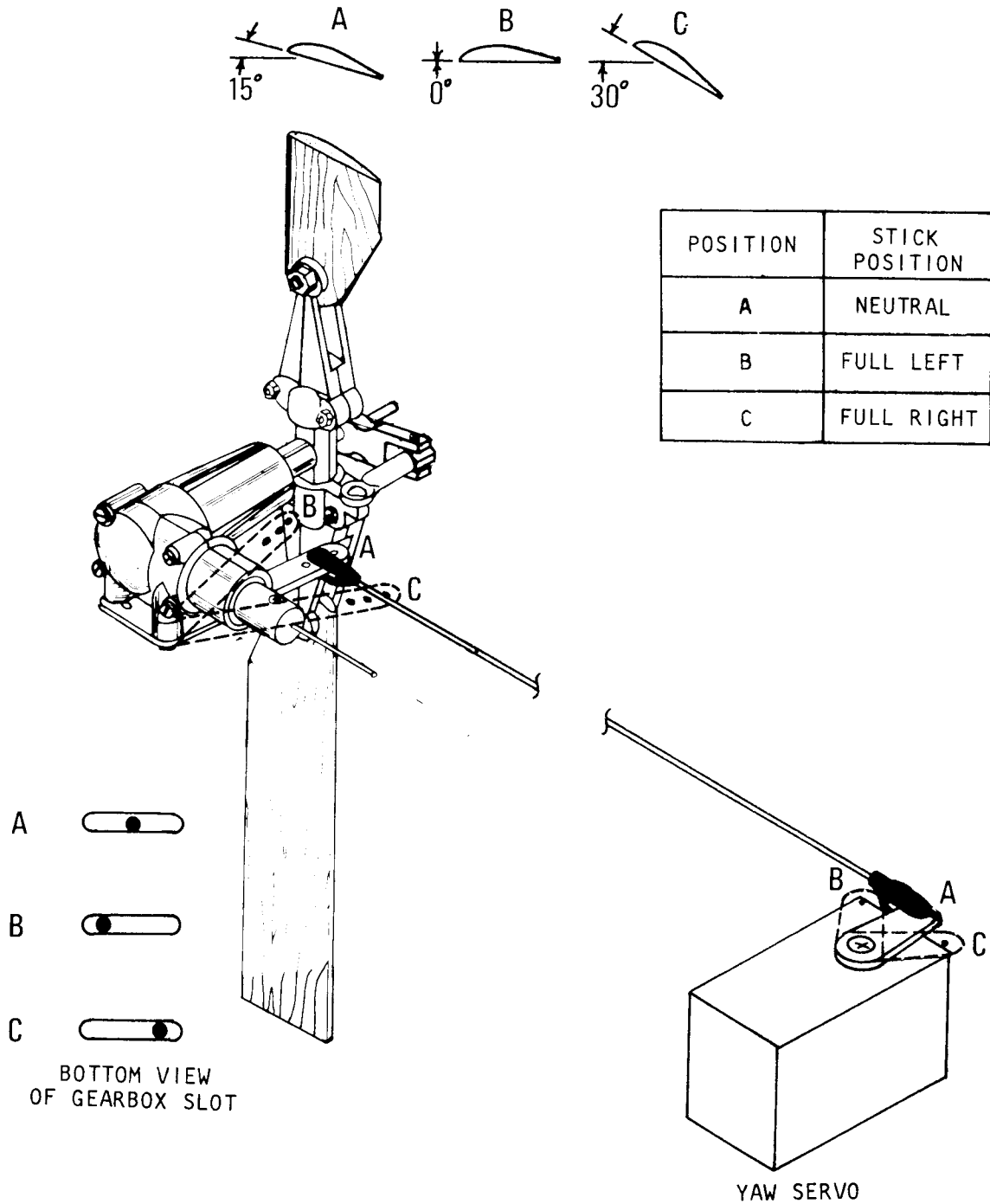


Figure 15
TAIL ROTOR CONTROL SET-UP

- D. NOW, when the rudder stick is NEUTRALIZED, the blades will look like position 'A' in Figure 15 and, when the rudder stick is full RIGHT, the blades will look like position 'C' in Figure 15.

Note: The above is an initial set-up and the adjustments may need to be varied during flight set-up. Maintaining a central setting of the pin in the slot should always be observed, however, so that you may always have full control available to you.

