




# APPLICATION NOTES

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APPLICATION NOTE 4

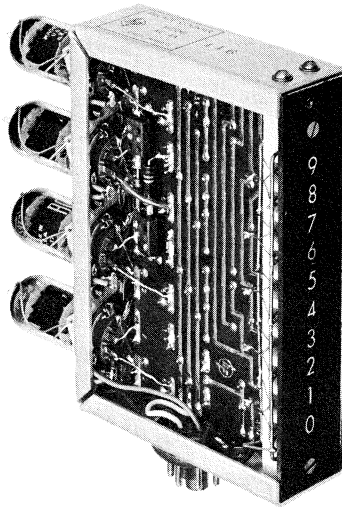
 MODEL AC-4A

DECADE COUNTER

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 MODEL AC-4A  
DECADE COUNTER



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## A. BLOCK DIAGRAM OF SIMPLE ELECTRONIC COUNTER

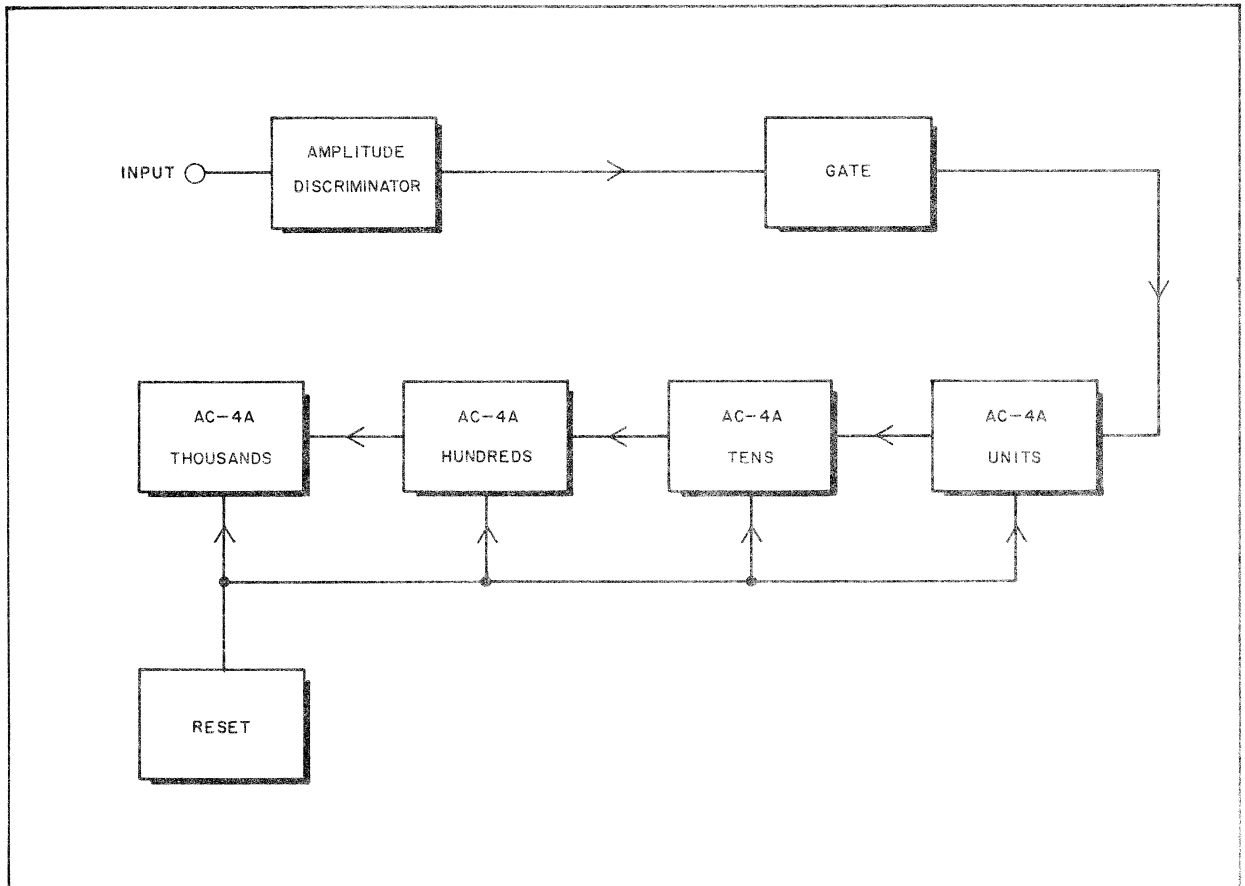


Fig. 1. Block Diagram of Basic Electronic Counter

Fig. 1 is a block diagram of an electronic counter, which consists of the following sections:

