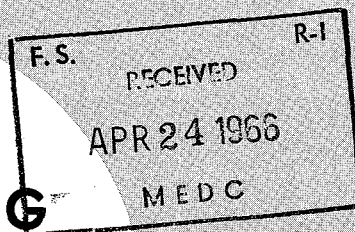


ENGINEERING TECHNICAL INFORMATION SYSTEM



FIELD NOTES • TECHNICAL REPORTS • TEXTS
DATA RETRIEVAL • CURRENT AWARENESS

Field Notes

Volume 4 Numbers 1 and 2 January-February, 1972

Control That Survey

W. H. Boley and Carl Fannesbeck

Methods of Improving Traffic Counter Reliability

Gerald L. Ames

A Sub-Routine for Use with the Monroe Epic 3000 Programmable Printing Calculator

LeRoy E. Lewis

Hand-Held Platen for Relative Orientation of Stereomodels

Richard Brush



FOREST SERVICE • U.S. DEPARTMENT OF AGRICULTURE

ENGINEERING FIELD NOTES

This publication is a monthly newsletter published to exchange Engineering information and ideas among Forest Service personnel.

The publication is not intended to be exclusive for engineers. However, because of the type of material in the publication, all engineers and engineering technicians should read each monthly issue.

The publication is distributed from the Washington Office directly to all Forest, Regional, Center, Station, Area, Laboratory, and Research Offices. Adequate copies are printed to provide all who wish a personal copy. If you are not now receiving a personal copy and would like one, ask your Office Manager or the Regional Information Coordinator to increase the number of copies sent to your office. Use form 7100-60 for this purpose. Copies of back issues are also available from the Washington Office and can be ordered on form 7100-60.

It is intended that the material in the Field Notes be primarily written and used by Forest Service Field Engineers; however, material from other publications may be used.

Field Note material should always be informative and cannot contain mandatory instructions or policy. The length of an article may vary from several sentences to several typewritten pages. Material need not be typed (neatly written or printed is acceptable), or edited before being submitted to the Washington Office. The Washington Office will edit and prepare the camera copy to accommodate our format and allowable space.

Each Region has an Information Coordinator to whom field personnel should submit both questions and material for publication. The Coordinators are:

R-1		R-6	Kjell Bakke
R-2	Alfred Buerger	R-8	Ernest Quinn
R-3	Dan Roper	R-9	Clifford Hill
R-4	Fleet Stanton	R-10	Gerald Coghlan
R-5	Chuck Paletti	WO	Stan Bean

Information contained in this report has been developed for the guidance of employees of the U. S. Department of Agriculture - Forest Service, its contractors and its cooperating Federal and State agencies. The Department of Agriculture assumes no responsibility for the interpretation or use of this information by other than its own employees.

The use of trade, firm, or corporation names is for the information and convenience of the reader. Such use does not constitute an official evaluation, conclusion, recommendation, endorsement, or approval of any product or service to the exclusion of others which may be suitable.

F I E L D N O T E S

CONTROL THAT SURVEY

By W. H. Boley, Forest Engineer, Manti-LaSal National Forest and
Carl Fonnesbeck, Supervisory Civil Engineer, Region 4

How many times have you lost a road survey due to lapse of time, or resurveyed the same route due to difficulty in re-establishing a previous alignment? If your answer is never -- read no further. If your answer is yes, the following may be an answer to some of your problems.

The control, and subsequent perpetuation, of a route survey is simple, inexpensive, and reflects on your good judgment. However, perpetuation does require some advance planning.

Take for example, a road planned for moderate speed (30 MPH) and future surfacing. The typical Forest Service survey for this facility would consist of a "P" line with angle points references and temporary bench marks set at intervals of approximately 1,000 feet. By following the design, curves are staked, slope stakes set, and road construction begins. After rough grading, the centerline is again surveyed and grade staking accomplished.

