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TECHNICAL NOTES

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 314

SPIRAL TENDENCY IN BLIND FLYING

By Thomas Carroll and William H. McAvoy
Langley Memorial Aeronautical Laboratory

Washington
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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

TECHNICAL NOTE NO. 314.

SPIRAL TENDENCY IN BLIND FLYING.

By Thomas Carroll and William H. McAvoy.

Summary

The flight path followed by an airplane which was being flown by a blindfolded pilot was observed and recorded for a number of pilots. When the pilot attempted to make a straight-away flight there usually developed a tendency to deviate from the straight path and to take up a spiral one.

Introduction

Tradition says that the normal tendency of man who is walking without a visual reference, as when lost in a forest or in a dense fog, is to take a circular path. This traditional tendency has been investigated experimentally and reported upon exhaustively by Dr. Asa A. Schaeffer, of the Zoological Laboratory of the University of Kansas, in a paper entitled "Spiral Movement in Man," (Journal of Morphology and Physiology, Vol. 45, No. 1, March, 1928). He finds that whether walking, swimming, rowing a boat, or driving an automobile, the tendency of a blindfolded person is always to follow a spiral path. Such a tendency would naturally be of greater importance in flight than perhaps anywhere else, and it was the intention of these experiments,

carried on by the National Advisory Committee for Aeronautics at Langley Field, Virginia, to determine whether the same tendency normally appeared in the piloting of aircraft.

Methods and Apparatus

For the purpose of these experiments, a dual control VE-7 airplane was used. The subject pilot was placed in the front seat, which was located approximately at the center of gravity of the airplane. In this position the subject pilot was less influenced in piloting by the accelerations. A safety pilot, who also served as observer, occupied the rear seat.

A face mask type of goggles, in which the glasses were replaced by light-tight pieces of cardboard and black paint, was used as a very effective blindfold; they are shown in Figure 1.

The subject pilot was usually directed to take off and fly to some safe altitude at which steady air conditions existed, in the meantime getting accustomed to the flying qualities of the airplane. At this point the observer took over the controls, and the subject pilot assumed the "blind condition" by putting on the goggles. The airplane was then brought into position for straightaway flight by the observer and turned over to the subject pilot, who then attempted to maintain straight flight.

Results

It was found, without exception, that no subject pilot maintained a straight flight path for any appreciable time, but soon brought the airplane into a properly banked turn, which was maintained for varying periods. This circling flight, after a few turns, frequently assumed a shorter radius with a consequent greater bank, terminating in the nose dropping well down into a diving spiral. At this point the safety pilot reassumed the control and placed the airplane again in straight flight or in a wide turn to the left or right, and the subject pilot then attempted to attain and maintain straight flight, as previously explained. There appeared little difference in the results, whether they started in straight flight or in a turn.

A continuous record was kept during the intervals of flight made by the subject pilot. By assuming a zero starting point at the beginning of each flight, it was possible to follow the course of the airplane, including at the same time information in regard to the degree of bank, air speed, and any unusual maneuver that the pilot made in his endeavors to maintain a straight flight path.

As will be seen by a study of the individual flight path plots, it would be very difficult to combine this information in chart form. While somewhat difficult to indicate the various positions assumed, it is hoped that by a study of the indi-

vidual plot, the tendencies of the subject pilot will be evident. It is very apparent that there is little regularity in the flight paths followed, although in some cases the subject pilot evidenced a homotropic tendency, that is, to turn continuously in the same direction during each trial.

In the total number of cases examined, it was found that equally as many turned to the right as to the left, while a very small proportion of the flights showed a heterotropic tendency, that is, to turn in either direction, or to reverse directions in a single flight. Whether the subject pilot was right or left-handed made little difference in this respect.

Conclusions

Many pilots have felt that the flying sense was largely one of muscular balance and that visual reference played a more or less insignificant part. These experiments should serve to remove this idea and develop the appreciation of the fact that muscular balance plays an extremely small part in flying, excepting in correlation with visual reference in the development of a polished technique. Visual reference of some sort must be provided, either by the horizon, by the reflection of the sun or moon while in dense fog or clouds, or by proper instrumental equipment.

It will be noted that these experiments in no way parallel any normal condition of flight, since, being blindfolded, the

subject pilot had absolutely no opportunity for visual reference of any kind, a condition which seldom could occur in actual practical flight.

The fact should not be neglected that the use of proper navigational instruments provides an artificial horizon, if not in a single instrument, then in the correlation of several instruments, such as a turn and bank indicator and an air-speed meter.

It can be recommended to all pilots that a careful self training in the use of and reliance on navigational instruments of this character will provide them not only with definite mechanical assistance, but likewise will go far to remove the psychological hazard of blind flying.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., July 25, 1929.

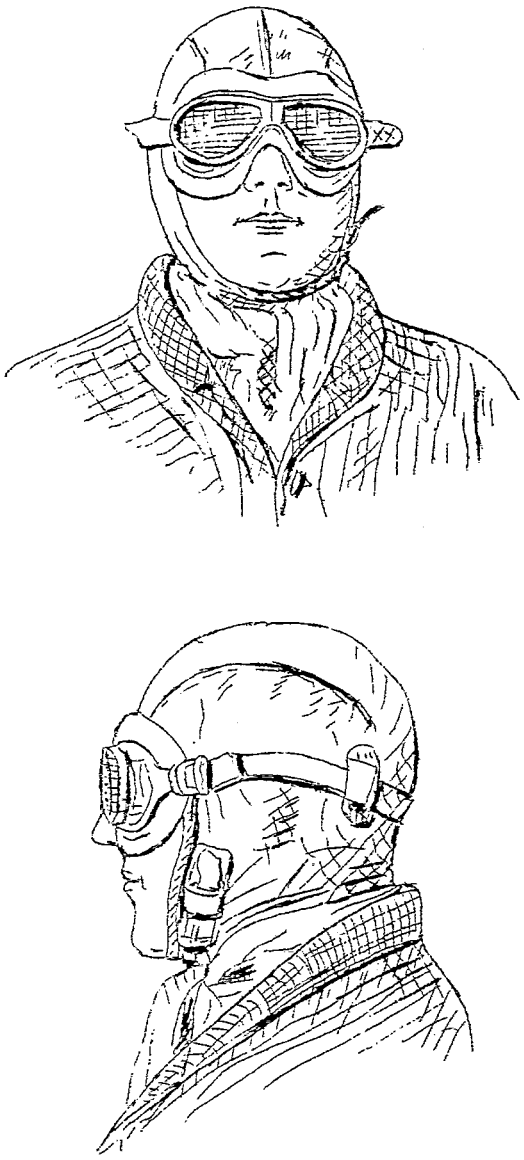
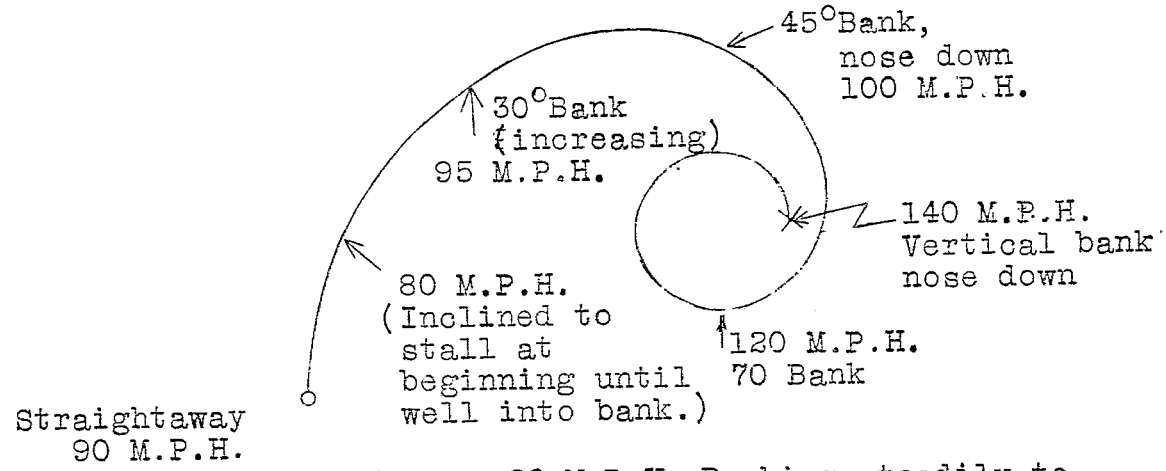
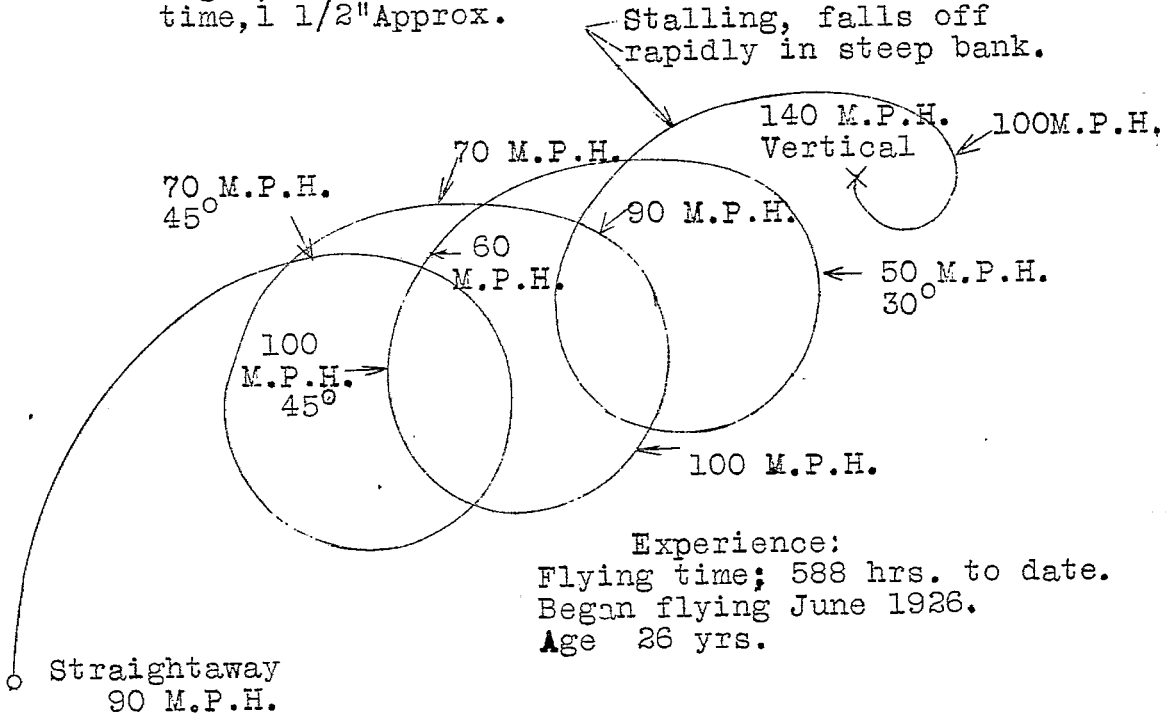


Fig. 1

Flight No. 1, Straightaway, 90 M.P.H. Pilot fell off rapidly in this flight.

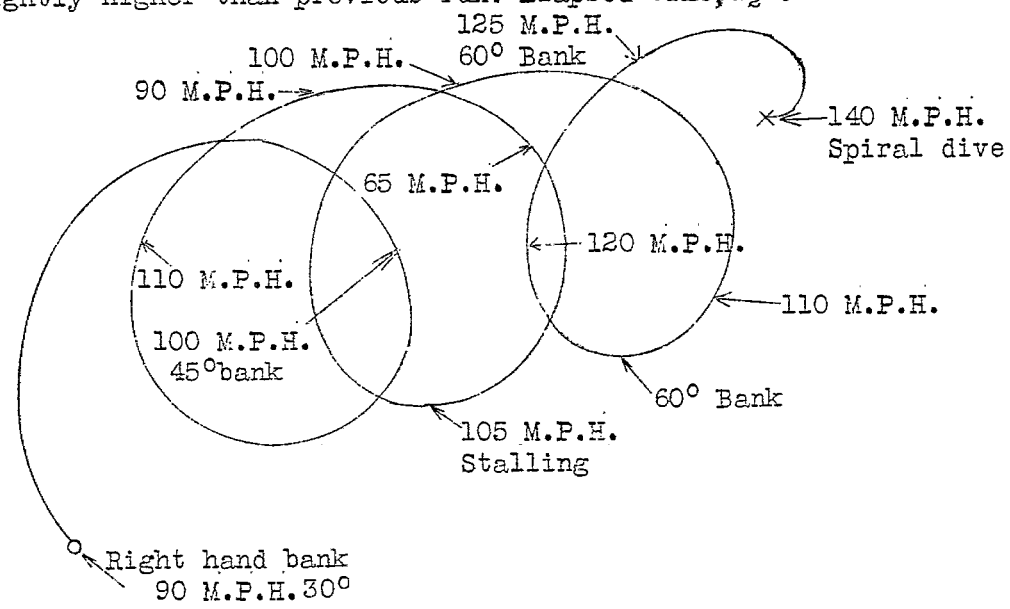


Flight No. 2, Straightaway, 90 M.P.H. Banking steadily to right, alternating nose down, nose up. Elapsed time, 1 1/2" Approx.

