A DUAL-CONTROL COURSE-LINE COMPUTER
CAA TYPE IA

By
William L Seibert
Alan L Saunders
and
Logan E Setzer

Electronics Division

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Sinclair Weeks, Secretary

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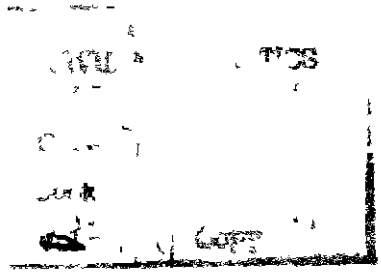

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A DUAL-CONTROL COURSE-LINE COMPUTER
CAA TYPE I A

SUMMARY

The CAA Type I A course-line computer features dual control units, a factor which enables the pilot to preset the parameters of the destination or of the waypoint on one of the control heads without interrupting the operation of the computer The pilot can then alternate control heads in flight Thus, when the flight plan is comprised of a succession of waypoints, the guidance which the course-line computer furnishes becomes more convenient to use than that guidance furnished when a single control head is employed The solution of practical air-traffic-control problems may require the pilot to make several changes of course in rapid succession The course-line computer with dual control heads enables the pilot to preset the parameters of a course into one head while he is flying a course set into the other head Either set of parameters can be introduced immediately by means of a selector switch

The operation of the CAA Type I A is similar to that of the CAA Type I course-line computer, a description of which is contained in a previous publication, CAA Technical Development Report No 152 As a result of the compact construction and of the use of miniature components, a two-to-one reduction is size and weight with respect to the CAA Type I computer control head was accomplished The two control heads are mounted on the aircraft instrument panel in standard instrument openings The computer accuracy remains unchanged

INTRODUCTION

A course-line computer is a type of airborne equipment which accepts information from the distance-measuring-equipment (DME) and the very-high-frequency-omnirange (VOR) receiving equipment and which, after properly processing this information, presents the results on meter-type indicators which provide the pilot with "track-guidance" and "distance-to-go" information for any selected course and destination within the range of the DME and of the VOR station When using it as a navigational aid, the pilot or the navigator is required to set on the corresponding controls of the course-line computer (1) the distance of the destination or of the waypoint from the omnibearing-distance (OBD) station, (2) the bearing of the destination from the OBD station, and (3) the intended course

The CAA Type I A course-line computer is similar to the Type I computer except for the control heads The computer consists of four principal units the servoamplifier unit, the control unit, two of which are used in the Type I A computer, the waypoint-distance indicator, the course-deviation indicator, and the junction box with interconnecting cables Autosyn resolvers and linear potentiometers are used in the amplifier unit to resolve the problem set into the control head in a form suitable for presentation on the course and distance indicators used for VOR and DME operation [1]

The development work on the CAA Type I A dual-control course-line computer was prompted by the study conducted by the Radio Technical Committee for Aeronautics (RTCA) Special Committee SC-49 The following is quoted from the final report of that committee

> "It appears that in some terminal area operations requiring several changes of course in quick succession, the ability to preselect computer parameters will be very desirable "[2]

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[1] Chester B Watts Jr , and Logan E Setzer, "CAA Type I Course Line Computer," CAA Technical Development Report No 152, January 1952

[2] "Study of Performance Objectives of Course Line Computers," Final Report, RTCA Special Committee SC-49, July 1949, Unpublished

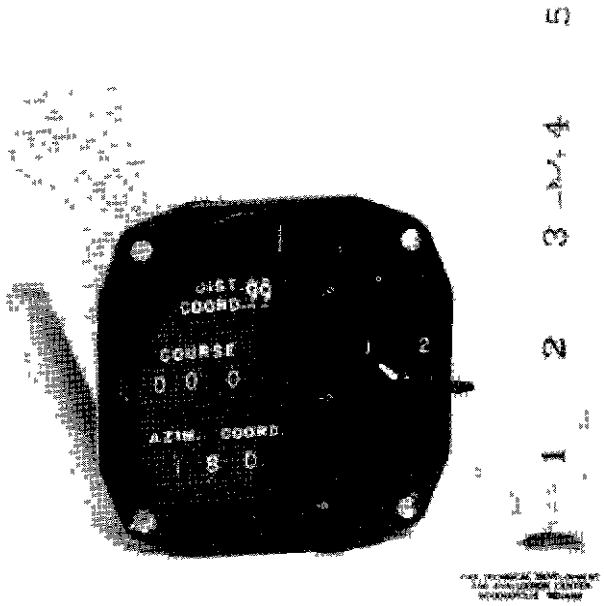

Fig 1 Dual-Control-Head Computer

This report describes a practical dual-control course-line computer with emphasis on the design, the construction, and the use of the dual-control feature The results of several flight tests are included to indicate how the utility of the course-line computer is extended by the use of dual control heads

