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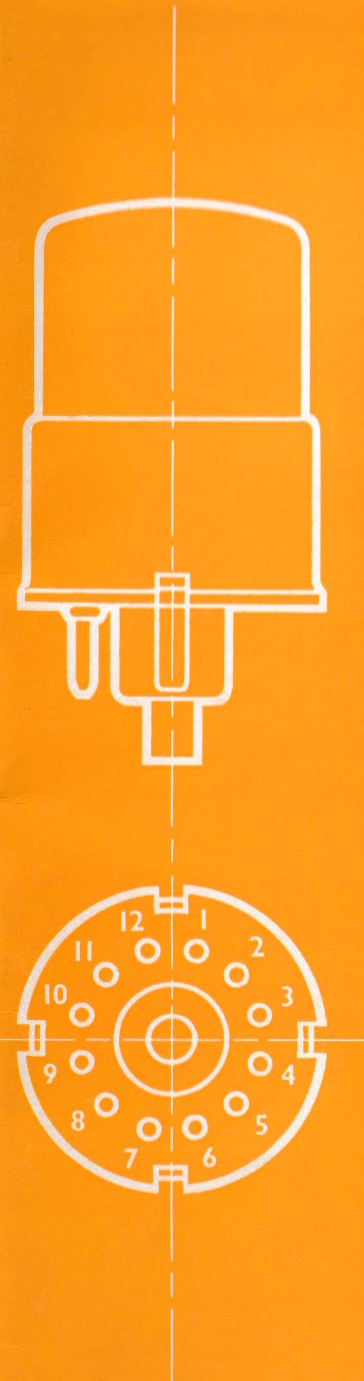


STC

VALVES

APPLICATION REPORT

G10/241E NOMOTRON

A cold cathode gas-filled

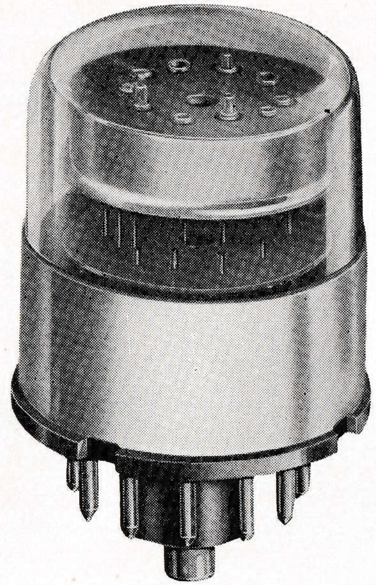
single pulse unidirectional

Operating Range: 0-20 kc/s

Decade Counter

Cathode Output: 40V, 3.7mA

Standard Telephones and Cables Limited



G10/241E NOMOTRON

APPLICATIONS INCLUDE

Tachometry

Counting and Batching

Frequency and Time Measurement

Direct Operation of Electro-Magnetic Relays

Sequential Monitoring of up to ten different Waveforms

STC COMPONENTS GROUP

Standard Telephones and Cables Limited

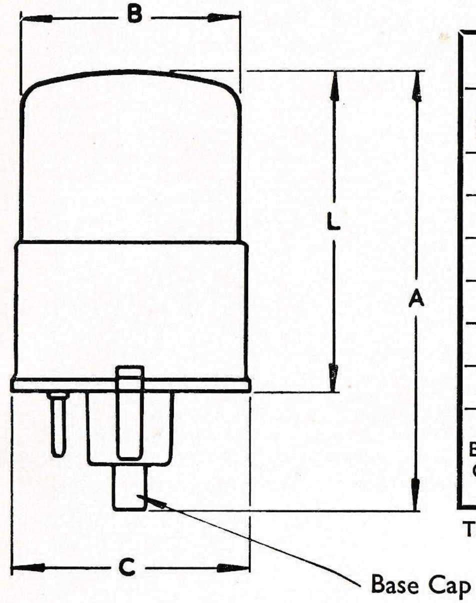
SPECIAL VALVE SALES DEPARTMENT

FOOTSCRAY, SIDCUP, KENT

Footscray 3333

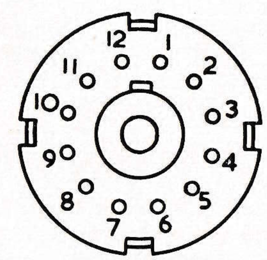
CONTENTS

1. MECHANICAL DATA



BASING ARRANGEMENT			
PIN NO.	ELECTRODE	PIN NO.	ELECTRODE
1	SHIELD	7	CATHODE 5
2	CATHODE 0	8	„ 4
3	„ 9	9	„ 3
4	„ 8	10	„ 2
5	„ 7	11	„ 1
6	„ 6	12	TRANSFER
BASE CAP	ANODE		

The net weight of the tube is 66 g. (2·3 oz.)