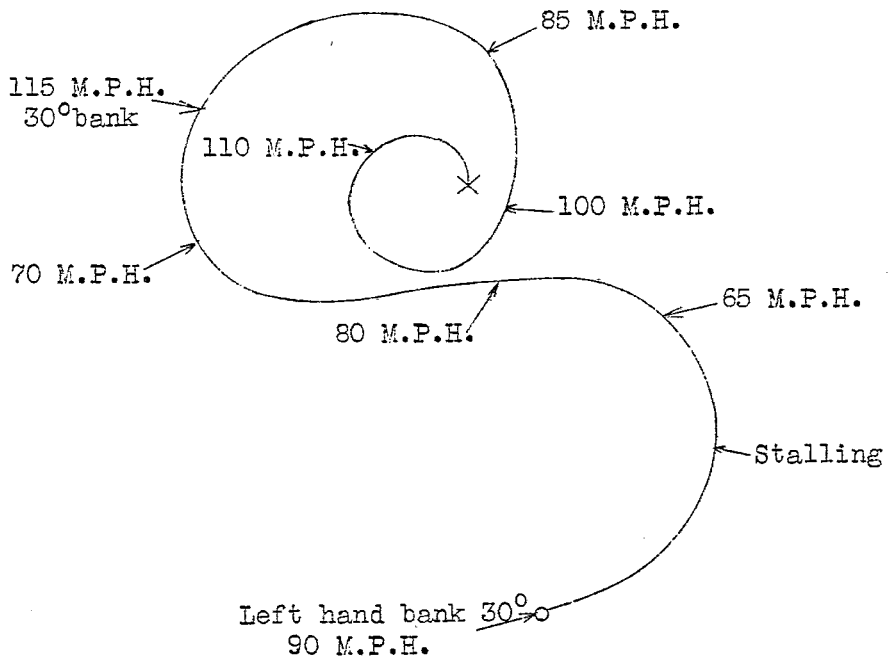


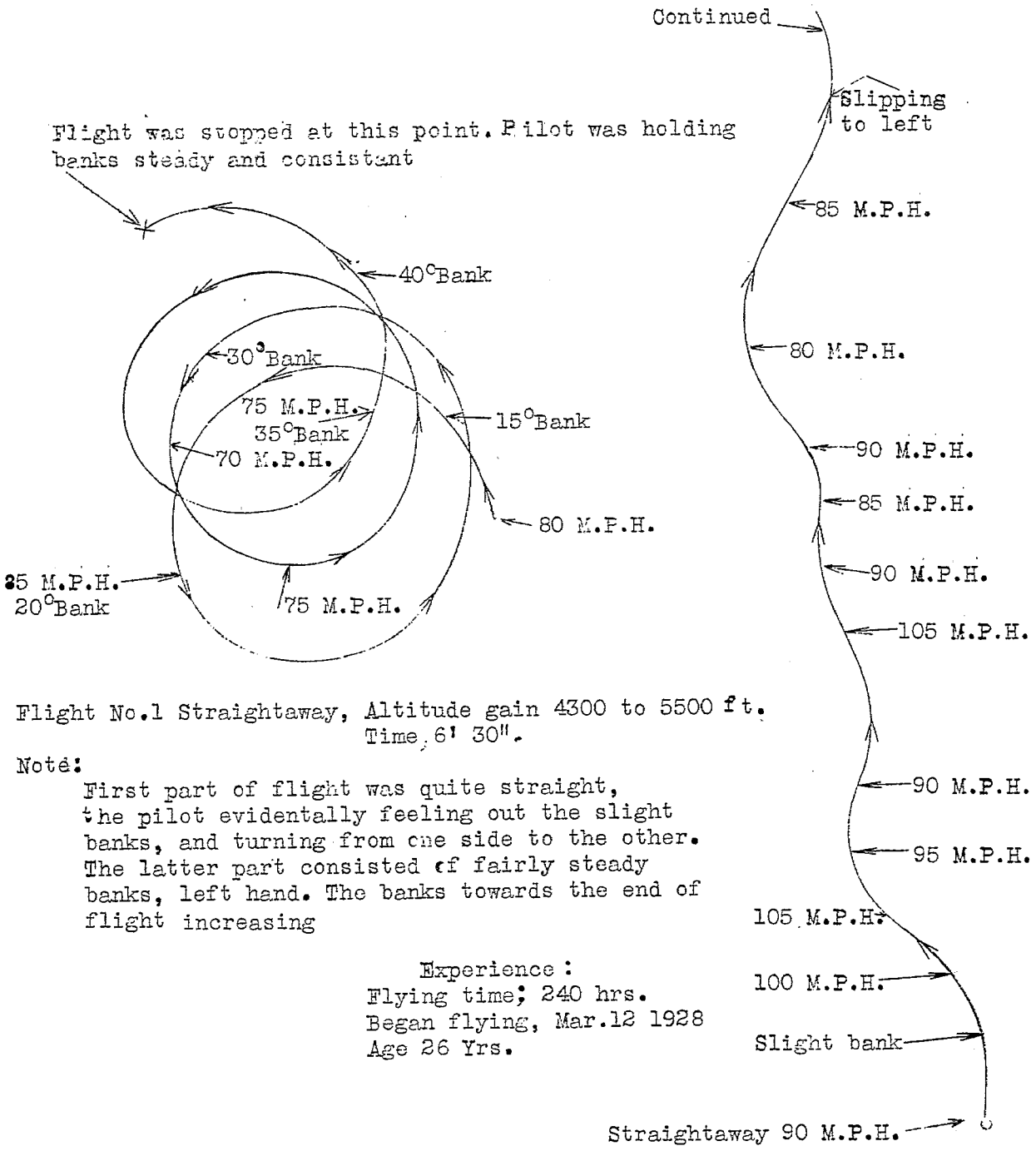
Experience:
Flying time; 588 hrs. to date.
Began flying June 1926.
Age 26 yrs.

Flight No. 3, Right hand bank, 90 M.P.H., 30°. Air speeds slightly higher than previous run. Elapsed time, 1½".



Flight No. 4, Left hand bank 90 M.P.H., Reversal of direction showing tendency of pilot to fall off into right hand turns. This is consistent with previous flights.





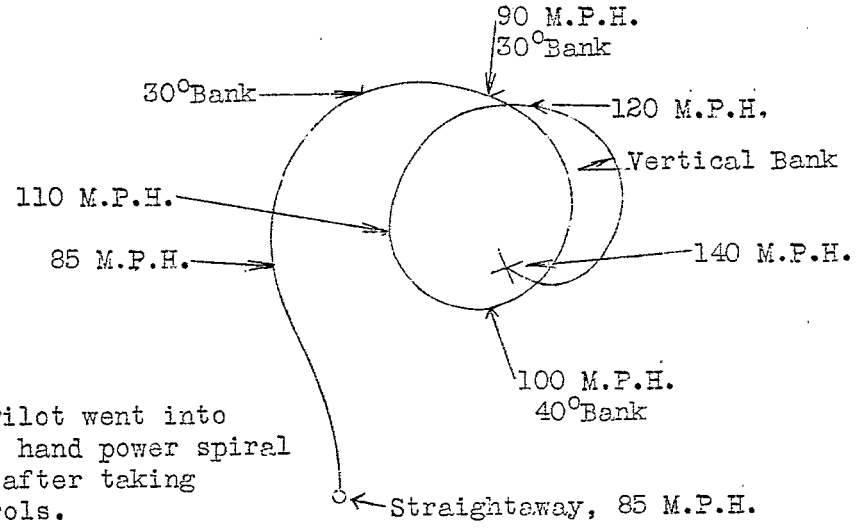
Flight No.1 Straightaway, Altitude gain 4300 to 5500 ft.
Time, 6' 30".

Note:

First part of flight was quite straight, the pilot evidentally feeling out the slight banks, and turning from one side to the other. The latter part consisted of fairly steady banks, left hand. The banks towards the end of flight increasing

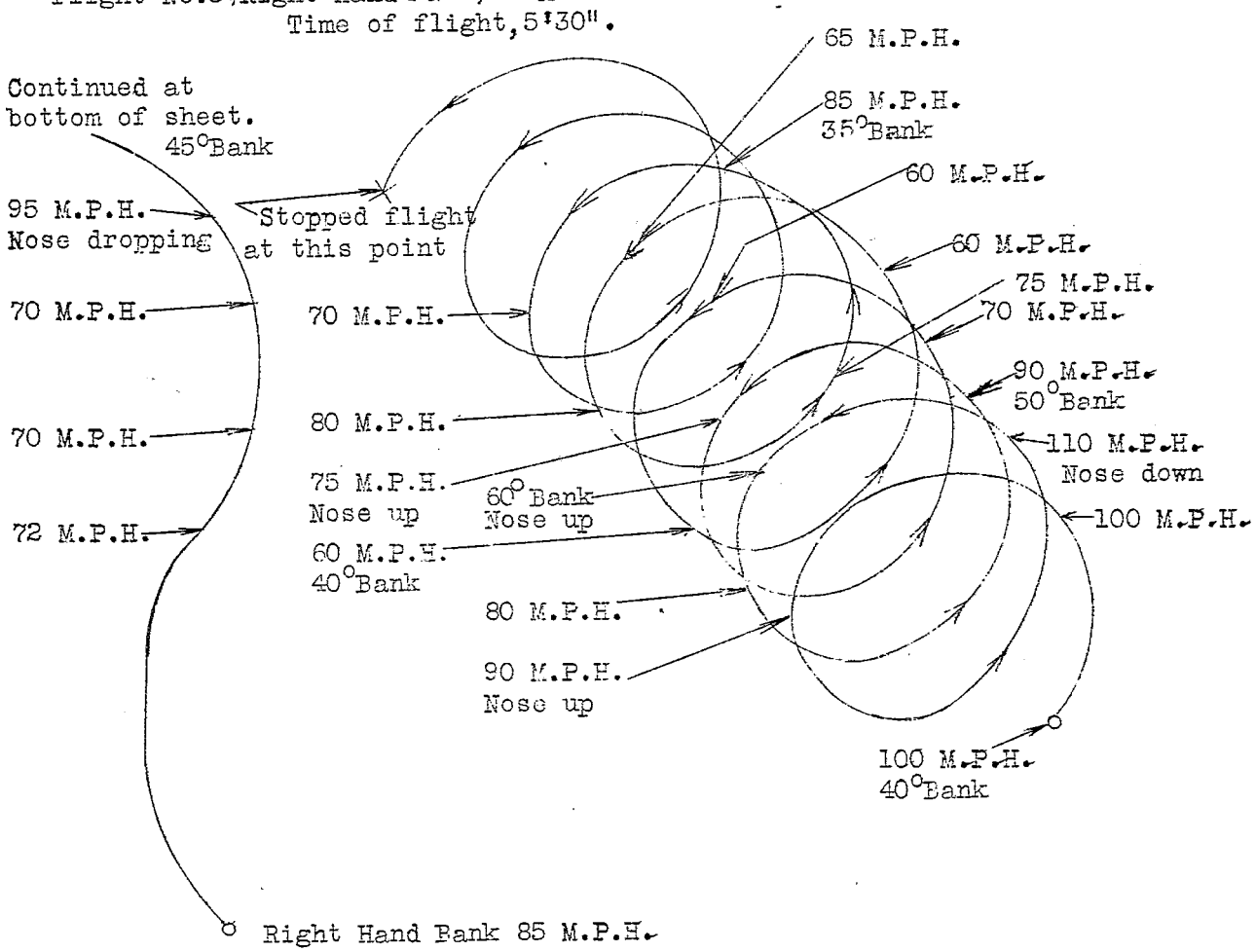
Experience:
Flying time; 240 hrs.
Began flying, Mar.12 1928
Age 26 Yrs.

Flight No.2, Straightaway, Altitude loss, 4600 to 400 Ft.
Time of flight, 1' 15".

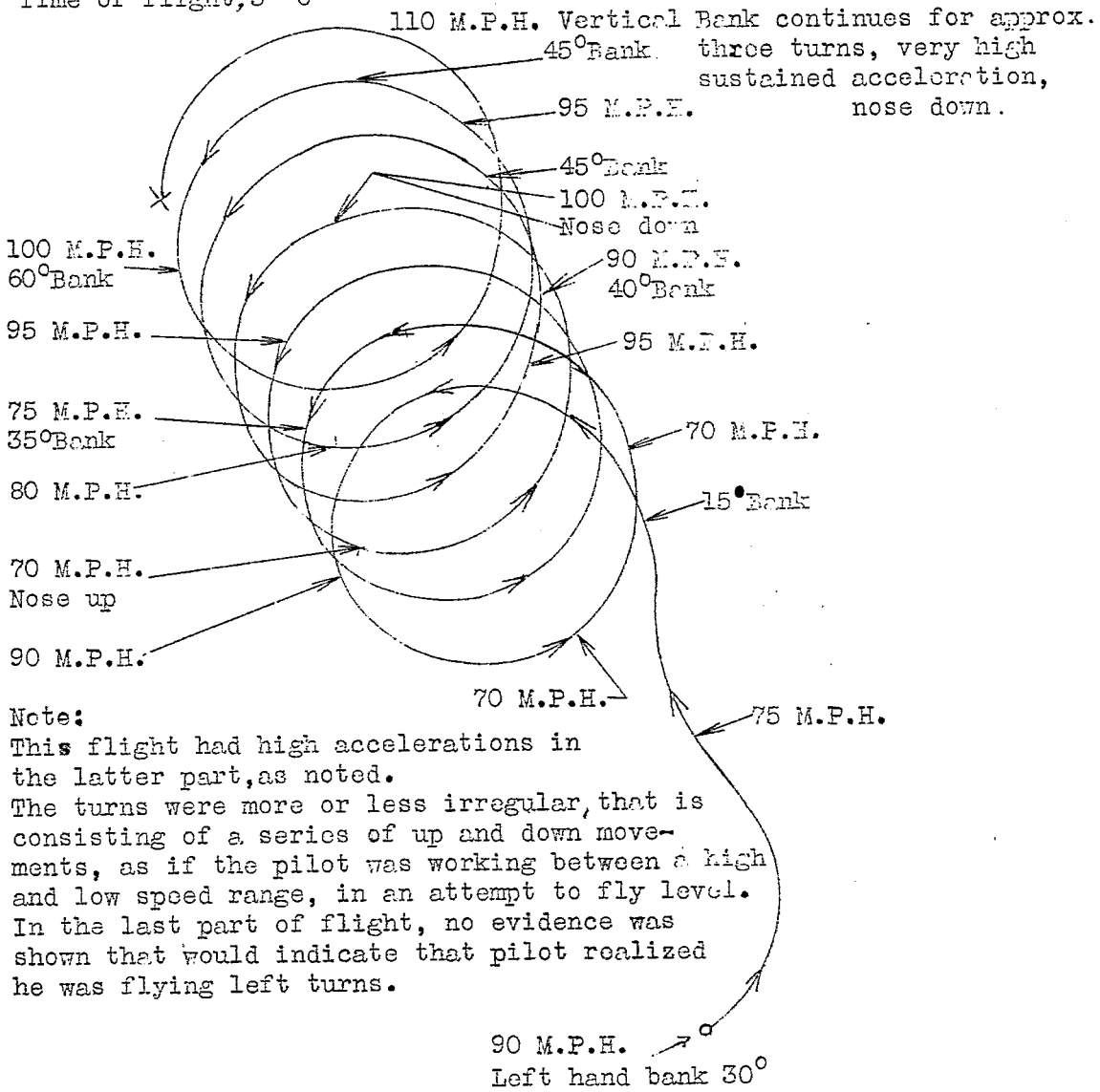


Note:
Pilot went into right hand power spiral soon after taking controls.

Flight No.3, Right Hand Bank, Altitude 4000 to 6000 Ft.
Time of flight, 5'30".