DESCRIPTION

Control-head size was the limiting factor in the construction of a practical dual-control-head computer, therefore, much effort was spent in designing a compact dual-control head which could conveniently be mounted on the aircraft instrument panel As shown in Fig 1, two- and three-digit counter-type indicators were used for setting in the co-ordinates of the desired

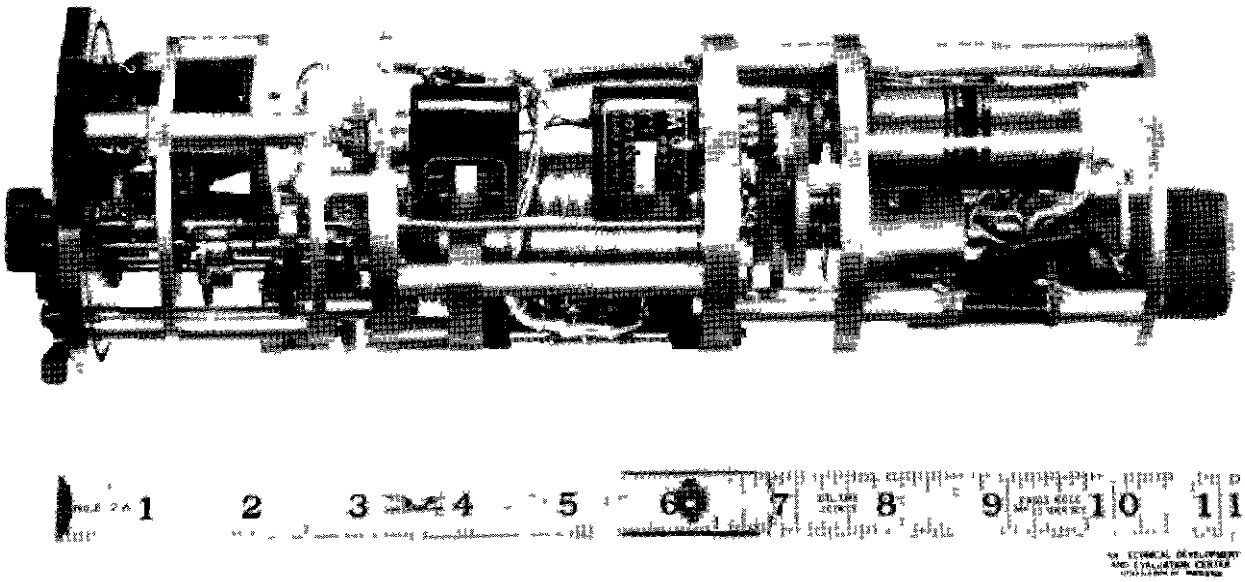

Fig 2 Exposed View of Control Head

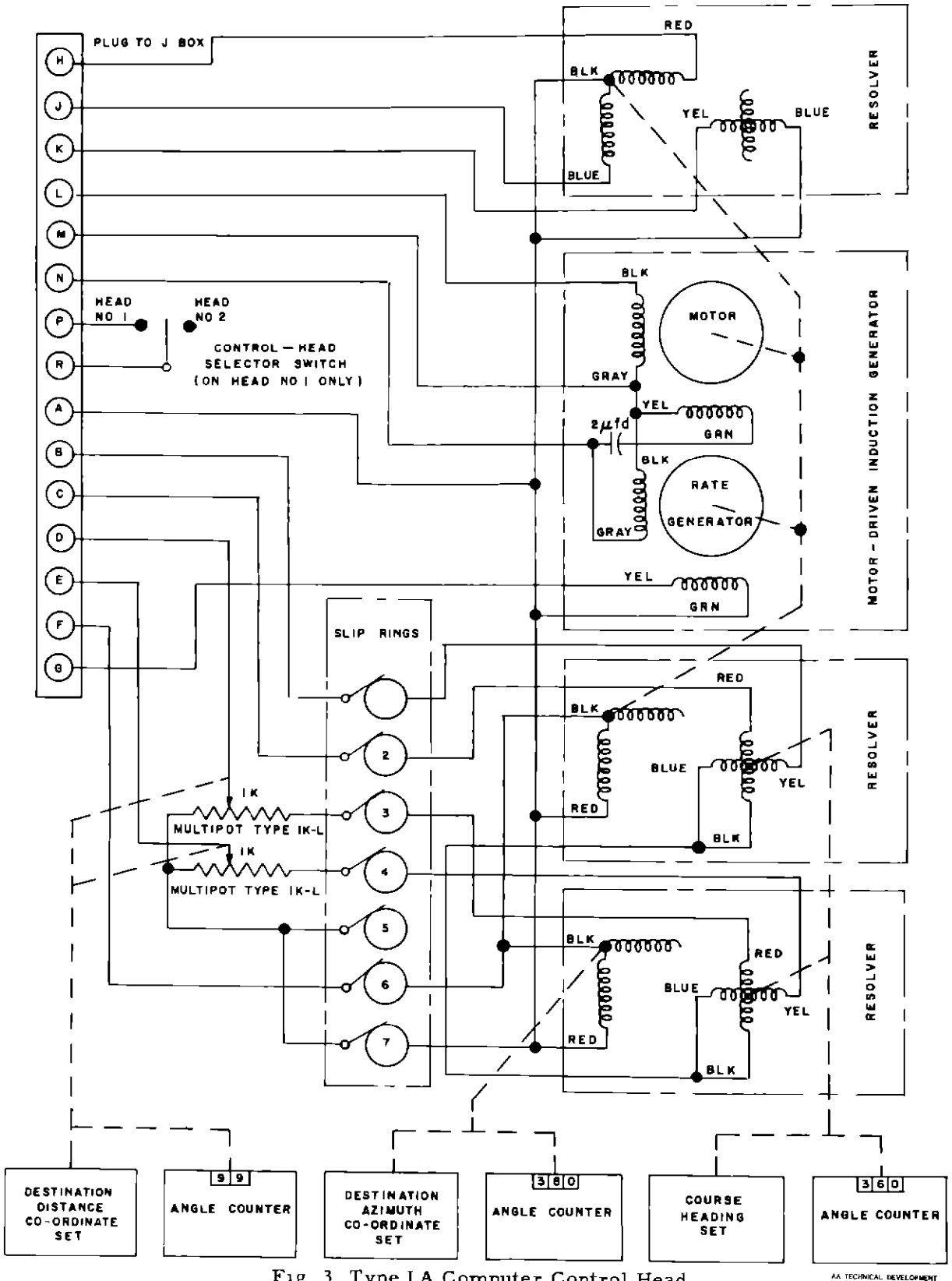

Fig 3 Type I A Computer Control Head

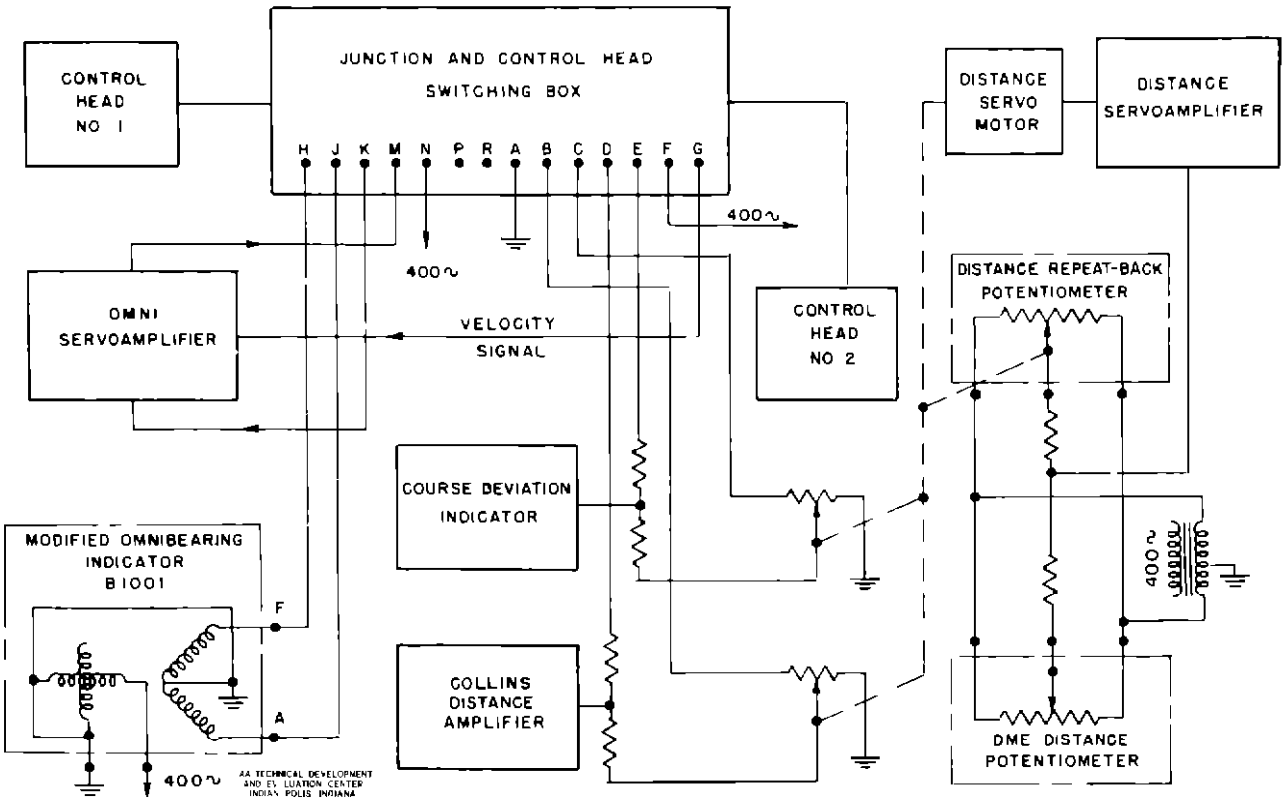

Fig 4 Block Diagram of CAA Type I A Course-Line Computer

course These counters were manufactured by the Kearfott Manufacturing Corporation, Newark, N J Control head No 1 also contains the head-selector switch which transfers the computer operation from one control head to the other by operating