BUILDING INSTRUCTIONS

FOR

RC-HELICOPTER

Heli-Baby

HUBSCHRAUBER Schlüter MODELLBAU

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I. FIRST OF ALL YOU SHOULD READ THIS !

"Heli-Baby" came into being under the motto, a helicopter to construct, as simple and as unproblematic as possible in assemblage as well as in action.

For this reason the copying of a certain type was deliberately dispensed with and the whole arrangement accomplished exclusively according to the technical necessities.

Nevertheless, or because of this, the result is a typical-looking helicopter; and the arrangement of the large wide-view cockpit with the seat and instrument panel completes this picture and allows for the individual styling of details.

In assembling the mechanical parts, you should strictly abide by the building instructions recommended. This will guarantee you a technically sensible building sequence, a favourable working tempo, and a high degree of safety during future flights.

But above all, please do not take any alterations into your own hands ! Apart from the fact that the use of the various materials, screws etc. is according to the rather high strain they will be subjected to, the function of the separate components is in exact harmony with each other.

The pieces are packed according to their sequence in assembly. Only open the next bag according to its stage in assembly. As far as possible, the separate groups of components have already been assembled together according to their sequence in later construction.

"Heli-Baby" can be steered by using any modern proportional radio control system with 4 servos. Particulars can be found in the Building Instructions.

Practically any 6,5 ccm (0.40 cu.inch) motor with a crankshaft of 1/4" (= 6,35 mm Ø) can be employed for drive. Nearly all engines used these days have a crankshaft of this diameter.

And now, have a lot of fun with your "Heli-Baby", and work very carefully! It will give you far more pleasure if you do and is the starting point for your future success !

II. BUILDING INSTRUCTIONS

1. Frame (Bag 1)

Screw the two side-plates together with 1 long and 3 short rails using iron screws M 3 x 8 and nuts M 3. Secure tightly. Screw the motor supports onto the side-plates loosely using 4 socket head screws M 3 x 25, 4 large washers, and 4 lock nuts, fig. 1.

2. Skids (Bag 2)

Underneath the frame screw on both the struts, using for each 1 socket head screw M 3 x 10 and lock nut M 3. Screw the skids onto the struts using clamps and iron screws M 3 x 10 with nuts M 3. Align at right angles and fasten tightly, fig. 2.

3. Motor Unit (Bag 3)

Following the sequence shown in fig. 3, mount the cooling fan onto the motor and using the crankshaft nut fasten securely. Mount the clutch onto the cooling fan using 2 socket head screws M 4 x 15, and secure the motor loosely for the moment onto the supports using 4 socket head screws M 3 x 35 and lock nuts, fig. 4.

Then insert as follows, the washer, clutch bell with gear shaft and support with bearing (bearing facing gear), screw on the support with 2 socket head screws M 3 x 30 and 2 lock nuts loosely. Align the thus assembled unit exactly, tighten all screws, and make sure the clutch turns freely.

Fasten the pulley (belt groove facing motor) and secure tightly with a set screw M 3 x 3 through the hole in the side-plate, fig. 5.

4. *Main Shaft and Washplate (Bag 4)*

Fasten the main shaft with the large gear into the frame. See fig. 6 for the order of sequence of the parts. Slide up the main shaft with gear from underneath between the side-plates, slide in the lower support with bearing (bearing downwards) and upper bearing support (bearing upwards). Using 4 socket head screws M 3 x 30 with lock nuts screw on the supports firmly, but beforehand adjust the gear play by shifting round in the slots of the side-plates. Make sure the main shaft stands vertically ! Slip the brass ball onto the shaft and secure with socket head screw M 3 x 3. The main shaft should have no axial play at all, fig. 7 .

Slip the swashplate with the cone spring and collector onto the shaft, press the cone spring about 5 mm together and clamp the collector (for the time being) firmly. Mount the holding rod for the outer swashplate ring, see fig. 8, with 2 screws M 2. Screw two ball screws onto the outer ring. Fasten the steering arm onto the upper ring with a nut M 3. Tighten the nut. For the complete drive mechanism see fig. 9.

5. *Tail-Pipe (Bag 5)*

Push the tail-pipe from behind into the side-plates, pull out from the front the belt for the tail rotor drive with a wire hook and place it on the pulley, fig. 10.

Look through the back of the tail-pipe to make sure the belt is not twisted.

N.B. The belt must go from the upper side of the rear pulley to the left side of the front pulley, or, when the main rotor - seen from above - turns to the right, the rear rotor shaft - looking from the left - must also turn to the right.

Clamp the tail-pipe between the side-plates using 4 socket head screws M 3 x 30 and lock nuts M 3. Do not secure the screws too tightly otherwise the side-plates are liable to bend. Take care that the rear rotor shaft that protrudes longer on the left side is horizontal.

6. *Rear Rotor (Bag 6)*

Assemble the rear rotor, as shown in fig. 12, according to how the parts are laid out in fig. 11. Be sure that:

a. *the steering rod sits easily in the pushrod guide slot but has no play. By moving the steering rod back and forth the slot can be widened. Add a drop of oil.*

b. *the tail is bent as shown in the lower left corner of the plan and screwed in under the pushrod guide directly onto the tail-pipe.*

c. *the tail rotor blades are sanded over lightly, the ends lacquered and covered with self-adhesive foil provided, and this insert into the plastic holders and fasten, making sure that by contact with any obstacle they can sway away easily.*

7. *Canopy and Stabilizer (Bag 7)*

Construct the cabin floor and rear wall with opening for the tank with the plywood panels provided. As shown in fig. 13 fasten this onto the rail using 4 screws M 3 x 10 with 4 washers, and 4 nuts. Fit in the tank (order no. 729). Cut out the vacuum formed pilot seat, the instrument board and pedals and attach (polystryol glue), fig. 14. Attach the pilot (order No. 735) straight and securely onto the back of the seat with a rubber band.(For further instructions see paragraph 14).