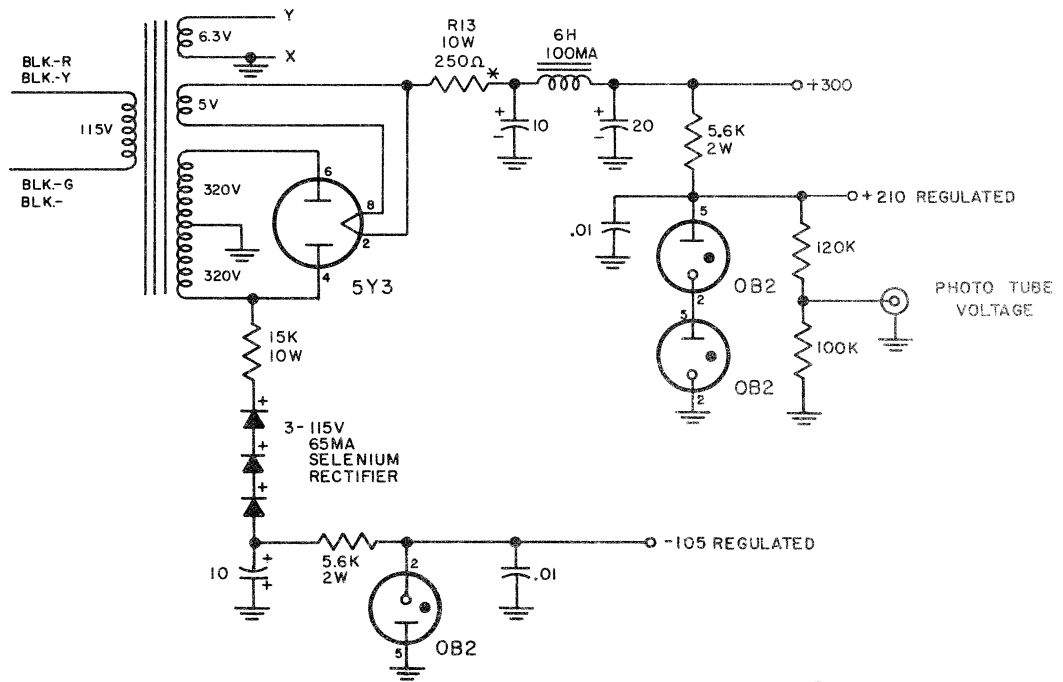
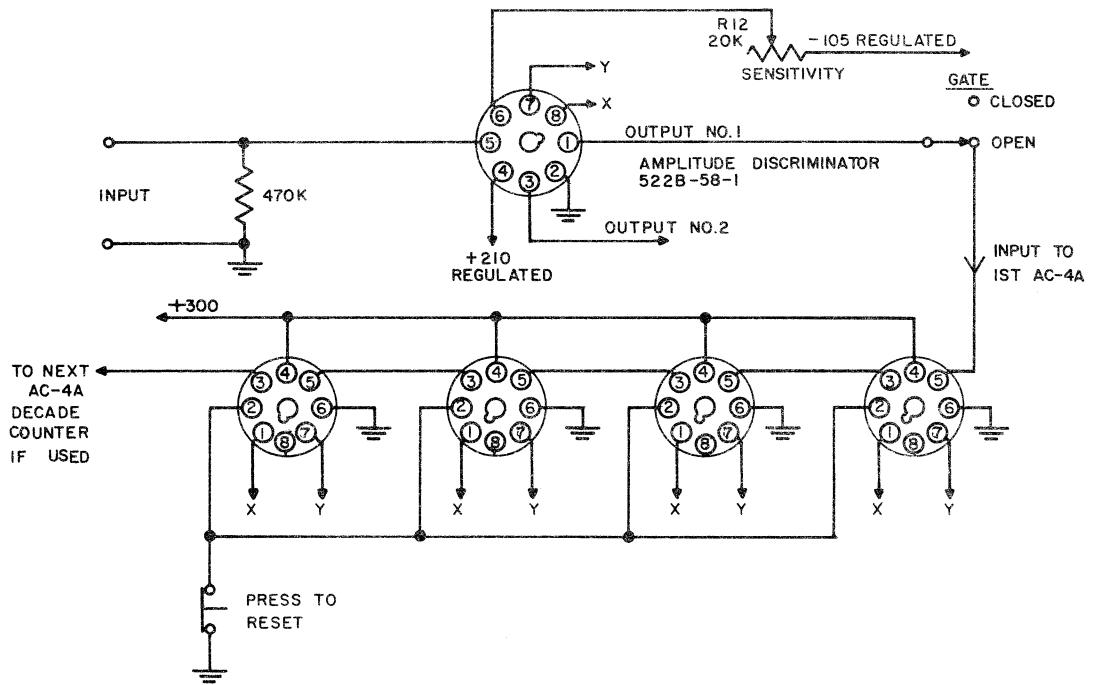
AMPLITUDE DISCRIMINATOR, which connects to the INPUT voltage to be counted. From this signal input, which may be a sine wave, square wave, or pulse, the Amplitude Discriminator develops the required driving pulse for the first AC-4A Decade Counter. The output pulse of the Amplitude Discriminator is of the same amplitude and rise time regardless of the amplitude and rise time of the signal to the INPUT.

