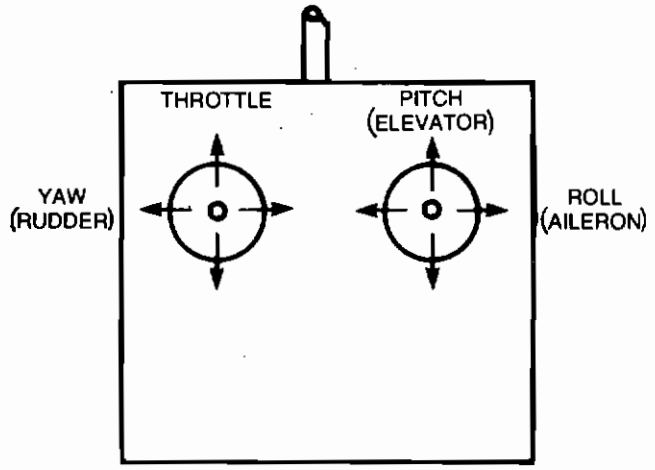
GIVE IT A WHIRL

John Gorham

LEARNING TO FLY
The Control Functions of the R/C Helicopter

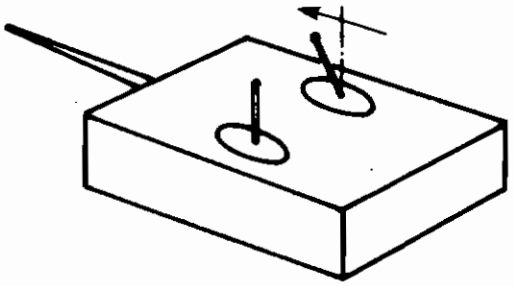
Before we commence on the initial stages of learning to fly an R/C model helicopter, we should understand the functions of the controls of the transmitter and their effect on helicopter flight. Since most R/C helicopter fliers now use Mode II control configuration on their transmitter, we will limit our discussion to this mode of control only. Flyers who are using other arrangements will be able to readily understand how their own particular arrangements will apply. We will not discuss in this article the details of how the controls and linkages of the R/C helicopter operate. There are many different arrangements and this topic is well worth a separate article which will appear soon.

Mode II, as most readers will know, is an arrangement of controls whereby the right hand stick of the transmitter controls the pitching and the rolling of the aircraft and the left hand stick controls the engine throttle and the yawing of the model.

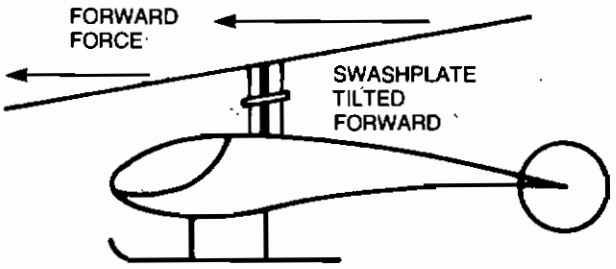


MODE II STICK ARRANGEMENT

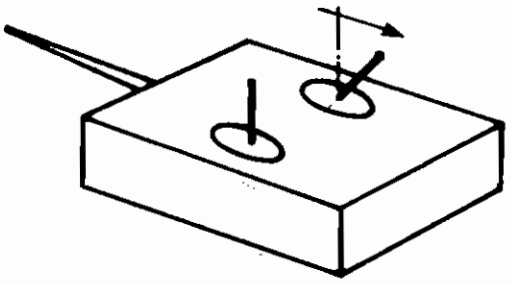
Translated to the R/C model helicopter, the right hand stick, when pushed forward, will tilt the swashplate in a forward direction, and by means of the arrangement of linkages from the swashplate to the controls in the rotor head, will cause the main rotor blade system to tilt forward (that is to say down) at the front edge. This action will cause the helicopter to commence moving in a forward direction, or stop movement in a backward direction, since a forward force will be created by the tilting of the rotor disc to follow the same motion as the swashplate. In the case of a 'rigid rotor' system, the forward force will be developed by an increase in lift at the rear of the rotor disc, and a decrease at the front. Since the main rotor plane cannot itself tilt, the whole helicopter must then tilt forward and this will again provide the required forward flight force. Pulling the right hand stick down on the transmitter, or towards the flyer, will result in the swashplate tilting backward. This in turn, will cause the rotor blade system, or the helicopter, to tilt backward or create a



