Maximum-performance maneuvers

chapter 10

Maximum-performance maneuvers are presented here in order to help you to develop and perfect your technique in operating an aircraft to obtain maximum flight performance. These maneuvers are Maximum-performance Climbing Turns, Chandelles, and Lazy 8's.

Conscientious practice of these maneuvers will pay big dividends in providing you with a knowledge of control pressures, timing, and planning — all of which are necessary to expert flying.

Because of the amount of bank required in these maneuvers, the limits of the gyros may be exceeded. Therefore, before entry to any one of them you should cage the gyros.

Since the same conditions of flight apply to all three of the maximum-performance maneuvers, before entry to any one you will set up the aircraft with the following conditions in effect:

Gyros caged
Throttle at 25″ Hg
Propeller at 1850 RPM.
Mixture lean for smooth operation
Gear and flaps up
Canopy optional

MAXIMUM-PERFORMANCE CLIMBING TURNS

This maneuver is a climbing turn beginning from straight and level flight and ending in a wing-level, nose-high pitch attitude. The aircraft is made to perform to its maximum extent; that is, you gain the most altitude possible for a specified degree of bank and power setting without stalling the aircraft.

This turn is taught to aid in developing the proper timing and "feel" for maximum-performance flight, and to develop proper torque control and roll-outs at low airspeed. For these reasons, it will also prepare you for chandelles. This maneuver is also used to regain altitude after an altitude-losing maneuver, such as a spin, has been completed.

Since the maximum-performance climbing turn is a clearing maneuver in itself, it is not necessary to make clearing turns. Look in the direction of the turn, however, and clear the area before beginning and while performing the maneuver.

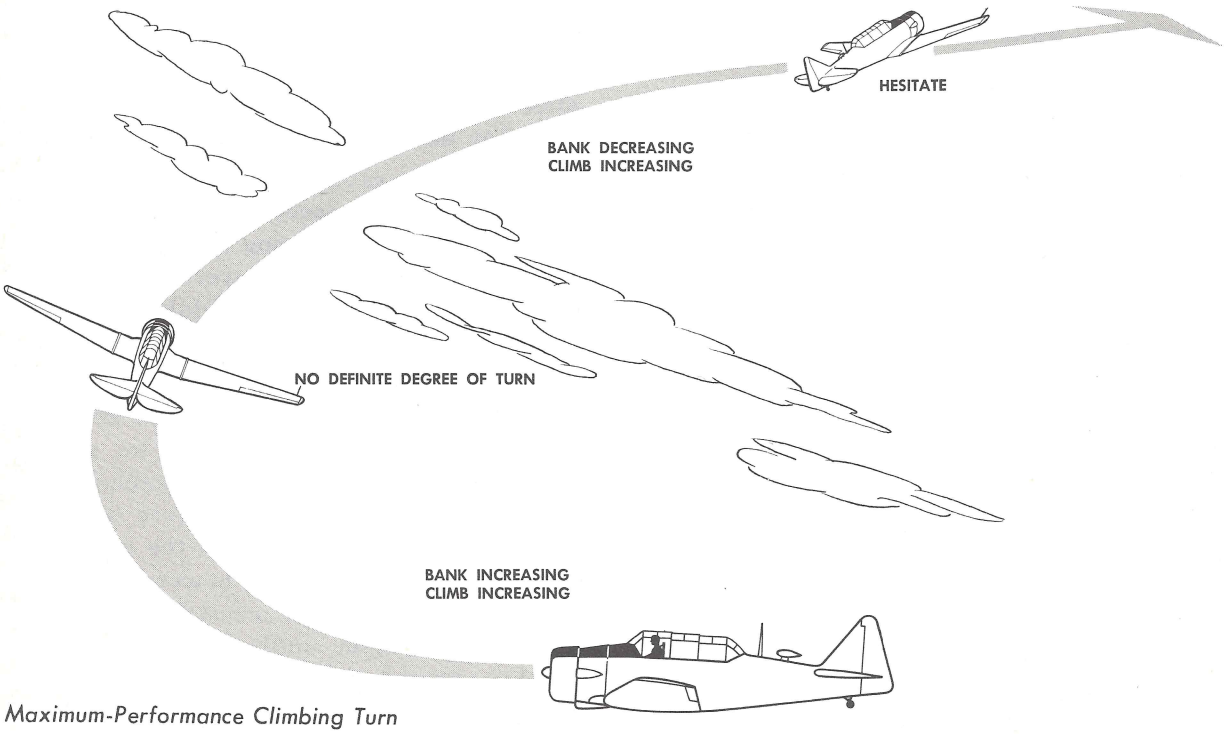
From straight and level flight and normal cruising speed, blend rudder, aileron, and backstick pressures simultaneously to start a climbing turn. During normal climbing turns, the pitch and bank attitudes were held constant throughout the climb. In the maximum-performance climbing turn, however, the pitch and bank attitudes are constantly changing. Continue rolling-in until the angle of bank reaches approximately 60°. Keep the nose rising at a constant rate all this time.