a stepping, solenoid, selector switch in the junction box Fig 2 is an exposed view showing the construction and placement of the various components of the control head Fig 3 is a schematic diagram of one of the control heads and shows the connections from the control head to the other computer units

The distance and omnirange servoamplifiers are identical to those used in the Type I computer and are mounted in one-half of a standard ATR case No attempt was made to miniaturize this particular unit of the computer

As shown on the block diagram, Fig 4, the computer course information is fed to the course deviation indicator (CDI) normally used with the omnibearing selector (OBS) when omnirange radials are flown The course width of a course-line computer is independent of the distance from the aircraft to the OBD station and can be adjusted to any desired course sensitivity The course width of the Type I A computer is approximately eight miles, five dots to five dots on the CDI, which is the same as the course sensitivity of an omnirange receiver operating approximately 23 miles from an OBD station and adjusted for a 20° course width The distance information is fed to a Collins waypoint-distance indicator [3] The operating distance of the computer is adjusted for a maximum of 100 miles Fig 5 shows the distance-to-waypoint indicator mounted with the two control units on the instrument panel of a DC-3 aircraft belonging to TDEC The switch at the left of the control heads controls the power to the computer and the course information to the CDI When the computer is in operation, the computer left-right guidance is connected to the CDI, otherwise the navigation-receiver left-right guidance is connected directly to the CDI

