NATIONAL RADIO ASTRONOMY OBSERVATORY
Green Bank, West Virginia

Telescope Operations Division Report No. 2 - A

NRAO STANDARD CALENDAR

Troy Henderson

JANUARY 1965

No. of Copies: 25

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Troy Henderson

The forty-eight month digital calendar is designed for the purpose of making the date available to a digital output system with the minimum of operator attention and maintenance. The output for digital purposes is in the binary coded decimal form (8,4,2,1). The output logic is such that 1 is equal to ground and 0 is equal to -18 volts. The general coding of the calendar's digital circuits is seen in figure 1 where stepper switch position calls for a 2 at the output.

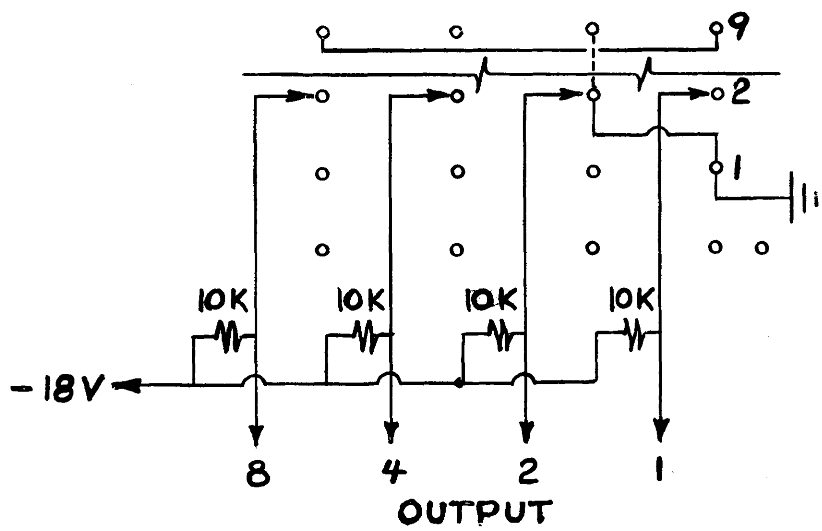


Figure 1. General coding for digital output circuits.

A second output system using Nixie tubes for display of month and day has the general circuit configuration shown in figure 2.

The front panel and digital output for years is taken from pre-coded "digiswitches". The digital output from the year selector has the general logic where ground equals 1 and -18 volts equals 0. Years output also has the inverse of this logic where -18 volts equals 1 and ground equals 0. Years for front panel display are read directly from the switch settings. Final output for both front panel display and digital is in the sequence of month, day, and year.

Operation of the calendar is controlled by providing external "normally-open" contacts that are pulsed at 2400 E.S.T. hours each day. The closure of this contact places 24 volts across the motor magnet of steppers K1 and K2 advancing these switches one position. After having stepped through the correct number of days for any given month, steppers K1 and K2 are advanced to home (starting) position. An off-normal switch is closed across 24 volts when stepper K1 reaches home position. This off-normal switch applies 24 volts to the motor magnets of steppers K3 and K4 advancing them one position. Through interrupt contacts on steppers K3 and K4 24 volts again activates steppers K1 and K2 advancing them to read the 1 st day of this new month.

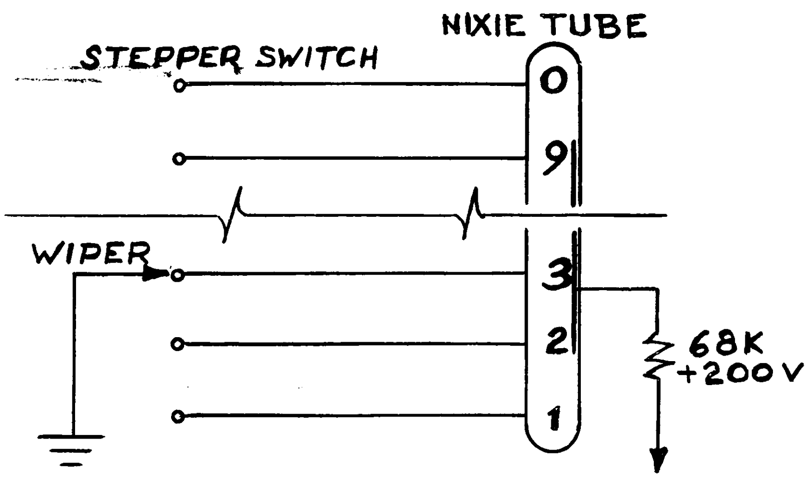


Figure 2. General circuit configuration for Nixie tube output.