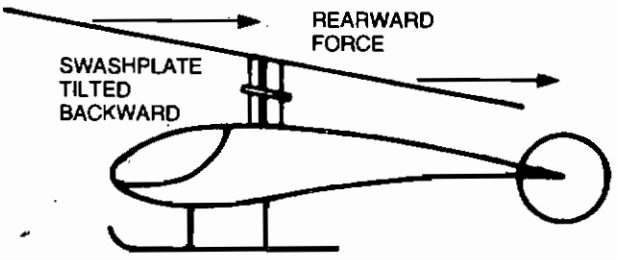
RIGHT STICK MOVED FORWARD



HELICOPTER MOVES FORWARD

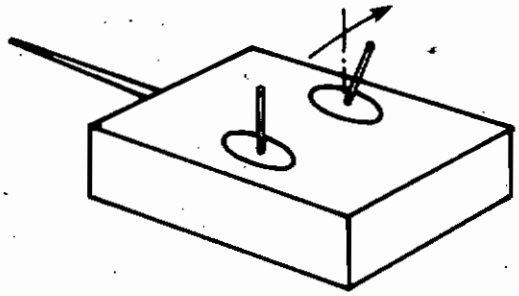


RIGHT STICK MOVED BACK

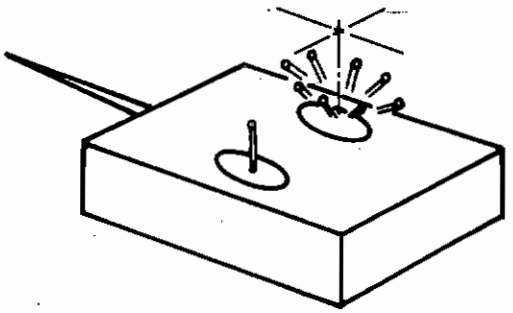


HELICOPTER MOVES BACKWARDS

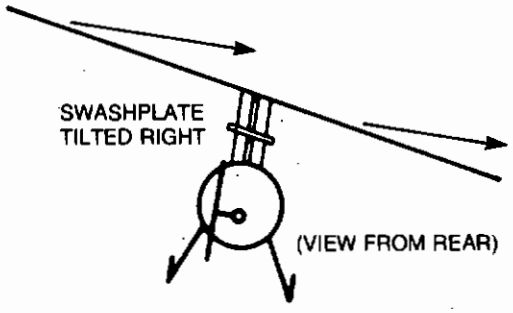
Reprinted from 'RCM', July 1980



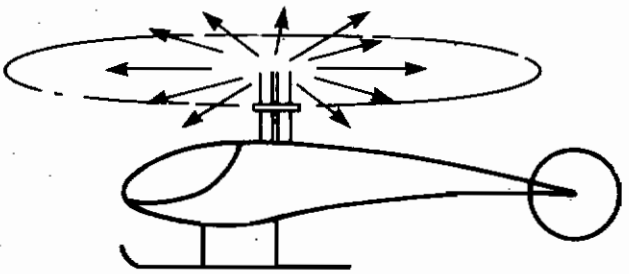
RIGHT STICK MOVED TO RIGHT



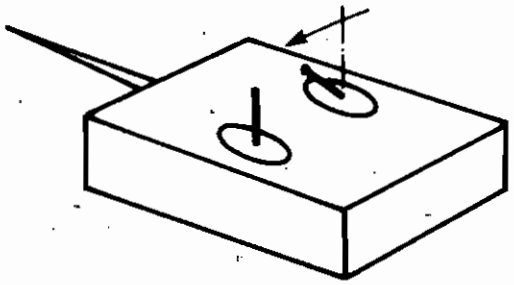
RIGHT STICK MOVED ANY DIRECTION



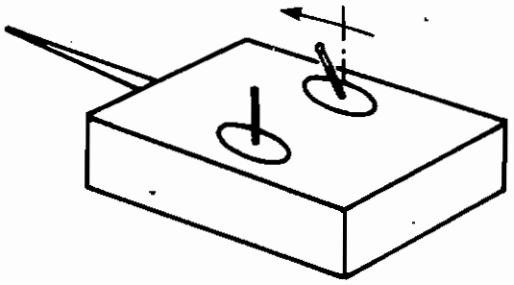
HELICOPTER MOVES TO RIGHT



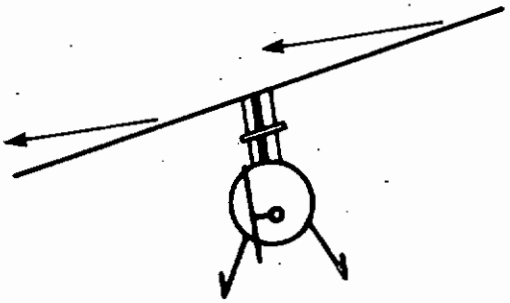
HELICOPTER MOVES OFF IN SAME DIRECTION
(USUALLY!!)