Cut out canopy shell halves. Allow for a border of about 5 mm on the grooved outer edge of the back and floor space. Affix the canopy halves along the middle seam (PVC glue) so that later the borders can snap over the back wall and floor. When fitting the canopy, first slide the floor opening over the floorboard, tilting the cabin slightly backwards, then swing the canopy up and let the upper edge snap over the rear wall. When the installation of the radio control unit is completed,

secure the seat on the corners using self-tapping screws 2,9 x 9,5, and the canopy with a rubber band as shown in the plan.

Construct the stabilizer and rudder fin using the plastic plates according to fig. 15, and using 4 screws M 3 x 10, 8 washers and 4 nuts M 3, and the plastic clamps, secure onto the tail rotor. The vertical rear edge of the stabilizer should be 20 cm away from the hub of the tail rotor.

8. *Installation of Radio Equipment*
Any modern proportional radio control system with 4 servos can be used. The servos are required for following functions:

1. *Turns around vertical axis (change of direction) by blade adjustment of tail rotor.*

2. *Movement around lateral axis (tilting) by forward and backward tilting of swashplate, thus causing the entire main rotor system to move forward and backward.*

3. *Movement around longitudinal axis (rolling) by crosswise motion of swashplate to right or left side corresponding transverse movement of main rotor system to the right or left.*

4. *Taking off and descending of entire helicopter by accelerating and slowing down and/or increasing or decreasing rpm's of main rotor and thereby effecting degree of pull of main rotor.*

Installation of the radio control equipment must be done in accordance with the manufacturer's instructions. Due to the fact that the steering way of the various servos varies, no statement can be made as to the position of the rods or transmissions. For this purpose the steering way required is indicated in the building plan. Position of the steering rods as well as of the turning lever can be seen from the building plan. The adequate transmissions must be determined in accordance with the different movements of the servos. See figs. 16-17-18.

When installing the rods it must be assured that same are mounted straight-lined without play and in a way guaranteeing a smooth run. Apart from these basic rules, no special features are required in connection with the servos.

In attaching the servos it is advisable to use the appropriate methods offered by most manufacturers. The diagrams provide further information for this purpose. Servo 1 can be simply screwed against a wooden wedge onto the rear wall, or set upon a self-made plywood trestle. Because the servos on the market do vary greatly, no definite standard information is possible.

When connecting the throttle, the lever on the carburetor must be bent about 90° so that the steering rod, when coming forward, can get the right grip.

Servo 4, as well as the receiver and battery, is to be so arranged that they fit under seat. The switch fits comfortably on the rear wall of the cabin under the tank. The antenna can hang out loosely from the floor of the canopy. Following figs. 19 and 20 as already described in para 7, the seat with pilot and the canopy can be mounted.

Methods for fastening the servos are indicated in the building plan. By lineal-working servos, the servo for the tail rotor (No. 1) can also be placed downwards on the cabin floor. In a way similar to the throttle (No. 4), the rod can lead out the back and run straight up to the tail (as can be seen on the photo on the box top). Make sure that the rod moves absolutely freely.

9. *Control Function of Transmitter*
Basically the movements to be made by the swashplate are controlled by a self-neutralizing stick. Moving the control stick forward will cause

forward tilting of the swashplate (forward flight); moving the control stick backward will result in backward tilting of swashplate (backward flight). Moving the same stick to the right means tilting of the swashplate to the right (flight to right side). Moving the stick into the opposite direction will cause the swashplate to tilt to the left (transverse flight to the left). In most cases the above movements are controlled with the right hand.

The left hand controls mainly the tail rotor. Moving the stick to the left results in a reduction of pitch of tail rotor; movement to the right results in an increase of same. Motor throttle is controlled by the same stick, whereby backward movement of the stick affects a higher rate of rpm and lifting of the helicopter. This movement is not neutralizing.

10. Cooling Duct and Fuel Tank Connection

Cut out the two halves for the cooling duct from the plastic parts as in fig. 21. The openings for the needle valves should be made to fit the appropriate motor being utilized. Fit the two halves onto the frame as shown in fig. 22, bore the holes for the clamping bolts and secure with 2 screws M 2 x 10 and 4 washers and 2 nuts. Be sure that the fan can turn freely inside the housing.

As in fig. 22, attach the connection for the tank and establish the fuel line to the motor. The tank can be filled through the hose coming from the tank through the lower connection nipple. During transportation or when the motor is not in use, the hose end, which is normally attached to the motor, can be attached to the upper tank nipple.

11. Main Rotor (Bag 8)

The main rotor hub is already assembled.

Following the order as shown in fig. 23 and fig. 24, attach the sheet metal triangles from the side onto the ends of the transverse shaft protruding from the rotor hub, and usinf 2 socket head screws M 3 x 30 and 2 lock nuts M 3, screw onto the side of the aluminum seesaw.

Push the stabilizer bar through the sheet metal triangles and the transverse shaft. On one end slide on a washer and a set collar, on the other end a washer and the control lever. Finally screw the steering blades onto the ends of the stabilizer bar, turn the wings tightly in opposite direction till they are in exact alignment and cannot become loose.

As shown in fig. 25, place the rotor hub on the main shaft; balance the stabilizer bar exactly by backward and forward movements and fasten, either with the set collar or the control lever. The control lever must be screwed on firmly and in an exact line with the steering blades.