How many times does the survey crew retrace the same ground in accomplishing the above operations? Consider for a moment a different approach to ground control. A control survey, which precedes route survey activity, is accomplished to establish both horizontal and vertical position of a network of permanently marked (brass caps, copperwelds, etc.) stations. The high order of accuracy realized by use of electronic distance measuring and theodolite equipment is superior to accuracy achieved with conventional survey methods.

Most Forests cannot justify acquisition of this equipment due to its high cost and limited application. However, this service is available from the Field Surveys Unit located in the Regional Office and from any number of private firms.

The advantages of this control survey are:

1. A high order of accuracy (both horizontal and vertical) of position is achieved. Orders of accuracy of 1:25,000 or better are not uncommon.

2. The procedure is economical. Setting monuments, control surveys, and computations average between \$100 to \$300/mile (1970 costs). A recent project done in Region 4 in this manner for a 10-mile job cost \$1,500.

3. The procedure eliminates the necessity of setting reference marks for "P" line points. In most cases the surveyor need never return to the preliminary line. The elimination of this step represents a substantial savings.

4. Any error in the conventional survey is quickly identified and/or isolated. By tying the conventional survey to each control monument, a series of closed traverses is effected. Error of closure for each leg is readily computed and adjusted if necessary.

5. The complete network may be tied to existing U. S. Geological Survey or U. S. Coast and Geodetic Survey control. The result is a state plane coordinate position for each survey point.

6. The established network forms a basis for future extension of contract.

Once a line is surveyed and tied to the control network, all design (including any alignment shifts) is handled by computer. When final alignment is accepted, a "Ties Program" or "COGO" turns out distance and bearing information for any or all points. The centerline may then be staked using either of two methods: (1) The conventional means is to survey the "L" line and check the location of the PC's and PT's by checking your control points using the "computer ties" program. (2) If control monuments are suitably located, the "L" centerline may be staked by intersection methods from two or more control monuments. The latter method, where feasible, offers some real economics in stake out. Following rough grading, the above methods may again be used to set final grade stakes.

The following criteria are desirable from the control aspect of the job:

1. Brass caps or other permanent type monuments set at random distances of approximately 1,000 feet and outside of construction limits. Permanence is the key. The new expoxies are excellent where rock is encountered.

2. Monuments must be intervisible. Careful reconnaissance offers economies in both the control survey and the subsequent alignment stake out.

3. The control survey should extend beyond limits of the road survey.

4. Any control monuments lost by any means need equal accuracy procedures for re-establishment.

5. An accurate station description prepared for each control station as an aid to recovery and precisely photo-identified on available photography.

It is generally good planning (economically) for the Forest or unit to place the monuments prior to the control survey by using either the Regional Office or contract survey crews.

This approach is dependent upon the standard of road scheduled for construction. It adapts readily where the new route essentially follows an existing road due to ease of access. It provides a ready means of checking surveys accomplished by A&E contract. Photogrammetric road design is accomplished using this system slightly modified.

The method discussed, with some variations of your own, may be the answer to some of your survey problems. Try it out.

.....

METHODS OF IMPROVING TRAFFIC COUNTER RELIABILITY

By Gerald L. Ames, Construction Inspector
Twisp, Washington

Over the past four years a study has been made for the Ametron STREETER-AMET Traffic Counter Models JR and JR.T. This period represents a total of 750 counter days or an average of 187.5 days per year. The methods that we have found for improving counter reliability may not be the only solutions but they do work well on the Okanogan National Forest. Hopefully, these methods will help those who may be having counter problems. Through a continuing program of study, we hope to find solutions to continuing problems.

The Okanogan National Forest is located in the North Cascades in an area that receives from 12 to 15 inches of precipitation each year. The major portion of this precipitation is received in the late fall and throughout the winter. During the summer months, when the traffic count program is in full swing, only occasional rainfalls are recorded and moisture is therefore not a major problem for the traffic counters.