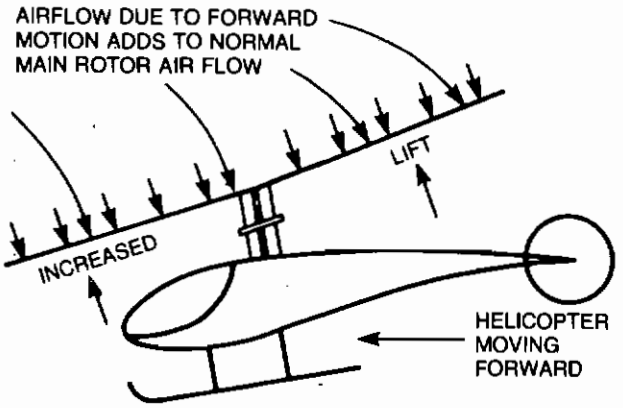
RIGHT STICK MOVED LEFT



RIGHT STICK MOVED FORWARD



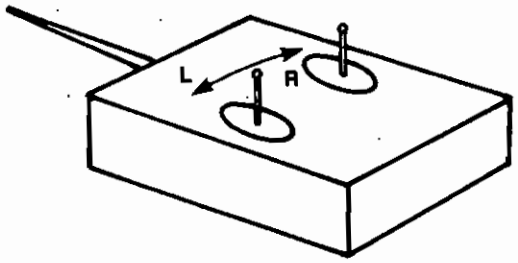
HELICOPTER MOVES LEFT



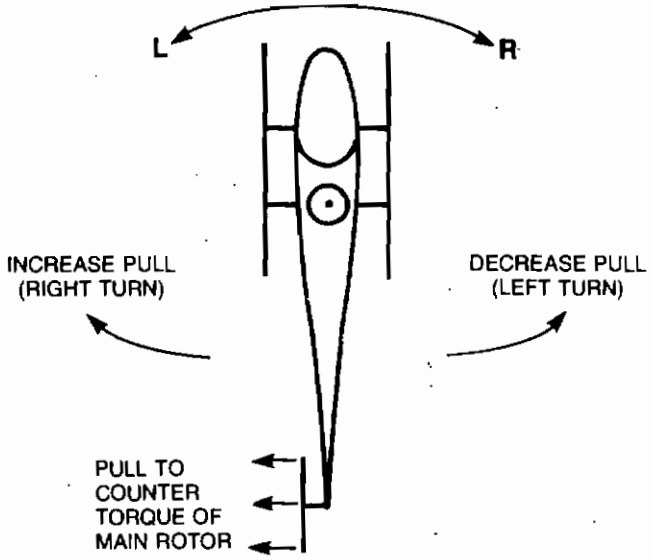
HELICOPTER MOVES FORWARD
— AND CLIMBS

backward force and this will cause the helicopter either to stop going forward and/or to commence moving in a backward direction.

Moving the right hand stick to the right will cause the swashplate to tilt to the right with a similar action of the rotor blade system, as with pitch, except that now the rotor blade system, or the helicopter, will tilt to the right resulting in a force which will cause the helicopter to move sideways to the right. Conversely, movement of the stick to the left will cause the swashplate to tilt to the left and the helicopter to move to the left. Naturally, any compound position of the pitch/roll stick will cause the helicopter to move in the appropriate direction. That is, if the stick is pushed forward and to the right, the helicopter will move off at an angle diagonally forward and right. The above description is an over-simplification of what the control movements can really accomplish with the R/C helicopter since it applies predominately to the hover mode. Once the helicopter is moving forward or sideways in forward flight, the final result upon the helicopter's flight path is different. As an example: when the stick is moved up the transmitter, or for forward flight, the helicopter is now moving forward and the normal hovering air flow through the rotor blade is assisted or speeded up by the forward motion. There will be an increase in the total lift (transitional lift) for the same throttle or collective setting, and therefore the helicopter will tend to climb when the stick is moved



LEFT STICK MOVED RIGHT OR LEFT



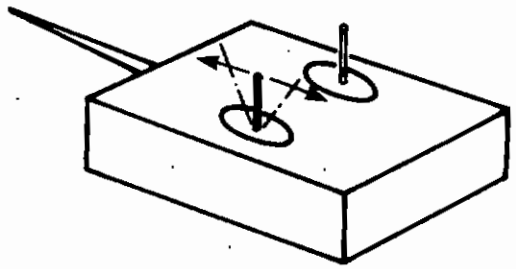
HELICOPTER ROTATES RIGHT OR LEFT

forward. Level flight can be restored, of course, by reducing the power (or collective pitch setting). This result is certainly different from applying down elevator on a fixed wing plane and will appear to be confusing at first. It is quite surprising how fast you can get used to this apparent phenomenon and forward flight control soon becomes very natural and instinctive. However, since we are discussing the **early** stages of learning to fly a helicopter in this article, we will only be concerned with the effect of the right hand stick on hover, which is to make the helicopter move or stop moving laterally in the direction that the right hand stick is moved on the transmitter box.