12. Main Rotor Blades (Bag 9)

Sand pre-cut and pre-drilled main rotor blades and, if necessary, refinish profile (exact cross section view can be seen from drawing of adjustment instructions). Please paint the blade tips only for better look and provide blades with enclosed self adhesive foil. This is done as follows: remove foil from backing paper and place foil on a smooth and even surface with self adhesive side up. Put rotor blade with convex side on top of foil, whereby foil must overlap trailing edge by appr. 1 cm. Press blade on foil in this position. Take care that trailing edge is straight lined. Put foil carefully around leading edge and press thoroughly in all places.

Mount completed rotor blades with blade mounts (516) to joint by using socket head screws M 3 x 15 with lock nuts. In doing this, the rotor blades must be in line with the flapping hinge. In addition, the lower sides of the blades must have a difference of plus 2 degrees to the stabilizer bar, which is achieved by turning the blade mounts. For this purpose attach pitch gauge underneath rotor blade at a distance of appr. 15 cm from outer blade end, align pitch gauge to straight lower edge and adjust stabilizer bar to same position. Fasten screws thoroughly (fig. 26). The pitch gauge (Plastic wedge) is in bag 10.

2. *Swashplate*
At neutral position of the control stick, the swashplate must be positioned in a right angle to the main rotor shaft. It is absolutely necessary to assure that the rods have sufficient play and do not touch during extreme movements performed by the swashplate. Also check the holding rod for the stationary part of the swashplate.

3. *Main Rotor*
The connecting rod between swashplate and stabilizer bar must be checked and adjusted in a way permitting an exact horizontal position of the swashplate (right angle to main rotor shaft) and horizontal position of steering blades to stabilizer bar at the same time.

4. *Tail Rotor*
The servo for the tail rotor being in neutral position, the angled part of the steering rod must be located in the centre of the pushrod guide slot. Check again as to easy run, adjust tail rotor blades to appr. 8 degrees pitch to fuselage longitudinal axis (adjustment instructions). Alteration of the pitch is performed by shifting both collars at the outer ends of the steering rod. When checking maximum movement, please make sure that the pitch can be reduced to a minimum of 0 degrees, even better is minus 2 degrees when control movement to the left side is performed (nose of fuselage turns to the left). Maximum pitch for movement to the right: approx. plus 14 degrees.

5. *Motor Adjustment*
Adjustment of motor throttle differs from type to type and must be performed manually. Basically it can be said that full speed must be obtained at full movement of control stick. Final adjustment will be made later on with engine running.

6. *Fuel*
In general there are no special requirements as to the type of fuel to be used. Experience has shown that normal fuel can be used for helicopters without any problems. Mixtures consisting of Methanol with appr. 18-20% caster oil have proven to be best. An improvement of throttle function and a smoother run can be accomplished by adding approx. 2% supreme gasoline.

7. *Starting the Engine*

To start the engine use the starting belt provided. The belt is placed on the cooling fan pulley, whereby both ends come out on the one side of the chassis.

After filling the fuel tank (see chapter II/10) attach the fuel hose to the carburetor connection. Open the carburetor slightly from the neutral position. (But on no account give full throttle!) Open the needle valves about 3-4 turnings, and, keeping the air vents closed, press your finger on the tank so that a little fuel spurts into the carburetor. Connect the glow plug clamp to the glow plug either from below through the chassis, or at an angle from the side.

At the beginning the helicopter and main rotor should be held by an assistant, start the engine by pulling the starting belt rapidly to and fro until you feel and hear the first ignition. Pull the belt with a swing all the way through so that the engine, when seen from above, turns to the left. Now the engine can finally start up and run freely. A short acceleration while the rotor is still being held is not harmful, but the centrifugal clutch should not be subjected to strain for too long or unnecessarily. After a little practice you will not need an assistant - by holding the helicopter with one hand and the starting belt with the other, wrap the end to be pulled firmly around two fingers and let the other end run loosely through the same hand, fig. 30.

Of course, an electric starter can also be used. For this purpose the starting belt provided can be converted by welding into an endless belt. The belt length is about 300 mm, this is then hung on the carburetor from the side of the helicopter and after ignition put between the metal plates of the chassis.

Attention ! Centrifugal force of rotor blades is appr. 50 kg. For this reason only use original parts and the screws described for assembly !

Place the completed rotor head with the stabilizer bar on two supports so that it can oscillate. Cover the lighter, upward oscillating blade with self-adhesive foil until weight distribution is perfectly balanced. On each blade tipe tape a different distinguishing colour to identify each blade when testing the rotary level.

IMPORTANT: Balancing must be performed with the utmost care while the entire smooth operation of the rotor system is fully dependent on an equal weight distribution.

13. *Final Assembly of the Main Rotor*

Slide the finished rotor head onto the main rotor shaft and secure with socket head screw M 3 x 15 and lock nut. Loosen the clamp bolt on the collector and turn the upper part of the swashplate so that the steering arm stands directly beneath the ball and socket joint of the control lever. Join both arms of the ball and socket joint with the linkage. Adjust the linkage in such a way that when the swashplate is in a vertical position, the control lever as well as the steering blades lie exactly horizontal. This adjustment is only true for the horizontal position ! Owing to the transmission ratio, operating the swashplate can alter the setting engle of the steering blades much more than the control angle of the swashplate ! During these adjustments be sure that the cone spring presses the swashplate lightly down. (Spring pushed about 5 mm together) fig. 27.

Swing and test the cardanic suspension of the rotor head in every possible position to make sure that the control rod does not bump against anything anywhere.

14. *Odd Jobs*

With that, the assembly of the "Heli-Baby" is practically completed. According to your own personal taste, the model can be decorated with the enclosed decals or even lacquered in various colours. Further decoration possibilities of the cockpit are practically unlimited - from round rods and even from the leftovers from the plastic parts, you can make a control stick, pitch lever, card pockets, etc. etc.

A TIP: The pressed ridges on the canopy exterior should be painted black. This can be done quite effectively using a felt nib pen for plastic, which can be obtained at any stationers.