B12E base

DIMENSION	INCHES	MILLIMETRES
A (MAX.)	3·06	77·8
B (MIN.) B (MAX.)	1·50 1·61	38·1 41·0
C (MAX.)	1·72	43·7
L (MIN.) L (MAX.)	1·75 2·0	44·5 50·8

Fig. 1

A special socket has been designed for use with this tube (McMurdo type X12E). The locating spigot corresponds approximately in radial direction to the "O" Cathode.

The Mounting Position is unrestricted. For visual indication of the count the tube is viewed through the top end of the glass envelope. Additionally, cathode identification may be facilitated by the use of a numbered escutcheon plate surrounding the tube.

2. ELECTRICAL DATA

2·1 D.C. CHARACTERISTICS (nominal)

Anode-cathode breakdown voltage	280	V
Anode-transfer electrode breakdown voltage	280	V
Anode-cathode maintaining voltage (approx.)	180	V

2·2 LIMITING RATINGS

Minimum H.T. supply voltage	310	V
Maximum anode voltage relative to a non-conducting cathode	250	V
Maximum cathode current (static condition)	5	mA
Minimum cathode current (static condition)	2·4	mA
Maximum shield bias	110	V
Minimum shield bias	75	V
Ambient temperature range	—55 to +90°C	
Minimum operating frequency :		

Prolonged conduction on one cathode should, in general, be avoided. Where this type of operation is anticipated a value of cathode current close to the minimum should be chosen and it is desirable that the tube should periodically be subjected to continuous cycling at any convenient frequency between 50 and 5000 c/s.

2·3 TYPICAL OPERATING CONDITIONS

		up to	up to	up to	
	Frequency	1 kc/s	5 kc/s	20 kc/s	
	Circuit	Fig. 5	Fig. 5	Fig. 6	
	H.T. supply voltage (stabilised)	315—345	315—345	325—345	
	Transfer electrode bias (nominal)	75	75	90	V
	Shield bias (nominal)	90	90	90	V
†	Anode load resistor (2% tolerance)	24	24	24	kΩ
†	Anode load capacitor (20% tolerance)	0·25	0·25	0·05	μF
	Cathode load resistor (5% tolerance)	15	15	15	kΩ
*	Cathode load capacitor (20% tolerance)	0·02	0·005	0·001	μF
	Transfer pulse width	15—100	12—20	8—12	μs
	Transfer pulse amplitude (measured at the input capacitor with G10/241E in circuit.)	120±15	120±15	120±15	V
	Cathode pulse output (min.)	40	40	40	V
	Cathode current (nominal)	3·7	3·7	3·7	mA

† See circuit diagrams. (pages 8 and 10)

* The value of capacitor used should be the maximum permitted for the particular application but should not normally exceed 0·1μF. In applications where higher values are unavoidable the shunt capacitor in the anode circuit should be omitted to avoid extended current surges.

3. BASIC MECHANISM OF OPERATION

The tube contains ten main cathodes (k_0 to k_9) brought out separately to base pins. The cathodes are equally spaced around a circle and between each is a transfer electrode (t). The transfer electrodes are joined and taken to a single base pin. Around the cathodes is a single anode cup and there is a shield to restrict the glow to discrete areas.

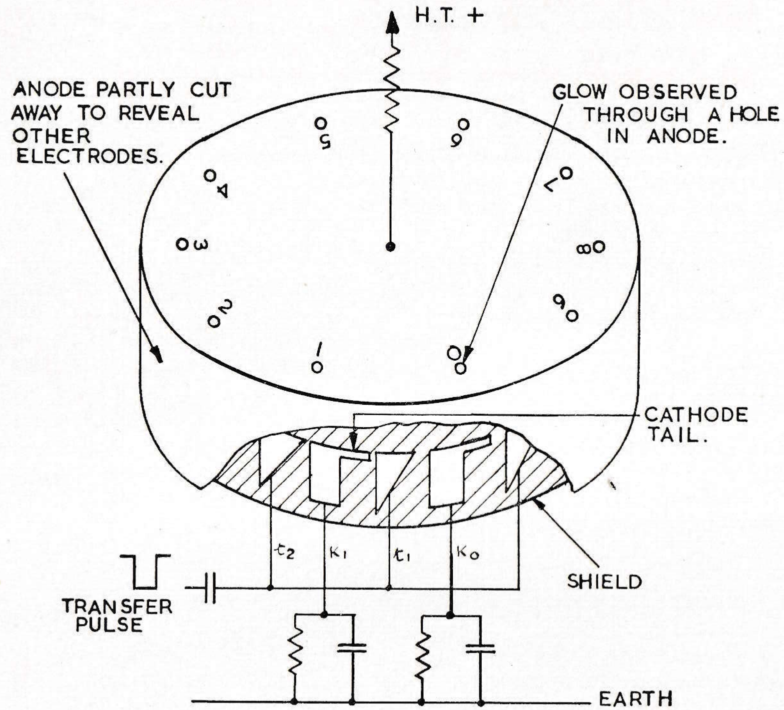


Fig. 2 Electrode structure and principal electrical connections (simplified).

