INTRODUCTION

Since the advent of Sports Car Rallying in America, more and more people have become actively interested in this fascinating hobby. Although the imported small cars have provided the impetus for the sport, many a standard American car is furnishing its owner with a new medium of enjoyment.

As a result, Rallying has become an ideal companion (boy-girl, husband-wife) sport and growing practice and familiarisation in this field has led to the development of many skilful driver-navigator teams. However, the mathematical burden placed upon the companion navigator (armed with slide rules, calculating tables, stop watches and, perhaps, even a comptometer) has led to the growing conviction that there must be an easier way to solve the many intricate Time-Distance-Speed calculations which form an essential part of Rallying. They are right.

Kearfott engineering has developed a unique device called the Kearfott Precision Rally Computer, which has solved many of the navigator's problems. This unit has been used successfully for several years and its inventor, Jim Helen, has perfected a system of rally navigation, which avoids most of the pitfalls of leg-to-leg type navigation. In addition, practically no knowledge of mathematics is required of the user.

Several other devices of a similar nature are now available to the rallyists. However, none of these other instruments provide the precision calculating capabilities that are inherent in the Kearfott Rally Computer, and in certain circumstances they create problems which are more difficult to cope with than the simple problem they are designed to solve. Using the Kearfott Rally Computer in the manner described in Section V will enable a driver-navigator team to do a better job of Rallying and will provide more fun in the bargain.

THE HELEN SYSTEM OF NAVIGATION

The advent of the Kearfott Rally Computer has made possible the use of a new simplified rally navigation procedure. Gone is the need for TSD tables, slide rules, dual stop watches, dual odometers and all the gadgets associated with the classic system of leg-to-leg rally navigation. The only additional equipment needed by the owner of a Kearfott Rally computer, aside from his odometer-equipped car, is a good watch, one with a settable sweep second hand being preferable. To the novice these statements may smack of Madison Avenue commercialism. However, the rallyists who has learn-d to cope with the multitude of problems that are part and parcel of the Classic System will want to be shown how this "new way of life", this new Utopia of rallydom, is possible. The Helen System of Rally Navigation is a continuous process of checking your conformance to the required schedules by use of the information furnished by the Kearfott Rally Computer. As will be described in Section V, once you have started the rally, it is never necessary to re-zero your odometer, watch or the computer. The Computer is an "accumulative" type device that will supply upon demand time data for any distance or distance data for the desired time. Because of this it is possible to directly utilise continuous rally mileage information as is frequently given on Rally route instructions, without the need for reducing continuous mileages to leg mileages. This continuous process of acquiring and using TSD data is the new basic concept of the Helen System of Rally Navigation. Never before has the rallyists been able to devote so much of his time to the most important part of rallying, STAYING ON COURSE!

DESCRIPTION

The Kearfott Rally Computer is a precise mechanical calculator that presents the results of its computations on large, easy to read, drum type counters. The Rally Computer is compact in size and is comprised of the following:

The Kearfott Precision Rally Computer

* *Time Counter* - This unit is graduated in minutes and seconds. It displays increments of, or total elapsed time for the rally. It can also, as later described, be set up to read time of day if rallyists prefer this mode of operation.

* *Speed Counter* - This unit is graduated in Miles Per Hour and can be read to 1/100 of a M.P.H. This counter is manually set
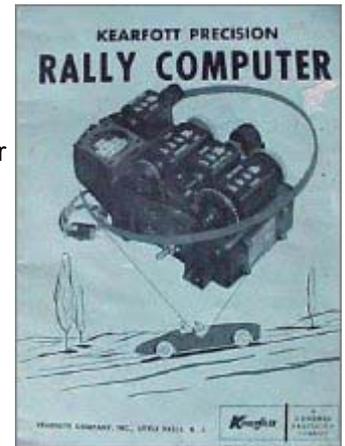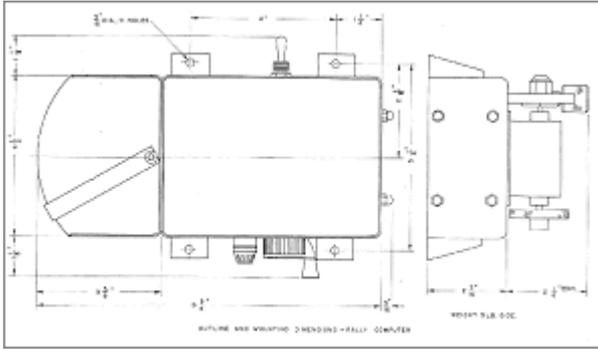
by the navigator in accordance with the "average speed" information given in the rally instructions. A locking device is attached to the Speed Counter to prevent accidental shifting of the speed setting. The range of speed settings designed into the Kearfott Rally Computer is from a minimum of 10 M.P.H. to a maximum of 60 M.P.H. The Speed Counter should never be forced beyond these limits.