Final Bench Set-up

Now that your "Cobra" has been completed and most of the major adjustments have been made, it is time to finalize and refine some of these adjustments before starting the engine and commencing your trimming and flying.

A. Collective Pitch and Throttle

If you refer to the servo set-up for collective pitch, it will illustrate the fundamental relationship of movements required in a collective pitch helicopter. The movement of the pitch angle of the blades themselves should be from approximately 1 1/2 degrees negative to about 7 or 8 degrees positive while the throttle moves from idle to full. At throttle stop position, or trim zero, the blades will be at about 2 1/2 degrees negative angle. Some experts will prefer different settings but this is a good starting point for the "not-so-expert" flyer.

Now it is very easy, in a collective pitch helicopter, to overload the engine with the wrong settings or, sometimes even worse, to have the engine screaming at high collective settings. The way to counter this is to set the throttle of the engine so that it opens 'slowly' at first and progressively faster as the throttle is advanced. Collective should move 'quickly' at first and then at a slower speed towards the end of the rotation of the servo. The engine throttle lever should be set up as shown in Figure 2 and the servo arm should move from an almost horizontal position down to 90 degrees when the throttle is fully opened, thus increasing the amount of motion of the throttle per servo degree as the throttle is advanced.

The collective pitch servo moves from just less than the 90 degree position to a position where the rod is almost in line with the servo arm, thus 'reducing' the amount of movement towards the end of travel

Playing around with these ratios can give you exactly the amount of engine power that you require for each setting of collective pitch. This factor is a very important one if you are to enjoy the advantages of flying a collective pitch helicopter. Don't worry if you have problems with this at first - it is quite complex and you may need to seek help in setting up this part of the system. Even the 'experts' have trouble with this one and some would set-up their helicopters quite differently from the method described above. However, try the above for 'starters' unless you have an 'expert' friend to help you do it.

With collective throttle set to full up/open position, the mixing arms on the rotor head should be just above level (see Figure 16).

Check that the swashplate is level and that the pitch and roll channels are 'zeroed', including the trims. Now, if you have a pitch gauge, check that the rotor blade angle is 7 - 8 degrees positive.

Set collective/throttle transmitter stick to low position. Set trim to high. Your blade angle setting should now be minus 1 to minus 2 degrees. Half stick should be 3 1/2 degrees to 4 1/2 degrees positive.

With the settings described, your machine should hover at approximately 1500 rpm (head speed) and at full throttle in forward flight the head speed will increase to about 1650.

B. Cyclic Controls Set-up

Make sure that the paddles are set in line with each other, looking end-on. Also check, by looking end on at the paddles, that they are both parallel to the swashplate.

When the swashplate is at right angles to the main shaft, the paddles should be at the same angle. If the swashplate is tilted forward or backwards when the flybar and the paddles are lined up across the helicopter, then they should, in turn, follow the angle of the swashplate movements.

The same applies for a sideways tilt of the swashplate when the flybar and paddles are lined up fore and aft of the helicopter. The swashplate should be level in pitch (at 90 degrees to the main shaft) but tilted 1 or 2 degrees to the right in roll when the transmitter pitch and roll controls are centered (main lever and trim lever).

C. Carburettor Setting

Check the carburettor settings. With a fully open throttle lever on the transmitter, the carburettor barrel should be wide open. At zero throttle lever, but full throttle trim, the throttle barrel should be open just a small amount (about 1/16"). Finally, you should be able to close that small opening to zero by moving the throttle trim to zero. The 'mixing' of throttle and collective pitch settings is shown in Figure 16 and has been described in 'A' above.

D. C. G. Setting

The C.G. should be set to lie between being coincident with the main shaft and 1/4" ahead of it. A forward C.G. will permit better aerobatics and a C.G. on the main shaft will lead to improved hovering. There are several ways of

checking the CG. The best way to Check CG is to straddle the helicopter with your hands, put your forefingers underneath the main drive gear edges, exactly opposite each other, on the outside of the helicopter. Position the fingers so that they are in line with the main shaft, and then lift the helicopter. You can then, by moving your fingers forward or back, accurately locate the center of gravity. Adjustment of the center of gravity can easily be made by adding a small amount of lead to the nose of the helicopter. You can glue it in the nose of the canopy or on to the front edge of the lower servo tray. Before you add weight, however, make sure that your battery is located as far forward as you can get it.