This article covers, very briefly, our present traffic counter program and the methods that we have found to be effective in improving counter reliability, comparison studies between JR and JR.T. models, battery tests, and maintenance and overhaul. The final item covers methods of reducing the possibility of corrosion damage.

METHODS OF IMPROVING COUNTER RELIABILITY. In order to have an effective counter program, we have found it necessary to assign one man to the traffic counters. He is responsible for taking the regularly scheduled readings, and during the winter he overhauls and maintains all Forest traffic counters. This method assures a consistent high quality in maintenance and overhaul. It also enables this man to be entirely familiar with the traffic counters and their idiosyncrasies.

We are making it a practice to paint over the window on the top of each counter which forces the reader to open the counter providing a visual check of the interior and battery conditions. Each time a reading is taken the counter is checked for proper operation.

Vandalism is a major problem with this type of equipment and we have found only one way to reduce this type of damage. The counters must be made as inconspicuous as possible, even though it is impossible to hide them completely due to the roadtube requirement. Placing the counters in areas where the public has no reason to stop is effective in reducing vandalism. An example of a good place for installation is a narrow spot on the road where no parking is readily available. Installations near popular fishing spots and camp areas should be avoided whenever possible.

JR vs. JR. T. The two traffic counter models used are the JR and JR. T; both models operate basically the same. The JR. T has a 12-volt transistorized circuit which is a more complicated system and stops operating at about one volt higher than the JR model. The benefit is that, even if the condition of the contact points deteriorates, operation will continue for a longer period of time. The JR is also classed as a 12-volt system, but it is more tolerant of low voltage for continuing operation. An additional advantage of the JR is that it requires less time to disassemble. The battery hookup is different on the two traffic counters and in all cases a new man should follow the proper wiring schematics until he is entirely familiar with each hookup (Figs. 1 and 2). If a proper maintenance and overhaul program is carried out, the stated differences will be of no consequence. Both models were used with equal effectiveness in all tests conducted. We have considered converting all JR counters to the JR. T counters, but from the results of this study, the expenditure appears unjustifiable.

BATTERY TESTS. Extensive tests of battery life and failure have been made with some very gratifying results. The batteries used in these tests were Everready 6-volt weatherproof No. 510F, NEDA 917. Two batteries are connected in series to produce a 12-volt system for the traffic counters. Each battery consists of four zinc-coated cells of 1-1/2 volts each. During normal use the zinc coating is slowly consumed by a chemical action within each cell. But, should the contact points stick in a closed position, an abnormal load would be produced that can, within 2 days, almost totally consume the zinc coating, resulting in discharging the battery. This condition was simulated in our shop by shorting the test batteries in a manner that duplicated sticking points in a traffic counter. Both new and used batteries were tested and all were leaking within 2 days.