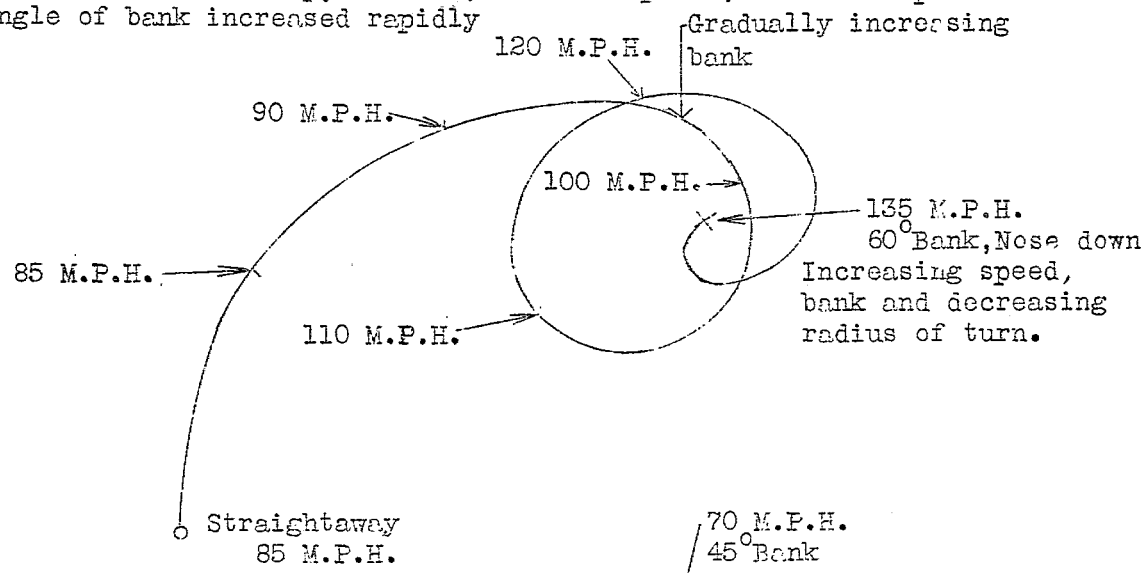


Flight No.4,30° Left Hand Bank,
Time of flight,5' 0"

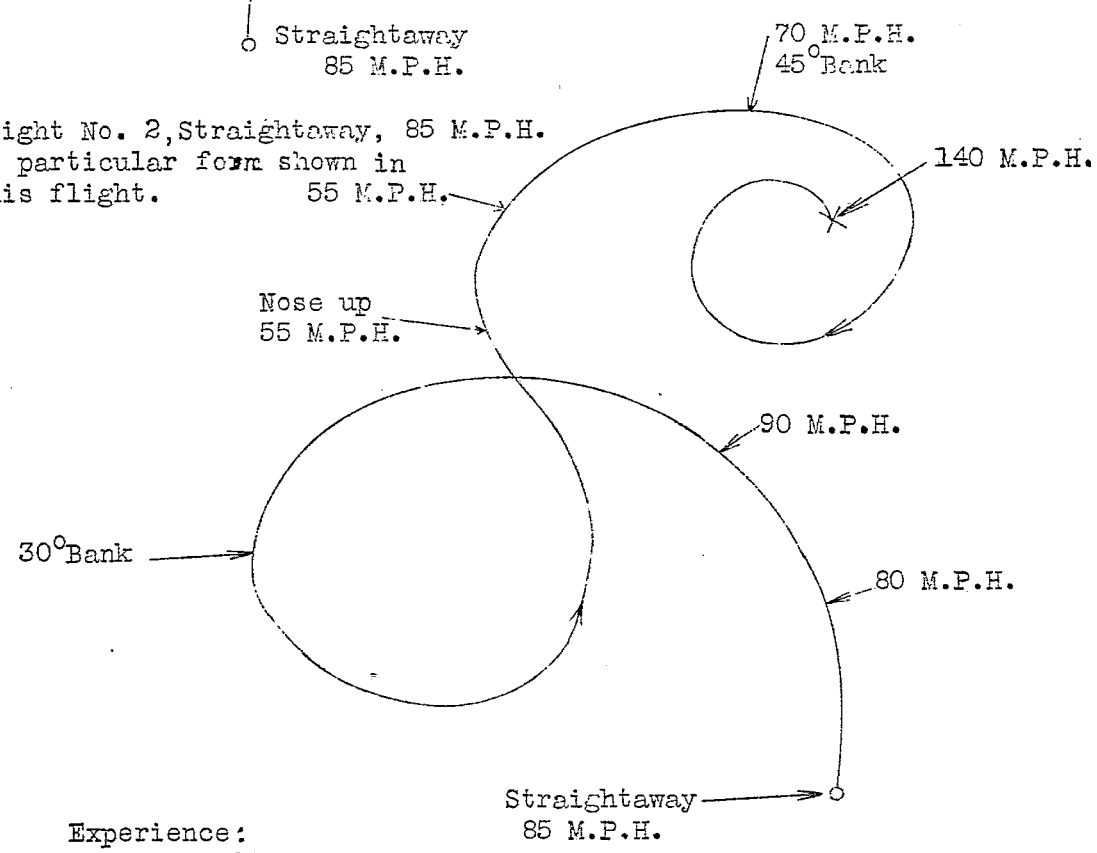


Note:
This flight had high accelerations in the latter part,as noted.
The turns were more or less irregular, that is consisting of a series of up and down movements, as if the pilot was working between a high and low speed range, in an attempt to fly level.
In the last part of flight, no evidence was shown that would indicate that pilot realized he was flying left turns.

Flight No.1, Straightaway, 85 M.P.H.
Note: Pilot banked to right immediately, air speed fairly constant, until bank reached approx. 35° , from that point, both air speed and angle of bank increased rapidly

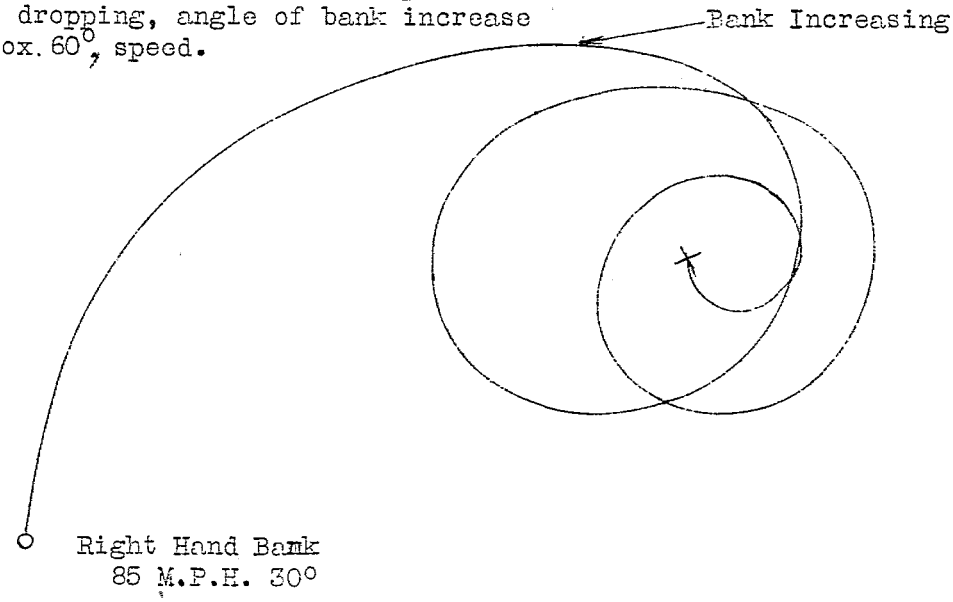


Flight No. 2, Straightaway, 85 M.P.H.
No particular form shown in this flight.

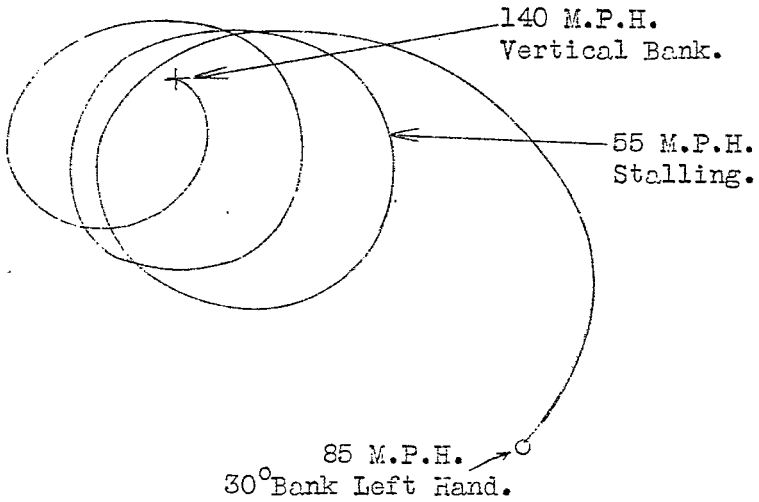


Experience:
Flying time, 590 hrs.
Began flying Aug.22, 27.
Age 27 yrs.

Flight No.3, Right Hand Bank, 85 M.P.H.
Note:
Steadily increased air speed, nose dropping, angle of bank increase to approx. 60°, speed.



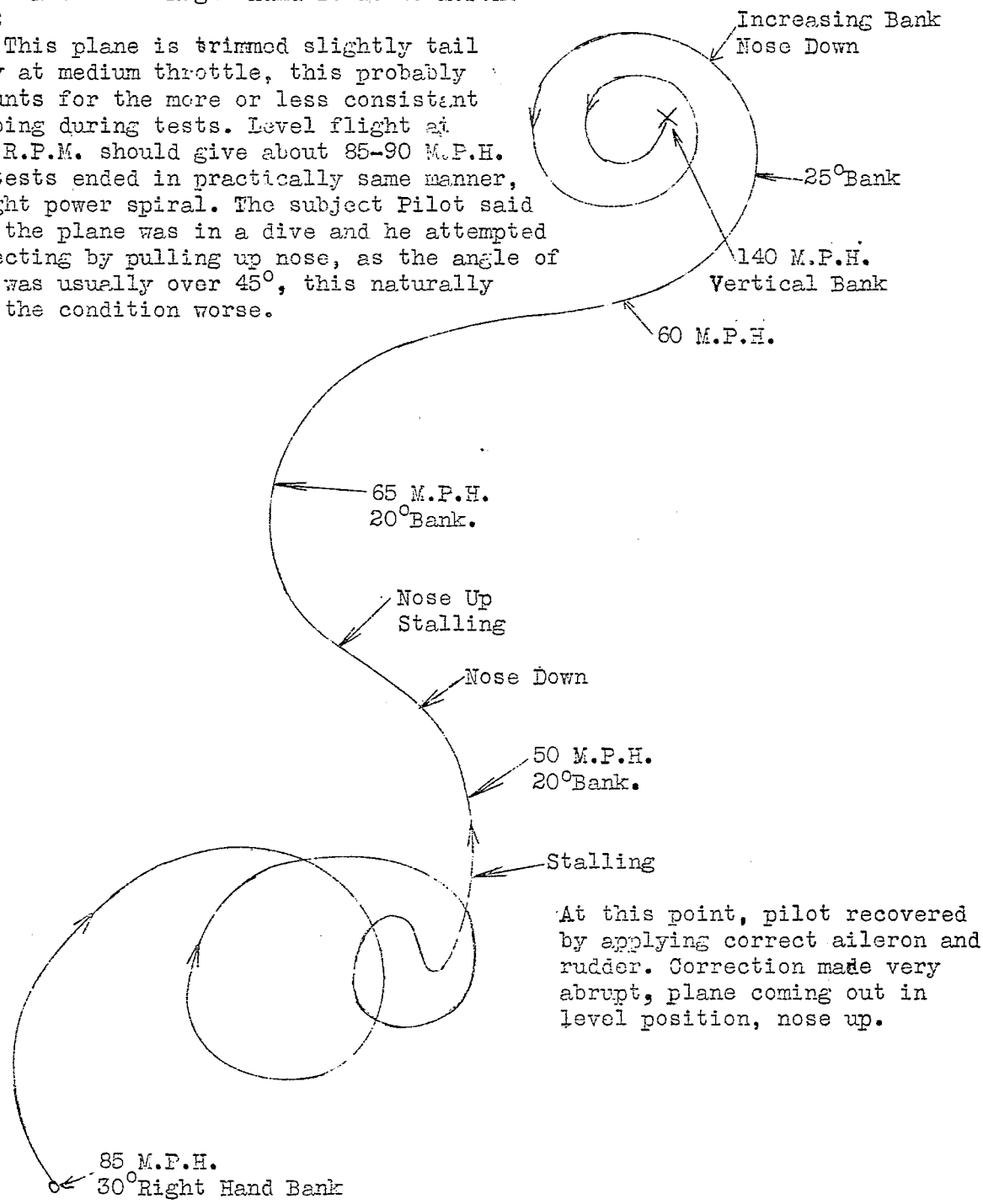
Flight No.4, Left Hand Bank 30°.
Note:
Steadily increased bank to left, air speed increasing, nose dropping, no definite attempt to maneuver out of turn. Approx. three full turns before maximum speed was reached.