If a glow discharge be assumed between the anode and k_0, the potential between them will be the normal maintaining voltage of a gas-filled valve ; the difference between this and the anode supply voltage is the voltage drop across anode and cathode load resistors. The asymmetric geometry of the cathode and transfer electrodes makes any shift of the glow discharge inherently unidirectional. When a negative pulse is applied to the transfer electrodes, the discharge is compelled to spread to the most strongly primed transfer electrode t_1 and the fall of anode voltage (due to increased current in the anode resistor) extinguishes the anode k_0 gap. At the end of the negative pulse, t_1 will return to its positive bias potential and since k_0 is positively biased by the residual charge in a capacitor in the cathode circuit the discharge moves to the most strongly primed unbiased electrode, i.e. k_1. At first, the discharge transfers to the cathode " tail " but quickly moves to the main part of the cathode to avoid the excessive maintaining voltage associated with high current concentration on the small tail area. Priming of t_2 is thus effected in readiness for the next transfer pulse.

The positively biased shield electrode confines the discharge to the front surfaces of the transfer electrodes and cathodes. The transfer mechanism may be appreciated by reference to the waveform diagram of Fig. 3 while the variation of current distribution can be obtained from the static characteristics shown in Fig. 4. It should be noted that curves with $R_k = 0$ are included, since, at the instant the discharge first moves on to a cathode, the impedance to earth instantaneously approaches zero before the cathode capacitor begins to charge.

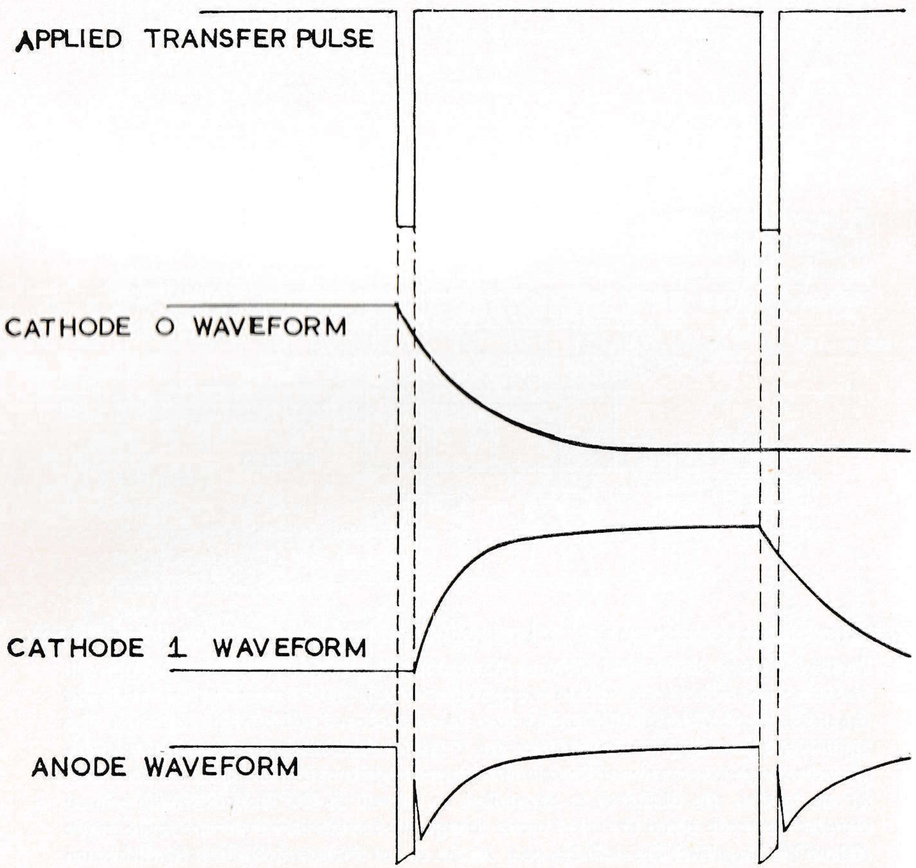


Fig. 3 Waveforms.