"Heli-Baby" can even be flown without the seat and canopy. During the try-outs, the beginner might find this preferable. If this is the case, an easy to fasten weight-balancer should be installed on the front floor of the cabin to compensate the missing parts. (See the next chapter for determining the centre of gravity).

For the first training flights, the float kit should be attached, order no. 771. The frame projects quite a distance on both sides and through the elasticity of the floats any degree of unevenness can be overcome - which is of great advantage during the early trial runs. As can be seen in fig. 28, the float frame can be attached in place of the skids.

III. ADJUSTING AND TESTING

1. *Centre of Gravity*

The centre of gravity must be directly under the main rotor shaft. To test this, lift model with one finger under the lower end of the main rotor shaft (below the large gear), as in fig. 29. The model should then so tilt, that the main rotor shaft stands vertically (with an empty tank), or with a minimum forward inclination of 1-2° (with a full tank). The model should also be crosswise perfectly balanced. Any discrepancy eventually arising can be equalized out by shifting the battery. This is simplified by the tunnel in the seat section which protrudes quite a way towards the front.

The belt can be welded together thus: hold the cut off ends on a piece of metal heated to up to 200° C, melt the two joints slightly and press them immediately together. The resulting bulge can either be trimmed with a pair of scissors or ground on a grindstone.
This same welding method is also applicable for the rear rotor drive belt.

8. *Breaking-In of Engine*
Brand new motors can be installed into helicopters without test run performed beforehand. Experience has shown that it is advantageous to break in the engine after installation into the helicopter, because the motor actually is never operated at full throttle. Upon starting the main rotor should be released as soon as possible so that it can turn freely. Now, at a relatively rich needle adjustment, you can "play" with the throttle, which is favourable for the motor. However, final motor adjustment cannot be achieved at once.

9. *Throttle Adjusting*
Upon sufficient breaking-in of the engine, maximum speed adjusting is performed as follows: hold landing gear onto bottom or a table. The tank should be half filled and needle adjustment relatively rich. Now progressively turn to high speed. Close needle valve progressively. As a result, motor rpms will increase and then decrease again because needle adjustment is too lean. Now the needle valve is to be reopened again up to the point where reduction of rpms would start to take place. In this position the engine should run a minimum of 30 seconds without decrease in rpm. Remark: too rich a needle adjustment is better than too lean an adjustment. Then adjust idling in accordance with manufacturer's recommendations. Adjust idling in a way permitting clutch to release with utmost ease. Thereby transition must be smooth during acceleration.

> *Whenever testing and operating a helicopter you must be well aware of the fact that running rotor blades have a force which may not be underestimated. The blade tips reach a circular speed of up to 400 km per hour. The centrifugal force of each rotor blade amounts up to 60 kg. Therefore please observe the following basic rule: use original parts only when assembling rotor blade connection, rotor head and blades ! Inspect blade mounts currently and also check screws and nuts and exchange same in cases of doubt ! Especially beginners should never fly with spectators nearby. Children and curious people are a source of danger. Never fly over spectators, which is avoided with airplane models as well.*

10. *Checking Alignment*
Both rotor blades must turn on the same level. For checking purposes rotor blades are turned at the highest possible rate of rpm. Check turning level of blades from the side. By means of the differently coloured blade tips you will easily identify which blade is turning on a higher or lower level. In case the difference amounts to appr. 5 mm, nothing has to be done. In case the difference is more than 5 mm, correction must be made. For this purpose, throttle engine and wait till rotor stops (never stop suddenly !).Use pitch gauge and check whether the blade running at the lower level shows a pitch difference of less than 2 degrees to the stabilizer bar. If this is the case, adjust pitch of this blade by releasing both clamp screws of blade mounts and turning same. Do not forget to tighten screws ! In case the blade turning on the higher level shows a difference of more than 2 degrees to the stabilizer bar, reduce pitch.

Remark: If required by weight of model and when using floats, adjustment may deviate from the recommended pitch of 2 degrees. Principle: Degree of pitch of main rotor blades should allow the model at full power to lift without interruptions, but not too quickly. A large pitch results in a considerable increase of lifting performance on one hand, but on the other hand the motor must be throttled too strongly when landing.

During the initial period of operation it may happen that the blade level changes due to "settling" of rotor blades in blade mounts. Depending on the lifting performance achieved so far, it must then be decided, whether the pitch must be reduced at the blade turning on the higher level or whether the pitch must be increased on the blade turning on the lower level.

11. Trim of Tail Rotor
Now we have reached the phase requiring trim of tail rotor. For this purpose model must be placed on the ground (surface must be even and smooth) with the nose pointing into the wind. Accelerate slowly until helicopter becomes lighter and starts to "swim". Find out whether the model turns off around vertical axis. If adjustment was made exactly, the trim of transmitter must be sufficient for correction. Following rule is applicable: if model turns with nose to the left side, increase pitch. Trim tail rotor until model shows no tendency any more to turn around vertical axis during slow and smooth acceleration. During adjustment attention must be paid to eventual changes of direction of wind. In case the trim of transmitter is not sufficient, correction must be made by adjusting the collars on the pushrod. These initial hovering flights, however, are only made to trim the tail rotor and to get a feel for the model. Before starting with actual test flying, please study the following basic rules.

IV BASIC RULES FOR FLYING

Basic Rule No. 1: Never tether the model to the ground
by means of strings or similar devices. The model must move with utmost ease, thus enabling the stabilization of the main rotor to operate efficiently. Tethering of the model would prevent any natural flight movement right from the beginning and would completely unbalance the helicopter. Furthermore, this would require the pilot to perform the most difficult flight manoeuvre immediately, which is flying above a certain fixed point. This is asking too much for the beginning.