When approximately a 60° bank has been obtained, begin rolling the wings level with coordinated rudder and aileron pressures. Allow the nose to keep rising, however, until the wings become level. Since the angle of bank is decreasing during the roll-out, the vertical lift will increase slightly. For this reason, you will find it necessary to release a slight amount of back-stick pressure in order to keep the nose rising at a constant rate. If you fail to release some back-stick pressure, the nose will tend to rise too rapidly during the roll-out.

The wings should become level just before the maximum-performance, or the maximum-climbing attitude, is reached. When they do become level, hold the flight attitude constant momentarily. At this point maximum torque correction should be applied with right-rudder pressure. Now slowly lower the nose to the level flight attitude. This hesitation is momentary and should not be held until a stall occurs.

Since the nose attitude is rising at a constant rate throughout the entire maneuver, the airspeed is constantly dissipating. The power setting remains constant, however, and as the airspeed drops off, the effects of torque become more and more prominent. Because of these increasing torque effects, right-rudder pressure will have to be gradually increased in order to counteract torque and to remain in coordinated flight. This right-rudder pressure should be applied gradually, as it is needed, throughout the entire maneuver. Of course, the greatest amount of right-rudder pressure will be needed at the termination of the maneuver since the nose is then in the highest pitch attitude, and the airspeed is lower than at any other time in the maneuver.

As the bank becomes steeper, more vertical lift is being lost, so more back pressure must be applied to the stick in order to keep the nose rising at the same constant rate. The greatest amount of back-stick pressure must be applied at the point where the steepest bank is encountered, because this is the point



Maximum-Performance Climbing Turn

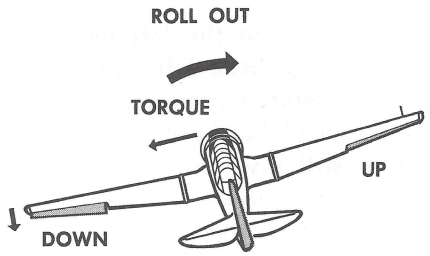
where you have the greatest loss of vertical lift. If you failed to apply sufficient back-stick pressure at this point, the nose would not continue to rise at a constant rate.

No definite degree of turn is required in this maneuver. As soon as a bank of approximately 60 degrees is attained, begin the roll-out. Do not hesitate at this point. The rate of roll-out should be the same as the rate of roll-in. If the rate of climb is fast, the rate of roll-in and roll-out should necessarily be fast in order to level the wings before a stall occurs.

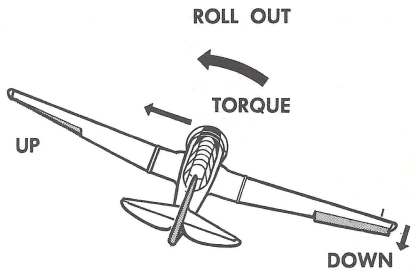
If the rate of climb is slow, the rate of roll-in and roll-out should be slow, so the wings will not be leveled before the maximum-performance, or maximum-climb attitude is attained.