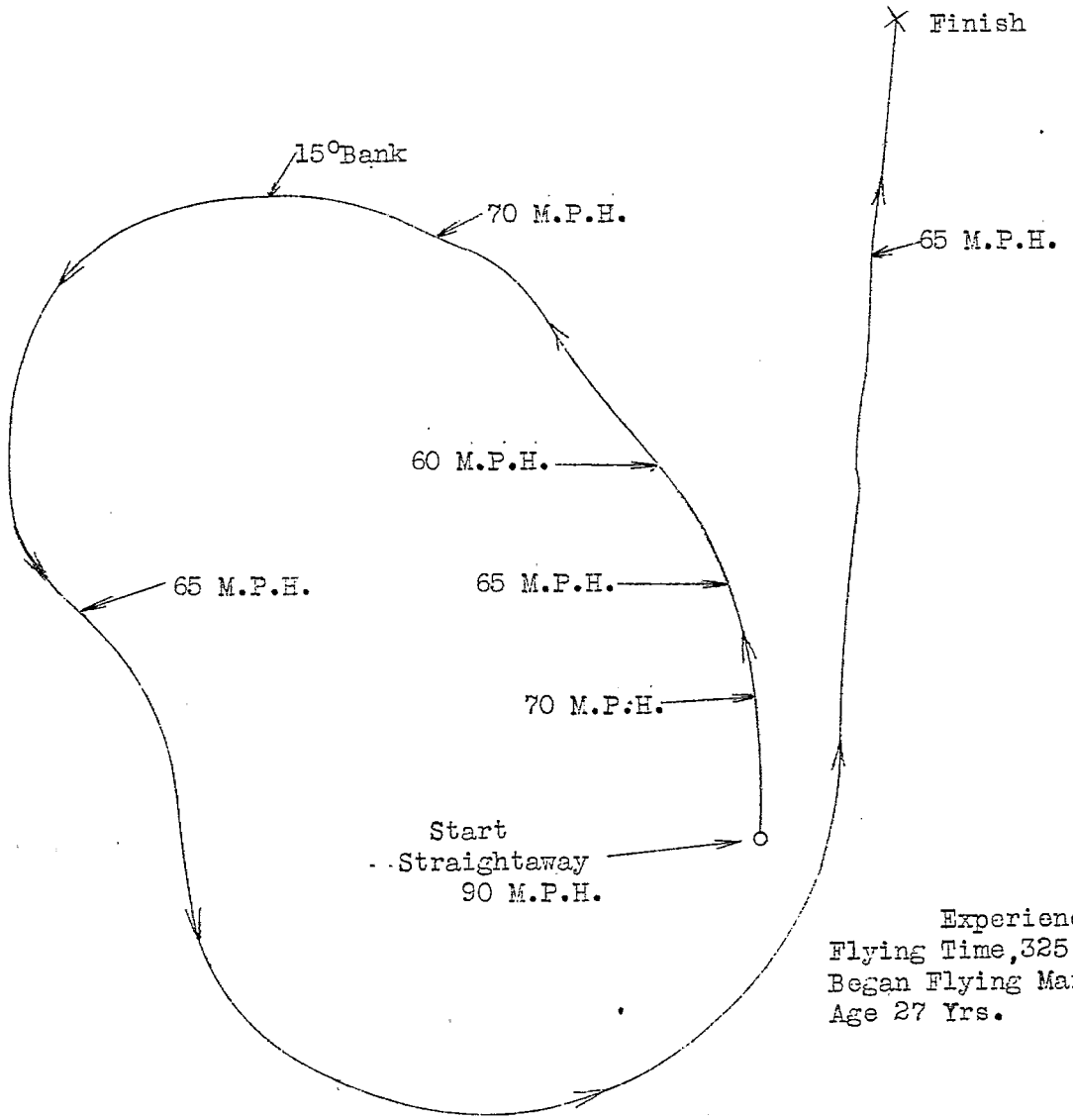
Flight No.5 30° Right Hand Turn. 85 M.P.H.

Note:

This plane is trimmed slightly tail heavy at medium throttle, this probably accounts for the more or less consistant climbing during tests. Level flight at 1400 R.P.M. should give about 85-90 M.P.H. All tests ended in practically same manner, a tight power spiral. The subject Pilot said that the plane was in a dive and he attempted correcting by pulling up nose, as the angle of bank was usually over 45°, this naturally made the condition worse.



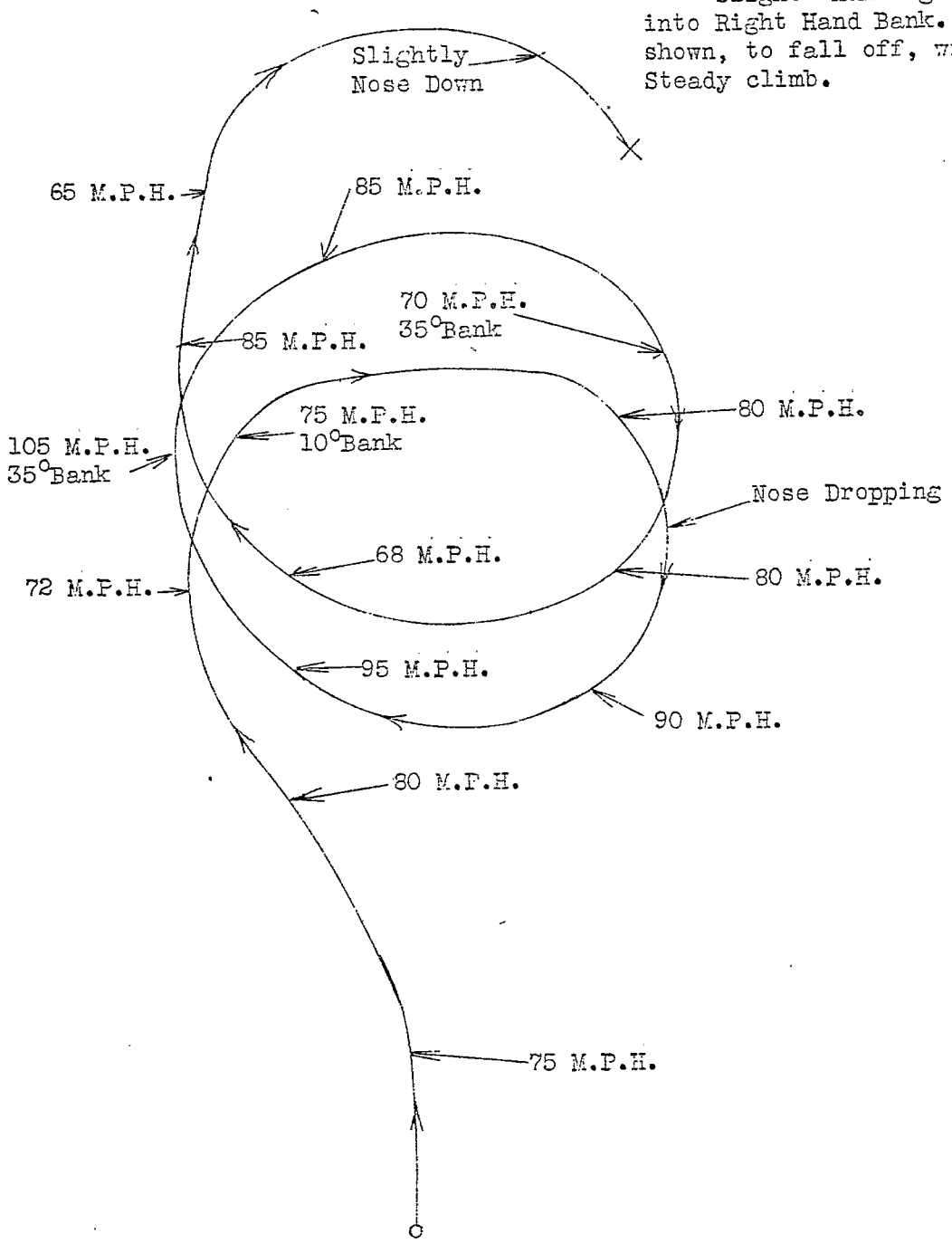
Flight No.1, Straightaway, 90 M.P.H.
Elapsed time, 2'30"
Note:
Pilot was climbing throughout flight, control was very steady, slight tendency to fall off when stalling speeds were reached. (60 M.P.H.)



Experience:
Flying Time, 325 Hrs.
Began Flying March 1-28.
Age 27 Yrs.

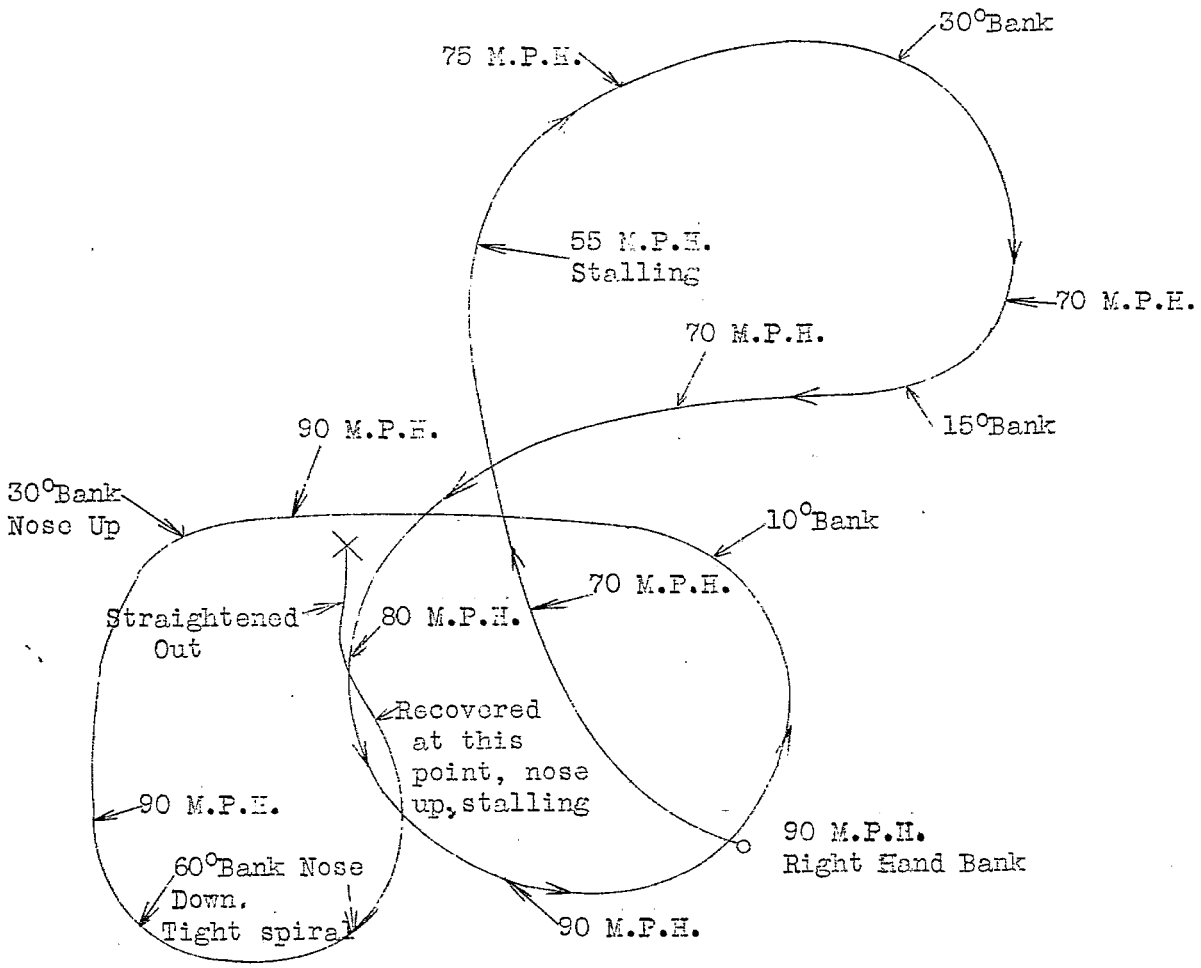
Flight No.2, Straightaway Level, 90 M.P.H.
Elapsed Time, 4'30"

Note:
Slight "Hunting" after getting into Right Hand Bank. No tendency shown, to fall off, with nose down. Steady climb.



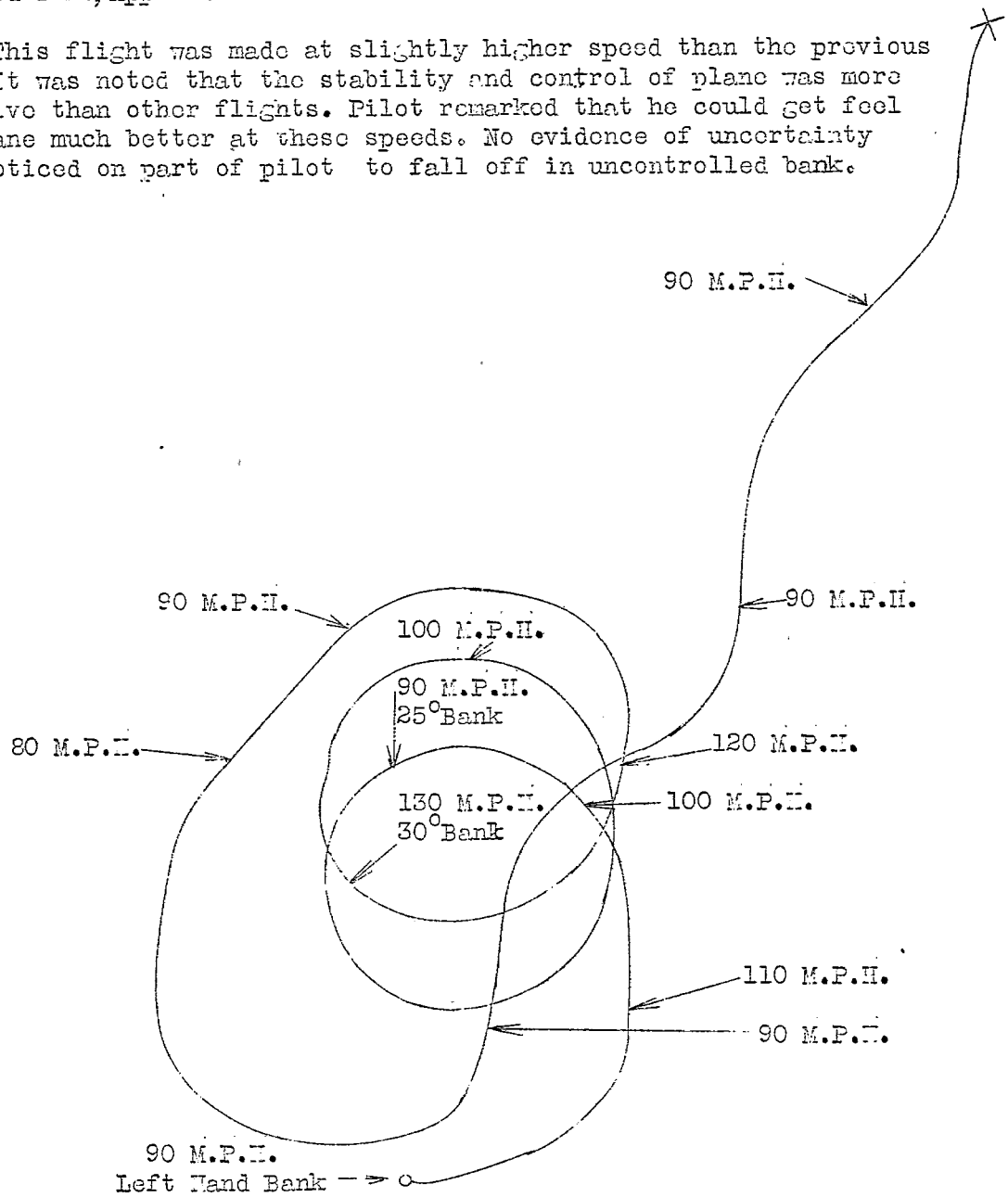
Flight No 3 Right Bank, 90 M.P.H.
Elapsed Time, 5'30"
Note:

In this flight the pilot was climbing airplane continusly. Plane rather unstable in stalled positions. The last turn developed into rather bad power spiral, but pilot recovered from this position before high speed condition was reached. Recovery was normal for this position. It is believed that pilot either chanced upon correct recovery first off, or attempted first one side, and then the other for purpose of feeling turn.