Basic Rule No. 2: Keep nose of model into the wind
Especially in the beginning attention should be paid to the requirement of the nose always pointing in wind direction. Never try to start with crosswind, even if it seems to be easier, or even if there is only a slight breeze. If tail rotor was trimmed correctly before, the model will automatically put its nose into the wind immediately upon lift-off and it will be difficult for the untrained pilot to react to this sudden movement made by the helicopter. Starting with tail wind is even worse, because in most cases the model will turn by exactly 180 degrees and confuse the pilot completely.

Basic Rule No. 3: Walk with the model
Especially during the beginning always walk with your model. The best way to do this is to stay from the model at a distance of approx. 2-3 meters (nose of model pointing into wind direction). Then start model into any direction. In doing this, do not stay at one spot, but follow your model by trying to keep the distance of 2-3 meters. It is much easier to observe the model from a shorter distance. Furthermore, this will give you the advantage of maintaining the same direction your model has.

Basic Rule No. 4: Forget that the tail rotor is existing
During practical flying the pilot should completely overlook the tail rotor and thereby the side fins as well. On the contrary, the centre and the nose of the fuselage should be observed. As also practised with airplane models, a left turn around the vertical axis will be performed by moving the control stick to the left without paying attention to the movement to the right side executed by the tail rotor. It is surprising, how many pilots make the mistake of constantly watching the tail rotor instead of controlling the flying direction of the nose of the helicopter. In principle, the tail rotor is controlled like the rudder of fixed wing airplanes.

Basic Rule No. 5: Operate engine throttle slowly and smoothly
Slow and smooth acceleration and/or slowing down is most important, due to the fact that a change of rpms of the main rotor results in a change of torque. If acceleration is performed slowly and smoothly, this will guarantee simultaneous increase of rpm of main rotor and tail rotor, thus obtain-

ing a completely automatic torque compensation (also see remarks concerning steering). On the other hand, sudden and fast acceleration results in sudden and strong changes in torque, which must be compensated immediately by the tail rotor. This, in turn, results in a relatively unsmooth turn of the model around the vertical axis. This complicates correct determination of the steering movement of main rotor.

Basic Rule No. 6: Do not be afraid of tilted position
No danger exists in case of certain sloping position or tilt of the model, due to the fact that without touch to the ground the model shows no tendency whatsoever to tilt or turn over. You must be well aware of the fact, however, that the model will continue to fly or accelerate to the same direction or tilt. The acceleration in such cases can be quite considerable depending on the main rotor turning level. This does not mean that the model wants to turn over in this direction, provided that the landing gear is not caught by the ground.

Basic Rule No. 7: Practise hovering first
This rule is important because it will prevent unnecessary disappointment. Hovering must be exercised until perfection is achieved, because it constitutes beginning and end of all other flight manoeuvres. In addition, the low altitude during hovering is advantageous, because it allows immediate landing of the model in case of mistakes. In cases where the model turns over as a result of the landing gear being caught by the ground, no considerable damage is generally caused except for possibly broken rotor blades.

Basic Rule No. 8: Slow down in case of landing with tilted model
Especially during the initial phase of hovering training, certain steering mistakes cannot be avoided. Therefore it is recommended to land the model from low altitude. This is done by cutting of the throttle until the landing gear is in touch with the ground. Even if the model will touch the ground in tilted position, it will fall back on the training landing gear provided that the motor will be throttled suddenly and completely as soon as the model touches the ground (well adjusted idling will now be appreciated).

Basic Rule No. 9: Watch space between fuselage and rotor
The main rotor of a helicopter is controlled by the swashplate. This means the main rotor operates in accordance with the position of the swashplate. It is not important whether the swashplate is tilted by the control stick or inclined as a result of fuselage inclination. This means that the swashplate does not know the difference between a movement of the swashplate as a result of control or as a result of fuselage incline. This means: if the fuselage is in horizontal position and the swashplate is tilted by 3 degrees nose down, the main rotor will also tilt by 3 degrees. This will lead to a considerable acceleration forward, the fuselage will dip its nose. The degree of this tilt, for example, might be 2 degrees. If you leave the original swashplate position and add the 2 degrees tilt of the fuselage nose, the swashplate will now tilt by 5 degrees to the front. Consequently the rotor will follow the swashplate movement and move from the original 3 degrees to 5 degrees, which, in turn, would result in further undesired acceleration. To stop the forward movement, it will not be sufficient to bring the swashplate back to the neutral position. With a 2 degrees' forward dip, even if control stick is in neutral position, the swashplate as well shows a 2 degrees' forward dip. The main rotor will adjust itself to the 2 degrees and will thereby maintain a less stronger but still distinct forward acceleration. In order to bring the model back into neutral position, the swashplate must be controlled in a way to overcome the 2 degrees of tilt of the fuselage, i.e. it must be moved 2 degrees backward. This will return the swashplate to the horizontal position and the main rotor as well will be in horizontal position, thus accelerating no longer. In order to stop forward movement, the main rotor must be moved into opposite direction, backwards. Let us assume that a 3 degrees' backward movement (slowing down) would be required while the fuselage is tilted forward by 2 degrees. This would mean that the swashplate must be moved back by 5 degrees by transmitter stick.

Basic Rule No. 10: Do not lose courage
Do not become confused by the aforementioned explanations. It is true,

the control of a helicopter is not quite uncomplicated, but it sounds worse than it actually is. Generally people have only little knowledge about the flying technique of helicopters and completely wrong ideas about helicopter flying. These intentionally detailed instructions are to help you to gain a good knowledge about your helicopter.

V TRAINING FOR BEGINNERS

For beginners we recommend the float landing gear, which can be obtained as complete kit, Order No. 771. The large floats provide good stability of the model in all landing directions, they act as shock absorbers in cases of hard landing and they smoothly slide over uneveness and grass. Efficiency is somewhat reduced due to the fact that the large floats partially extend to the down wash of the rotor. This can be compensated by increasing the main rotor blade pitch.