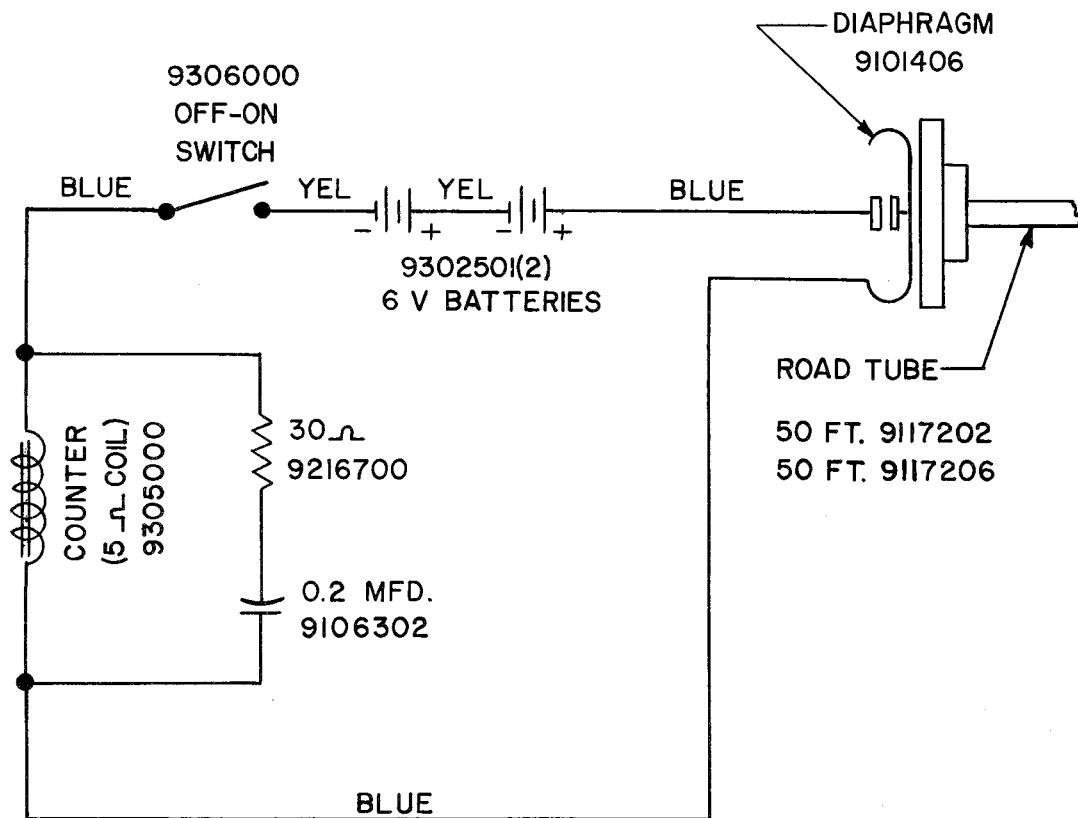
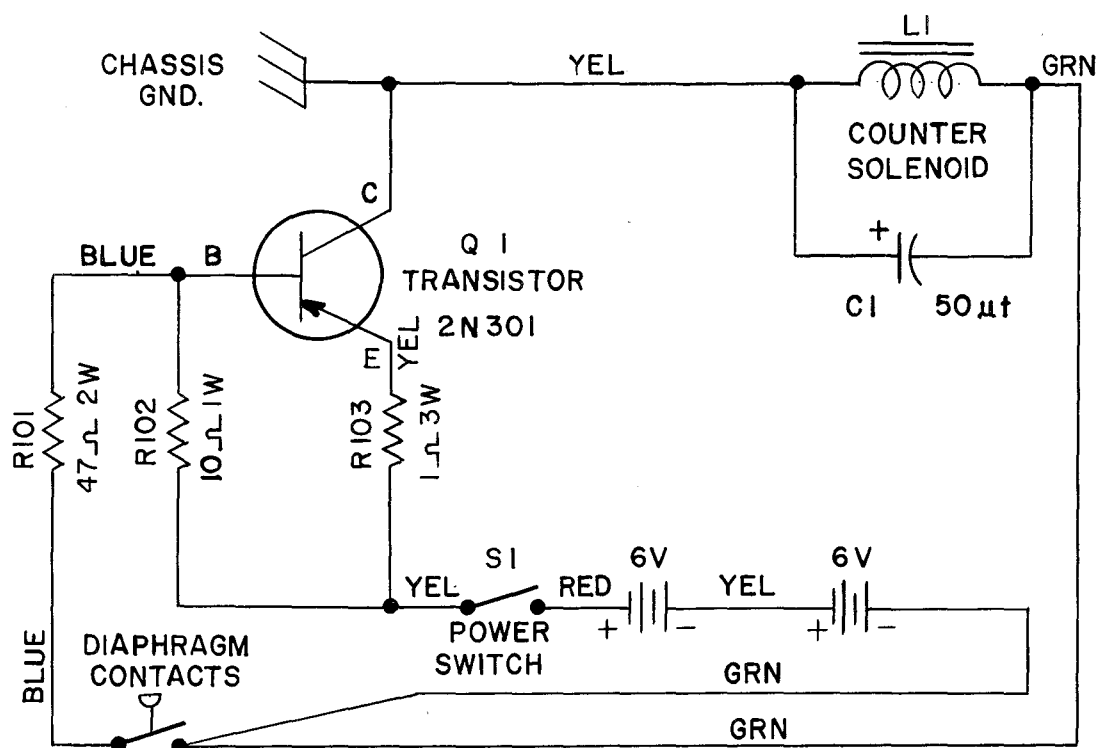