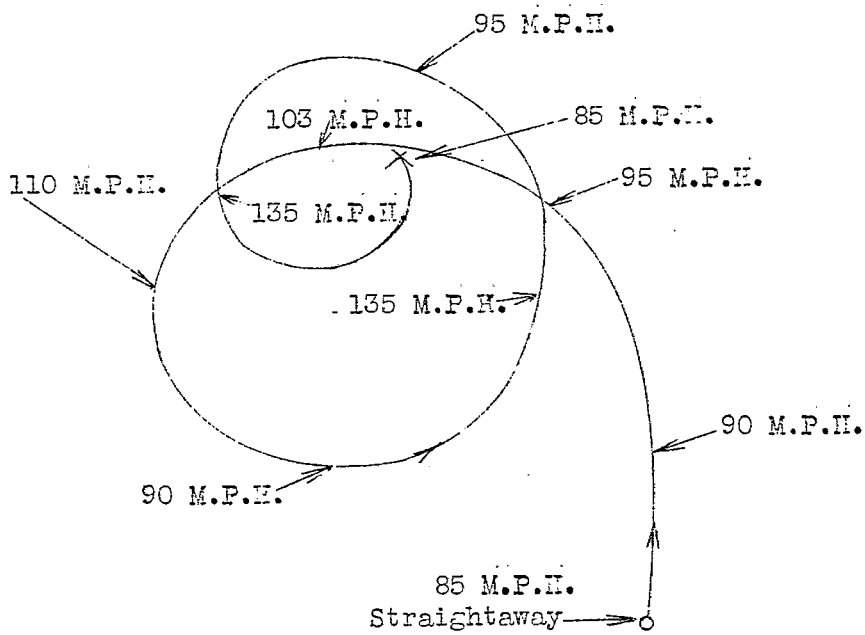


Flight No.4, Left Hand Bank, 90 M.P.H.
Elapsed Time, Approx. 6'0"
Note:

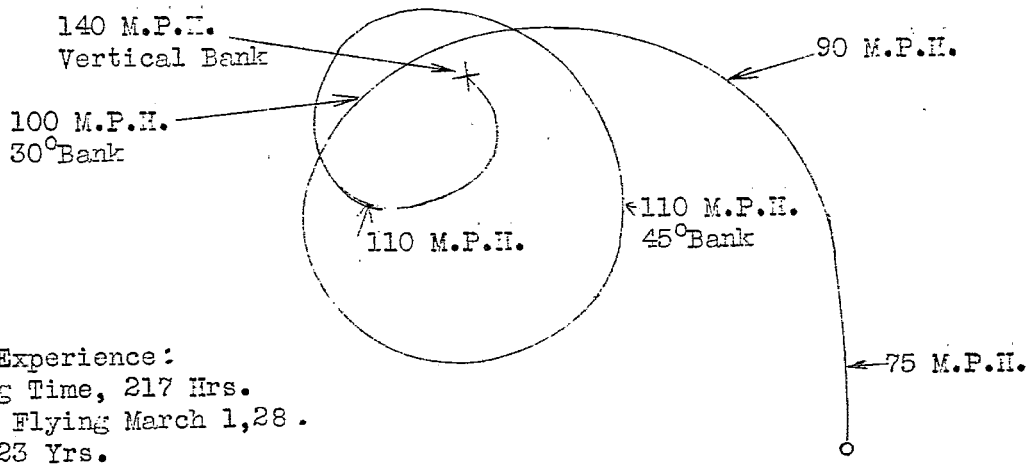
This flight was made at slightly higher speed than the previous one. It was noted that the stability and control of plane was more positive than other flights. Pilot remarked that he could get feel of plane much better at these speeds. No evidence of uncertainty was noticed on part of pilot to fall off in uncontrolled bank.



Flight No.1 Straightaway, 85 M.P.H.
Note:
Pilot did not have good horizontal control during this flight, alternating between high speed nose down condition and nose up position. However he did not hold stall position long enough for air speed to drop excessively.

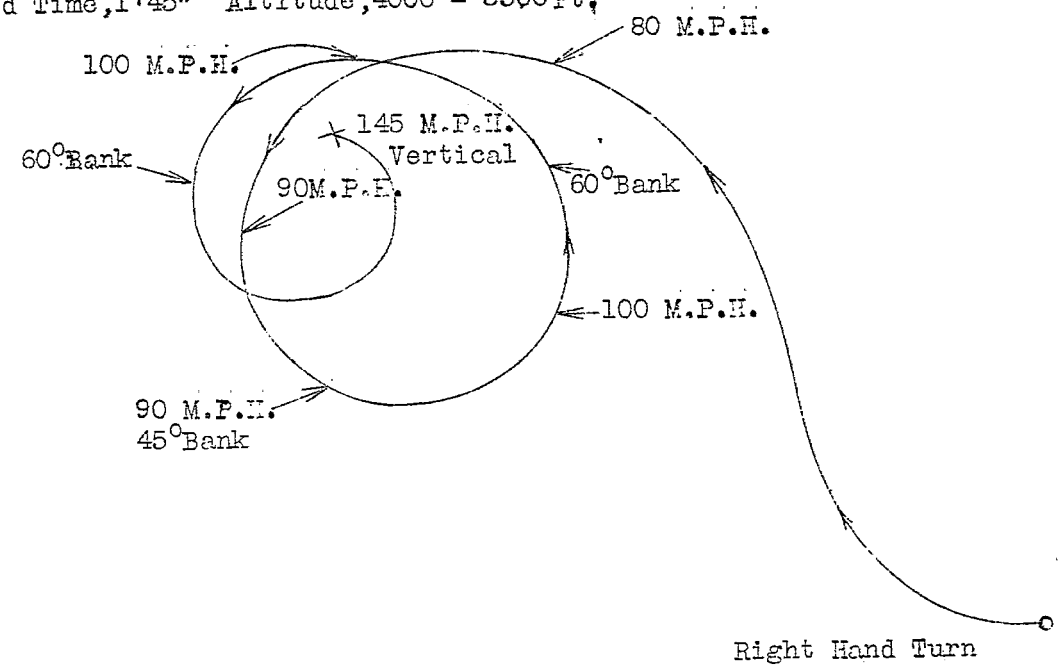


Flight No 2 Straightaway,85 M.P.H. 4400Ft.No loss.
Note:
This flight is similar to flight No 1, but does not have as severe alterations of air speed. Control in turns about the same.

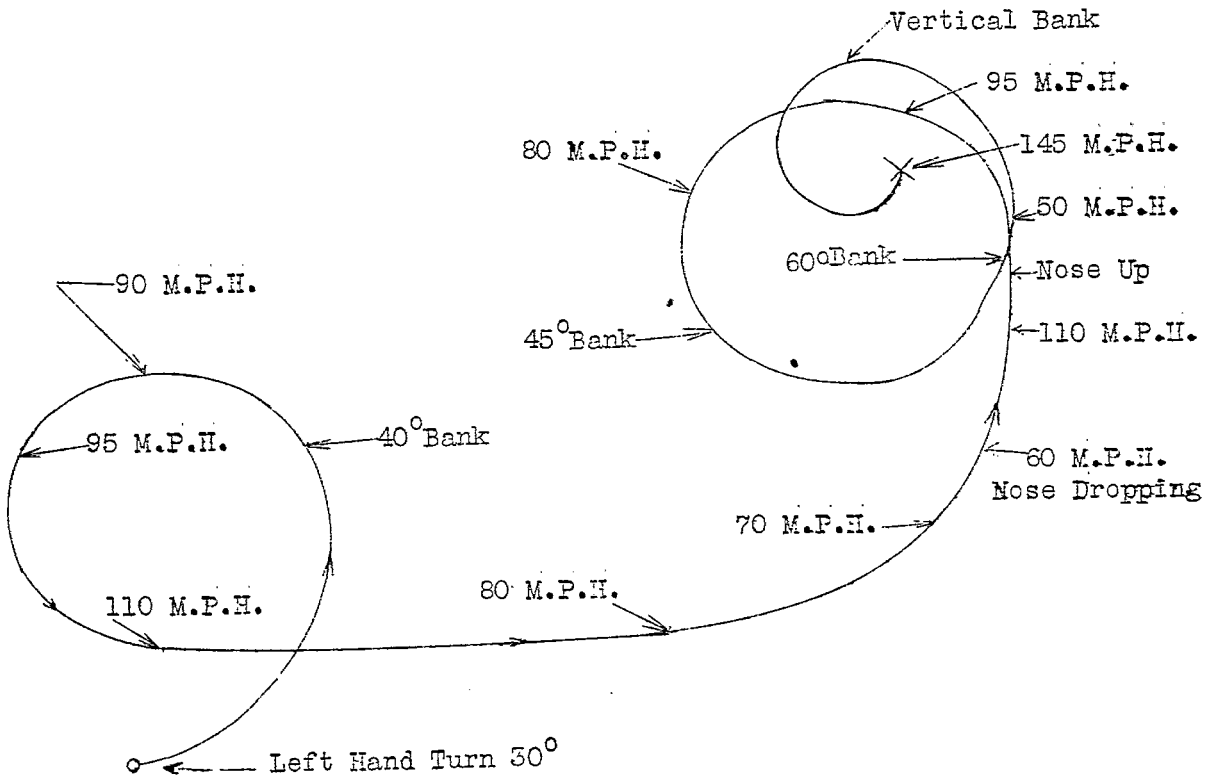


Experience:
Flying Time, 217 Hrs.
Began Flying March 1,28.
Age, 23 Yrs.

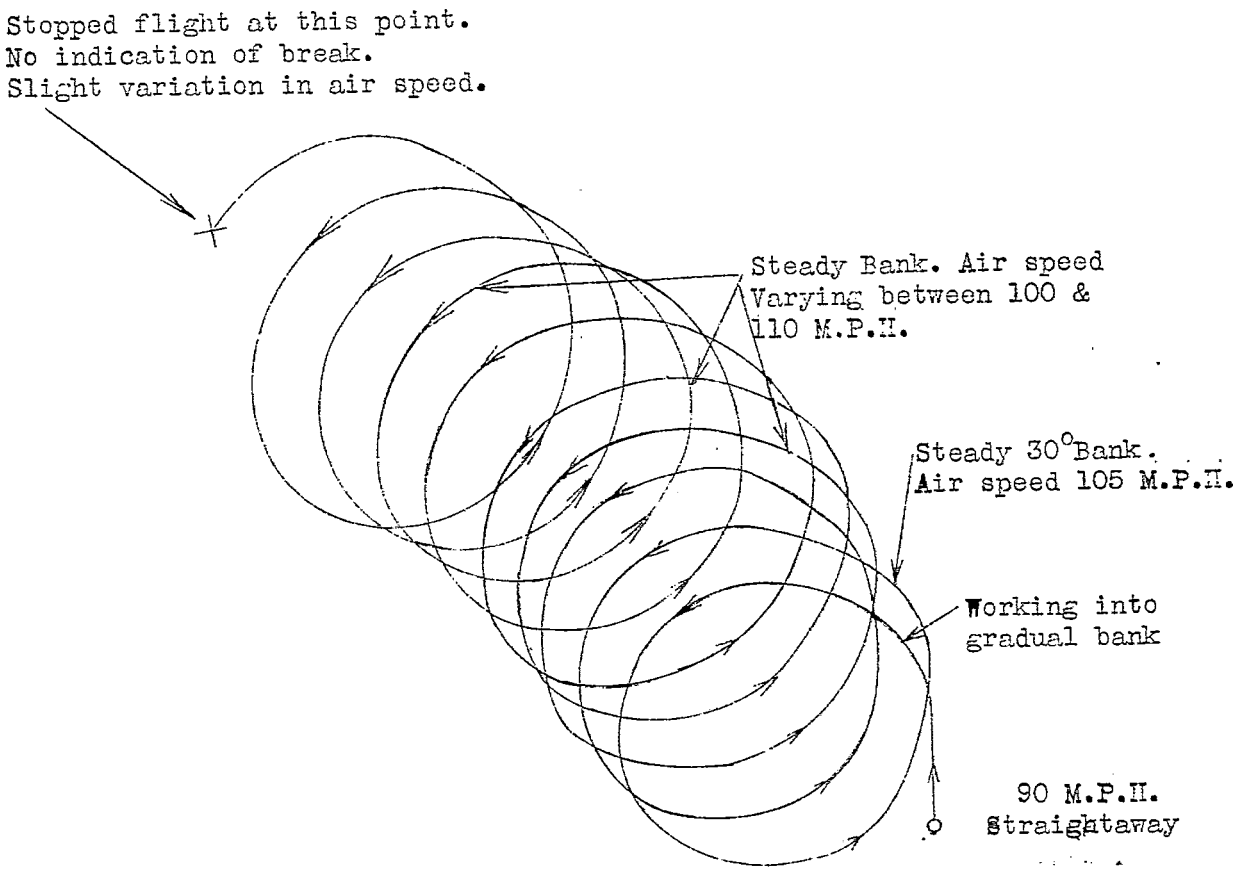
Flight No.3, Right Hand Turn, 30°.
Elapsed Time, 1'45" Altitude, 4000 - 3500 Ft.



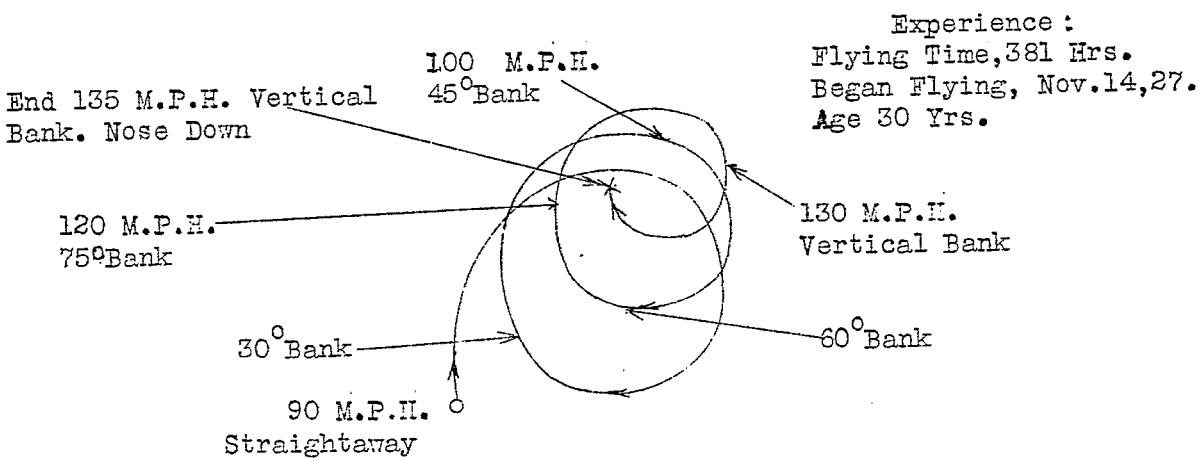
Flight No.4, Left Hand Bank, 30°.
Elapsed time, 3'0"
Altitude, 4000 Ft. - 3000 Ft.