To see how the calendar makes provision for the difference in length of months, assume the calendar to be reading the 28 th of February 1965. Since February 1965 is a 28-day month, the calendar must be made to do two things; first, the day count must be reset to read 1 and, secondly, the month count must be advanced one position to read the 3 rd month. Referring to figure 3 we can trace this reset action which is started by the "one pulse per day" at 2400 hours. Ordinarily this pulse would step the day count to 29; however, now instead of stopping stepper K1 and stepper K2 motor magnets are pulsed via relay K5. Relay K5 is pulsed by 24 volts from the "reset after 28 th (29 th and 30 th) day". After being advanced by the reset 30 th, steppers K1 and K2 are advanced to home position by the B-level of stepper K1. Homing of steppers K1 and K2 advances steppers K3 and K4 to read the 3 rd month. This step of steppers K3 and K4 in turn sets the day count to the 1 st of the new month.

Looking at the reset levels, A through F, of stepper K3 it is apparent that conditions of reset action for 1965 will be repeated for 1966 and 1967; however, the fourth February (F level) position has no provision for "reset after the 28 th day". This position makes the one 29 day February (leap year) during a 48 month period and must be kept in mind when initially setting the calendar. Stepper levels C and D of stepper K3 are made to control all resetting of the 30 and 31 day months.

The initial setting of the calendar should be done manually to insure that each stepper is set to its proper position. Once the stepper switches are correctly set, stepper K1 is lock-stepped with