Figure 1.--Wiring Diagram for
JR Trafficcounter



— ELECTRICAL BILL OF MATERIAL —

REF. CODE	DESCRIPTION	REQ.	PART NO.	MANUFAC.
Q1	Transistor	1	7098580	Tung-Sol
S1	Switch S. P. S. T.	1	9306000	C-H
L1	Solenoid (Counter)	1	9305000	C. P. Clare
C1	Capacitor 50 uf 25V	1	2003213	Sprague
R101	Resistor 47 ohm 2W	1	2006309	Ohmite
R102	Resistor 10 ohm 1W	1	2000501	Ohmite
R103	Resistor 1 ohm 3W	1	2002901	Ohmite

Figure 2.--JR Trafficcounter
(Transistorized)

The solution was applied to aluminum counter parts to observe its effects. In less than 2 hours a very definite foaming action was taking place. At the end of the 3-1/2-hour test, the corrosion had established in the form of black pits which covered nearly the entire surface.

Several tests were conducted to determine how long we could logically expect a set of batteries to last under the type of use we require. All of the batteries that were used during the 1970 counter season tested 5 to 5-1/2 volts after 191 days of continuous use. The batteries could have been used longer since there are indications that both counters will continue to operate below this level. However, low voltage operation is not recommended because of the increase possibility of leakage and a serious voltage drop in the event of cold weather. The battery drain during each count is negligible and with a good counter maintenance and overhaul program we can expect batteries to generally last a season without replacement.

MAINTENANCE AND OVERHAUL. In a traffic counter maintenance and overhaul program, probably the most damaging practice is to try to make the contact points last another year by filing them to remove pits or corrosion. Once they are filed, the points have a tendency to stick very easily which causes count loss, destroyed batteries, and possible corrosion damage to the counter. In addition, there is much time spent trying to keep the counter operational. The cost for both the Loop Conductor Assembly (Stock No. 9103506) and the Contact Screw (Stock No. 9101806) is \$2.15. A policy of automatic replacement of damaged points was used on the Okanogan during 1970, and not a day of counts was lost because of sticking points. When you consider the cost of lost counts and faulty operation the replacement cost is small. Each traffic counter has an optimum point setting which works best. This setting should be as far apart as possible (a setting of 5 or above on the diaphragm dial) while still working efficiently. The wider gap puts more tension on the contact loop assembly and will break contact more readily, thereby reducing the chances of sticking points.

TREATMENT OF TRAFFIC COUNTERS TO ELIMINATE CORROSION. During February 1970, 50 traffic counters were repaired because of damage caused by varying degrees of corrosion to major components. The degree of corrosion damage was directly related to the age of the counter. The new counters had relatively light damage whereas the older counters had moderate to severe damage in all cases.

A program of proper cleaning and coating can essentially eliminate damage from corrosion. Three types of treatments were used in an effort to eliminate future damage. The results of the treatments after one year of use are as follows:

Treatment No. 1: Fifteen counters received a thorough cleaning but no treatment was applied over the corrosion damage.

Results: These counters continued to receive heavy corrosion damage.

Treatment No. 2: Ten counters received a thorough cleaning and were coated internally with a good paint. We used Trustworthy Chrome Aluminum paint #56560, although a good chromate primer would probably have been as good or better. The major internal components which are subject to corrosion were similarly treated.