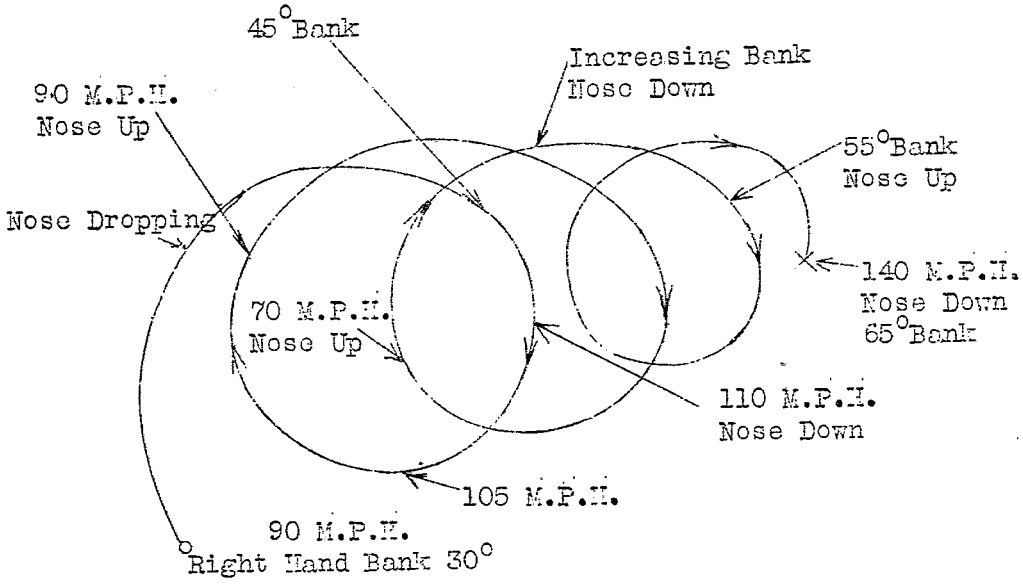
Flight No.1, Straightaway, 90 M.P.H.



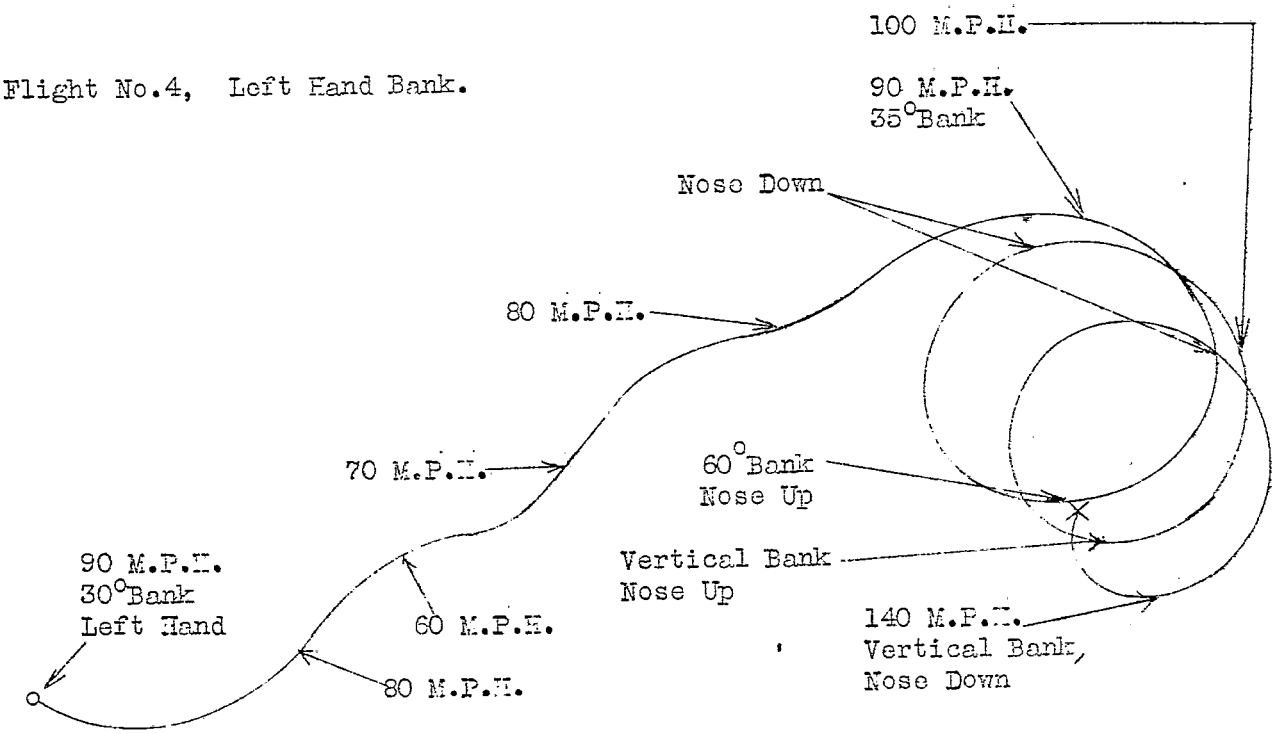
Flight No.2, Straightaway, 90 M.P.H.

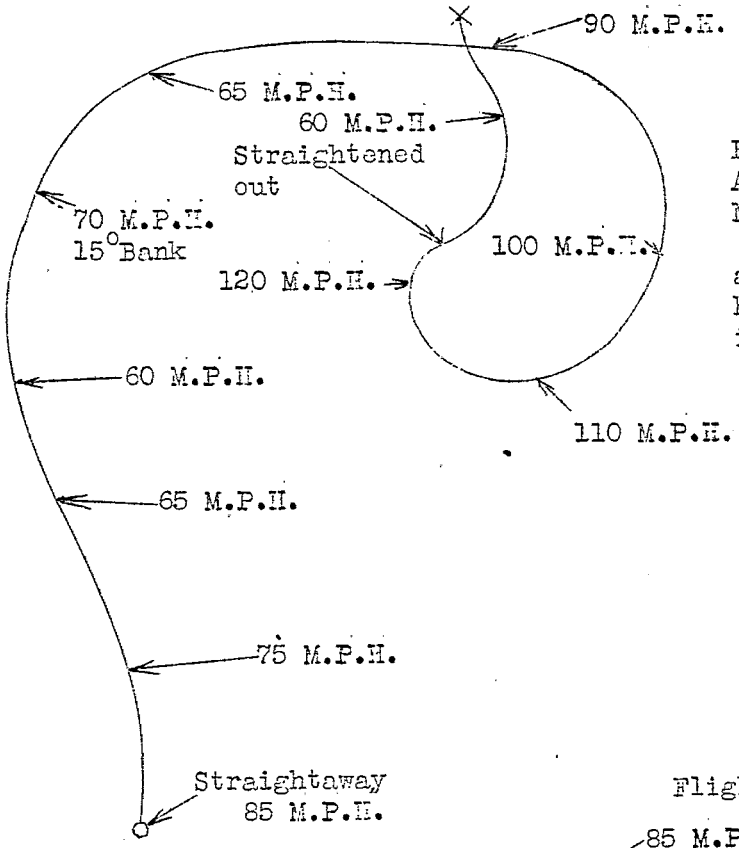


Flight No.3, Right Hand Bank 30°, 90 M.P.H.



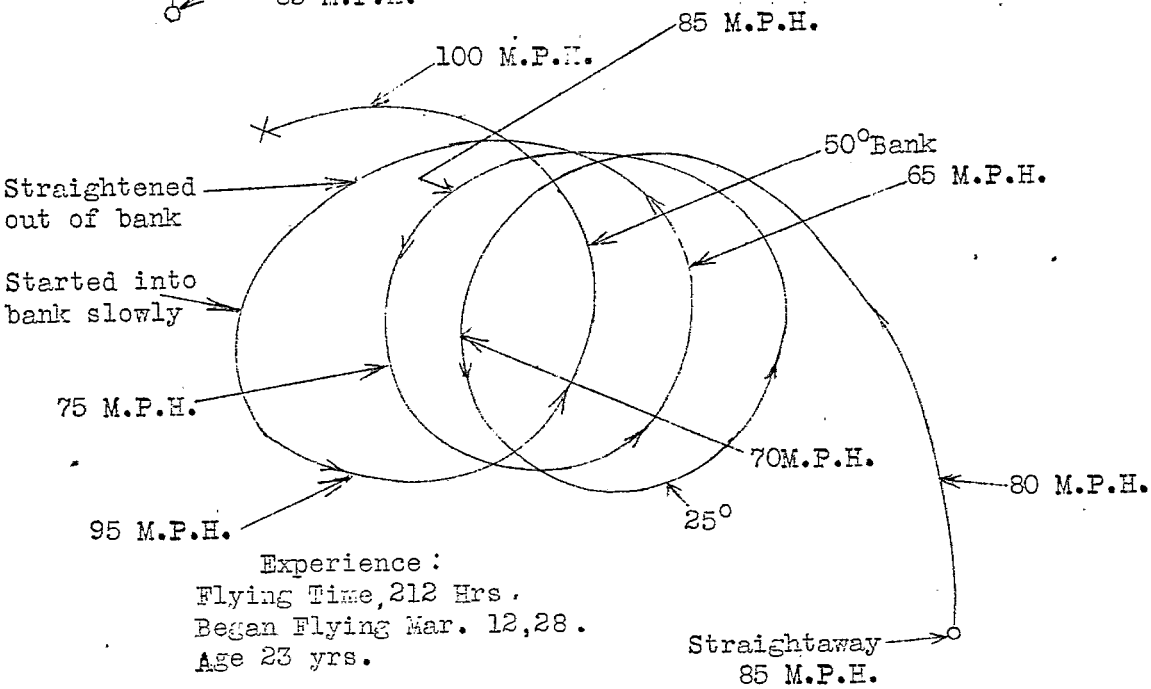
Flight No.4, Left Hand Bank.





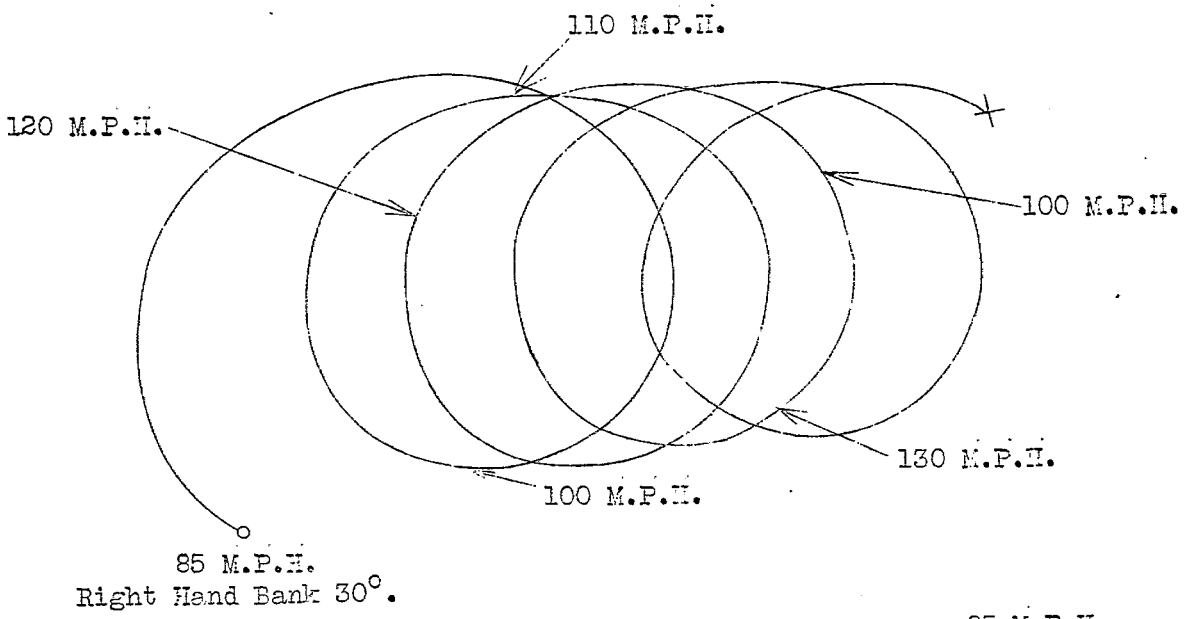
Flight No.1 Straightaway, Air Speed Low, Climbing.
Note:
Pilot is exceptionally stable, and holds his bank very constant in continued flight.