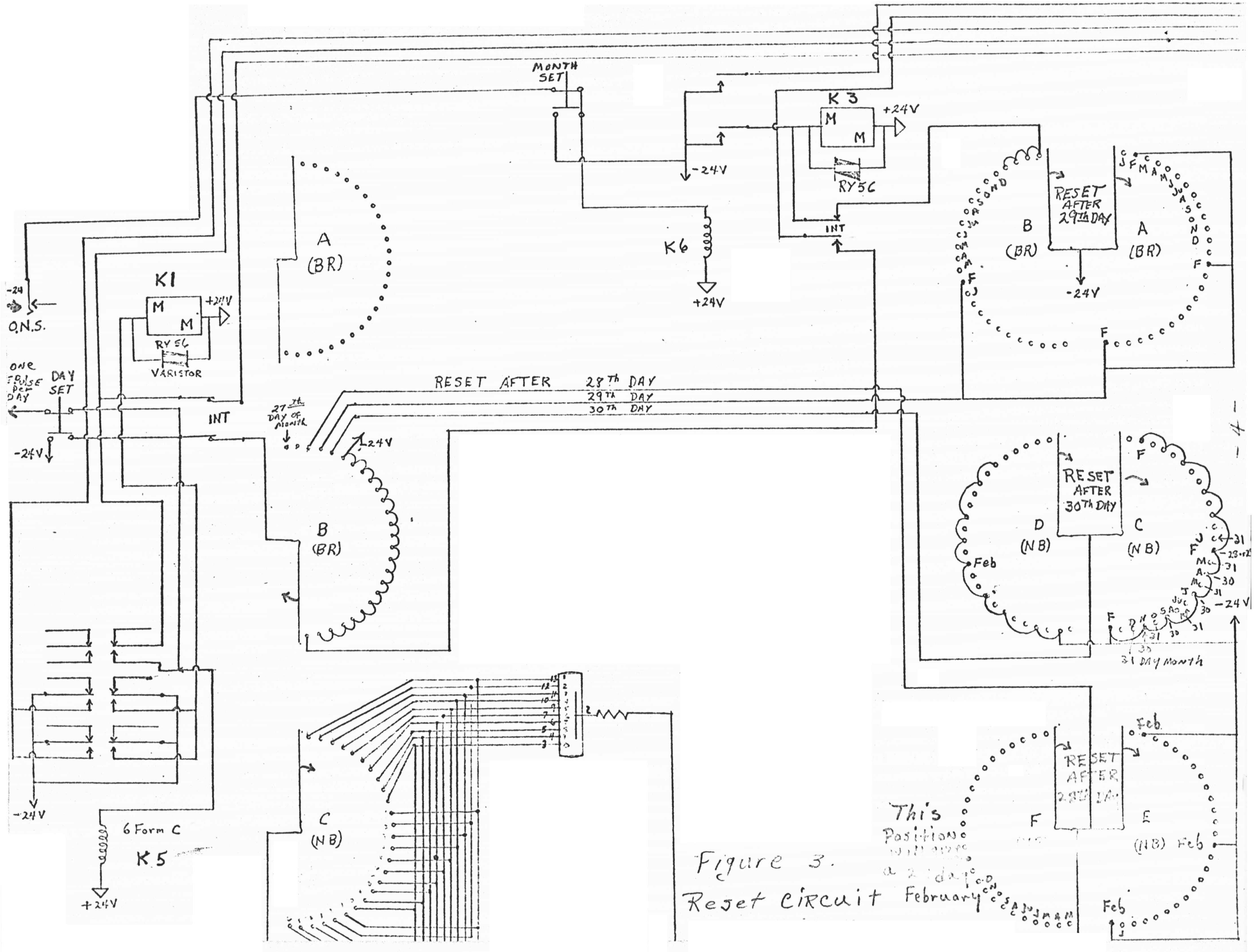


Figure 3.
Reset Circuit

stepper K2 through relay K5 and stepper K3 is lock-stepped with stepper K4 through relay K6.

If digital output does not agree with displayed date, the calendar should be checked for stepper switch alignment.

The calendar has been designed for rack mounting, which requires a 19 inch by 7 inch space for front panel display. All output, power, and "one pulse per day" connectors as well as both set switches are to be found on the chassis. Figure 4 shows the connections for the power and digital output connectors. The digital output has two sections listed as years. Pins C through N are coded in the general form where 1 equals ground; where as, pins t through AA are coded where 1 equals -18 volts.

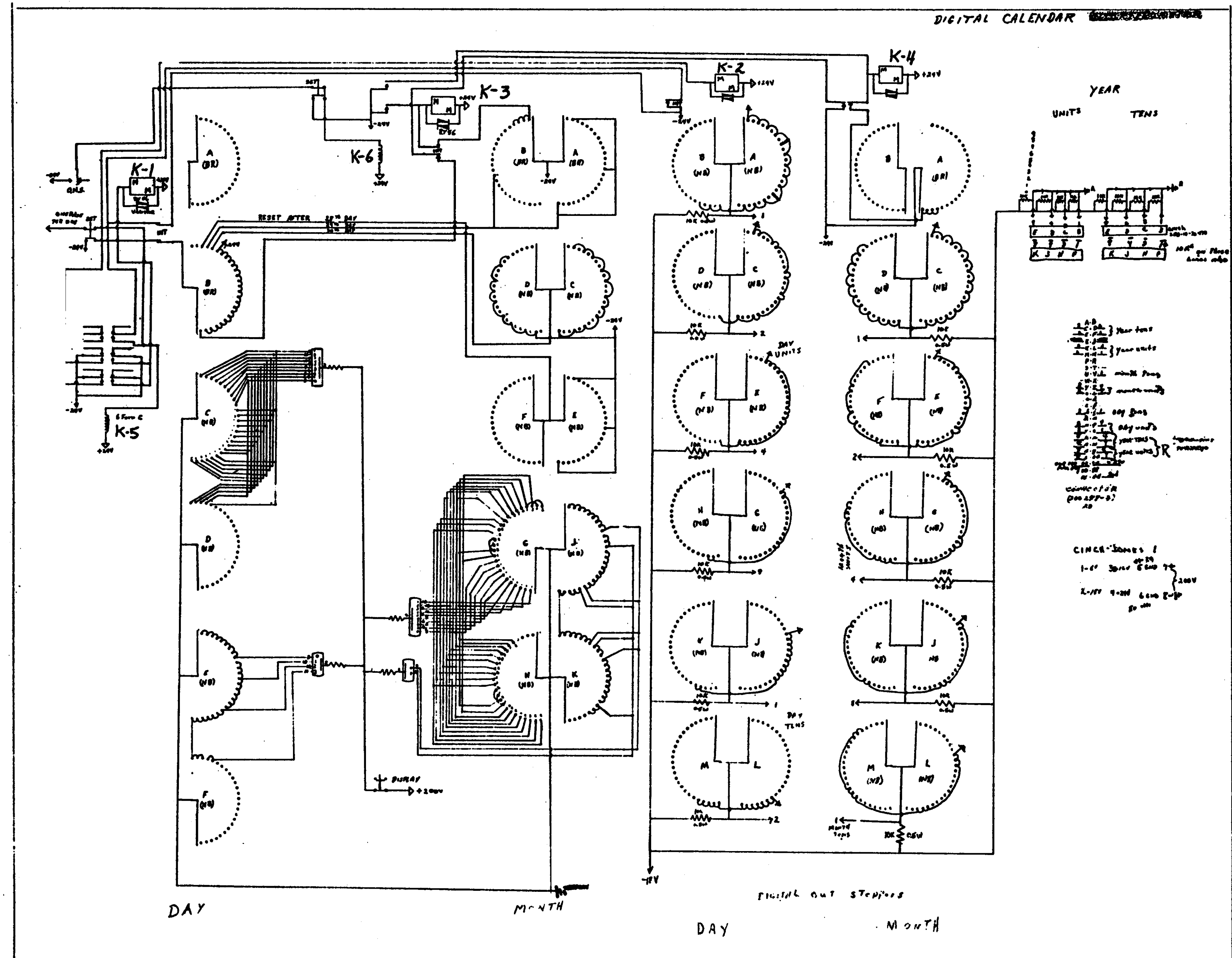
A*B
8 -C*D-4 Year tens
2-E*F-1
H*J
8-K*L-4 Year units
2-M*N-1
P*R
S*T
U*V-1 Month tens
W*X
8-Y*Z-4 Month units
2-a*b-1
c*d
e*f
2-h*j-1 Day tens
k*m
8-n*p-4 Day units
2-r*s-1
8-t*u-4 Year tens
2-v*w-1
8-x*y-4 Year units
2-z*AA-1
one pulse per day -BB*CC-(-24V)
DD*EE
FF*HH