Results: Most of the aluminum paint was removed during cleaning and had to be reapplied. Corrosion was still very much in evidence but was reduced approximately 25 percent from that for Treatment No. 1.

Treatment No. 3: Twenty-five counters received a thorough cleaning and coated with aluminum paint. After the paint was dry a heavy coating of Krylon No. 1307 (battery coating protector) was applied. The major internal components which are subject to corrosion received a coating of aluminum paint only.

Results: These counters remained in very good condition with no measureable corrosion. Two of the counters had very minor spots of corrosion which were removed by buffing lightly with steel wool. These minor spots appear to have been caused by an inadequate protective coating in these areas. The remaining 23 counters were wiped clean with a rag and showed no signs of corrosion.

The estimated cost of applying this last treatment (No. 3) which was the most effective is \$2.50. This is based on having to thoroughly clean the counter of corrosion which takes an average of 30 minutes. However, after the first year extensive cleaning is not required if the coating is effective as in our cases. Maintenance cost due to corrosion should drop to less than a dollar per year per counter after the first year's treatment.

.....

A SUB-ROUTINE FOR USE
WITH THE MONROE EPIC 3000
PROGRAMMABLE PRINTING CALCULATOR

By LeRoy E. Lewis, Cadastral Surveyor, Supervisor's Office
Francis Marion-Sumter National Forests, South Carolina

No attempt will be made in this article to explain the operation of the Monroe Epic calculators. We are assuming that the readers are familiar with the calculators, and like ourselves, have often wished for one more constant storage register to hold that negative number for recall at random intervals as opposed to a set pattern. This sub-routine can, in many cases, provide the equivalent of that second constant register and help eliminate errors in the repeated selection of the arithmetic control keys. Although adaptable to both the Epic 2000 and the Epic 3000, the use of six of the 14 programmable steps available in the Epic 2000 limits its effectiveness there.

Use of the sub-routine does give the operator the option of making the entered number a positive or negative operand at will and still retains full advantage of the electronic reliability of the Epic 3000. The sub-routine is given below and examples of its use in a few programs as developed in this office follow.

Sub-Routine to be Inserted at
Appropriate Point in Main Program

We define N as the positive number the option is to be exerted upon and F as the factor used in exerting that option. F is entered as 2 for a positive result and as 0 for negative result.

Depress	Learn
----	----
----	----
----	----
Enter	N
Depress	Repeat
Enter	F

Depress	Multiply
Depress	Invert
Depress	Minus
----	----
----	----
Depress	Auto

After depressing minus in the sub-routine, the first register of the Epic contains $\pm N$ depending upon the factor F entered after N. In the automatic mode $\pm N$ can now be used as called for by the other requirements of that particular problem.

The following three programs illustrate the procedure. The DMD program (Double Meridian Distances) and the Accumulative Double Products program (for calculation of areas) can be programmed on both the Epic 2000 and Epic 3000. The solution presented for the Law of Cosines, however, can only be used with the Epic 3000.

Other programs are available or being developed, and we would welcome suggestions for additional programs, both surveying and engineering, from any interested readers.

Note: In using the Accumulative Double Products program, the figure 20 (entered at step 3 following the last DMD entry) is the factor for converting square chains to acres. If the survey data was entered in feet, the conversion factor at step 3 would be 87,120; that is $2 \times 43,560$.

SOLUTION OF LAW OF COSINES

(For oblique triangle given two sides & included angle)

1	Depress	Start-Reset
2	Depress	Learn
3	Enter	'b'
4	Depress	Store
5	Depress	Repeat
6	Depress	Multiply
7	Enter	'c'
8	Depress	Repeat
9	Depress	Repeat
10	Depress	Multiply
11	Depress	Invert
12	Depress	Recall
13	Depress	Multiply
14	Depress	Repeat
15	Depress	Plus
16	Depress	Store
17	Depress	Repeat
18	Depress	Minus
19	Depress	Recall