The nose attitude is lowest at the beginning of the maneuver and highest at the completion, that is, when the wings become level. The nose attitude should progress from the lowest point to the highest point at a constant rate. Thus, the nose should not move erratically, but should describe a straight line diagonal to the horizon as it moves up to the highest point of the maneuver.

This maneuver should be practiced both to the right and to the left. When rolling out of a maximum-performance climbing turn to the left, remember the aircraft must be rolled out with coordinated stick and rudder pressures. When you use pressure on the stick to the right to begin the roll-out, the aileron on the left wing is lowered. This causes it to drag more than the aileron on the right wing, consequently, this drag tends to make the nose yaw to the left. At this point the airspeed has decreased considerably, so there is quite a bit of torque effect present which is also attempting to make the nose yaw to the left. Thus, there are two forces trying to pull the nose to the left: aileron drag and torque. The rudder is used to overcome aileron drag, or adverse yaw, when the aircraft is turned or rolled. The rudder is also used to overcome torque effects. In this case, you can readily



DOWN AILERON (DRAG) HELPS TORQUE PULL TO LEFT A LOT OF RUDDER PRESSURE NEEDED.



DOWN AILERON (DRAG) HELPS COUNTERACT PULL OF TORQUE NOT MUCH RUDDER PRESSURE NEEDED.

Control Pressures Needed in Right and Left Roll-Outs

see that to effect proper coordination a large amount of right-rudder pressure must be used during a roll-out to the right from a maximum-performance climbing turn to the left.

Now consider rolling out of a maximum-performance climbing turn to the right. In order to accomplish this, you must roll out to the left. When the stick is pressed to the left to begin the roll-out, the aileron on the right wing is lowered. This causes more drag on that wing, consequently tending to yaw the nose to the right. The effects of torque, however, are causing the nose to yaw to the left. Now, the aileron drag pulling to the right, and the torque pulling to the left tend to neutralize each other. In this case, if you were applying too much left rudder for the amount of aileron being used, you would be augmenting the effects of torque, causing more force to be acting to the left than to the right. This would cause the roll-out to be uncoordinated.

You can see that if the effects of aileron drag and torque are practically neutralizing

each other, a roll-out to the left can be accomplished with very little left rudder being applied. In many instances, releasing the existing right rudder which has been applied to correct for torque will give the same effect as positive left-rudder pressure. When the wings become level, however, the ailerons are neutralized and the aileron drag disappears. When this occurs, the effects of torque become more prominent and must be overcome with additional right-rudder pressure.

The proper way to roll out to the left, therefore, is roll out mostly with aileron pressure, releasing right-rudder pressure and if necessary apply slight left rudder to effect proper coordination. Then when the wings are leveled, and the aileron pressure is released, you must supply additional right-rudder pressure to properly correct for torque effects.

These same roll-out techniques must be employed in any maneuver that incorporates a slow speed roll-out, such as the chandelle, approach to a stall, etc.

CHANDELLES

The chandelle is a precision 180° climbing turn with a maximum gain of altitude. It is taught to develop a high degree of precision, coordination, and orientation. Conscientious practice of this maneuver will improve your ability to apply proper torque corrections through a large speed range, as well as develop a high degree of timing and "feel" for maximum-performance flying.

Since this is also a clearing maneuver itself, no clearing turns are necessary prior to the entry. Look in the direction of the turn, however, and clear the area before beginning and while performing the maneuver.