Digital output connector

(-6V)-1*2-(-18V)
(-12V)-3*4-(-24V)
-5*6-(24V)
(-200V)—7*8-(200V)

Power connector (CINCH-JONES)

Figure 4.



DIGITAL CALENDAR
K-1
K-2
K-3
K-4
K-5
K-6
YEAR
UNITS
TENS
RESET AFTER
DAY UNITS
DAY TENS
DAY
MONTH
DAY
MONTH

Figure 5

Parts List

K-1 Nixie tube day stepper - Automatic electric, type 45, PW106105DCAB, 6 level, A-level bridging.

K-2 Digital day stepper - A&E type 45, PW112105DCAA, 12 level, no bridging wipers.

K-3 Nixie tube month Stepper - A&E type 45, PW 110105 DCAC, 10 level, A and B levels bridging.

K-4 Digital month stepper - A&E type 45, PW 112105 DCAB, 12 level, A-level bridging.

K-5 6 form C - A&E, PP70060-37A, 250 ohms.

K-6 2 form C - A&E, PP 70060-17A, 500 ohms.

Nixie tubes (B5092)

AMP Incorporated, 200277-2, 50 pin connector.

Cinch-Jones 1, 8 pin connector.

Amphenol 4-65, 14S-7S, 3 pin connector.

Digiswitch 310B-2, Digitran Company.

10K 0.5 watt resistors - digital output.

68K 0.5 watt resistors - Nixie tube plate.

Set switches (N.O. and N.C. contacts)

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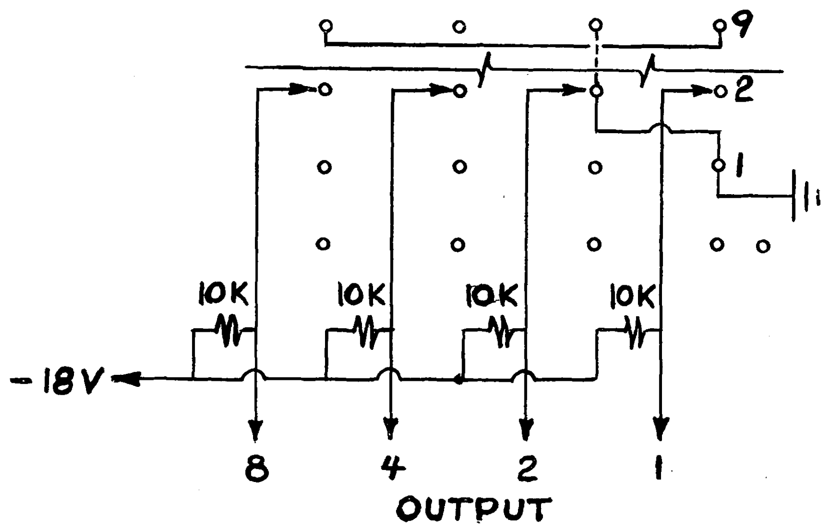