Formula:

$$a = \sqrt{b^2 + c^2 - 2bc\cos A}$$

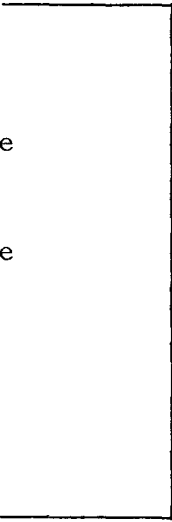
20	Depress	Minus	
21	Depress	Store	
22	Depress	Clear	
23	Depress	Plus	
24	Enter	Cos A	
25	Depress	Repeat	
26	Enter	F	
27	Depress	Multiply	
28	Depress	Invert	
29	Depress	Minus	
30	Depress	Recall	
31	Depress	Multiply	
32	Depress	Plus	
33	Depress	Square Root	
34	Depress	Print	
35	Depress	Auto	

Sub-Routine

Epic is now programmed.

1	Enter	'b'
2	Enter	'c'
3	Enter	Cos A
4	Enter	F
5	Read	Required answer 'a'

PROGRAM FOR DMD COMPUTATION

1	Depress	Start Reset	
2	Depress	Learn	
3	Enter	1st Departure on Keyboard	 Sub-Routine
4	Depress	Repeat	
5	Enter	2 if departure is easterly 0 if departure is westerly	
6	Depress	Multiply	
7	Depress	Invert	
8	Depress	Minus	
9	Depress	Store	
10	Depress	Plus	
11	Depress	Print	
12	Depress	Recall	
13	Depress	Plus	
14	Depress	Auto	

Epic is now programmed.

1	Enter	Departure
2	Enter	2 if departure is easterly 0 if departure is westerly
3	Read	DMD of course

Note: Optional - after last DMD is read Depress Manual, then print-Epic should print zero.

PROGRAM FOR ACCUMULATIVE DOUBLE PRODUCTS & FINAL
ACREAGE VALUE

1	Depress	Start Reset	
2	Depress	Learn	
3	Enter	Latitude	
4	Depress	Repeat	
5	Enter	2 if latitude is northerly 0 if latitude is southerly	
6	Depress	Multiply	
7	Depress	Invert	
8	Depress	Minus	
9	Enter	DMD of course	

Sub-Routine

10 Depress Multiply

11 Depress Print (Optional)

12 Depress Plus

13 Depress Auto

Epic is now programmed.

1 Enter Latitude

2 Enter 2 if latitude is northerly
 0 if latitude is southerly

3 Enter DMD of course

4 Read Double Product (if opted
 for at step 11 above)

After last DMD entry.

1 Depress Manual

2 Depress Print (optional, will give
 double area in square chains)

3 Enter 20

4 Depress Divide

5 Depress Print (read desired acreage,
 a negative number if traversed
 in a clockwise direction)

.....

HAND-HELD PLATEN FOR RELATIVE ORIENTATION OF STEREOMODELS

By Richard Brush, Engineering Technician
Boise National Forest

To achieve absolute orientation of a stereomodel, two previous steps must have been performed: interior and relative orientation.

Relative orientation is, in its simplest form, a complex procedure of trial and error movements of projector motions in a planned sequence.

On plotters using tracing tables (i. e., projection type) the operator moves the tracing table to several different horizontal positions on the plotter table. He also moves the tracing table platen vertically to keep the floating mark in contact with the surface of the ground.

Very few stereomodels are flat and level or very nearly so, therefore, the operator is constantly raising or lowering the platen.