* *Distance Counter* - This unit displays the number of miles that should be travelled for any given elapsed time. The Counter is graduated in miles and can be read to 1/100 of a mile. The drive to this unit is through a slip clutch, which permits the user to either reset it without disturbing the Time Counter or to hold it while resetting the Time Counter. The advantages of this capability will be explained under "Using the Computer".

* *Power Switch* - This toggle switch is mounted on the left side of the computer and is used to apply power to the driving motor. When pressed downward, it advances the computer any desired amount and will spring return to the "off" position when pressure on the toggle is released. When raised, it causes the computer to run backward (subtract) when needed, or for "clearing" the counters at the end of a rally. The switch "holds" in the "up" position and must be returned to its centre, "off" position to stop the drive motor.

* *Manual Drive* - When it is desirable to advance the computer by small amounts, this may be done manually by means of the knob on the Time Counter. This is required for precise setting of either Time or Distance. In addition to the computer, an "Accessory Group" consisting of a Next Turn Counter, Directional Indicator, and a Watch Holder are mounted at the upper end of the unit.

Accessory Group:

* *Next Turn Counter* - This unit is a manually operated "miles" counter. It is set up by the navigator and displays the mileage information provided by the route sheet, for the next instruction. It acts as a constant reminder to the driver that at the mileage shown, some specific action is required.

* *Direction Indicator* - This unit consists of a direction "scale" and a manually set pointer. Like the Next Turn Counter, it is set up by the navigator to display the direction the driver should follow at the next instruction. The direction "scale" is marked to display the three basic moves:
**S = Straight**
R = Right
L = Left
Also provided are intermediate marks which represent:
   "Bear" = less than a 90 degree turn
   "Acute" = more than a 90 degree turn

* *Watch Holder* - This unit consists of several foam rubber pieces and a neoprene "hold down". The Holder will accommodate a standard two inch pocket watch and protect it from vibration and shock. The Holder is opened to receive the watch by snapping off the two upper corners of the hold down piece from the retaining pins. Place the watch in the recess provided and snap the hold down back on to its retaining pins. It is necessary to install the Kearfott Rally Computer on a special mounting bracket within the car. This bracket is not supplied with the computer since installation possibilities vary widely between different cars. However, the bracket can be readily fabricated to meet particular car installation features and driver preferences. A typical installation is pictured in this brochure.
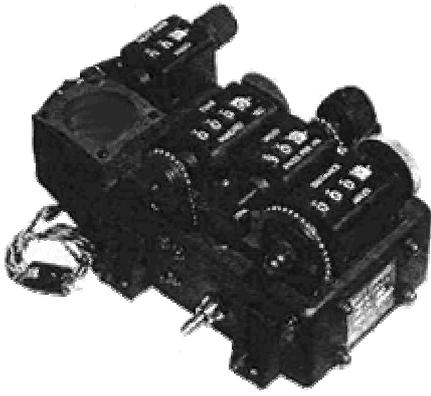
INSTALLATION

The Kearfott Rally Computer is designed to permit mounting in any position. Four mounting lugs are provided by which it can be fastened to any suitable support bracket. Since the space available for such an instrument varies from one car to another, most users find it necessary to construct a special mounting bracket. In cases where space is extremely limited, the Next Turn Counter, Turn Indicator and Watch Holder Assembly, may be removed from the computer and mounted in another location, thus the space required for the computer itself is at a minimum. The only connection between the computer and the vehicle, aside from mounting requirements, is an electrical connection. This provides power to the DC Motor which is used to drive the unit. The computer will run on 6 or 12 volt electrical systems. The computer is equipped with power lead wires and a connector plug. Also furnished is the mating receptacle. The power receptacle should be permanently connected to the vehicle's electrical system and so mounted as to provide for convenient plugging in of the computer. Connect the power receptacle so that the positive (+) wire goes to the large pin and the negative (-) wire goes to the small pin. Depending on the electrical circuitry in the specific vehicle, one of these wires will go to "ground", the other to the "hot side" power terminal on the ammeter, cigarette lighter or other accessible binding post. The computer should, when plugged-in, then run forward (adding) when the control switch is depressed, and run backwards (subtracting) when the control switch is in the up position. If the computer runs in the wrong direction, reverse the lead wires at the power receptacle.