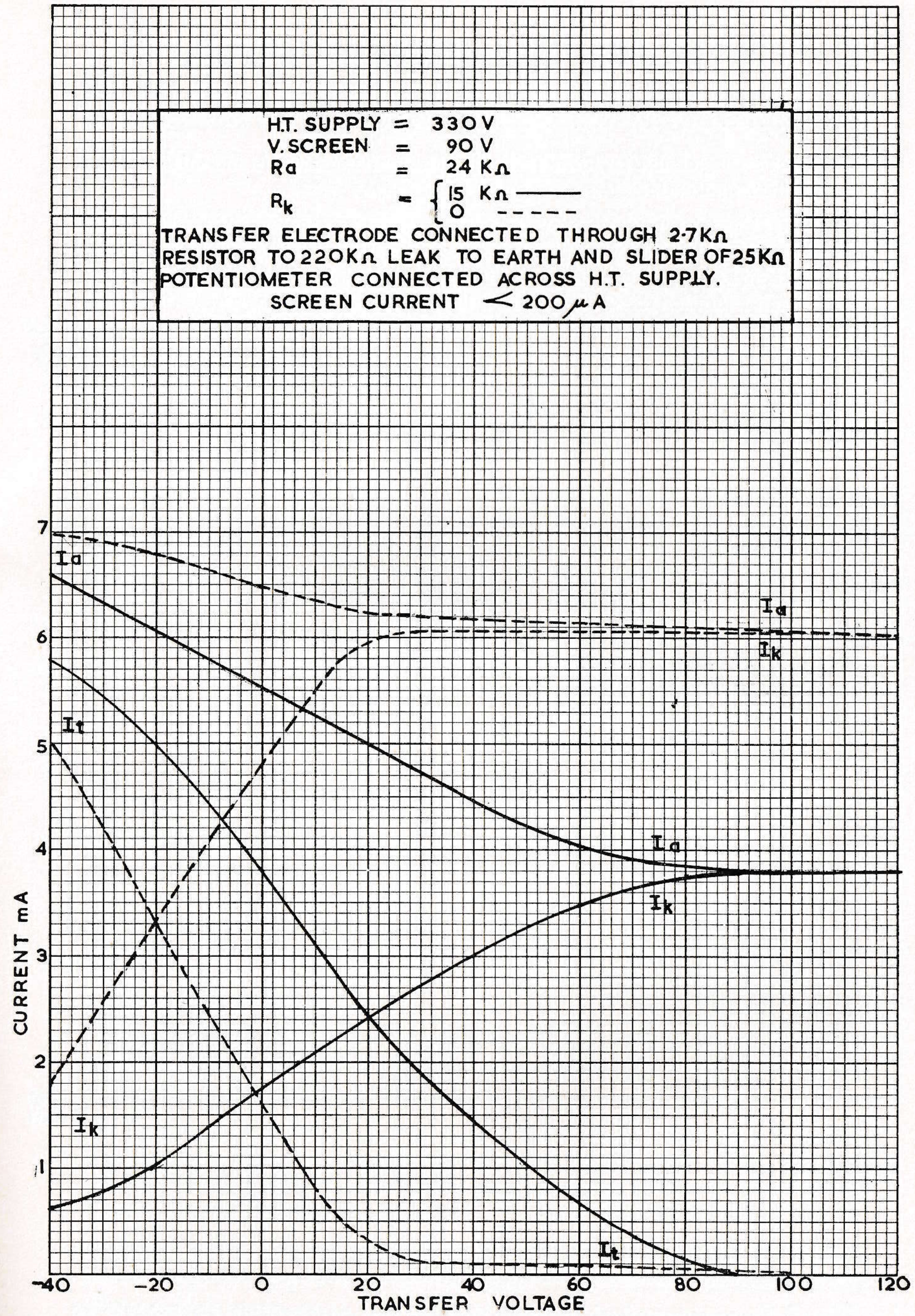


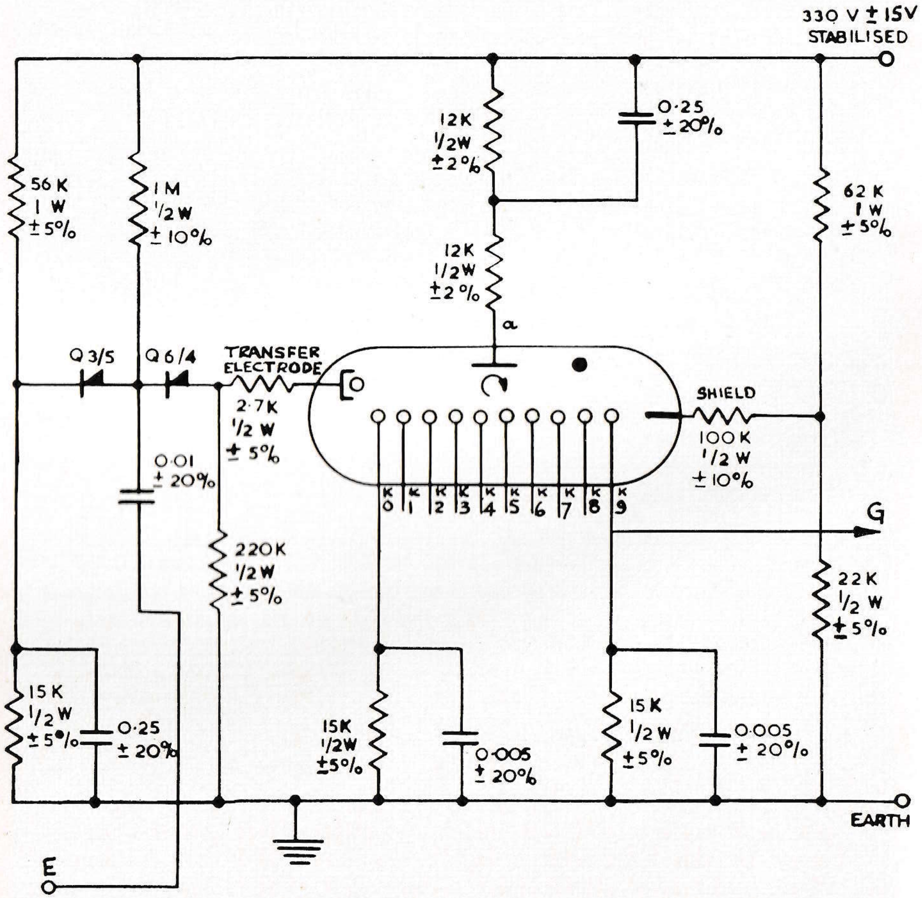
Fig. 4 Static Characteristics

4. PRINCIPAL CIRCUITS AND NOTES

4.1 CIRCUIT FOR OPERATION UP TO 5 ks/s

A basic operating circuit is shown in Fig. 5. The transfer electrode and shield bias are obtained from potentiometers across the power supply.

Sen Ter Cel Unistor type Q3/5 provides D.C. restoration of applied pulses. *Sen Ter Cel* Unistor type Q6/4 isolates the input circuit from the transfer electrode during quiescent conditions and permits a condition of bias equilibrium across the transfer leak resistor. For the pulse duration the Q6/4 Unistor is in its forward conducting state.



NEGATIVE SQUARE PULSE INPUT 120 ± 15V × 16 ± 4μ sec WIDE

N.B. The cathode circuits of cathodes 1 to 8 have been omitted from the diagram for simplicity. Resistance is in ohms, capacitance in μF.

Fig. 5 Recommended circuit values for operating G10/241E at speeds up to 5 kc/s.

4.2 TIME CONSTANTS OF CATHODE CIRCUITS

The rise of voltage across the cathode resistor is determined by the time constant of the cathode capacitor and the effective resistance of the anode and cathode resistors in parallel.

$$\text{i.e. } \tau_1 = \frac{R_a R_k}{R_a + R_k} C_k$$

The decay of voltage across the cathode resistor is determined by the time constant of the cathode resistor and capacitor, i.e., $\tau_2 = R_k C_k$. The minimum capacitance is set by the requirements for the cathode voltage to remain above 33 volts until the end of the transfer pulse, whereas the maximum value is determined by the need for the p.d. across the capacitor to decay to less than 5 volts before