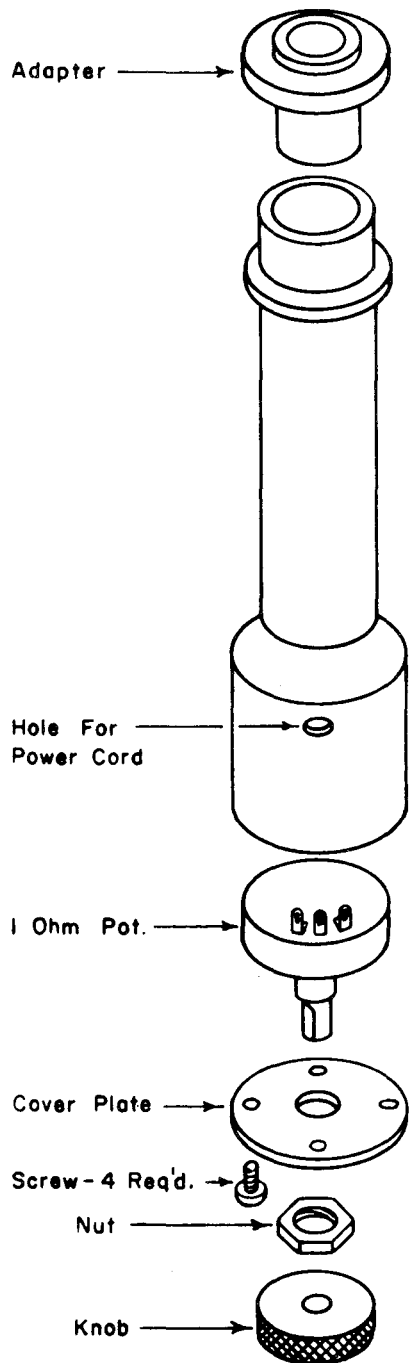
Because this operation is extremely tiring to the thumb and fingers, many operators, to save time, merely grasp the entire tracing table and lift it so the platen is at the desired height. After lifting the table the operator holds it suspended, sometimes at arms length, for a considerable period of time.

By constructing a device similar to the one shown in figure 1, the time required to clear the model of parallax can be drastically reduced -- usually by half.

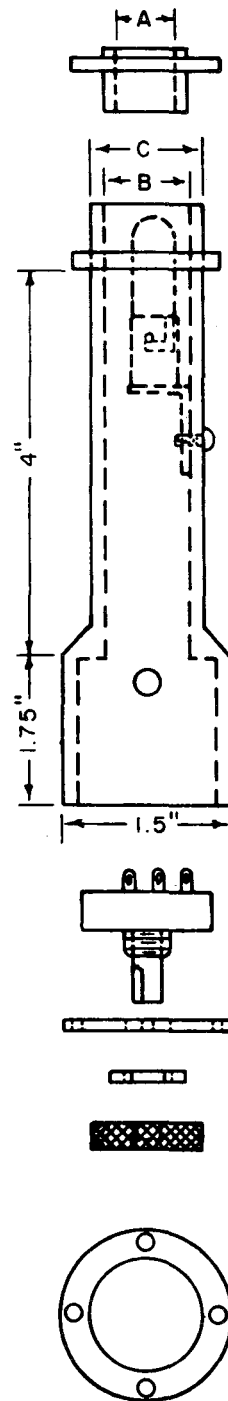
The device illustrated was constructed for a cost of \$32.00 plus the wiring. Our operator did the wiring. The unit can be plugged into an accessory outlet on the plotter power supply (such as panto graph) or can have its own plug-in wired to the plotter power supply.

The potentiometer should be 1 ohm linear taper. The bulb and socket are the same type used in the available tracing table. Without the adapter in the top end, the Kelsh tracing table platen can be used. With the adapter the Bausch and Lomb platen can be used. Exact dimensions can be obtained from existing equipment.

.....



Wiring Omitted For Clarity



"A" Dimension
To Fit B. & L.
Platen.

"B" Dimension
To Fit Kelsh
Platen.

"C" To Fit
Bearing Race.

All Other
Dimensions
Not Critical.

Figure 1.--Design for the Hand-Held
Platen

Editor's Note.

Your Field Notes will be published bimonthly beginning January 1972. Due to manpower shortage in the WO and lack of material submitted for publication, a respite is necessary. We hope to resume monthly issuances in the near future.