It is recommended to undertake the first flying tests on a large area without obstacles. The surfact must be even and smooth. The weather should not be too unfavourable, but an easy steady breeze is of advantage. Place your model on the ground with the nose into the wind and position yourself approx. 3 meters behind the model. Now start to accelerate very slowly and smoothly until clutch engages properly and slowly increase rate of rpm of main rotor. Maintain rpms reached and accelerate until helicopter starts to "swim". When doing this, observe turn around vertical axis (flight direction) and, if necessary, correct trim of tail rotor. If the model continues to fly into wind direction, you can slowly accelerate a little; please only accelerate a little because rpms of main rotor must increase first, which takes a while, and ground effect is established very quickly.Watch the model (middle of fuselage, never the tail !) and try to find out whether the model tends to tilt to one side. In case the model shows a tendency to tilt, correction is made by trimming of the main rotor via transmitter stick until a rough, vertical lift is obtained. If you have the feeling that the model does not want to fly away into one preferred direction (watch fuselage) you can accelerate a little until the model reaches an altitude of approx. 20-50 cm. Generally, the model is supported by an aircushion in this altitude, however, it will try to fly away into one direction. You will have to remember, into which direction your model tends to fly away and correct the flying direction by control of main rotor into opposite direction. When doing this, do not stay at one point, but move and walk with the model. Always try to keep wind direction. You do not have to return the model to the starting point right away. In the first instance it is important for you to be able to stop flying movements made by your model into any undesired direction. Stopping, however, may not be performed suddenly; for this purpose a certain period of deceleration is necessary. The starting, however, hovering and stopping manoeuvres must be repeated again and again. Let nobody lead you into temptation to accelerate and go to a higher altitude. It is true, flying outside ground effect is considerably easier, however, at the beginning it is much better to keep an altitude of 50 cm as the model can be brought down to the ground without damage when control mistakes are made, and these mistakes frequently do happen at the beginning. On the other hand, considerable problems will arise in cases of control mistakes in an altitude of 2 meters.

When steering the main rotor, do not be too faint-hearted, but perform distinct but short countermotions without hesitation. In doing this, observe position of fuselage closely. When the control mistake was not too a drastic one, do not land the model, but try to correct your mistake, thereby always walking with the model and keeping its nose into the wind.

As soon as you have exercised sufficiently and gain the experience preventing you from making basic control mistakes, you can leave the 50 cm safety altitude and fly at an altitude of 2-3 meters. Never try at the beginning to make round flights or turns around the vertical axis causing the model to take a position in cross wind. This will at this stage unmistakably lead to completely wrong control. When keeping an altitude of 2-3 meters do not only counteract to undesired flight movements, but also try to stay in one place, whereby it is absolutely unimportant whether you hover above an exactly fixed point. Most important at this stage is your ability to prevent undesired flight movements. Train the

hovering flights again and again and do not get tempted to start with round flights. Even though, at this stage, no difficulties would arise, as the engine is stable when moving forward. Landing, however, will involve difficulties, because you have to change from forward movement into hovering. Instead of this, try to move the model crosswise to the left and to the right by keeping the nose always into the wind. Later on you can even cross the airfield sideways by walking some meters behind your helicopter. If you are of the opinion that you can perform all flying exercises described so far without any problems, you can increase altitude to 8-10 meters. Please accelerate slowly to prevent the helicopter from gaining altitude too quickly. When descending, also apply throttle very slowly to prevent a sudden drop in altitude. To stop drops, relatively high motor efficiency is required, which results in strong acceleration and turning of the fuselage. Furthermore, the danger exists that in cases of fast descend the model is caught by the rotor turbulence and the dropping cannot be controlled any more (vertex ring).

Also, when making these flights, please remember: corrections by transmitter stick must be distinct but relatively short. Always observe position of model and reaction in flight movement. Always be aware of the fact that the model requires a certain period of time to slow down. Example: model is hovering at an altitude of 2 meters. The fuselage, although hardly noticeable yet, starts to tilt backward. Later you will know that this will lead to a backward flight and you will prevent this by forward correction. In the beginning, this correction in most cases comes too late and the model will start to move backward. Now you not only have to slow down the backward acceleration, but at the same time stop backward flight. Perhaps the model is now in a position 2 meters behind the previous point, but it stands still. Now return the 2 meters difference whereby nose is put downward with a short movement of transmitter stick. The model starts to move slowly forward. Before reaching the desired point, lift nose, wait till model stands still and put it immediately into horizontal position. All flight movements are controlled in this manner by following the basic rules listed below:

a. stop movement
b. start corrective movement
c. stop corrective movement
d. maintain new position

This corresponds exactly to the control of real helicopters.

VI ADVANCED TRAINING

As soon as you master hovering as explained before in the chapter covering the training for beginners, you have now arrived at the phase of advanced training and you can start with "intenional" round flights (while you possibly undertook some "unintentional" round flights in the past).