OPERATION INSTRUCTIONS

To explain the various uses of the Kearfott Rally Computer we will first describe the various phases of running a simple "straight" rally, in which all basic information is furnished by the rally instructions. In addition to the Kearfott Rally Computer, the rallyists must have a suitable timepiece, preferably one with a "settable" sweep second hand. Many rallyists use stop watches for this purpose, others prefer a good pocket watch. We will assume a stop watch is being used in the following procedure.

At the Start:

1. "Zero" the Kearfott Rally Computer. The Time and Distance counters should both read 000.0 and the Speed counter can be any mid-range setting, say 30.0 M.P.H.
2. "Zero" the Odometer (Trip Counter) which is part of your automobile's speedometer.
3. "Zero" your stopwatch.

On the Starting Line:

1. Upon receipt of your rally route instructions from the official starter, determine the required average speed for the first section of the rally.
2. Set the Speed counter so that it reads the same number of Miles Per Hour as shown in the rally instruction (say 30.0 M.P.H.).
3. All that now remains is to start your stop watch when the Starter gives the "Go" command.

On the Road: The most important part of rallying is staying on the course! The "Accessory Group" on the computer is designed to simplify this task.

1. Navigator reads, aloud, the next instruction. Example: "1.75 miles, Right on West Street."
2. Sets next turn counter to 1.75 miles.
3. Sets Direction Indicator to "R"

We now have an opportunity to run a TSD check. A look at our stop watch tells us we are in our second minute, three minutes coming up.

1. Advance the computer until the Time Counter reads 3 minutes 0 seconds. This is accomplished by depressing the Control Switch until the required minute appears on the Time Counter. The knob on the Time Counter should be used to precisely position the Time Counter.
2. Observe mileage reading on Distance Counter it will read 1.50 miles (at 30.0 M.P.H.).
3. Watch for 1.50 miles to come up on your odometer. At the instant it does, look at the sweep second hand on your watch. If you were exactly on time, the sweep second hand was straight up, 3 minutes and 0 seconds. If it reads 3 minutes and 10 seconds, you are 10 seconds late. This procedure is repeated at such intervals as are considered necessary. Obviously the more frequently you check, the closer you can control your speed. With the Kearfott Rally Computer it is possible to do a TSD check every 10 seconds. (Don't forget that right turn on to Jay Street at 1.75 miles).

Changing Average Speed:
Let us assume that our rally instructions contain the following statement:

15.0 Right at Tee (change to 26.78 M.P.H.).

This means that 15.0 miles from the start we will come to a Tee intersection and at that point we are to change our average speed to 26.78 MPH and then continue at this new rate until further instructions are given. The new average speed can be put into the computer at any convenient time and it is not necessary to stop your car, reset your watch or reset your odometer.

To Set in New Average Speed:

- Advance the computer until the Distance Counter displays the required (15.0) miles.
- Reset Speed Counter to the new average speed (26.78 M.P.H.).
- The computer may now be used as previously described. Time will continue to accumulate, as will distance, but at the new ratio just set in.

Time Out:
Let us assume that during the rally, the instructions read something like this:

60.0 Between this point and the next instruction are several gas stations.
15 minutes additional time is allowed for fuelling.

The Kearfott Rally Computer is designed to handle this situation very easily. Proceed as follows:

1. Advance computer in normal fashion until Distance Counter displays the required (60.0) miles.
2. Read the Time Counter and write down the number. Let's assume this number is 130 minutes 48 seconds. Add to this number 15 minutes to get 145 minutes 48 seconds.
3. Hold the Distance Counter knob and advance the Time Counter to the new setting of 145 minutes and 48 seconds. The Distance Counter will still read 60.0 miles. This operation is possible because of the slip clutch on the Distance Counter Drive.
4. You have now added 15 minutes to the total elapsed time for the rally and at the same time retained the correct distance information.
5. Stop for fuel, then proceed to the next instruction, arriving early if possible.
6. Stop at instruction point.
7. Run computer up so that Distance Counter reads same mileage as given in instruction.
8. Time Counter will then show the time at which you should be leaving that point.