GATE, which in its simplest form is an ON-OFF switch connected between the output of the Amplitude Discriminator and the first AC-4A Decade

Counter. The Amplitude Discriminator puts out pulses as long as it receives an input of sufficient amplitude; however, pulses cannot operate the AC-4A Decade Counters unless the GATE is closed. This GATE may be a simple ON-OFF switch as shown in Fig. 2, a pair of relay contacts, a vacuum tube biased in and out of cut-off, a diode arrangement or other circuit configuration, depending upon the speed and accuracy requirements placed on the GATE by the application.

AC-4A DECADE COUNTERS, which count all pulses from the Amplitude Discriminator when the GATE is OPEN. When the GATE is CLOSED, the AC-4A's remain indefinitely on the last count received and display the total as one numeral in each decade illuminated by a neon lamp. The output of one AC-4A Decade Counter will drive the input of the next without additional circuitry.

RESET. It is usually desirable to return all AC-4A's to zero before beginning a new count. All AC-4A's can be reset to zero simultaneously with a RESET switch as shown in Fig. 2, or in automatic counting equipment this can be done with a thyatron circuit as shown in Fig. 8 or Fig. 9.



- NOTE -

Adjust the value of R13 for +300 volts output from power supply under load.

Fig. 2. Simple Electronic Counter Using the 522B-58B Amplitude Discriminator to Drive the AC-4A Decade Counter Units