E. Linkages

All the linkages which move the controls must be free and it is recommended that you check once again by disconnecting the links from each servo, in turn, and move the control rods backwards and forwards with your fingers to make sure that there are no restrictions or friction in the run. Of course a new helicopter will always possess more friction initially but should rapidly decrease after the first few tanks of gas have been used.

It is extremely important to successful helicopter flying to have a very smooth but positive connection between the servo and the flight controls of the helicopter. Any impediment or friction here can easily make the helicopter fly badly, even to the point of being unstable. So please check the smoothness of your control runs and also that there is no 'free play' in the controls. The slightest movement of the transmitter stick should result in movement of the paddles, the swashplate, the tail rotor blades or the throttle barrel of the engine.

FINALLY, CHECK THAT ALL NUTS AND SCREWS HAVE BEEN PROPERLY TIGHTENED.

Now you can commence your first flight testing to fine tune the settings, 'track' the rotor blades and refine the collective pitch settings to suit your engine.

The "Cobra" is extremely stable in the hover and very predictable in forward flight. In fact it is almost identical to a pattern plane in forward flight. So, if you don't achieve these characteristics at first, work on the setting up of the controls until you do because a well set up "Cobra" is a real joy to hover, maneuver close or fly at high speed and do aerobatics. Any further questions on setting up, see your local dealer, your local fliers, or call the factory direct. We will be glad to help you at any time.

The "Cobra" helicopter is intended for the modeler who has had some experience in building and can (or has) at least hovered an RC helicopter. However, in the event that a 'first timer' has purchased this kit, a set of flying instructions appropriate to his experience is included here. The accomplished flyer will already possess this expertise and he will rapidly explore the capabilities of "Cobra" in aerobatic flight.

FLYING INSTRUCTIONS

Trimming and Flying

Try and find a quiet spot, certainly away from pets and children, and a smooth surface such as concrete or asphalt. Have somebody with you when you are testing a helicopter in case there is an accident and you need immediate assistance.

Now, follow the engine manufacturer's instructions to set the idle and the top end carburettor adjustments of your engine. With a new, non-ringed engine, it is advisable to have at least half an hour of bench running. This will also help you to familiarize yourself with the carburettor settings of your engine.

Use a fuel with about 12% nitro in it and, if you wish to ensure a slow 'break in', use some Castor oil in your fuel. Start the engine and, with the transmitter idle trim at full, the engine should run at a 'fast idle'. The clutch will engage at around 1,500 RPM. It cannot be stressed too highly that when starting the engine, and until you are actually ready to hover the helicopter, the rotor head should be held firmly in one hand. If you watch any expert flying his machine, you'll see that he does this and it is simply to cover the possible cases of the engine being started at full throttle by accident, or your radio not being switched on, or somebody else's radio interfering with yours, or a link is missing from your helicopter, etc., etc. Any one of a number of things could cause the engine to start at high speed and, if you are not holding the rotor head firmly, then the helicopter, at best, could start off violently and hurt you or anybody near. At the worst, it could take-off, out of control, and unless you were able to regain control quickly, you would lose your helicopter and possibly hazard other people's property or even life. So please observe the 'Golden Rule' for all good helicopter flyers - - - HOLD THE ROTOR HEAD FIRMLY WITH YOUR HAND ALL THE WHILE THE

HELICOPTER IS NOT ACTUALLY IN POSITION FOR FLYING! AND, AS SOON AS THE HELICOPTER HAS LANDED AND THE BLADES HAVE COME TO REST, HOLD THE HEAD AGAIN FIRMLY BEFORE YOU DO YOUR SHUTTING-DOWN OF THE ENGINE! AND NEVER AIR-TAXI OUT FROM THE PITS OR NEAR PEOPLE OR PROPERTY!

So now on to the first phase of learning to fly.

There certainly are some flyers who are so well coordinated that they can hover a helicopter successfully after a very few attempts. These people fall in the same category, we believe, as those fixed wing flyers who can take-off, fly around and land fixed-wing planes with little or no effort and in a very short time. This section of the "Cobra" manual, however, is intended for the 'average modeler' who eventually has a heck of a lot of fun flying model aircraft, but takes a little time (and effort) to achieve this result. So, unless you possess more than average coordination, or you have a lot of money and time, we offer the following method of simplifying the process and learning to fly with little or no damage to your machine and your ego.