Using Computer on "Time of Day":
For rallyists who prefer the use of a pocket type watch (not a stop watch) which is running "Time of Day" rather than some arbitrary "Zero Time", the following procedure may be used with the Kearfott Rally Computer. Let us assume the following set of conditions exist at the start of a rally.

Official starting time, Car #0 = 10:00 A.M.
You are car #7
Your starting time = 10:07 A.M.

Your watch is running "Time of Day"
Computer is "Zeroed Out"

Do the following:

9. Hold Distance Counter at 000.0 miles and advance computer until Time Counter reads: 7 minutes 00 seconds.
10. The computer is now ready to use, starting at 10:07 A.M.
11. During the first hour, the Time Counter will read the same minutes as your watch.
12. During successive hours the Time Counter will read 60, 120, 180 plus minutes, etc. For example:

Watch	Time Counter
10:07 A.M.	007 Min. 00 Sec.
10:30	030 " 00 "
11:00	060 " 00 "
11:15	075 " 00 "
12:20 P.M.	140 " 00 "
1:00 P.M.	180 " 00 "
2:00 P.M.	240 " 00 "

This procedure allows you to use one good time piece for your TSD reference which is running Time of Day so that you can also quickly verify your arrival time at control points, by referring to the same watch.

"Zeroing Out" the Computer:
At the end of a rally or at the end of a section of a rally, should it be necessary to restart from a new zero mileage and time, the following procedure will simplify the "zeroing out" process:

1. Run computer to the nearest big round number on the Time Counter. For example; 200 minutes.
2. Manually adjust the Distance Counter, by using its red knob, to the nearest round number. For example; 110 miles.
3. Do the following arithmetic to find overall average miles per hour:
   $$\frac{\text{Miles} \times 60}{\text{Minutes}} = \text{M.P.H.}$$

   $$\frac{110 \times 60}{200} = \frac{6600}{200} = \frac{66}{2} = 33 \text{ M.P.H.}$$

4. Set Speed Counter to the calculated M.P.H. (33.0).
5. Now, run computer back to zero. Both minutes and miles will "zero out" simultaneously, and the Computer will then be ready for the next series of problems.

VI. CALIBRATION
When your Kearfott Rally Computer was assembled at the factory, it was calibrated for zero error at 30 miles per hour. You should find no significant error between 15 and 30 miles per hour. Due to the mechanical characteristics of the "Ball-Disc Integrator" which is the heart of the computing mechanism, slight errors are inherent at speed settings below 15 M.P.H. and over 30 M.P.H. These errors can be eliminated, however, by establishing correction factors for speed settings in the under 15 M.P.H. and over 30 M.P.H. ranges.

Procedure for Establishing Correction Factors:

1. "Zero Out" both Time and Distance Counters.
2. Set Speed Counter at, say, 35.00 Miles per Hour.
3. Advance Timer Counter to exactly 60 minutes 00 seconds.
4. Distance Counter will read very nearly the required 35.00 miles. If it is over, say, 35.02 miles then a slight reduction in the speed setting must be made to compensate for the error.
5. Run the computer back to zero.
6. Reset the Speed Counter to a slightly lower rate, say, 34.98 miles per hour.
7. Run-up to exactly 60 minutes again.

8. If the Distance Counter now reads exactly 35.00 miles, you have established a correction factor for 35 miles per hour. This factor being - .02 miles per hour.

You can repeat this procedure for every 5 miles per hour or even of each 1 mile per hour, depending on how fussy and accurate you want to be. This routine will enable you to eliminate even the very slight inherent errors in the Kearfott Rally Computer. Your correction factors can then be tabulated on a small card and mounted in your car for ready reference.

Using Correction Factors: Let us say that during a rally you are required to use an average speed of 44.98 miles per hour. Your correction factor card shows the factor for 45 M.P.H. to be - .06 M.P.H.

1. Subtract .06 from 44.98
2. Set in to the computer 44.92 M.P.H. on the Speed Counter.
3. The Computer will now calculate at precisely the desired rate of 44.98 miles per hour.

NOTE: Only extremely capable rallyists are able to run as accurately as the information provided directly by the Kearfott Rally Computer. The foregoing procedure was developed for those persons who desire the very utmost in precision TSD computations.