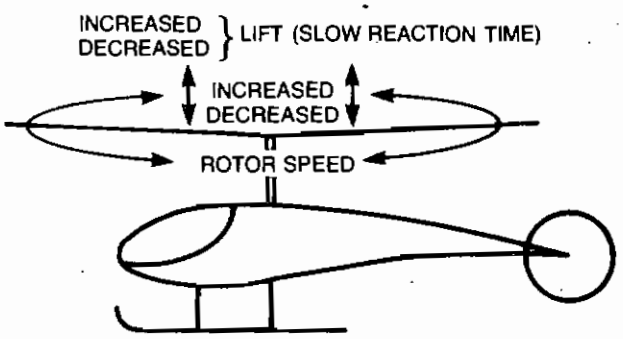
We should, at this point, at least be aware of one other basic difference between an airplane and a helicopter. With a plane, deflecting the rudder surface will have an effect only when in forward flight. With a helicopter there is a need for a permanent rotary turning force in the hover. This is because the aerodynamic drag of the main blades turning will cause a similar but opposite rotational force on the body or fuselage of the helicopter. So a certain amount of pitch on the tail rotor blades is needed to produce the right amount of side force to counteract the main rotor reaction upon the body. Turning the helicopter right or left is then accomplished by increasing or decreasing the pitch of the tail rotor blades from this basic setting. Now, again considering the hover mode only, moving the left hand stick (the rudder control on a plane) to the right or left will cause the pitch or both tail rotor blades to increase or decrease equally. The resulting pitch change will either cause the tail of the helicopter to move to the left or to the right. The majority of flyers prefer that the 'sense' of this movement is such so that moving the stick to the right will cause the nose of the helicopter to pivot around its vertical axis to the right. Conversely, left stick will cause a rotation of the helicopter to the left. This will then produce the same result in forward flight as the conventional "stick direction for rudder" does on a fixed-wing aeroplane.

Movement of the throttle, or a vertical movement of the left hand stick, will cause the engine to increase its torque and the rotor blades their speed, if we are concerned with a non-collective pitch helicopter, and this will result in the helicopter rising vertically upwards. There will be a time delay due to the need for the whole engine/rotor-system to 'spin-up' to the new speed.

If the helicopter has **collective pitch** (explained in last month's

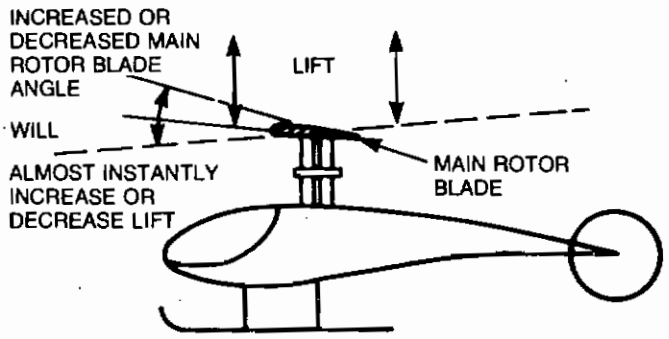


LEFT STICK MOVED 'UP' OR 'DOWN'



HELICOPTER RISES OR FALLS VERTICALLY

column); the angle of both main rotor blades to the airflow will also increase as the engine power **increases**, which will result in the helicopter rising but with much less change of engine and rotor blade speed than with a non-collective pitch helicopter and, of course, in much quicker time. Lowering the lever towards the bottom of the transmitter box will have the opposite effect of reducing rotor speed



or rotor blade pitch and cause the helicopter to descend. So the vertical height of the helicopter in a hover mode (and in forward flight) is basically controlled by the left hand stick, normally used for varying the forward thrust of a fixed wing aircraft.

Next month we will be discussing several phenomena concerned with the ground handling and the initial stages of hovering, which, if well understood ahead of time, will greatly east the initial learning problem. Keep 'em whirling. □