Now, learning just one function at a time is really impractical unless a training rig to 'tether' the helicopter is used. Learning the functions two at a time, however, is quite easy and many people have learned (with no damage to the helicopter) in this way.

So why not try the one hand (two function) at a time method?

One pre-requisite to learning, in any event, is to have a well trimmed helicopter. Even an experienced flyer, if the helicopter is not trimmed, can find it difficult to maintain a stable hover, and you will normally find that the experienced flyer will land the machine again, several times, after very short experimental lift-offs, if necessary, to get the trim right. So, before you learn to hover, it is extremely important to seek the help of an expert or a reasonably accomplished flyer, if one is available in your vicinity, to hover your helicopter for you and to make sure that it is properly and accurately trimmed. The helicopter blade angle setting in pitch (main and tail) must be correct. The 'tracking' of the blades must be right and the helicopter drive elements and engine must be running smoothly and well. If all of these things are not correct, then don't continue. Once the helicopter is in trim and running smoothly then, and only then, should you commence your learning to hover. If the drive elements are not operating properly, re-check all the clearances and settings. If the blades are 'out of track' and you do not have any expert help available, then you should proceed as follows:

First we must stress that you should not, repeat not, track your main blades by holding your helicopter by the tail boom while lifting it into the air. This is an extremely dangerous practice and is strongly discouraged by GMP.

However, tracking the blades is certainly a difficult procedure for the beginner since it requires the actual hovering of the helicopter for a short period in order to be able to observe which blade is higher than the other. We will, however, describe this procedure for you and, even if you cannot observe the blades yourself, you should try to lift the helicopter to a hover just for a second or two while a friend or somebody else kneels down, at a safe distance of course, and observes the 'tracking'.

'Tracking' is a measure of the lift of each of the blades, which should be equal. If the lift of one blade is greater than the other, then the tracking is wrong and there will be vibration and a loss of control. The tip of one blade must be marked with a piece of colored vinyl or Monocote during the building phase and the idea behind this will become apparent now. If you look at the edge of the blades while they are running and the helicopter is just lifting off the ground, you will notice that if the blades are tracking you will see only one blade at the tip, but if they are not tracking you will be able to clearly see one blade higher than the other. Because the blades are marked individually you should then be able to judge which of the blades is the higher. Now, to correct this tracking, you must change the pitch of one of the blades.

Before we do, however, we should also note one other factor and that is that the main blade speed of 'Cobra' should be around 1,500 RPM at lift-off with a throttle setting of about half. If the speed is higher than this, then in order to adjust the tracking, we should increase the blade pitch angle that is lower of the two. If 'Cobra's' blade speed is lower than 1,500 RPM, then we should lower the pitch of the blade which was higher. This means that by adjusting the pitch of one of the main blades we can make one blade run higher than the other, or by adjusting both together we can lower the rotor speed of the helicopter.

Because "Cobra" has "collective" pitch you may also change the rotor speed by increasing or decreasing the collective pitch setting after 'tracking' the blades as described above.

Finally, please note that your high end throttle adjustment (needle valve) should be set so that the engine is on the verge of running rich (occasional four-cycling or "burbling") until the helicopter has lifted off. Even in the hover your engine should still "burble" occasionally.

If you find that you need much more tail blade pitch angle than has been suggested in the instructions and the helicopter's nose is always trying to turn to the left, then you are probably running with too much pitch on the main blades. If, however, you find the helicopter blades are running very fast and the nose always appears to be wanting to go to the right, then you are probably running with too little pitch on the main blades at lift-off. You will soon become accustomed to being able to adjust both the speed of the main rotor blades and the tracking of the blades by adjusting one of them.

Place the helicopter on a smooth and level surface and start the engine. Stand back and to one side, about 6-10 feet away from the machine. The reason for this is that you will now have the best view of the fore-and-aft and side-to-side movements of the helicopter if you are looking at it from 45 degrees. For instance, if you stand directly behind the helicopter, then the fore-and-aft movements are harder to detect. The secret of accurate hovering is to make control inputs at the instant that the helicopter starts to move and maximum anticipation is helped by the best and earliest visual information.

Now, take a deep breath and try to relax. Run up the engine with the throttle lever until the helicopter is 'light on its skids', so that it apparently weighs perhaps only a pound or less instead of its normal weight. Under these conditions it is then quite easy, by using the transmitter tail control lever, to move the nose of the helicopter to the right and to the left, back to the center again, to the left, to the right, back to the center again. All the while you are doing this you will make small adjustments in throttle in order to keep that one pound of weight constant.