For this purpose, lift the model to an altitude of appr. 2 meters during hovering. Retrim exactly and exercise hovering by moving the model sideways. After having done this successfully for 2-3 minutes, bring model to a stand-still and initiate forward flight by dipping nose slightly. You have done this many times during hovering, but you used to stop this movement immediately in order to stay in one place. Now you do not slow down (if model starts to move slowly forward, do not accelerate). The model will now accelerate more and more and you will find that the model tries to fly a slight circle to the right. At low speed, this right hand circle is very wide. If you want to be sure, continue this way and the model will automatically fly a perfect right hand circle back to the starting point with the nose against the wind. A slight breeze, however, is the prerequisite so that the helicopter will not be drifted away. However, if you want to perform a proper straight flight, you have to prevent the model from getting too fast. If the model is moving too fast, lift the nose by applying the main rotor transmitter stick, which should result in a standstill of the helicopter in not too far a distance from yourself, because you will have to control an exact hovering flight afterwards. You are not used to do this from a large distance and it is not easy as well. Try to

maintain an average forward speed by tilting main rotor correspondingly. Undesired tendency to turn to the right can be counteracted as follows:

a. left control of tail rotor and
b. left control of main rotor

In the beginning, the model may possibly not describe a straight line. This, however, is not essential, as you will have sufficient time available to make corrections. During proper, straight flights, corrections are required due to the following reasons:

Trim of tail rotor as well as main rotor was made for stationary hovering only. For example, the tail rotor must balance the entire torque of the main rotor without receiving support by the side fin. This will change during forward flights due to the fact that now the side fin provides a stabilizing effect. This means that the tail rotor receives assistance from the side fin, which, in turn, causes the tail rotor to operate too strongly, which, in turn, results in a right turn of the fuselage around the vertical axis. Correction of the tail rotor is made by decreasing the pitch with an appropriate movement of the transmitter stick to the left side.

The main rotor system will show a certain aileron effect to the right hand side. The reason for this is that the blade located at the left side of the rotor is turning against the wind when the rotor turns clockwise, while the blade located at the right side of the rotor turns with tailwind. Therefore, the blade on the left side will have more lift than the blade on the right. In order to balance the aileron effect to the right, the main rotor must be corrected to the left (real helicopters show this typical feature as well).

It is quite obvious: the faster the forward movement, the stronger the corrections to the left to be performed on the tail rotor as well as on main rotor (crosswise).

The distance obtained in the meantime will be approx. 20-30 meters and you wish to initiate a turn. If this should be a right hand turn, all you have to do is to neutralize the tail rotor and cross position of the main rotor. In case you wish to fly a left hand turn, increase tail rotor pitch as well as the aileron effect of main rotor to the left. Now it will be essential that you are in a position to reduce the pitch to at least 0 degrees, otherwise a left hand turn will not be possible.

When flying a turn, the helicopter, like fixed wing models, shows a tendency of losing altitude. For compensation the nose of the model must be lifted a little by correction of the main rotor, which corresponds to the operation of the elevator in case of airplane models. All these control operations do not involve any problems, as they are performed slowly and the modeler has sufficient time available for thinking.

At this point, however, the following remark must be made:
It is not quite easy to determine the exact flying position of a helicopter from side view, as you have no possibility to determine the position by means of tilted wings. If you have not watched the model very closely, it will be very difficult to decide from side view whether the helicopter is approaching the modeler or whether it is moving into opposite direction. In cases of doubt strong control movements, preferrably to the left side, will help you to determine the position of the model.

After completion of this first turn, the helicopter will be flying at a relatively high altitude, if you have not yet applied the throttle. The altitude must be maintained by slowing down. In the beginning, the slowing down will be surprising and unfamiliar to you, because you are used to hover with a relatively high motor performance. During forward flight, however, motor efficiency can be reduced considerably. Generally, round flights are performed with the throttle being half open.

When preparing for landing, speed will be further reduced. One would hardly believe that the helicopter can stay in the air at such low a motor efficiency. Normally modelers hesitate to apply the throttle; therefore the model arrives in too high an altitude and the modeler is forced either to repeat the landing approach or to bring the helicopter down slowly and vertically from this altitude. This must be done slowly in order to prevent the helicopter from being caught in its own rotor turbulence (downwash). In case this should happen, correct by strong pushing and accelerating. During landing flight the speed may not be too high. The landing course is corrected by means of the tail rotor. Let the helicopter approach and shortly before it will touch the ground lift the nose by means of the main rotor stick, which corresponds to operation of the elevator in case of fixed wing models. When doing this, prevent the model from lifting again. Also pay attention to the fact that the ascending force decreases at decreasing forward flight and that you have to accelerate slowly for hovering and landing. It is important to start the landing manoeuvre in a way permitting the pilot to have the usual position during the changing phase to hovering.

The landing flights should be exercised again and again. Do not neglect hover training either. After you learned how to perform round flights, you will notice that those are much easier than hovering, which might lead to the temptation of starting off immediately and perform quick flights with bad landings. Furthermore, eventual failures can show during the first minutes, during the hovering phase, which is not dangerous in view of the low altitude. For example, the motor adjustment might be too lean, which will undoubtedly show during hovering, because maximum engine performance is required. It is definitely worse, if round flights are performed with an improperly adjusted engine and the modeler must realize during the landing-hovering phase that the engine fails because of lean adjustment.

VII. MAINTENANCE, CARE AND REPAIRS

This very important chapter appears at the end of the Building and Flying Instructions, but it should actually stand right at the beginning while it forms the basis of each and every working aspect with the helicopter.

Your "Heli-Baby" is an absolutely robust construction, tailored to meet the raw demands in the field. But this does not alter the fact that technical supervision should be regularly performed.

Here are a few essential points:

Test that all (really all) screws are tight. Above all test all the screws on the blade mountings. Tighten also the clamping screws on the set collar and control lever. Do not forget the engine screws. Proof that all control rods can move freely, and that all rod links are correctly in place. You can even hang the rods out and test them without the servos being connected. Even the best pilot cannot fly a helicopter when the control parts jam. Make sure that the servos, receiver, battery, tank, seat and canopy are firmly in place. Keep your eye on the clutch and whole drive unit that they work easily. Be sure of absolute cleanliness during refuelling. Do not let loose tank hoses drag in the dirt, etc. etc.

Taking care means: from time to time oiling all mountings and moveable parts (special oil order no. 838). Above all, do not forget all the ball and needle bearings (11 in all), push rods guide slot on the main rotor as well as the control rods, the joints on the rotor head and the swashplate bearings. The large plastic gear is not to be oiled.