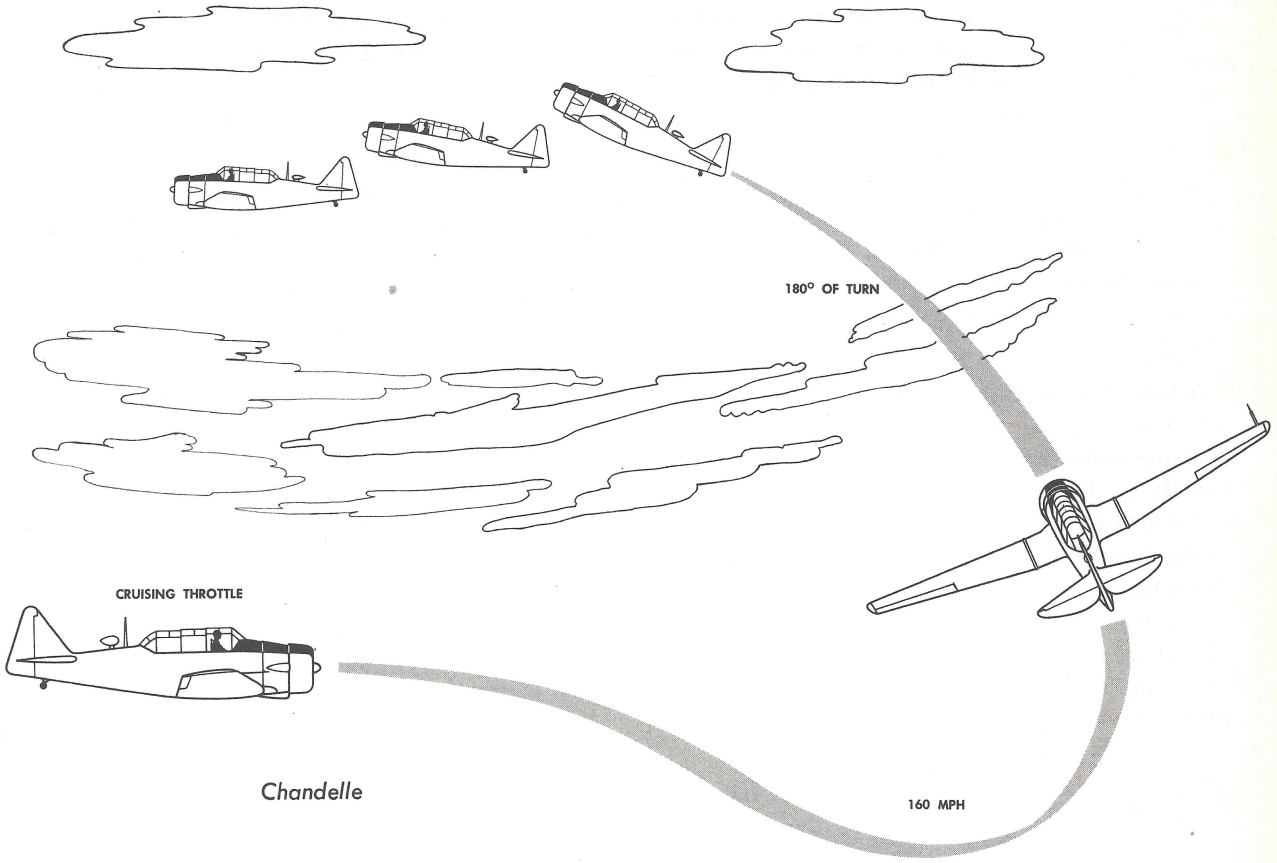
From straight and level crusing flight align the aircraft with a section line or road, lower the nose, and establish a shallow dive. When the airspeed reaches 160 MPH, blend rudder, aileron, and elevator pressures simultaneously to begin a climbing turn. This is accomplished in the same manner as the maximum-performance climbing turn. Allow the bank to keep increasing, and the nose to keep rising at a constant rate; the object is for the nose to describe a straight line diagonal to the horizon.

As the nose continues to rise and the airspeed dissipates, the bank becomes steeper. Back-stick, rudder, and aileron pressure should be blended to cause the bank to reach its steepest angle of approximately 60 degrees just as the aircraft has turned 90 degrees. Remember, the nose should be constantly rising during this time. At this point the vertical component of lift will have decreased to such an extent that quite a bit of back-stick pressure will be required to keep the nose rising at a constant rate.