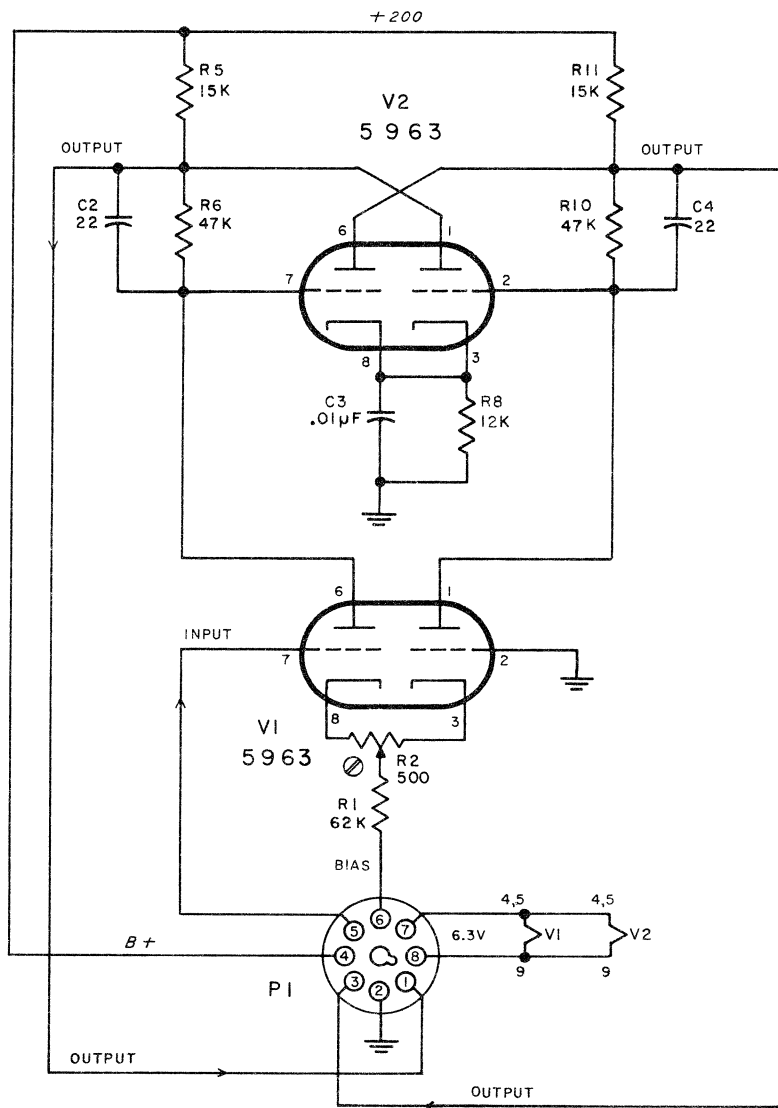
## B. AC-4A IN BASIC COUNTER CIRCUIT

Fig. 2 is a schematic circuit of the counter in Fig. 1. The Amplitude Discriminator can be built following the circuit in Fig. 3 (Schematic Diagram Amplitude Discriminator Unit for Model 522A/B). This Amplitude Discriminator is available from Hewlett-Packard Company as a plug-in unit -hp- Part No. 522B-58B. The GATE is a manually operated switch but could be a pair of relay contacts. Counters are RESET to zero with a manual pushbutton. The power supply should be able to furnish +300 volts at 15 ma and 6.3v ac at 1.2 amps for each AC-4A used, in addition to +210v regulated at 10 ma, -105v regulated at 3 ma, and 6.3v at .6 amp for the Amplitude Discriminator.

This counter will count at a maximum rate of 120 kc or more and the total number of digits displayed is limited only by the number of AC-4A's used.

To adjust R12:

- a. Connect a 1000 cps sine wave to the input of the Amplitude Discriminator (Fig. 2).
- b. Observe the output at Pin 1 with a scope or observe the AC-4A Counters for steady operation.
- c. Decrease amplitude of 1000 cps input.
- d. Adjust R12 for a symmetrical square wave or for steady operation of the AC-4A Counters.
- e. Repeat above steps until the minimum input voltage is reached.
- f. This is the correct setting of the sensitivity control for best operation at all input voltages and frequencies.



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SCHEMATIC DIAGRAM AMPLITUDE DISCRIMINATOR UNIT


 STOCK NUMBER 522B-58-B

Figure 3.

### C. DRIVING CIRCUIT FOR AC-4A

Triggering of the Amplitude Discriminator is at the approximate dc levels shown below when connected as in Fig. 2.

PLATE Pin 1 V2 (Fig. 3) is normally conducting for 0 v dc on Pin 5 (INPUT) of the 522B-58B Amplitude Discriminator.

PLATE Pin 1 of V2 cuts off when the dc level at the INPUT crosses approx. -0.4 volt going negative.