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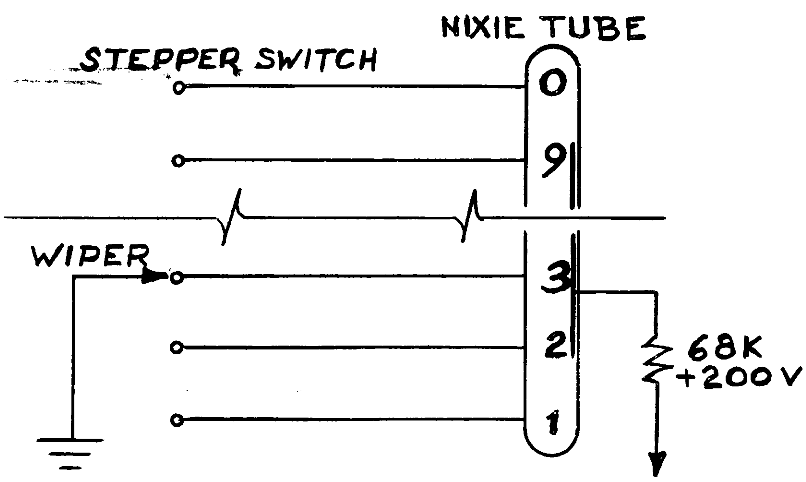

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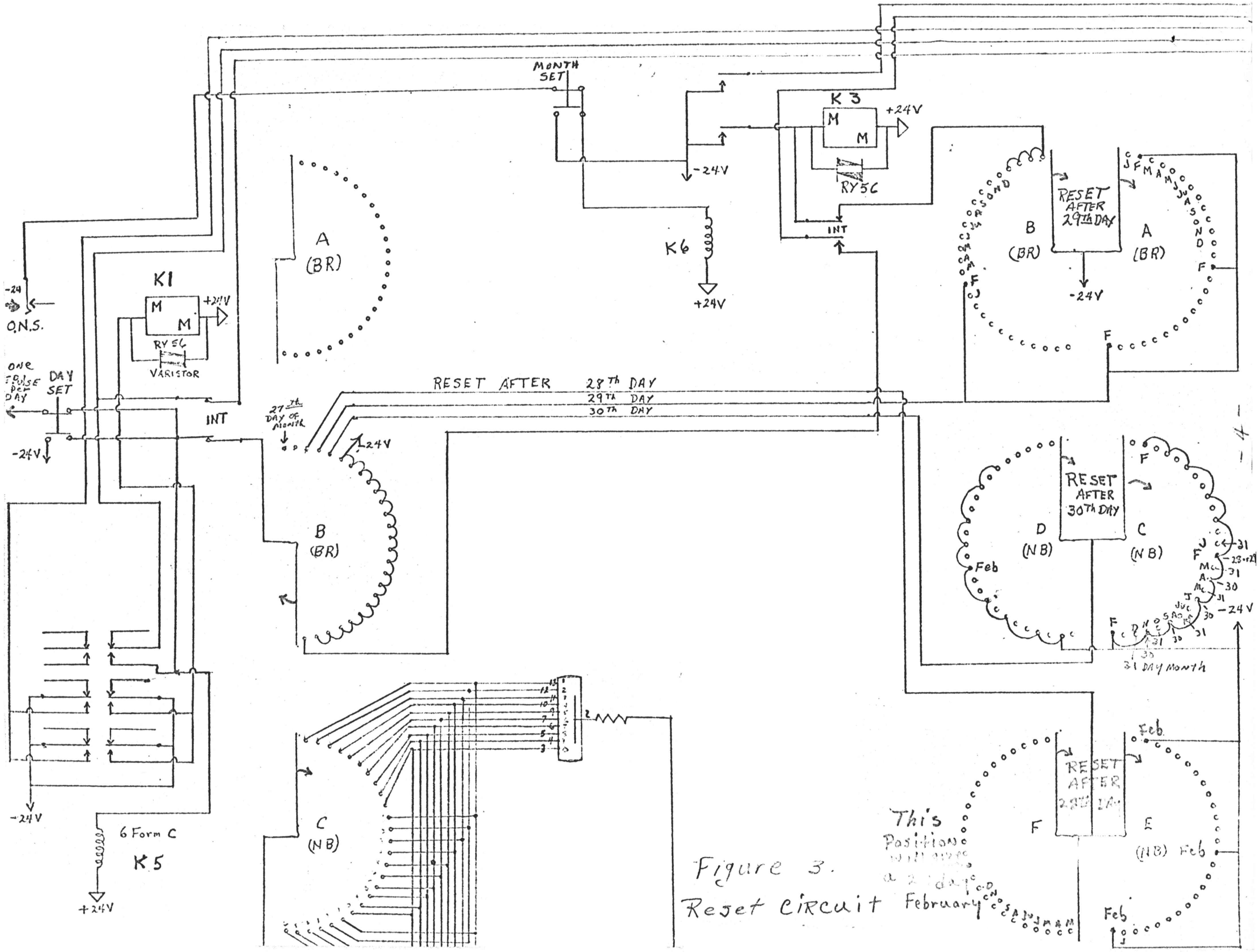