As soon as the 90° point is reached, begin rolling out of the bank. Allow the nose to continue to rise, however, at the prescribed constant rate. Since a large amount of back-stick pressure was applied when the bank was at the steepest angle, it will be necessary to release a small amount of back-stick pressure as the bank is decreased. This is due to a slight increase in the vertical component of lift as the roll-out is effected. By releasing some back-stick pressure, you will keep the nose from rising abruptly and excessively in the last part of the maneuver.

The roll-out should be timed so that the wings become level precisely as the 180° point is reached and as the nose reaches the highest pitch attitude in the maneuver. This should all occur simultaneously. At this point maximum torque correction should be applied with right-rudder pressure. Hold the flight attitude constant momentarily, then slowly lower the nose to the level-flight attitude.

This maneuver is essentially the same as the maximum-performance climbing turn in all respects except that a definite degree of turn must be accomplished in this maneuver. If the rate of climb is fast, the rate of turn should be fast in order to reach the 180° point before a stall occurs. If the rate of climb is slow, the rate of turn should be slow so that the 180° point is not reached before maximum performance is obtained. Of course, the rate of turn depends on the amount of bank, and the



Chandelle

amount of bank attained will depend on the rate of roll-in. So, if you pull up fast, roll in fast. If you pull up slowly, you must roll in slowly.

One point must be emphasized here. At the initial entry to the maneuver, you must cause the rate of roll-in to progress faster than the rate of pull-up. This is necessary because there is a greater amount of change in the degree of bank than in the degree of pitch from the beginning to the completion of the maneuver. For instance, you must increase the bank up to 60 degrees and then back to level again. That makes 120 degrees of bank change. The pitch attitude may only change about 50 to 60 degrees.

The nose should describe a straight line that is diagonal to the horizon, from the lowest point at the beginning of the maneuver, to the highest point at the 180° position.

Do not lead the airspeed but wait until you attain 160 MPH before applying control pressures and rolling into the maneuver.

Rolling out of a chandelle to the left requires that considerable rudder pressure be coordinated with the aileron, because you must overcome torque effects and aileron drag to remain properly coordinated when rolling out in this direction. Both torque and aileron drag are pulling to the left. Rolling out of a chandelle to the right, however, can be accomplished mostly with the aileron, releasing your torque correction as necessary, then applying slight-

ly more right-rudder pressure when the wings are level and the opposite aileron pressure is released. This technique is the same as that used in rolling out of maximum-performance climbing turns to the right.

The maneuver should be timed so the nose will not have to be lowered to prevent a stall before the wings are leveled. Conversely, after the wings have been leveled, you should not hold up the nose until a stall occurs but should lower it just before you stall.

LAZY 8's

A lazy 8 is, as the name implies, a slow and lazy maneuver in which the nose of the aircraft describes a large figure eight on the horizon. It is described as an eight because the figure drawn on the horizon by the projection of the longitudinal axis of the aircraft resembles a figure eight lying on its side. The horizon line bisects this figure eight from one end to the other while passing through the vertex. This maneuver utilizes a 360° change of direction and requires a continuous change of pitch and bank attitudes.

To execute the lazy eight, you will have to use a combination of the climb, dive, and the turn. This maneuver will be of great value to you because it will develop a high degree of orientation, planning ability, and "feel" for maximum-performance flying. It is a maneuver that will require you to use constantly changing control pressures, necessitated not only by changing combinations of climbs, dives, and banks, but also by constantly varying airspeeds.

The flight path across the ground is not to be considered, but in the interest of good flight-planning technique, the maneuver should be performed so the initial turn is into the wind.

As an aid to making symmetrical loops and remaining oriented, you should select a prominent point on the horizon or such ground references as a section line or a road. The more references you use, the better chance you will have of remaining oriented and performing good lazy eights.

Since this is also a clearing maneuver itself, it will not be necessary to make clearing turns before the entry. Look in the direction of the turn, however, and clear the area before beginning and while performing the maneuver.

While flying in straight and level flight and at normal cruising speed, select the desired reference point on the horizon. This point should be up-wind from you. Now align the aircraft so that the reference point is directly off the wing tip, either right or left.