PLATE Pin 1 of V2 conducts again when the dc level at the INPUT crosses approx. -0.2 volts going positive from a negative peak.

An AC-4A driven from this Amplitude Discriminator will count at "A" if driving from Pin 3, at "B" if driven from Pin 1 of the Amplitude Discriminator.

Positive dc levels at the INPUT (Pin 5) WILL NOT trigger this discriminator.

An attenuator and a dc buck out voltage can be used in the input circuit of the Amplitude Discriminator if it is desired to trigger the counter at some particular place on an input wave.

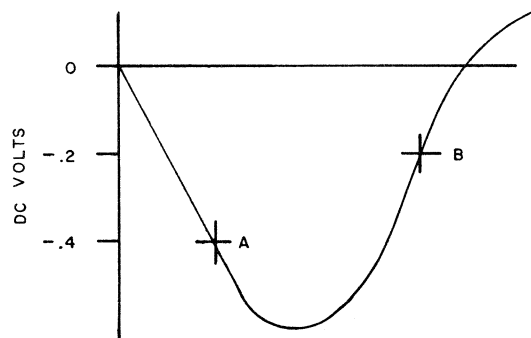


Fig. 4. Trigger Levels of the 522B-58B Amplitude Discriminator Connected as in Fig. 1

#### D. REMOTE READOUT CIRCUITS FOR USE WITH AC-4A

The staircase output voltage from base Pin 8 of the AC-4A Decade Counter Units is a dc voltage proportional to the digit indicated by the AC-4A.

This voltage can be used to operate printing systems using coincidence detectors or can be read out on remotely located dc meters or ink recorders using the circuits shown in Fig. 6 or Fig. 7.

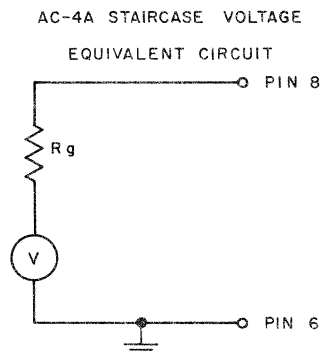


Fig. 5. Staircase Equivalent Circuit

Staircase voltage output is between base Pin 8 and GND.

The load on the staircase output, including a short, has no effect on operation of AC-4A Counter.

$R_g$  - Approx. 700k

$V$  - +135v count of 0 to +55v count of 9 in approximately equal steps.  
Tolerance on any step is  $\pm 1$  volt.

The staircase output voltage will vary with the unregulated +300 volt supply to the AC-4A's.

The staircase voltage can be +55 volts at count of ZERO, +135 volts at the count of NINE if R11, R14, R27, and R38 in the Schematic Diagram of Model AC-4A Decade Counter are all changed to the opposite plate in each binary.

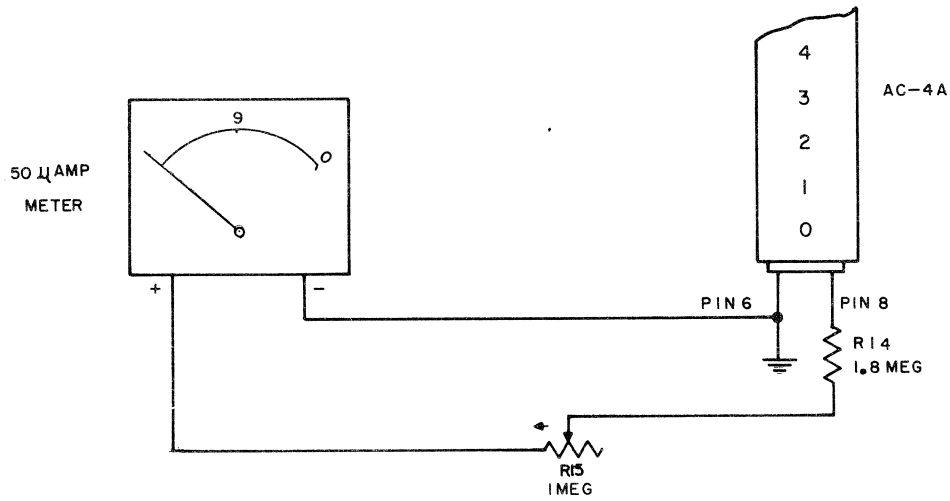


Fig. 6. Remote Readout of AC-4A Using Ground Return for Meter

1. Reset AC-4A to ZERO.
2. Adjust R15 for full scale deflection of meter.
3. Step AC-4A one digit at a time and mark meter scale.