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             P*R
             S*T
             U*V-1    Month tens
             W*X
           8-Y*Z-4 }  Month units
           2-a*b-1
             c*d
             e*f
           2-h*j-1    Day tens
             k*m
           8-n*p-4 }  Day units
           2-r*s-1
           8-t*u-4 }  Year tens
           2-v*w-1
           8-x*y-4 }  Year units
one    }   2-z*AA-1
pulse  }   -BB*CC-(-24V)
per    }    DD*EE
day    }    FF*HH

      Digital output
        connector
```

```
   (-6V)-1*2-(-18V)
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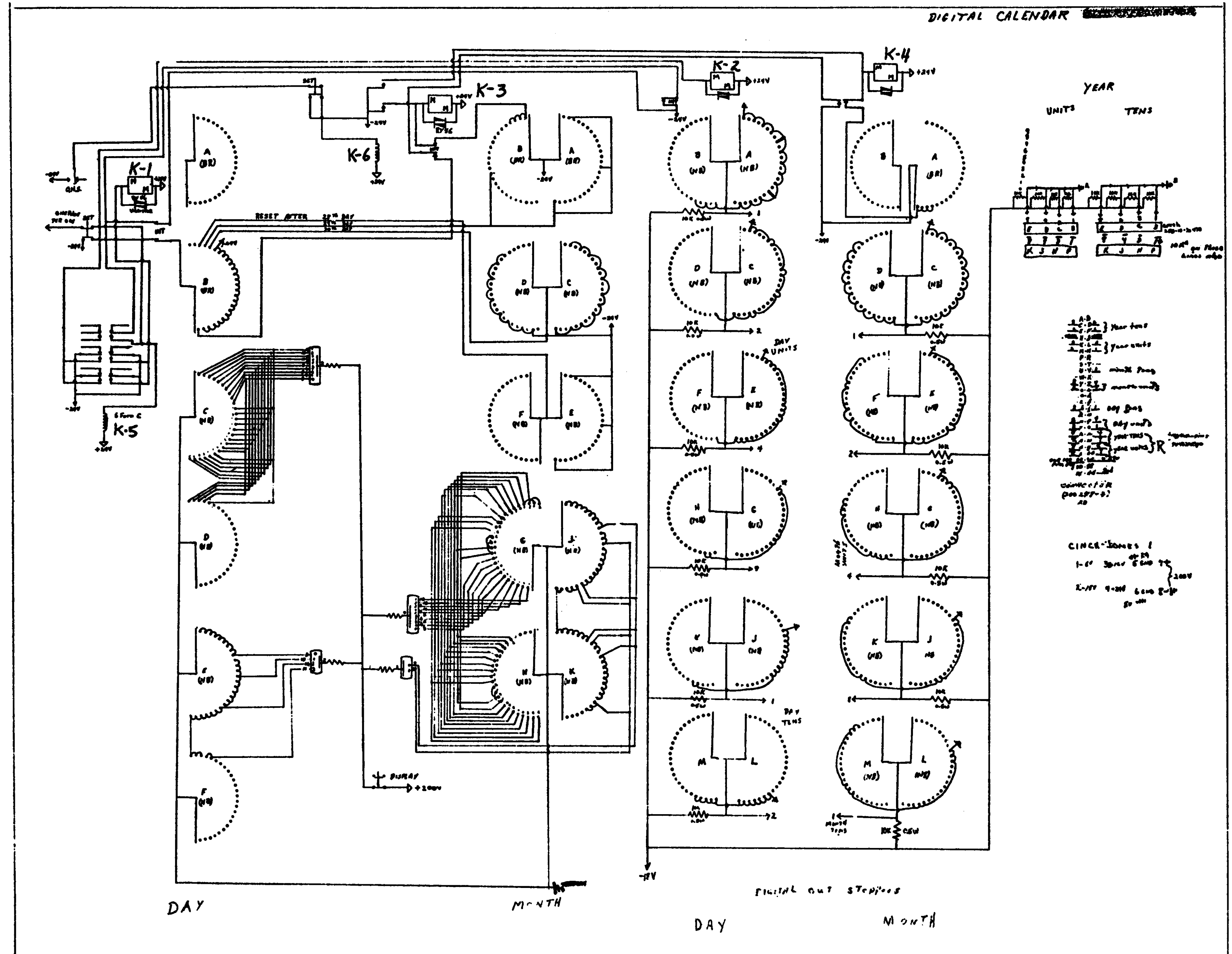
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NATIONAL RADIO ASTRONOMY OBSERVATORY
Green Bank, West Virginia