Additional instructions for "Super-Heli-Baby 2", Order no. 717

The model "Super Heli Baby 2", order no. 717, differs from the earlier model "Super Heli Baby" only in the rotor head. In this rotor head experience and parts of the "Bell 222" model has been incorporated. The pusher pieces has been left off of the main rotor shaft, the mixing levers outside the main rotor. Instead of this pusher a longer pitch leverage has been developed, which now controls a mixing lever incorporated in the main rotor proper. This new pitch leverage is exchanged against the former rods, after main rotor shaft has been removed. Control and adjustment of swash plate and driver remain unchanged. The 7 mm dia. main rotor shaft is fitted with a 1o mm dia. adaptor at the top, so that the new and wider rotor hub may be put on.
Rotorhead assembly is as follows:

The pre-assembled blade shaft holders (555) are fitted between the side plates (551) using two socket head screws M 3 x 30 and lock nuts M 3 each. In doing so, put the control arms through the slit in the side plates (551). The spacer sleeves (568) are also placed between the side plates (551). In the two bottom holes insert 2 socket head screws M 3 x 30 and fasten lightly with lock nuts M 3 between the side plates.

In the bottom diagonal holes now insert the pre-assembled rotor hub (560), the black steel bearing (563) with the longer end ahead. The side plates, which have been only loosely assembled, are now spread a little and placed onto the steel bearing (563). Now fasten all 6 screws on the side plates securely.

Screw 2 ball links (434) with nuts M 3 into the control arms.

This now pre-assembled unit is placed on the mainrotor shaft together with rotorhub and reducer sleeve. Socket head screw M 3 x 30 with steel bearing disk (570) is pushed through steel bearing (562) and diagonal hole of main rotor shaft and fastened with lock nut M 3.

Now screw in 3 ball links (434) in mixing lever (561), with hexagon nut M 3. Ball link should face downwards. Mixing lever (561) is placed on crossshaft at top of rotor head. You will probably have to spread mixing lever to accomplish this. Stabilizer bar (564) is pushed through cross shaft. Use grease. Put washers on each side. On one end use set collar(559) and on the other end control lever (562). Ball joint with ball shows to inside.

Plastic control paddles (749) are turned onto stabilizer bar ends, using epoxy or similar glue on the thread. Adjust control paddles exactly parallel. Thread will cut itself into paddles, but take care not to overturn threading at the end.

Now move stabilizer bar back and forth until it is exactly in balance. This is important and must be done with great care, as control reaction and smooth rotor operation depend highly on perfect balance. After determining exact center position of bar, set collar (559) is fastened with socket head set screw M 3 x 3. Control lever (562) is also fastened to stabilizer bar with socket head screw M 3 x 3. Stabilizer bar should retain some axial play and move easily within the rotor hub. When tightening control lever (562) please observe that it should be positioned exactly parallel with the control paddles.

When assembling control paddles please note that rotor rotates to the right, looking from above. The narrow edge of the control paddles should therefore show ahead, looking in direction of travel.

To improve stability, balancing weights may be added to the stabilizer bar (oder no. 755). These weights can be added on the field, without having to alter any other setting of the model. No more than two sets of weights should be used.

Screw one ball joint without ball onto protruding pitch lever and on center ball joint of mixing lever. Adjust ball joint so that mixing lever is in an exact horizontal position, when arm of toggle, at lower end of pitc lever, shows vertically downward. (Both levers in center position).
The connecting lever between swashplate and control lever for stabilizer bar is fitted with two ball joints, led through the driver and onto the ball joint of the swashplate, and lever for the stabilizer bar. Snap on there Levers should be adjusted so that control lever (562), in an exact horizontal swashplate position, is also in an exactly horizontal position. Control paddles should also be horizontal.
2 each ball joints are screwed together with control rod (433, 20 mm long), so that about 4 mm rod still shows between both shaft ends of the ball joints. With these rods, now connect ball links of mixing lever with ball links of blade control levers. Take care not to distort the blade control levers and that these have the same spacing to rotor head and side plate. (Distance between side plate and hex nut for fastening of ball link= about 8 to 10 mm).
The assembly of the main rotor blades and the entire basic adjustment of them, as well as the movement of the collective and cyclic pitch control remains unchanged. See Super Heli Baby instructions, order no. 706.
Additional note: The main rotor used on the Super Heli Baby 2 is cardan suspended. Thus the spacer sleeves (568) only act as end stops. The Super Heli Baby 2 therefore corresponds in it's characteristics of cyclic pitch control with the fully cardan rotor of the Super Heli Baby.
By adding rubber sleeves onto the spacers it is possible to limit the tilt movement of the rotor head, so that an improved control reaction may be expected. In some cases it may be advisable to use shock absorbers (567) with rubber absorber cushions (569). These are contained in the kit for the "Bell 222", or may be ordered seperately. When doing so, care must be taken to maintain a high rotor rpm. Too low rotor rpm will lead to "nodding" of model. This practically stable main rotor setting arrangement should however be reserved for real experts.

There is also the possibility, in accordance with the main rotor head of the "Bell 222", to install the aerobatic mixing lever (566). Two additional 3 mm holes must be drilled in the top ring of the swash plate, at a 90 degree angle to the already existing holes.

The assembly of the aerobatic levers is done as described for the "Bell 222". This modification should also be reserved for a real expert.

Further information may be obtained from the instructions for "System 80", available under No. 890. The information required is listed there on pages 11 and 12.
The rotor head parts for the model "Super Heli Baby 2", order no. 717, correspond to the parts for the rotor head of the "Bell 222", which is listed under aerobatic rotor, order no. 802, in the spare parts list.