the cathode is required to conduct again. During the transfer pulse the voltage on the cathode previously conducting is given by $V_{k(T)} = V_{k(b)} + (V_{k(q)} + V_{k(b)}) \exp(-t/R_k C_k)$, where $V_k(b) =$ applied cathode bias voltage (normally zero and $V_k(q)$ = steady cathode voltage during conduction.

In straight counting it is unnecessary to have more than three RC cathode circuits provided that the charge on the capacitor decays sufficiently during interpulse periods. Under these conditions k_1, k_3, k_5, k_7, and k_0, k_2, k_4, k_6, k_8, respectively, are joined together; k_9 has its own circuit since the out putpulse for operating further circuitry is taken from this cathode. Any other cathode to which reference is to be made must also have its own circuit.

To give a sharper termination to the output pulse from a cathode, it is sometimes convenient to connect the cathode resistor to a negative line and prevent the cathode potential from falling below zero by catching with a diode. This technique is illustrated in figure 11b on page 17.

4.3 TRANSFER PULSE CHARACTERISTICS

The broad requirement of the transfer pulse is that it should be of sufficient amplitude to reduce the anode-earth potential to less than 160 volts, and that its width should be such as to ensure that the glow spreads across the transfer electrode surface during that time. It will be seen that the pulse should be as wide as possible, but must be directly related to the cathode circuit time constant, since it is necessary to ensure that there is a bias voltage on the previously conducting cathode of at least 33 volts at the end of the pulse.