Telescope Operations Division Report No. 2 - B

MOVE OF THE 85-2' TELESCOPE

James F. Crews

DECEMBER 1965

(Includes FEBRUARY '66 Supplement)

No. of Copies: 25

MOVE OF THE 85-2' TELESCOPE - DECEMBER 8, 1965

James F. Crews

The following is a resume of the move of 85-2 telescope from station 6 (27) to station 1 (12) on December 8, 1965. This move had been planned initially on December 6, but was cancelled that day because of wind, and snow predicted by both the Charleston and Elkins weather bureaus. On 7 December, the move was again cancelled because of the fear of high winds. This seemed to have been a wrong decision by 0900, but it was then too late to start. The night of December 7 had a low of perhaps 3 degrees F, which helped somewhat by firming the roadway. It was decided at 0700 on December 8 to move, with the prediction by both weather bureaus that wind would be very low, likely never exceeding 15 miles per hour. Various people were alerted to the move on the basis of their need to arrive at the telescope for their work contribution. The following is a chronological run-down on the move itself:

0705-0745 -- Disconnect and stow telescope cables from cable tray. The hydraulic oil reservior for lifting had been heated for several days. It was decided to surge oil out into the lines and cylinders to try to warm them. The pump motor refused to start on either telescope power or baseline power, although the contactor whose coil is cut-out by a motor overload protective device did operate. The motor finally started after 5 minutes of fiddling, and did not give any further trouble during the day. This thing still needs to be looked into.

0815-0825 -- Disconnect 4160 power. About 10 minutes required to remove 4160 umbilical cord and return power to baseline for "Lifting pump-motor".

0825-0858 -- Remove telescope hold down bolts. The bolts were very hard to break loose, requiring the effort of 3 and sometimes 4 men. This is attributed to shrinkage with cold weather. It was also noted that when the bolts were loosened on the northwest anchor point, the point moved approximately 1/8 inch toward the south leg and although no measurements were made, a few of the bolts on the northeast leg were binding and were difficult to remove.

0858-0915 -- Lift telescope. One cylinder on each dolly had to be given an assist in breaking away by a small hydraulic jack. This is not considered too important, since the dolly pivots anyway, and little effort is required.

0918-0928 -- Move over pads at station 27 and set telescope down again. Each extended piston collected frost because the piston was somewhat colder than ambient.

0930-1010 -- Move from station 27 to station 24. The aircraft towing tractor lost most of its power and had to be supplemented by the Michigan end-loader, pulling in series with the tractor by wire rope. This served to eliminate the problem of the dozer (working on the northwest leg) getting ahead.

1011-1024 -- Lift telescope for going over station 5 (24).

1027-1037 -- Move over station 5 and set down.

1038-1058 -- Move to station 4 (21).

1059-1110 -- Lift telescope for going over station 4 (21).

1111-1118 -- Move over station 4 and set down.

1119-1132 -- Move from station 4 to new station 19. This is where the 2% grade is encountered. Problems of traction by the dozer and of sinking in by the northwest dolly were encountered. Because the dozer had to continuously maneuver for traction, the telescope arrived at station 19 completely out of alignment, so that the dolly wheels on the south leg would not clear the concrete piers in plan view.

1132-1226 -- This time was consumed in lifting the telescope and jockeying to clear station 19. The dozer had to be aided at times by the snow blower and the Michigan end-loader.

1227- -- Start set down after clearing pad.

1230- -- Lunch - activity ceased.

1315-1320 -- Move from station 19 to station 3 (18). During lunch break and this move, wind gusted to 25 m.p.h. and often remained steady at 20 m.p.h. up to 1 minute. The desirability of setting down at station 3 was considered, but W. Horne felt there was no need to do so.

1321-1334 -- Lift telescope to clear station 3 (18).

1335-1341 -- Move over station 3 and set down.

1342-1401 -- Move from station 3 to station 2 (15). No problems encountered here. End-loader still helping aircraft tower. A. Robischaud delivered a message to continue to station 1.

1402-1412 -- Lift telescope to clear station 2.

1413-1419 -- Move over station 2 and set down.

1420-1441 -- Move from station 2 to station 1. Again - no problems.