Soon your reflexes will learn how to coordinate the sideways movements of your left hand with the movements of the helicopter rotating to the left and to the right and the up and down movement of the left hand to vary the 'lift' of the helicopter. Do not make any right hand or cyclic movements when practicing this exercise.

It's hard to say how long you should keep up this practice, but certainly you should continue until you can do it without feeling strained during and after each session. When your left hand has been trained to keep the tail straight and the altitude constant, you can now commence to learn coordination of the helicopter's lateral movements with your movement of the right hand stick. So now the next step is to open the throttle so that the helicopter rises in a positive manner to a position between 3 and 5 feet off the ground. It's hard to believe this when you first begin to learn, but if a hovering helicopter is well trimmed and adjusted, there really is plenty of time to maintain, or to correct, the helicopter's movements sideways, backwards and forwards.

An analogy which reflects this argument and that beginners seem to understand is that you can regard the helicopter as a large balloon floating a few feet off the ground. The balloon can wander around as a result of small gusts of wind from different directions. We can keep the balloon stationary in front of us by 'patting' it at the

right place and at the right time. If it moves away from us and we pat it towards us it may need another pat to stop it coming and position it where we want it. Except, of course, it will drift off again after a short while and we will have a continuous task of providing the right control inputs to keep the balloon stationary in front of us.

Once you have learned to fly the helicopter, then the 'pulsing' will blend into smooth, but still very small control commands. However, at the early stages, remember to think of the helicopter as a balloon which, let's say, is drifting towards you. You 'pulse' the stick towards it, you pat it back. As it starts to drift back, you'll need a small input in the opposite direction to pat it and stop its motion so that it settles in the spot that you want it. Don't forget that you can start a helicopter moving in one direction with the force produced by the right hand stick but you will probably, unless you have given exactly the right force at the right time, have to give an opposite force in order to slow it down and to settle it in the position required. Please remember that the foregoing applies only when the helicopter is well designed and, most importantly, well trimmed.

So try these hovering techniques and see if it doesn't help to speed up and ease up the learning process. Make each 'flight' only a few seconds and then land. Each successful 'flight', however short, will place you higher up the learning curve. We have seen people learn by this method and be hovering confidently for five to ten seconds at a time in less than a single morning. So don't give up - you can fly an RC helicopter if you really want to. Good luck with your hovering sessions.