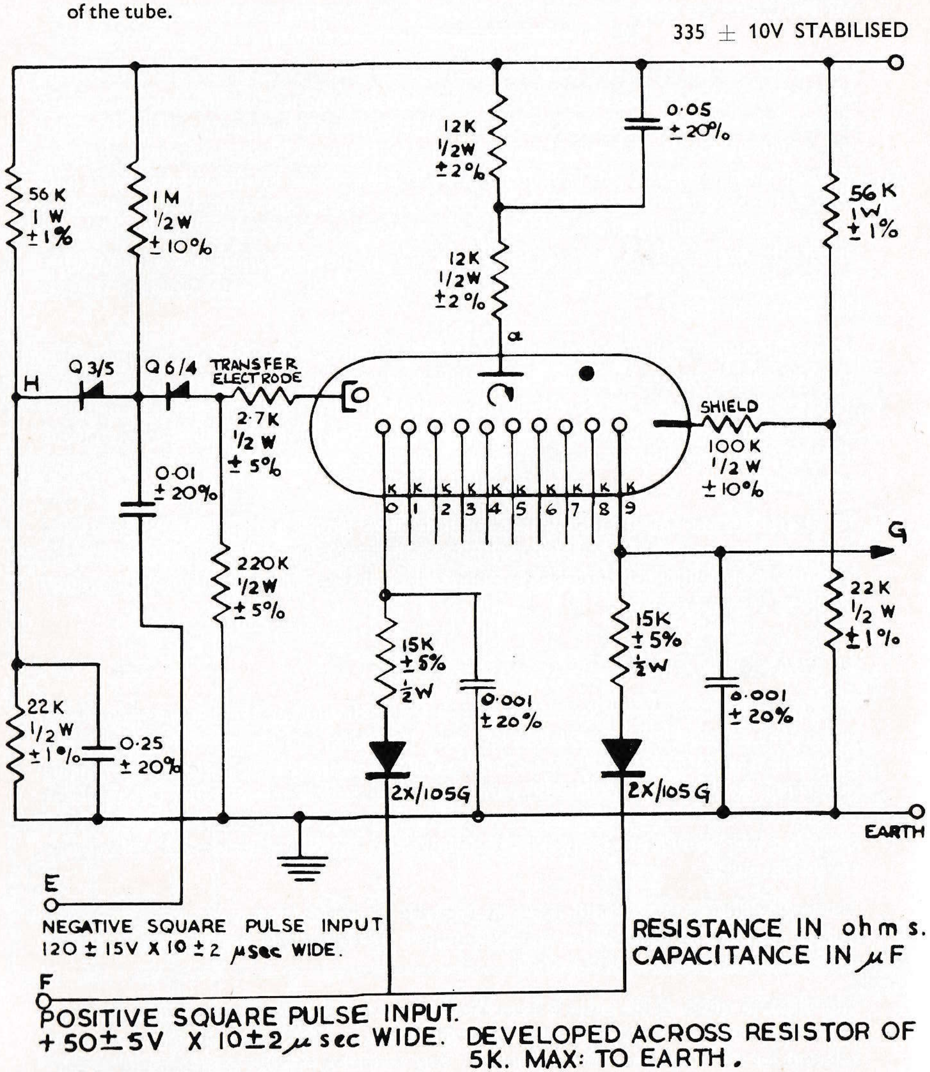
The lower limit of pulse width is set by the rate of spread of glow over the electrode surface and may be reduced to approximately 4 micro-seconds provided the transfer pulse source impedance is kept small.

The effective width of the pulse is from the time the anode volts start to fall to the time at which the anode-earth potential difference rises to 180 volts. At this point the adjacent forward cathode will break down. Any variation in pulse shape should be considered in the light of these requirements.

The input impedance which this circuit, with the G10/241E inserted, offers to the pulse source is approximately 13 kilohms. The pulse source should be matched to this load value.

4.4 OPERATION AT FREQUENCIES HIGHER THAN 5 kc/s

Satisfactory operation can be obtained with the circuit shown in Fig. 5 at frequencies higher than 5 kc/s. The cathode time constant must be made so short, however, that the transfer pulse width must be limited to an extent which may reduce the reliability of the tube.



N.B. The cathode circuits of cathodes 1 to 8 have been omitted from the diagram for simplicity. The shield electrode may be connected alternatively via 100K to point H. The 2X/105G has been re-coded GD8.

Fig. 6 Recommended circuit values for operating G10/241E at speeds up to 20 kc/s.