1442-1600 -- Lift and jockey telescope for final set-down on station 1 pads. In spite of what was thought to be a perfect guide in situation, the telescope was too far out of alignment to set down. Successive jockeying moves for a while worsened the situation. Initially the telescope had been parallel, but too far south. Jockeying for awhile resulted in loss of parallelism plus cocking of the 3 set down points in relation to the pads. Finally, the telescope was jockeyed and held by the towing vehicles to enable engagement at the south pier, and the other two pier key ways were engaged.

1615- -- The telescope was completely set-down and finish bolted. The dollies were jacked up so that they could be relieved of any side stresses as a result of the set-down process.

Total time of move from cable break-away to complete set-down and finish bolting was 9 hours 10 minutes.

Average time between stations when no trouble was encountered was 20 minutes.

Average time of lift up was 13 minutes.

Average time of moving over pad and setting down when no trouble was encountered was 9 minutes.

The effort and time required for aligning the telescope to enable station set-down plus the danger due to road bed and towing problems needs some consideration. I feel the aircraft towing vehicle should be done away with and another dozer rented for towing the south leg. On the basis of strain gauge measurements made by W. Horne during this move, it would appear desirable that there be displayed in each towing machine the power being delivered by all towing machines to their respective towing bars.

If we have the program this summer requiring a move per week I would recommend the rental of a dozer during this entire period.

It might be well to investigate thoroughly the prospect of having driving and braking power on the telescope wheels themselves.

There seems to be no solution to the problem of easily aligning the telescope before set-down. Due to the rather complex motion, I feel that this situation is strictly trial and error, in spite of every effort to provide alignment guides.

How much jockeying and twisting can the telescope take before it is damaged? Obviously, when we get in trouble, we have to make every effort to prevent damage to the telescope. Even so, in a real problem where the telescope begins to settle, minor damage would be far better than letting the telescope settle without being able to anchor it until a solution for removal could be found. Unfortunately, such decisions must be made on the spot and quickly.

In conclusion, I think our present methods fall somewhat short of being desirable. I feel that the people who are responsible for moving the telescope are quite capable and are doing an excellent job in spite of the difficulties involved. A major improvement would be to put the telescopes on rails. This is by all means desirable for the VLA.

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Green Bank, West Virginia

SUPPLEMENT TO: "Telescope Operations Division Report No. 2"

MOVE OF THE 85-2' TELESCOPE

James F. Crews

FEBRUARY 1966

No. of Copies: 25

MOVE OF THE 85-2' TELESCOPE - February 6, 1966

James F. Crews

This additional information is to be included as a part of this report. This section relates to the move of 85-2 from station 12 (old 1) to station 18 (old 3) on February 6, 1966.

In this case, weather predictions were accomplished internally rather than relying on the weather bureau. Weather conditions were good for the move about 2 days before the scheduled date of February 9 through about 2 days thereafter.

An effort was put forth on this move to reduce the time required from system-off-line to system-on-line.

About 1.5 hours were required to disconnect and stow telescope umbilical cables. A similar amount of time was required to reconnect these cables. Cable disconnecting was completed before 0800. The following is a chronological rundown of the move:

Remove hold down bolts -----	0808 - 0838
Lift telescope -----	0838 - 0858
Move telescope off pad -----	0902 - 0903
Let telescope down -----	0904 - 0909
Move station 12 to station 15 -----	0909 - 0920
Power availability trouble sta. 15 --	0921 - 0942
Lift telescope station 15 -----	0945 - 0959
Move over station 15 -----	0959 - 1000
Let telescope down -----	1002 - 1008
Move station 15 to station 18 -----	1008 - 1025
Lift telescope station 18 and set down on pad -----	1028 - 1205
Bolts in and tightened -----	1205 - 1228

Total time required from telescope bolt breakaway to telescope down on station 18 and tightened down was 4 hours 20 minutes. If telescope cable disconnect and reconnect had been done serially with move, total time would have been 7 hours 20 minutes. This does not include time required to get electronics working again.

Since we anticipate moving once per week this summer, one should look for ways of shortening the time. The only possibilities seem to be 1) that during this series of observations we will be going from station to station and will jump no station with the possible exception of station 19, 2) cable disconnecting and reconnecting can be co-ordinated to a point so that cables are being handled while another operation is in progress. With the exception of familiarization by the people doing the work, there seems to be no other way to safely reduce the time required to accomplish a move.

It would appear that in any case, 6 - 8 hours will be required from off-line to on-line. Additional time will be required for electronics warm-up.