[3] Watts and Setzer, op cit

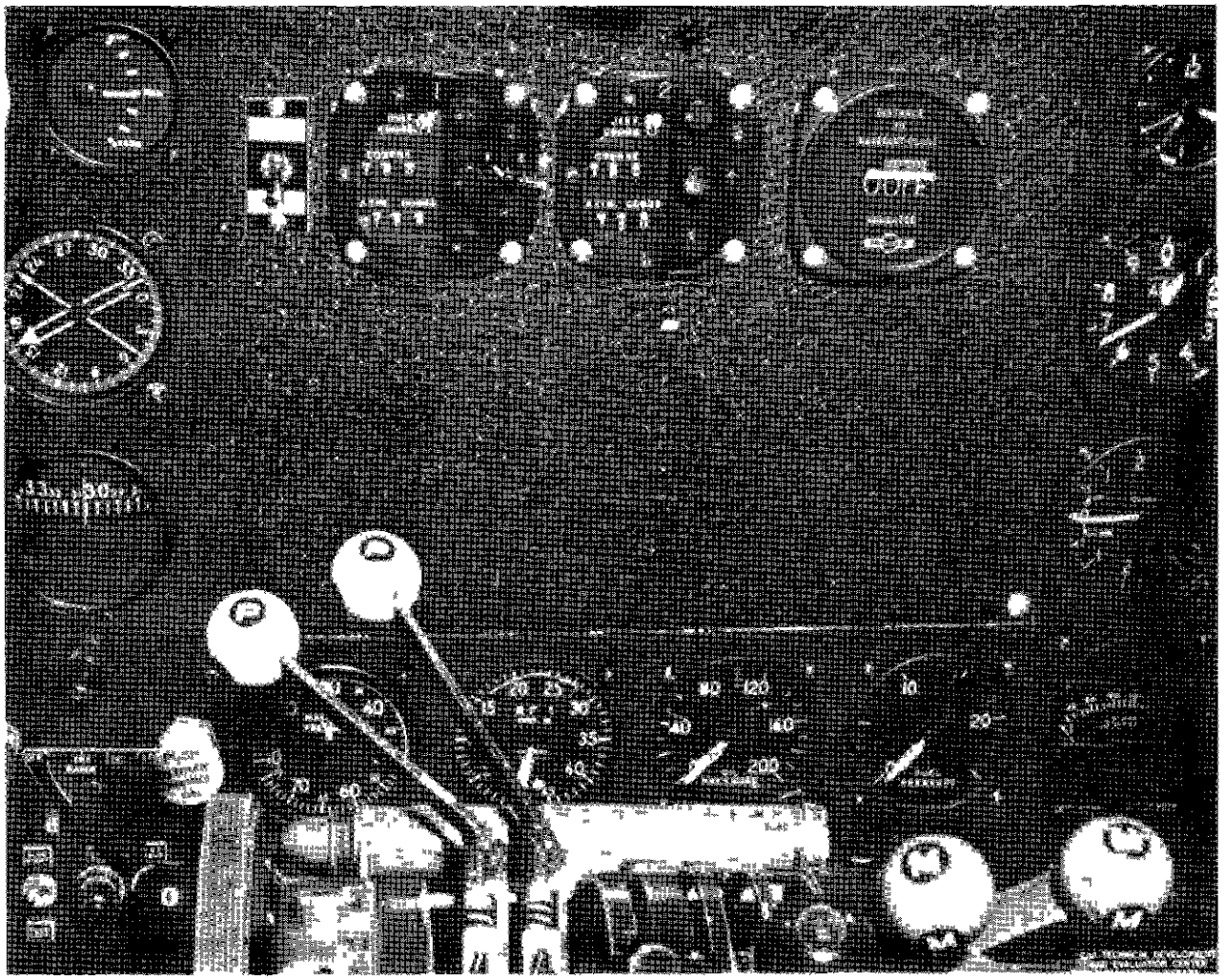

Fig 5 Instrument Panel of DC-3 Airplane

FLIGHT TESTS

In planning the flight tests, courses were selected which would provide an opportunity to evaluate the dual control heads in preselecting and immediately introducing a new set of flight parameters The flights were flown along a square and a triangular course, each approximately 12 miles on a side, and around a 5-mile-long race-track-type holding pattern The square and triangular patterns were chosen in an effort to simulate, in part, vector approach and departure routes to and from congested terminal areas which are remote from the OBD station The coordinates of the waypoint and the setting of the desired course for each of the three vectors of the triangle and for each of the four vectors of the square were obtained from a map and were listed on a card The pilot preset the following set of flight parameters into one control head while he was flying by the information set into the other head When the distance-to-waypoint indicator indicated zero distance, the pilot immediately switched in the alternate control head, which was set to the parameters of the next waypoint, and flew the indicated courses This procedure was repeated each time the airplane reached a waypoint Figures 6 and 7 are plots of the track of the airplane along the selected courses