Blend aileron, rudder, and elevator pressures simultaneously to start a gradual climbing turn in the direction of the reference point. The initial degree of bank should be very shallow to prevent the rate of turn from becoming too rapid. Remember, the rate of turn results from the degree of bank and the airspeed. As the nose is raised, the airspeed dissipates, which causes the rate of turn to increase. Since the bank is being increased it will also cause the rate of turn to increase. Unless the maneuver is begun with a shallow bank, this combination of turning characteristics will cause the rate of turn to become too rapid and cause you to overshoot the reference point.

Time the turn and pull-up so that the nose reaches the highest pitch attitude when the aircraft has turned 45 degrees, or halfway to the reference point. The pitch attitude should now be approximately 50 degrees above the horizon, and the angle of bank approximately 45 degrees. Do not hold the nose in this high pitch attitude, but begin lowering it to the horizon and toward the reference point. Since the airspeed is still dissipating, right-rudder pressure will gradually have to be applied to counteract the effects of torque.

As the nose is being lowered toward the horizon, the bank should continue to increase so that it reaches approximately 60 degrees just as the nose reaches the horizon. The top center of the cowling on the nose should reach the horizon precisely at the reference point. This is the 90° point. At this point a slight amount of top aileron may be required to pre-

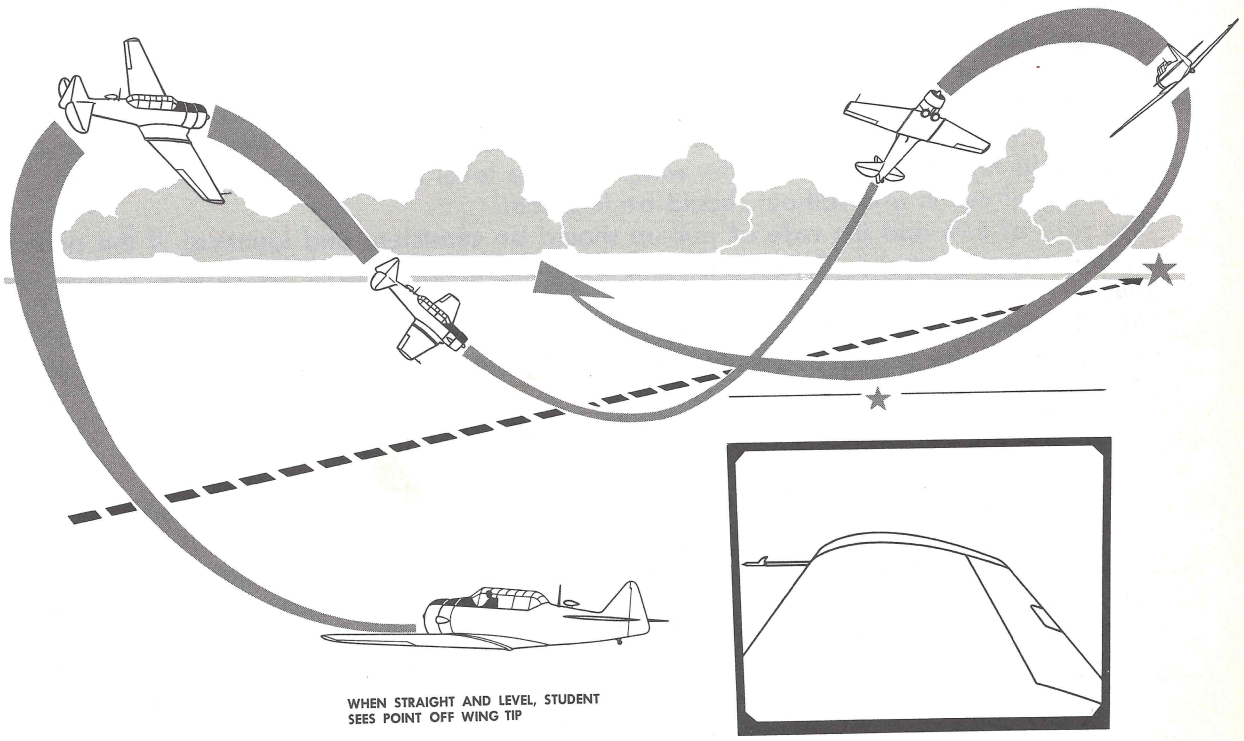
vent the bank from becoming too steep. The lowest airspeed will be encountered just before the nose reaches the horizon and should be 70 MPH below the normal crusing speed used at the beginning of the maneuver.