Flight No. 2, Straightaway

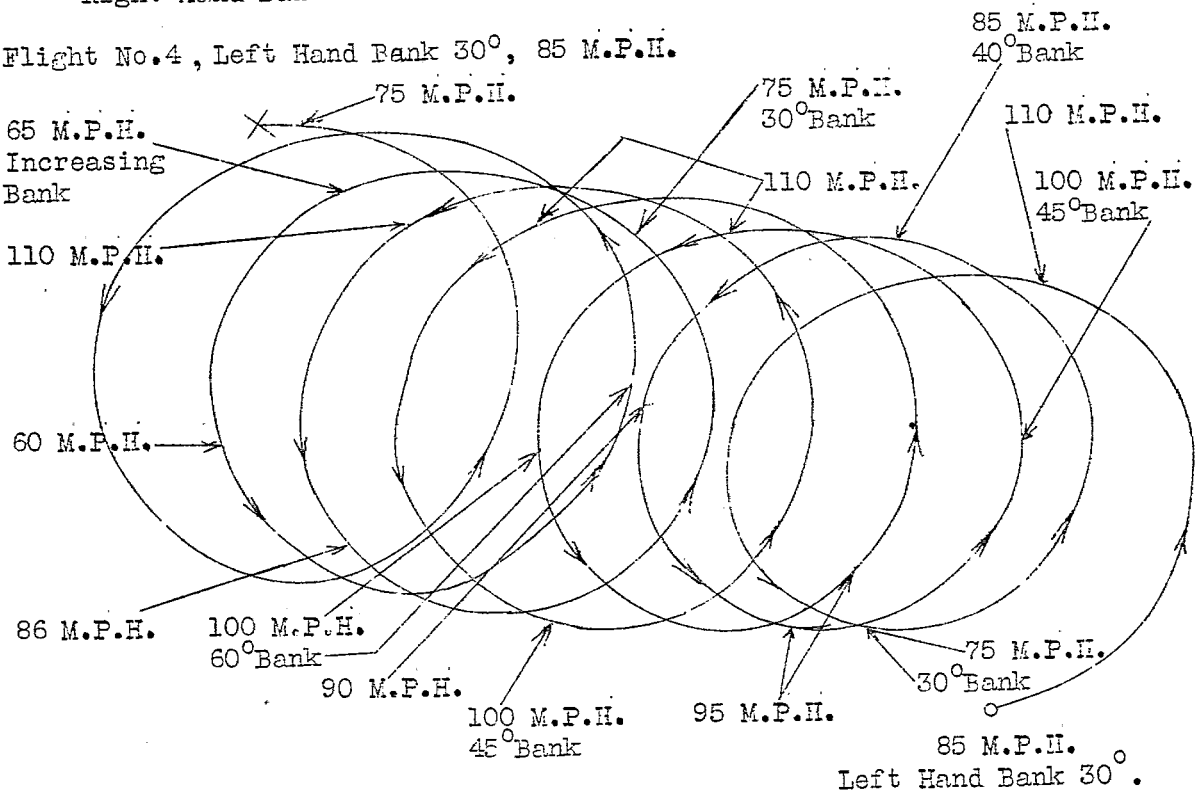


Experience:
Flying Time, 212 Hrs.
Began Flying Mar. 12, 28.
Age 23 yrs.

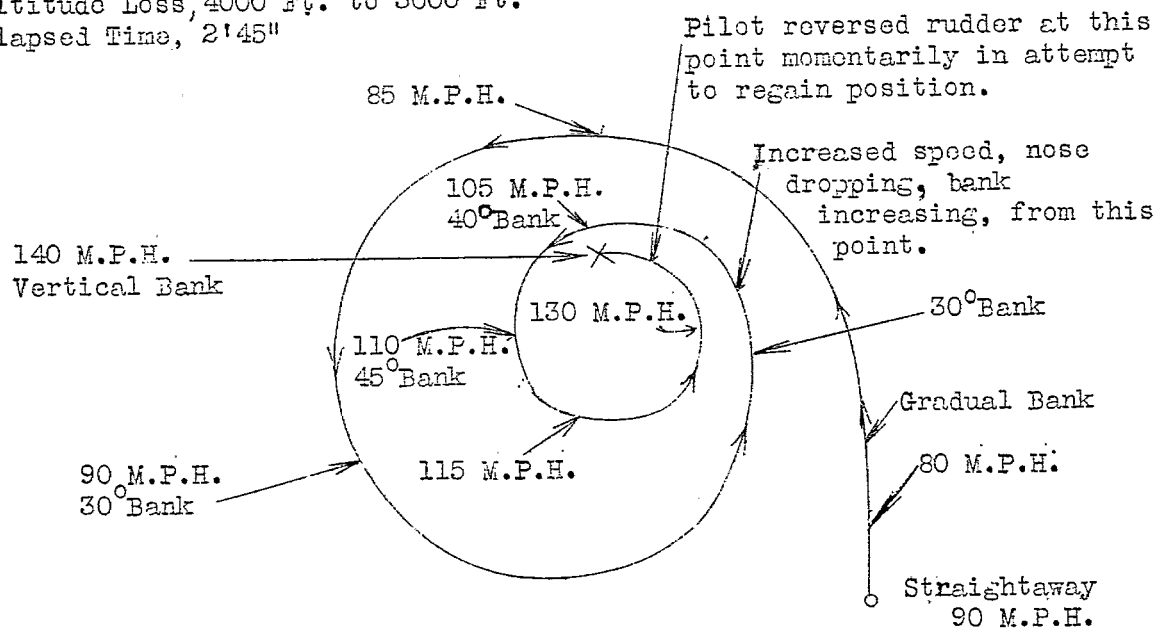
Flight No.3, Right Hand Bank 30°.
Elapsed Time, 2'30"



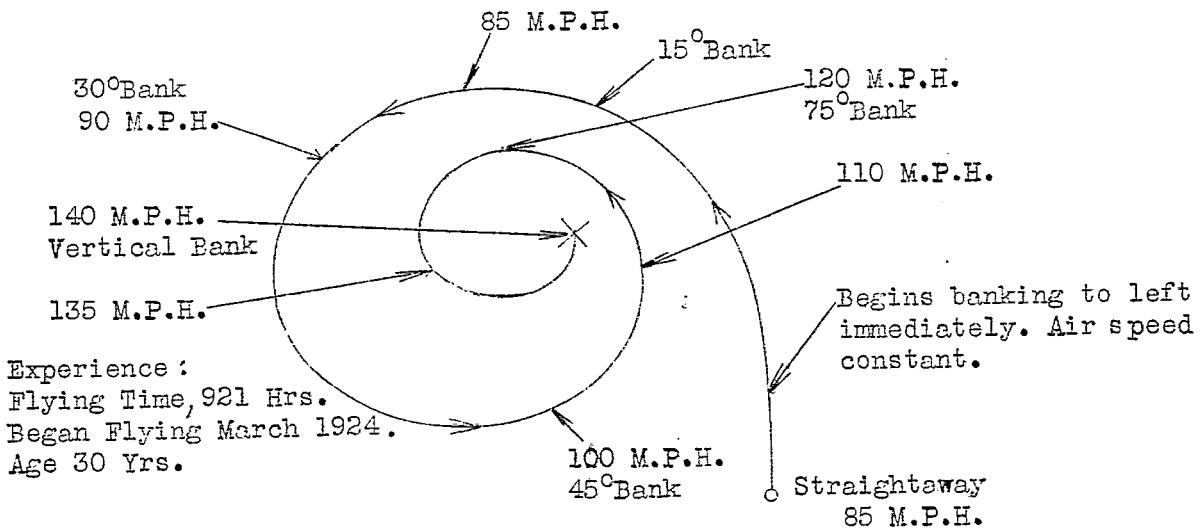
Flight No.4, Left Hand Bank 30°, 85 M.P.H.



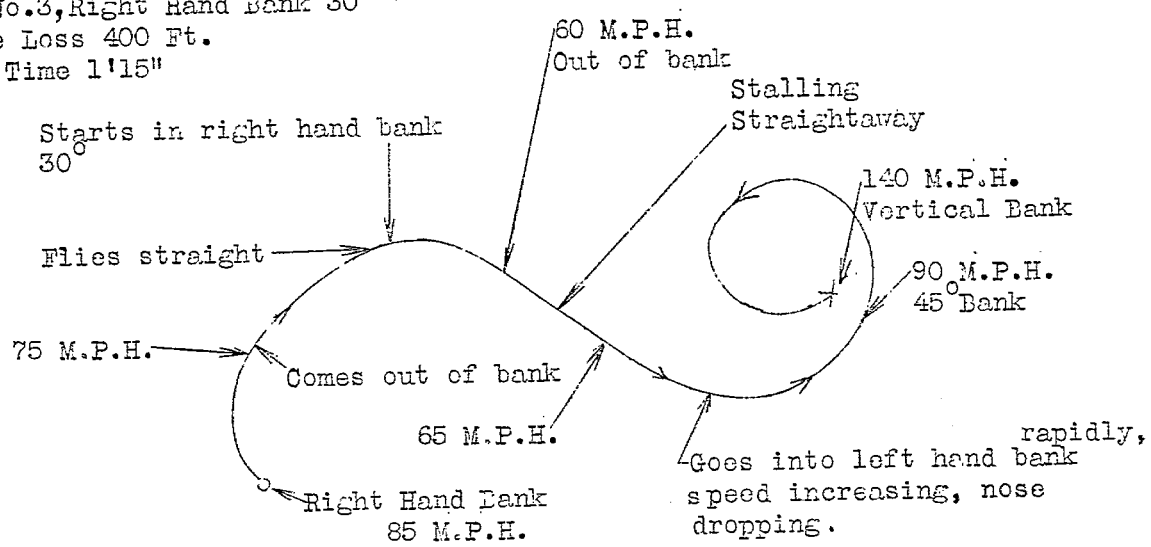
Flight No.1, Straightaway.
Altitude Loss, 4000 Ft. to 3000 Ft.
Elapsed Time, 2'45"



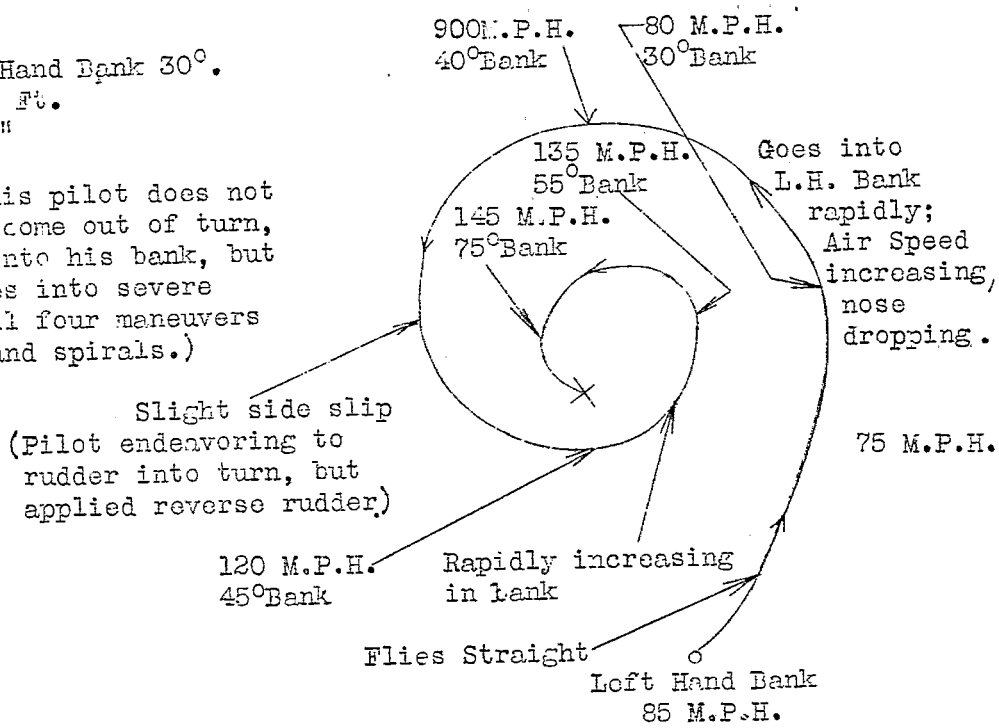
Flight No.2, Straightaway.
Altitude Loss, 450 Ft.
Elapsed Time, 2'0"



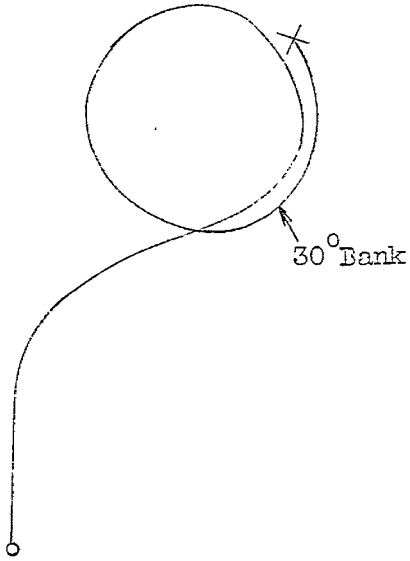
Flight No.3, Right Hand Bank 30°
Altitude Loss 400 Ft.
Elapsed Time 1'15"



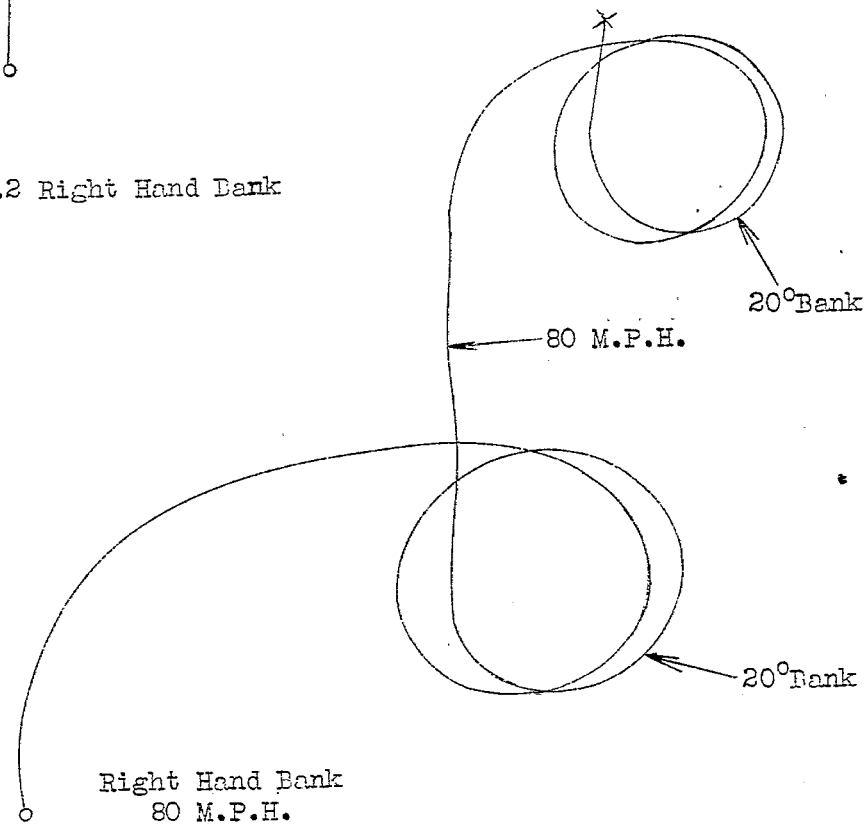
Flight No.4, Left Hand Bank 30°.
Altitude Loss 600 Ft.
Elapsed Time 1'00"
Observers Note:
This pilot does not have tendency to come out of turn, once being well into his bank, but rapidly progresses into severe power spiral. (All four maneuvers ending in left hand spirals.)