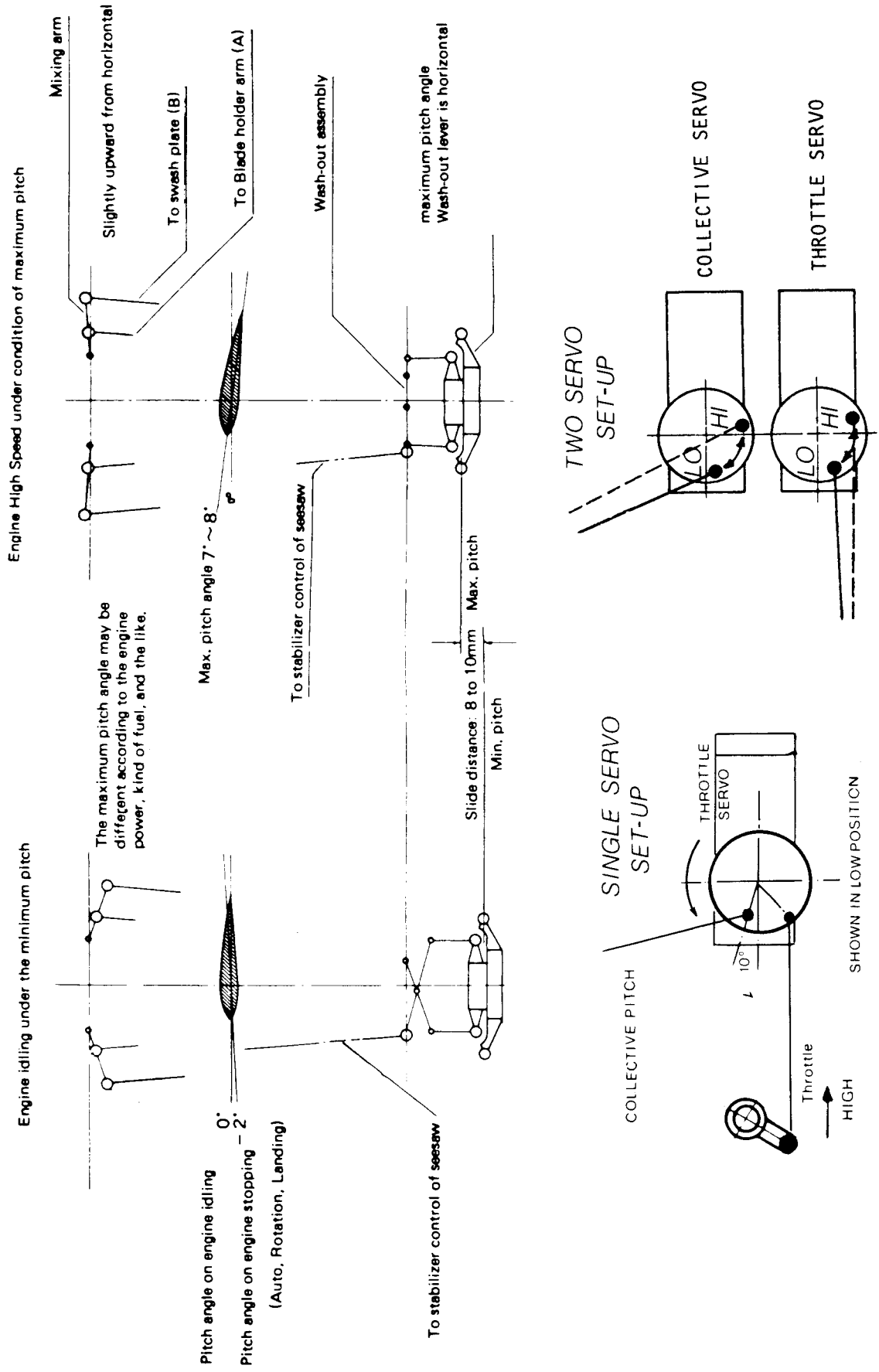
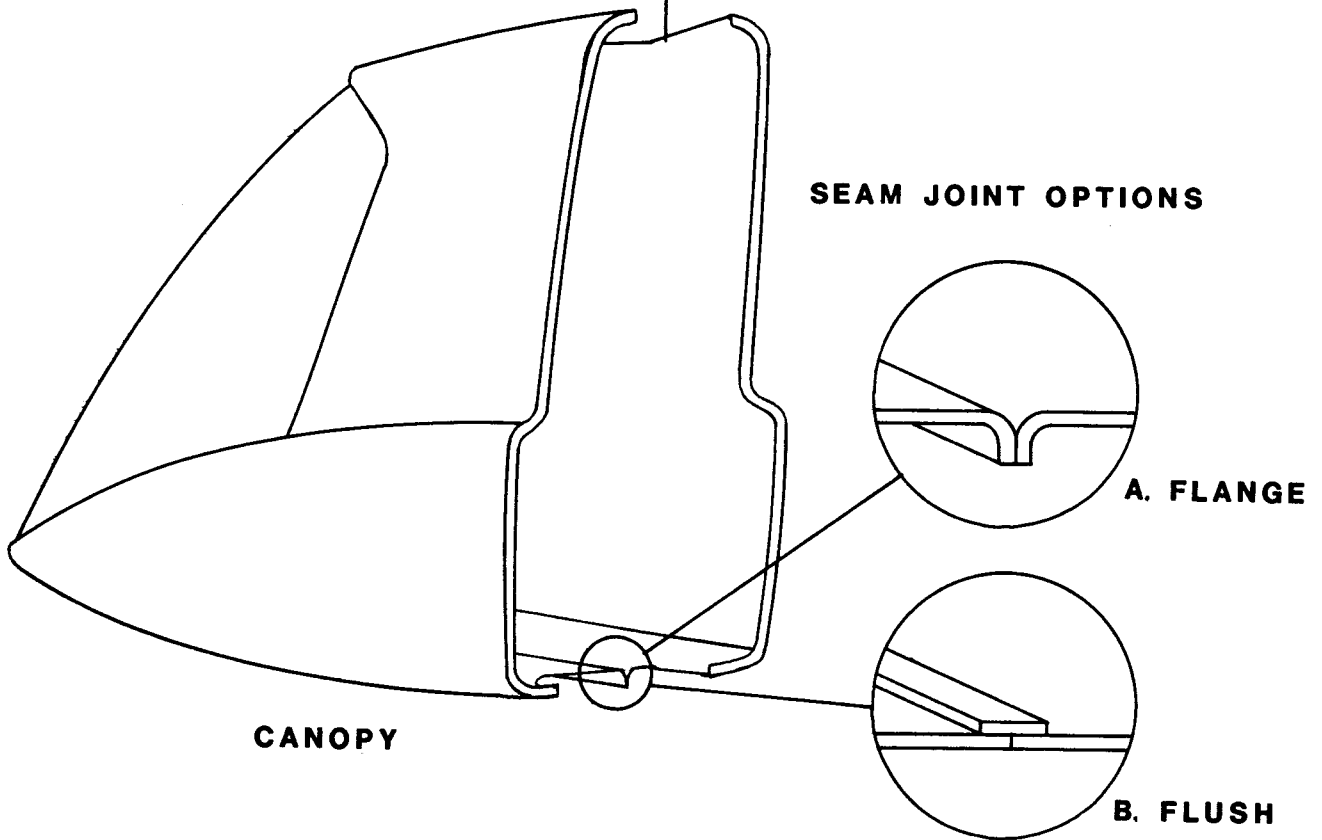
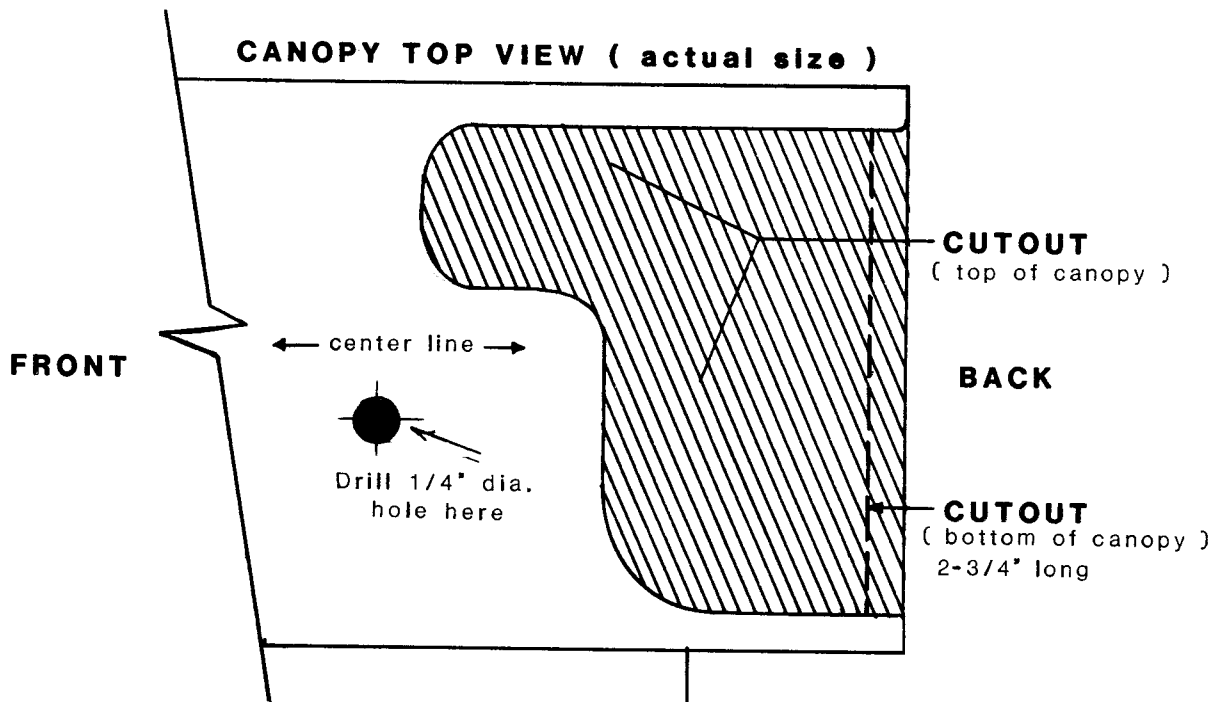


Figure 16 COLLECTIVE PITCH AND THROTTLE SET-UP



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