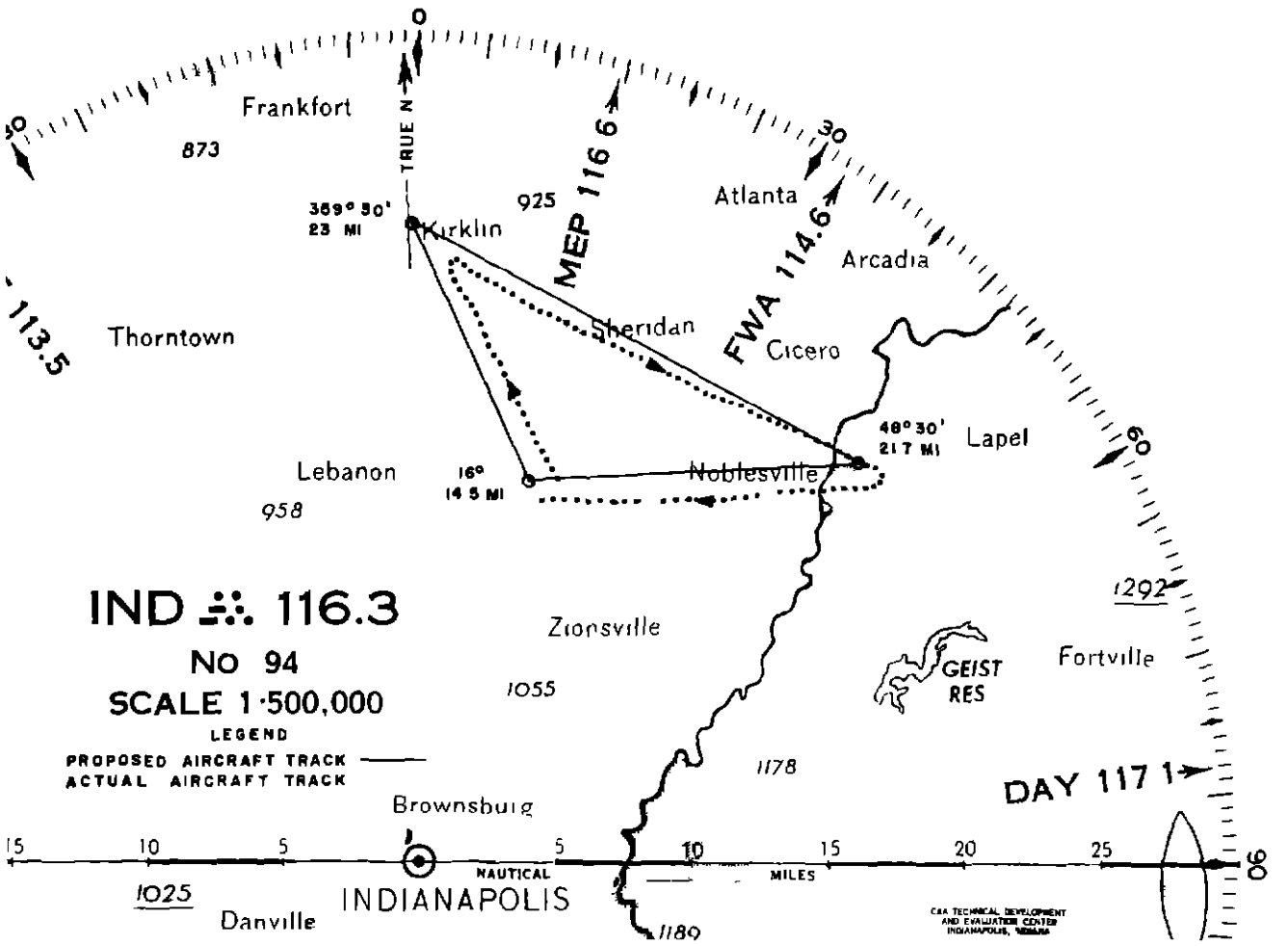

Fig 6 Track of Airplane

Preliminary flight tests indicated negligible differences between the course and the distance information furnished by either control head when they were set up with the same co-ordinates It follows that the performance description for the course-line computers given in Technical Development Report No 152[4] applies to either model of computer

The Type I A computer makes possible the establishment and execution of holding patterns between any two points within the range of a single OBD station without the need of additional markers or of other fix information The co-ordinates of the waypoints which identify these two selected holding points could be obtained from a map in the aircraft or could conceivably be obtained from the air-traffic-control center They are set into the computer control heads The *pilot selects the desired course by means of the control-head selector switch* When the aircraft arrives over one holding point as indicated by a zero distance indication on the waypoint-distance indicator, the pilot switches in the alternate control head and flies the aircraft to the other holding point This procedure of repeatedly flying two preselected alternate courses is all that is necessary in order to execute a holding pattern between two points with the dual-head course-line computer A race-track type of holding pattern was set up and was flown in the vicinity of Indianapolis Figure 8 shows the track of the airplane relative to the selected courses and to the holding points