Do not attempt to stop the nose at the horizon but continue to fly the aircraft down into a descending turn so the nose describes the same size loop below the horizon as it did above. As the nose passes through the horizon, begin to decrease the bank gradually and when the aircraft has turned 45 degrees, the nose should have reached its lowest point. This should be the same distance below the horizon as it was above in the climbing turn. The airspeed will be increasing all this time, so it will be necessary to gradually relax right-rudder pressure because the effects of torque are gradually disappearing.

When you have reached this lowest point, there are approximately 45 degrees of turn remaining before the 180° point is reached. At this point begin blending sufficient stick and rudder pressures to begin simultaneously raising the nose and rolling the wings level, so that the wings become level and the nose reaches the horizon precisely at the 180° point. This is the only point in the entire maneuver that the wings are in a level attitude.

The opposite wing should now be on the reference point, the nose on the 180° point, and the airspeed back to the original normal cruising speed.

Do not hesitate in straight and level flight, but immediately begin a climbing turn in the direction of the reference point. Of course,



Lazy 8

this turn will be opposite to the one used at the very beginning of the maneuver. Continue through the second 180 degrees of turn the same as you did through the first, and the maneuver will be completed with the aircraft headed in the original direction.

Right-rudder pressure must be gradually applied to counteract torque in both the right and left turns at the top of the loops. Of course, this rudder pressure will be greatest at the points of the lowest airspeeds.

During the turn to the right you will need slightly more rudder pressure than in the turn to the left. This is because you must keep the nose turning against the pull of torque. In the left turn you let some of the torque work for you in turning the nose.

The controls may seem to be more crossed in the right turn, because of the apparent need for slightly more top aileron to prevent overbanking.

This maneuver should be accomplished in a slow, lazy manner without hesitation and with constantly changing control pressures and flight attitudes. If the wings are leveled before the nose is back on the horizon at the 180° point, the eight will have a flat end.

The airspeed in this maneuver should range from straight and level cruising speed to approximately 70 MPH below this speed. During your initial training, however, do not concentrate on the airspeeds, but try to fly the pattern correctly. When you are able to visualize and fly this pattern properly, then you can adapt slight changes to the pattern to attain the correct airspeeds.

Things To Remember

A. Maximum-performance Climbing Turns and Chandelles:

The greatest amount of back-stick pressure must be applied at the point where the steepest bank occurs. To prevent the increased lift from pulling the nose up too rapidly some of this pressure will then have to be released as the wings are being rolled level.

The nose should continue to rise at a constant rate throughout the entire maneuver and should be at its highest point just as the wings become level at the end of the maneuver.

The rate of roll-in and roll-out should be identical.

The rate of turn and the rate of pull-up should be consistent and identical. If the pull-up is fast, the rate of turn should be fast. If the rate of pull-up is slow, the rate of turn should be slow.

At the maximum-performance or termination point, you should check the wings level, apply right rudder for torque correction, hesitate momentarily in the flight attitude, and slowly lower the nose.

Whenever possible, use ground references for orientation.

B. Lazy 8's:

Begin the maneuver with a shallow bank, then concentrate on pitch and bank attitude to make a good pattern.

Keep the nose moving at a slow, constant rate throughout the entire maneuver.

The only time the wings should be level is just as the nose reaches the horizon at the 180° point.

Apply sufficient right-rudder pressure to correct for torque during the low speed ranges.

Use as many ground references for orientation as possible.