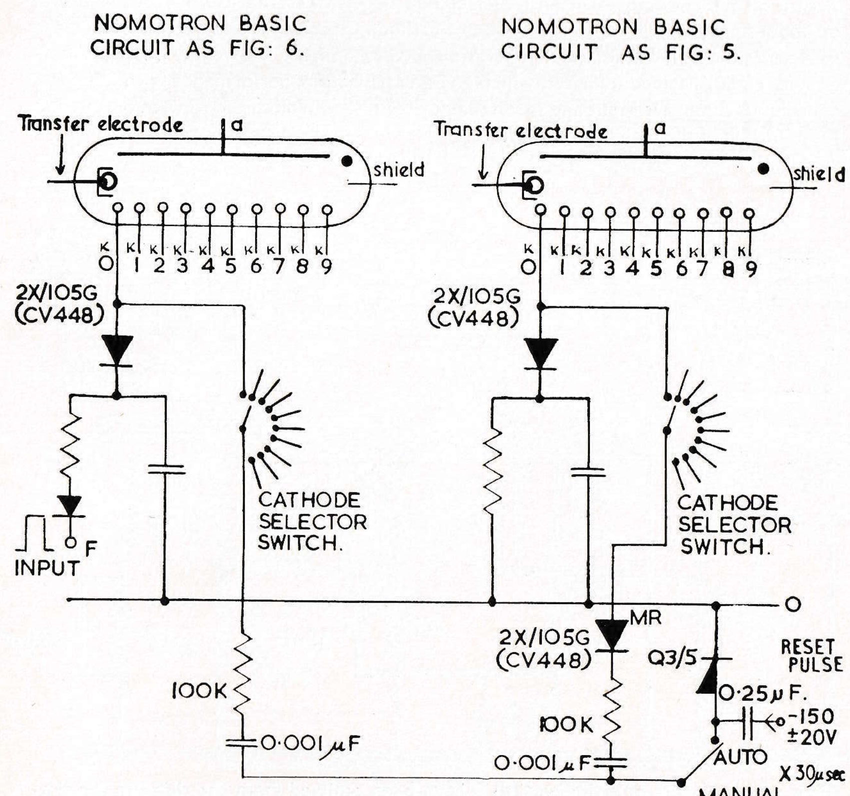
A sufficient pulse width may be combined with a very short time constant provided that discharge of the cathode capacitor is prevented until the end of the transfer pulse. Such a circuit is illustrated in Fig. 6 where a positive pulse simultaneous with the transfer pulse prevents conduction of the diodes in the cathode capacitor discharge circuits. Few extra components are necessary, since the positive pulse may also be derived from the output stage of the transfer pulse generator (Fig. 10, Section 5·3).

As an alternative, a pulse transformer or paraphase amplifier may be employed.

4.5 SWITCHING ON AND RE-SETTING

Switching on will probably produce breakdown at a cathode other than the desired one, and occasionally at two or more cathodes simultaneously which prevents glow stepping. Methods of obtaining breakdown at a single specific cathode or re-setting to that cathode are as follows :—

(a) Temporary disconnection of all other cathodes and the transfer leak resistor from the H.T. negative line.



N.B. The 2X/105G has been re-coded GD8.

Fig. 7 Basic reset circuits.

(b) Momentarily switching the required cathode to a negative supply.

(c) Applying a negative pulse to the required cathode. The width of this pulse must exceed that of the transfer pulse.

A circuit illustrating these last two methods is given in Fig. 7.

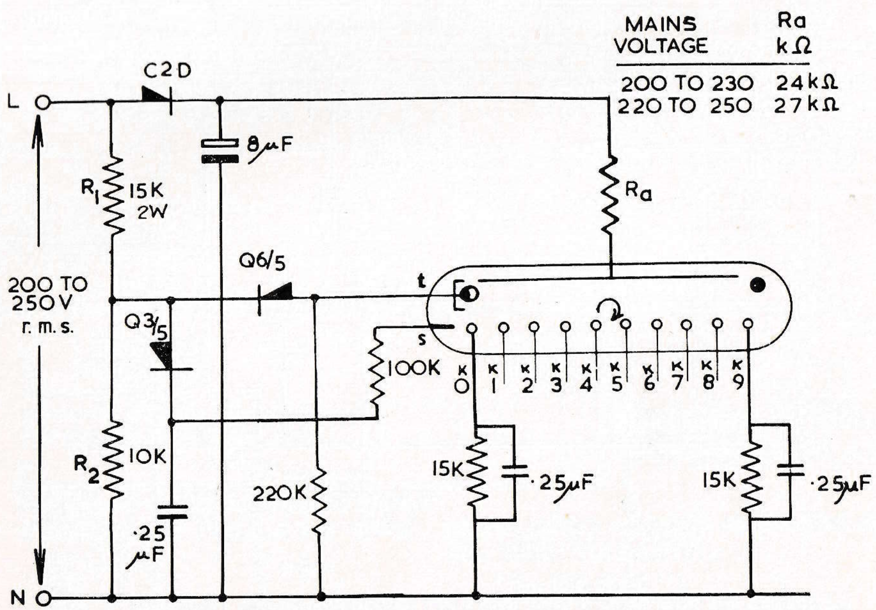
For simple counting only the zero cathodes need be wired for re-setting and the selector switch becomes unnecessary.

For batching, re-setting to any cathode may be required and a diode should be included between each cathode and its RC circuit.

Where a positive pulse is used to delay the cathode capacitor discharge in the first Nomotron stage (as in Fig. 7) an isolating diode (MR) is required in all subsequent re-set circuits.