[4] Ibid

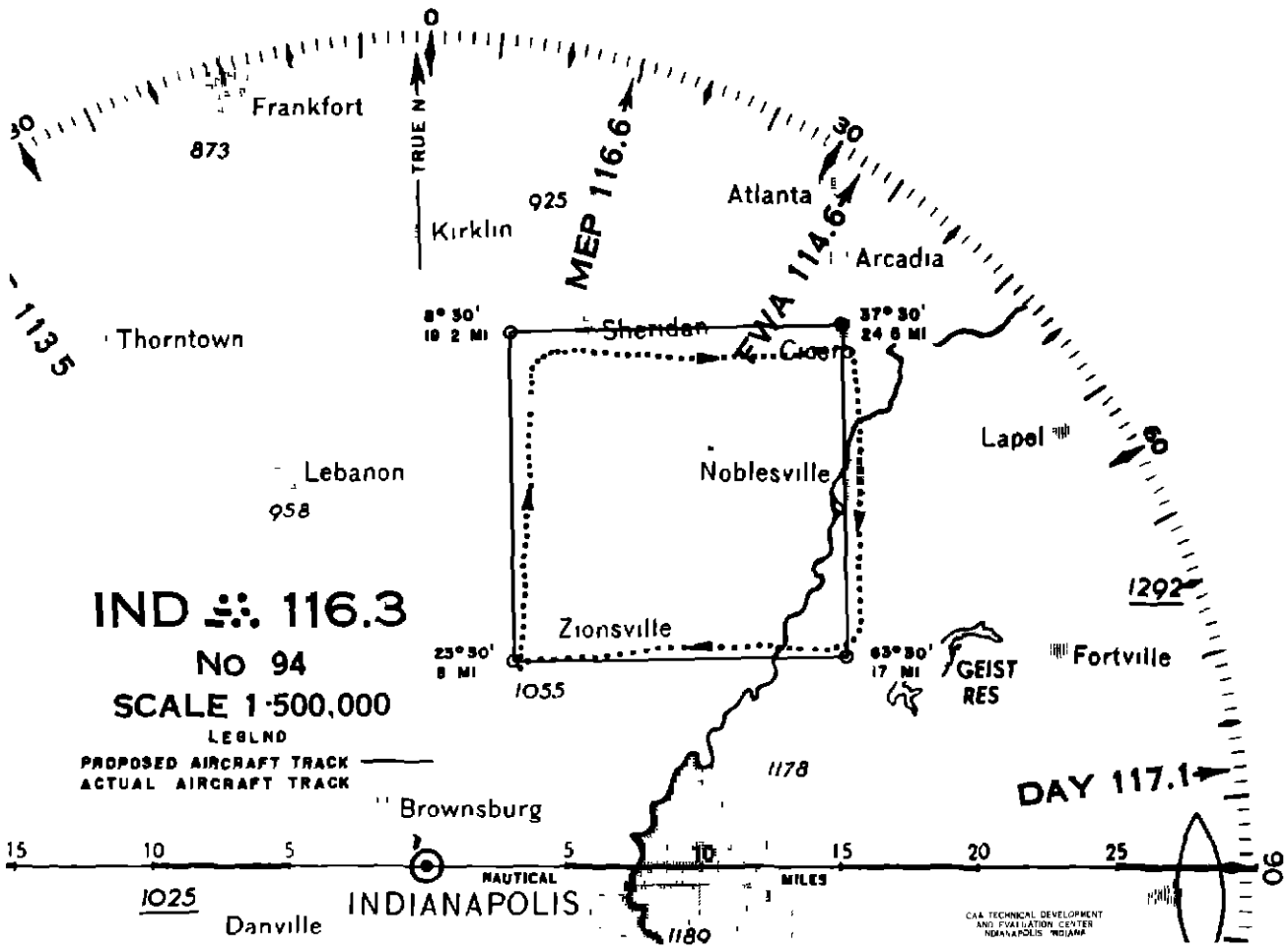

Fig 7 Track of Airplane

Tests were conducted to determine the time necessary to reset, in a single control head, the co-ordinates of consecutive waypoints The average time for several tests was approximately 30 seconds The pilot required from 10 to 60 seconds for each operation, depending upon the difference between the consecutive waypoint co-ordinates The time necessary to reset a single control head becomes critical in congested terminal areas where the pilot has to fly courses consisting of vectors, each of which may require two minutes or less By means of dual control heads the pilot can preset, at his own convenience, the co-ordinates of consecutive vectors and can switch control heads immediately upon arrival at a waypoint or at a destination