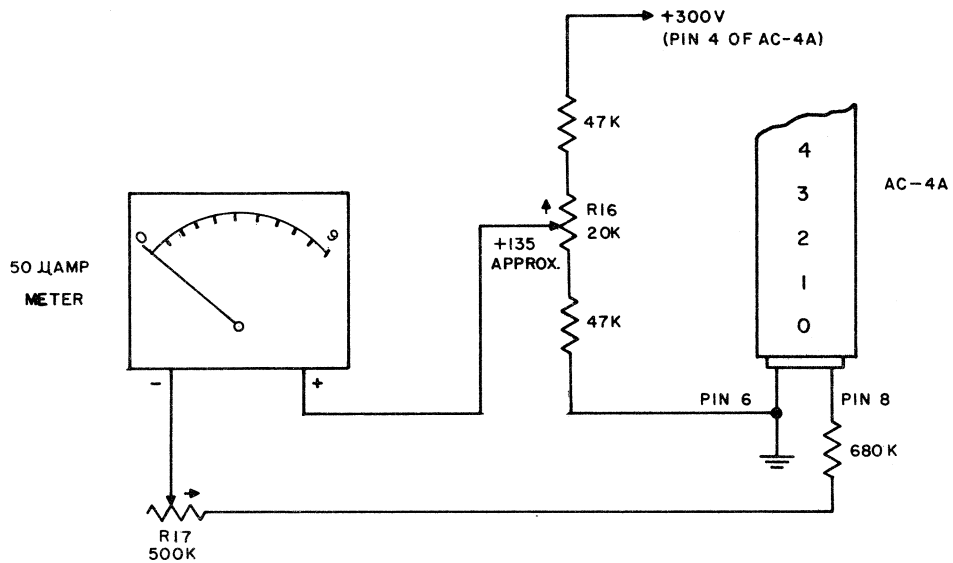
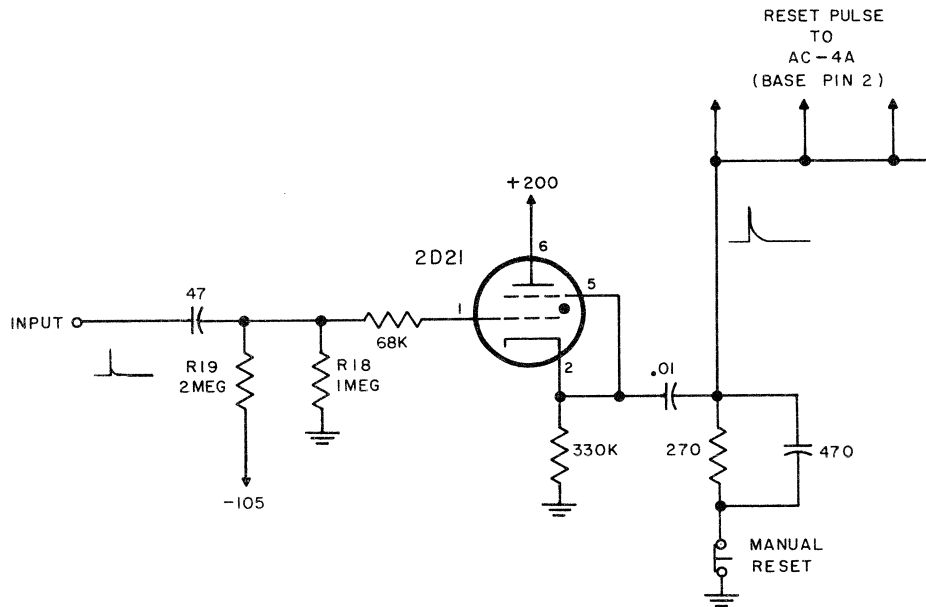


Fig. 7. Remote Readout of AC-4A Decade Counter Unit  
Using a Circuit that Supplies a DC "Bucking"  
Voltage to Permit Use of a Standard Meter

1. Reset AC-4A to ZERO.
2. Adjust R16 for 0 reading on meter.
3. Stop AC-4A on 9.
4. Adjust R17 for full scale reading on meter.
5. Reset AC-4A to ZERO.
6. Step AC-4A one digit at a time and mark meter scale.