IMPORTANT NOTICE Please remove both elastic bands from the chains of your computer before operating same. The small slack in the chains is essential to the proper operation of your computer. KEARFOTT COMPANY, INC.,

Do's and Don'ts for Users In the interest of enabling you to obtain the best results from your Kearfott Precision Rally Computer, we will issue bulletins from time to time which will cover items relating to the use or care of your Computer.

DO LIST

1. Experience gained during calibration and test of Kearfott Precision Rally Computers has established that for best repeatability, a change in the average speed setting should be made by cranking the Miles-Per-hour Counter beyond the number desired, then "back down" to the required speed. This is contrary to the instructions on your Calibration Card. The reason for this has to do with the mechanics of the integrator design.
2. Questions relating to the application of "odometer error" have come in from users and since this was not covered in the Instruction Book, we will discuss it here.
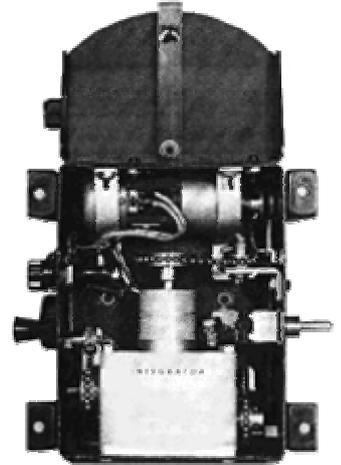
   Definition - Odometer Error
   The difference between Official Rally Miles and that appearing on your own odometer (usually expressed as a plus or minus percentage).

   Application
   The rallyist has two choices in the application of his odometer error to the time-distance problem.

   A. He may apply the correction as a direct incremental adjustment to his odometer thereby making it read the same as the Official Mileage.
   B. He may apply it as a correction to the required average speed and permit his odometer to run as it will. In regard to the second choice, if an odometer error of say, plus 1% exists, then an average speed of 30.00 miles per hour should be increased by 1% to 30.30 miles per hour. This would be cranked into the Computer which will then supply distance (miles) data for any total time that will be compatible with your normal odometer mileage.
3. Should it ever become necessary to recalibrate your Computer, the operation is quite simple.
   i. Set both Time and Distance Counters at zero.
   ii. Set Speed Counter at 30.00 miles per hour.
   iii. Run Computer up to exactly 60 minutes on the Time Counter.
   iv. If the Distance Counter shows a significant error from the required 30.00 miles, an adjustment may be made or you may leave it alone and handle the error as a correction factor as described in the Instruction Book.
   v. The adjustment is accomplished by loosening the two Allen Head set screws on the Speed Counter sprocket, next to the crank. (Use suitable Allen wrench.)
   vi. Hold the Speed Counter sprocket firmly taking care not to disturb its position, then
   vii. Turn the Speed Counter by means of its crank so that it is set to read the same number (m.p.h.)as the Distance

Counter (miles).
viii. Tighten the Alien Head set screws on the Speed Counter sprocket.
ix. You have now adjusted the Computer so that it should have zero error at 30.00 m.p.h.
4. Lost Mileage
Mr. Wallace B. Martin of Danbury, Conn., brings to our attention another method of handling the extra miles that accumulate while lost. While we prefer to reset our odometer to the correct rally mileage after an "off course" excursion, Mr. Martin suggests that instead of resetting the odometer, the extra miles that have accumulated on the odometer can be added to the Computer's Distance Counter more easily than they can be removed from the odometer (because of the slip clutch on the Distance Counter). This would put everything in order again with the exception of a direct reading of Official Miles if such is needed.

DON'T LIST

1. Don't be concerned about slack in the bead chain drives. A nominal amount of slack is necessary to insure smooth running. Smoothness will improve with use.
2. After long usage it may be necessary to increase the friction level of the slip clutch which is part of the Distance Counter drive sprocket.
   CAUTION - It is possible to do irreparable damage to the Ball Disc Integrator if the slip clutch friction is too high. In no event should the user be able to cause the Miles Counter drive sprocket to turn when its red knob is rotating the Counter. When adjusting the slip clutch, use two wrenches, one for the "end nut" and the other on the "hex hub" which is adjacent to the inner side of the drive sprocket. Do not attempt to adjust the "end nut" while holding the red knob to prevent rotation.
3. Do not oil the bead chains. They are designed to run dry and lubrication will cause them to accumulate dirt and become rough.

GENERAL With reasonable care your Kearfott Precision Rally Computer should give years of reliable service. Although it is a precise instrument, its design is rugged and successful prototypes have been in use for over three years.