CONCLUSIONS

The addition of a second computer control head provides a means of presetting computer co-ordinates so that left-right guidance and distance information along succeeding courses is immediately available to the pilot upon arrival at a waypoint This thereby eliminates the loss of navigational information during the resetting of the control head

The immediate availability of guidance along succeeding courses enables the pilot to use the course-line computer for flying holding and terminal-area patterns

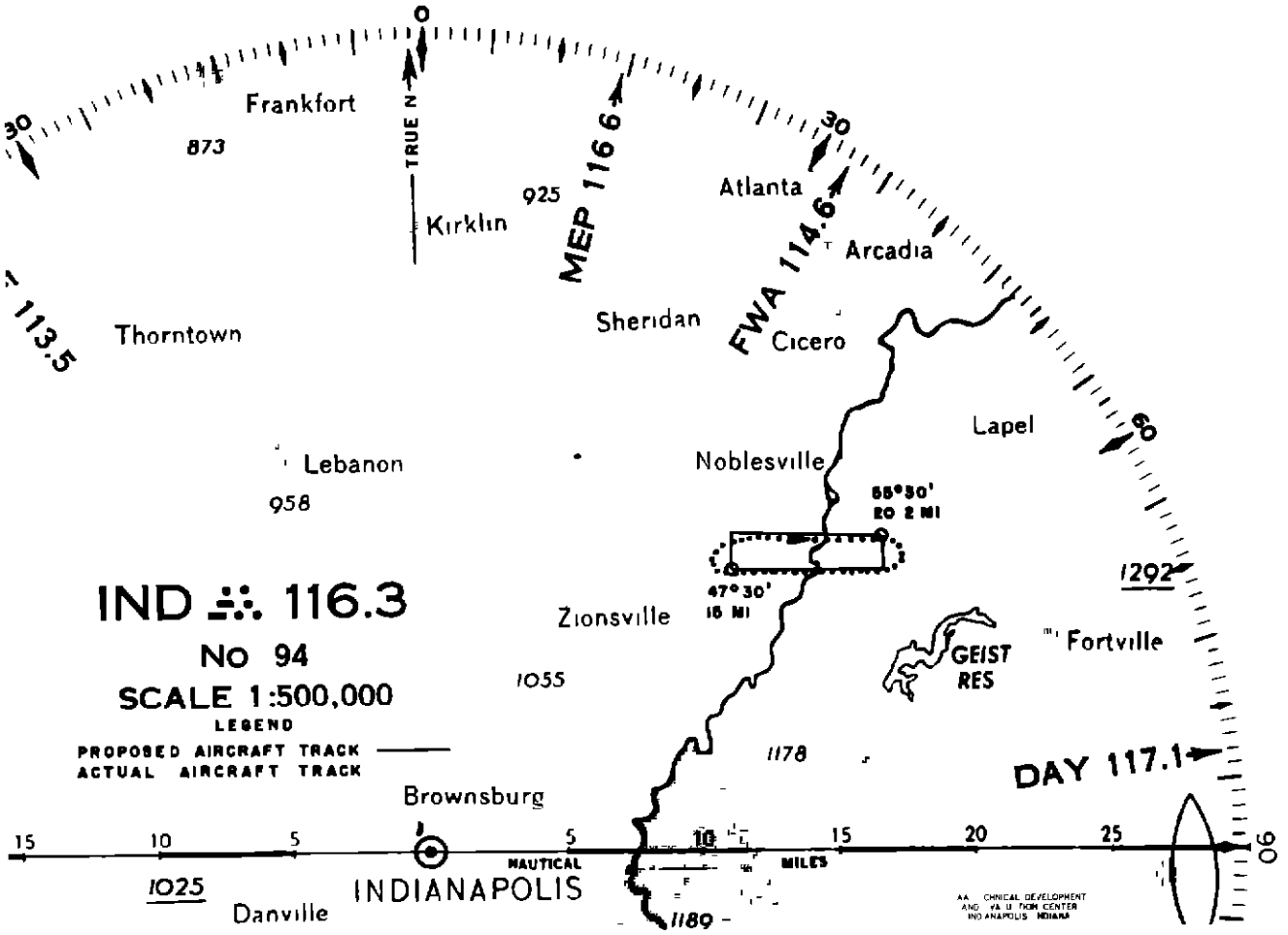

Fig 8 Track of Airplane

The design of the CAA Type IA computer demonstrates the practicability of mounting course-line-computer control heads in three-inch panel openings and of using a dual-head installation