## E. RESET CIRCUITS FOR USE WITH THE AC-4A

In automatic electronic counting equipment it is usually desirable to reset the Decade Counters with an electrical pulse rather than with a manual switch. The circuit in Fig. 8 will reset all AC-4A Decade Counters to ZERO simultaneously if a positive pulse is applied to the INPUT of the 2D21 Reset Thyatron. Depressing the MANUAL RESET will also return all decade to ZERO.



**Fig. 8.** Circuit to Reset AC-4A Decade Counters to Zero

### NOTE:

A positive pulse at the input to this circuit delivers a 150 volt positive reset pulse with fast rise and slow fall to reset all AC-4A Decade Counters to ZERO simultaneously. This circuit will function if R19 is removed and R18 is returned to approximately -30 volts. Smaller negative voltages than -30 will enable the reset thyatron to be triggered by a lower amplitude positive pulse but will also make it more susceptible to stray pulses from other circuits.

Resetting all Decade Counters to NINE (or more properly -1) may be desirable if the operation of a gate circuit puts an extra pulse into the counter circuits. A manual pushbutton used with this circuit should be connected to supply a positive pulse to the INPUT of the Reset Thyatron.

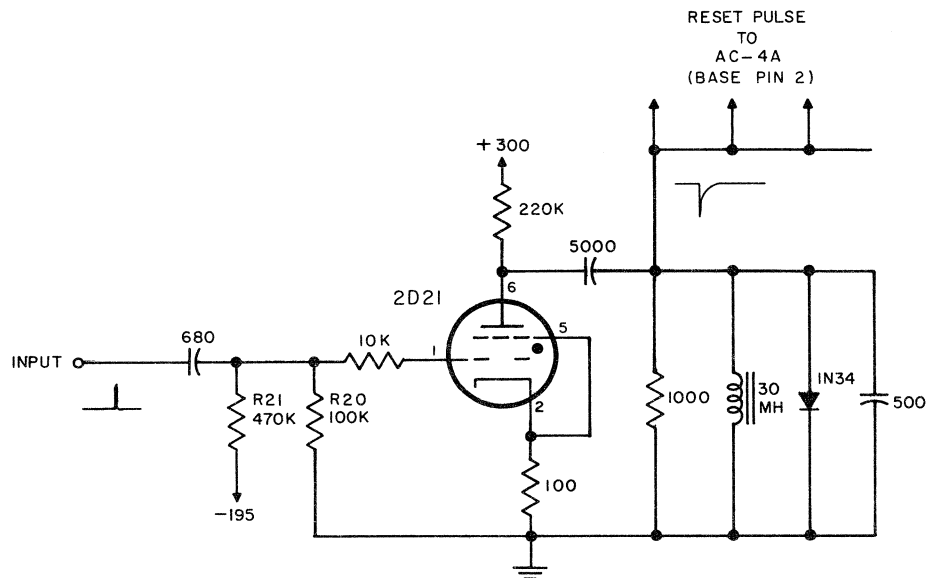


Fig. 9. Circuit to Reset AC-4A Decade Counter Units to Nine

NOTE:

A positive pulse at the input to this circuit delivers a 200 volt negative reset pulse with fast fall and slow rise to reset all AC-4A Decade Counters to NINE simultaneously. This circuit will function if R21 is removed and R20 is returned to approximately -30 volts.

The AC-4A can be reset to NINE with a manual pushbutton if the leads connecting the GND and RESET buses to the base plug are reversed where they join the printed circuit board. Refer to the reset circuit of Fig. 8 for details.