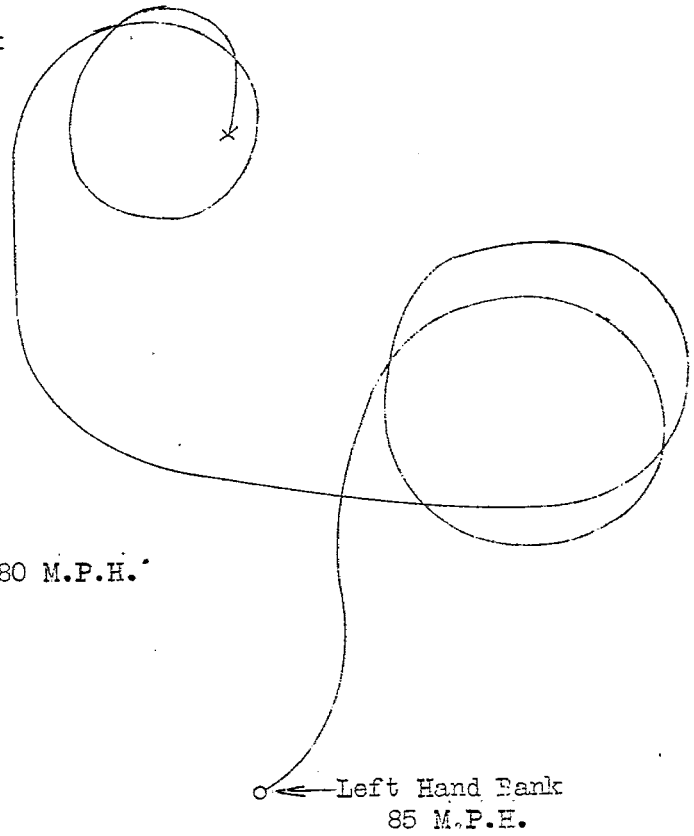
Flight No.1, Straightaway, 100 M.P.H.



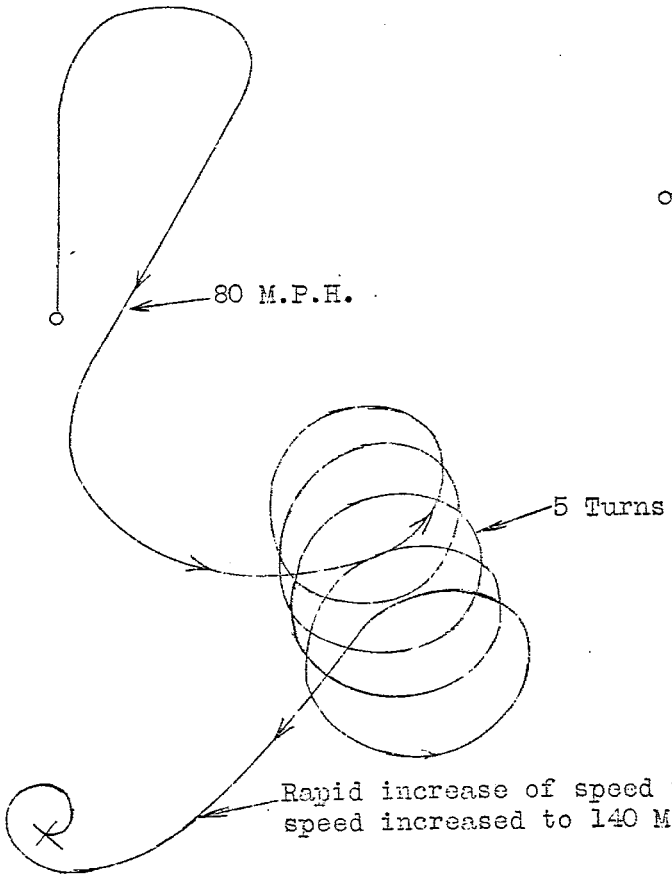
Flight No.2 Right Hand Bank



Flight No.3 Left Hand Bank



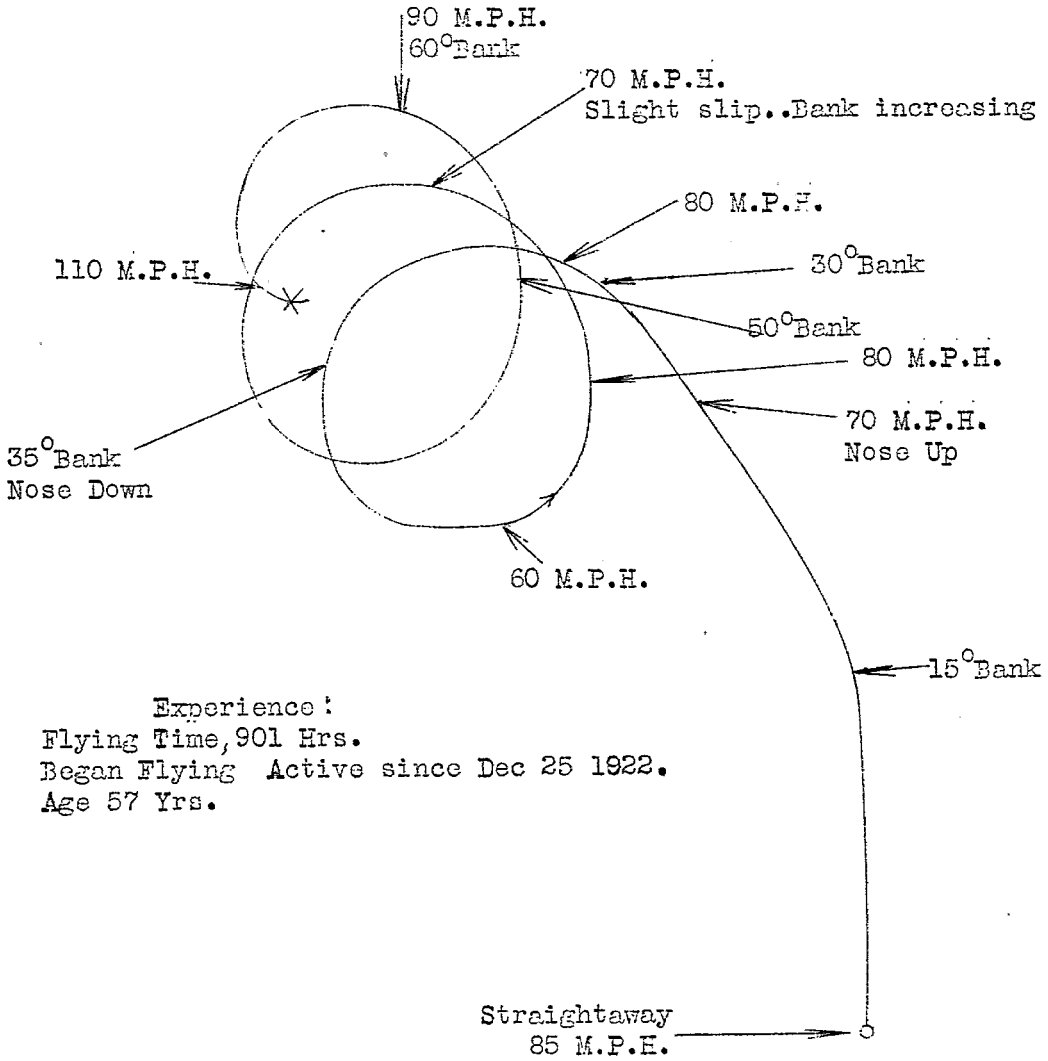
Flight No.4 Straightaway, 80 M.P.H.



Experience:
Flying Time, 2000 Hrs.
Began Flying 1917.
Age 33 yrs.

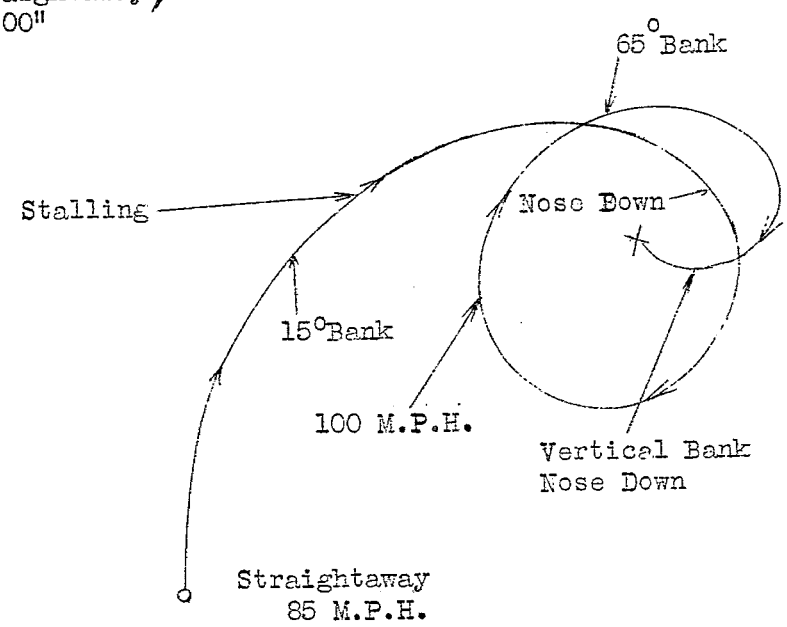
Flight No.1 Straightaway, 85 M.P.H. Level .
Elapsed Time, 2'00" .
Note:

Change of flight path very gradual. Approximately three turns of left hand bank were made very consistant, with slight variation in air speed. Angle of bank increased steadily with nose well on horizon, dropping slightly on last turn.

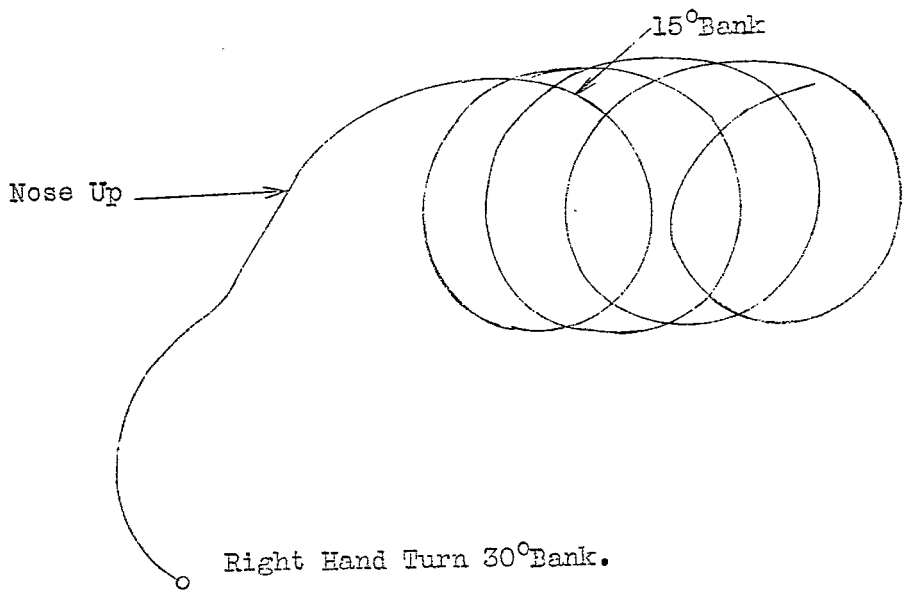
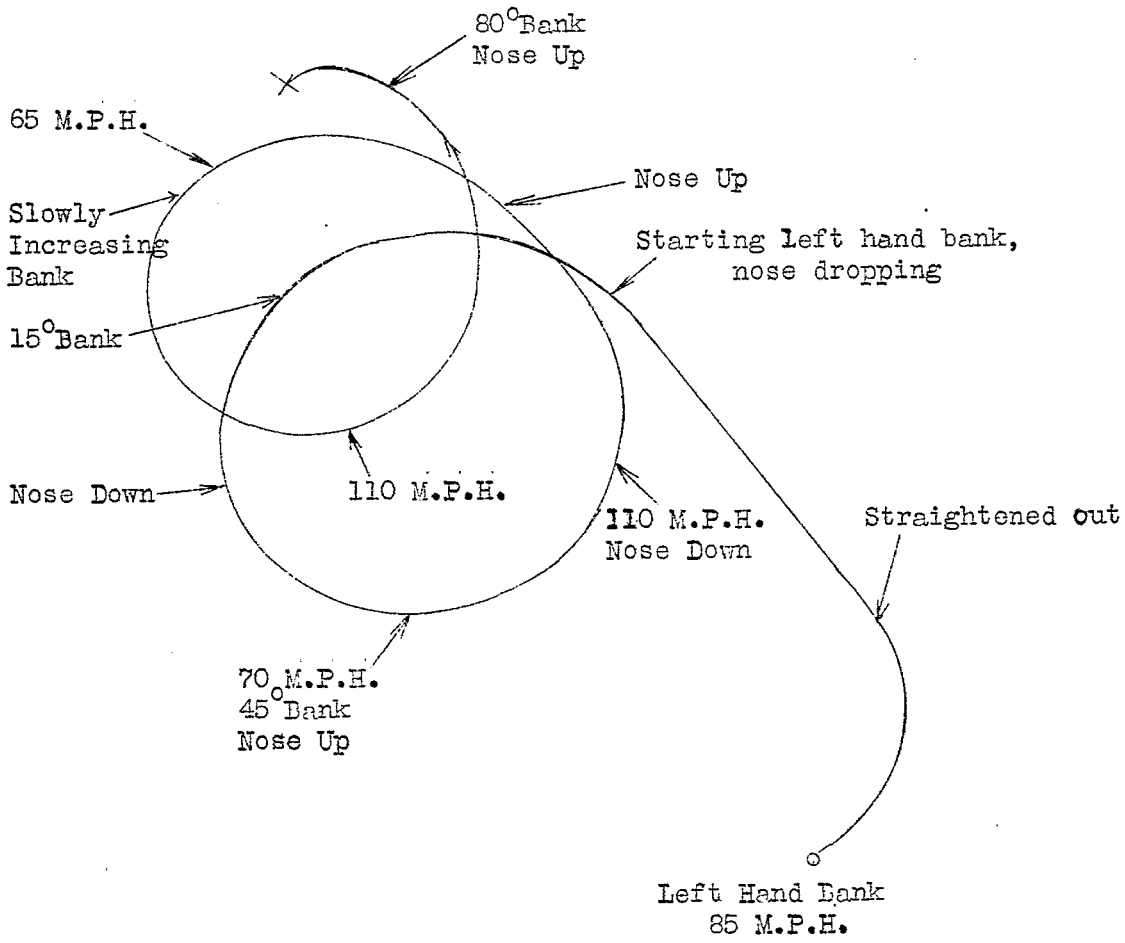


Experience:
Flying Time, 901 Hrs.
Began Flying Active since Dec 25 1922.
Age 57 Yrs.

Flight No.2 Straightaway, 85 M.P.H. Level.
Elapsed Time, 1'00"



Flight No.3 Right Hand Turn 30° Bank



Flight No.4. Left Hand Bank, 85 M.P.H.