4.6 OPERATION BY DIRECT SINE WAVE INPUT

Direct sine wave drive is not generally recommended because the comparatively long period of discharge to the transfer electrode necessitates the use of large values of cathode capacitance. For a given value of cathode capacitance and supply voltage the frequency range for satisfactory operation is very limited. However, a fairly simple circuit (Fig. 8) has been devised which gives a satisfactory performance with 50-60 c/s continuous sine wave input and is suitable for count-down circuits giving an output at a sub-multiple of the mains frequency.



N.B. The circuits of cathodes 1 to 8 have been omitted from the diagram for simplicity.

Fig. 8 Circuit for 50—60 c/s sine wave drive.

The capacitor which normally shunts one of the anode load resistors is omitted to avoid excessive current flow through the tube. The resistive potential divider (R_1, R_2) may be modified with reactive elements to phase shift the cathode waveforms relative to the mains sine wave. If isolation from the mains supply is required, the potential divider can be replaced by a transformer with 100 V r.m.s. output, and an anode supply voltage of about 315 volts provided.

4.7 GENERAL REMARKS

The anode resistor should be mounted as near the anode as can be achieved, and stray capacitances kept to a minimum. Stray capacitances affect the rate of rise of anode voltage with the trailing edge of the pulse, and it is desirable that this should be as rapid as possible.

There are no photoelectric effects and consequently the valve may be used in bright sunlight, darkness, artificial lighting, etc., without change in characteristics.

5. AUXILIARY CIRCUITS AND NOTES

5.1 GENERAL NOTE

The circuits which follow are intended as a guide and it may be found that alternative and perhaps simpler arrangements are better for particular, rather than general applications. A schematic diagram showing the relationship of the circuits is given in Fig. 18 appended for convenience in pull-out form.

Component tolerances are ±10% for resistors, and ±20% for capacitors except where otherwise stated.

5.2 PULSE SHAPING CIRCUIT

The output pulse width is determined by the RC time constant of the final (flip-flop) stage and if discrete input pulses with a rate of rise exceeding 40 V/μsec are available they may be fed directly into the differentiating network at point C, Fig. 9(a).

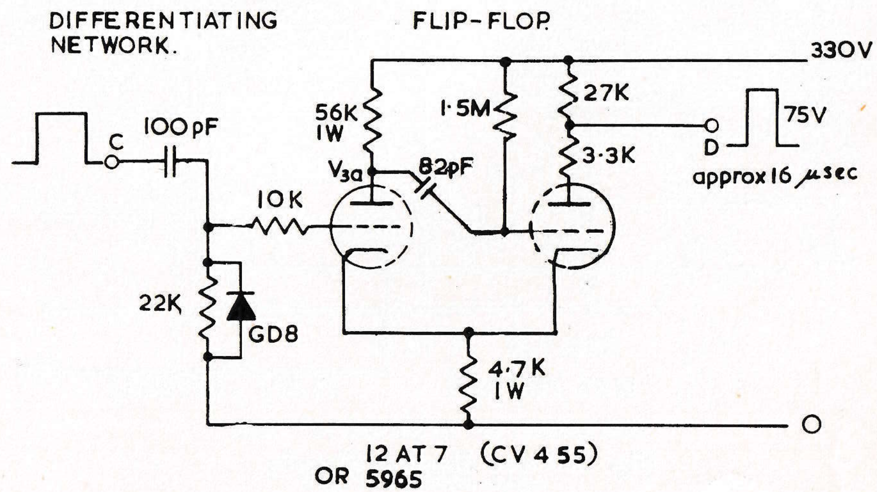


Fig. 9a Pulse Timing Circuit.

Input waveforms of various shapes may be catered for by preceding the pulse timing circuit fig. 9a by a pulse shaping circuit fig. 9b. A positive input is applied to terminal A but a negative input or sine wave is applied to terminal B. A d.c. coupled amplifier permits waveforms of low amplitude (down to 5 V peak) and low rate of rise to be used, and the output of this stage is converted to a sharply rising pulse by means of a Schmitt trigger circuit. The voltages at the grid of V_{2a} should be set so that the trigger circuit operates from the input signals, but not on stray signals (e.g. mains frequency). The "speeding up" capacitor shunting the resistor between V_{2a} anode and V_{2b} grid must be very small if the input waveform is not to distort the squareness of the output.

For gating the input pulses, a suitable valve such as gating heptode type 7032 may be introduced into the circuit. For positive input replacement of valve V1 (a) by the gating valve is often a convenient arrangement. Alternatively, the gate valve may be inserted between the flip flop and the driver stage. If type 7032 is used, care must be taken to design the circuit so that its anode and screen voltage ratings are not exceeded.

The width of the output pulse may vary slightly with frequency, and will tend to be shorter at high frequencies, which is the general requirement of the Nomotron.

The bias line may be stabilised by use of type G55/1K Stabiliser.

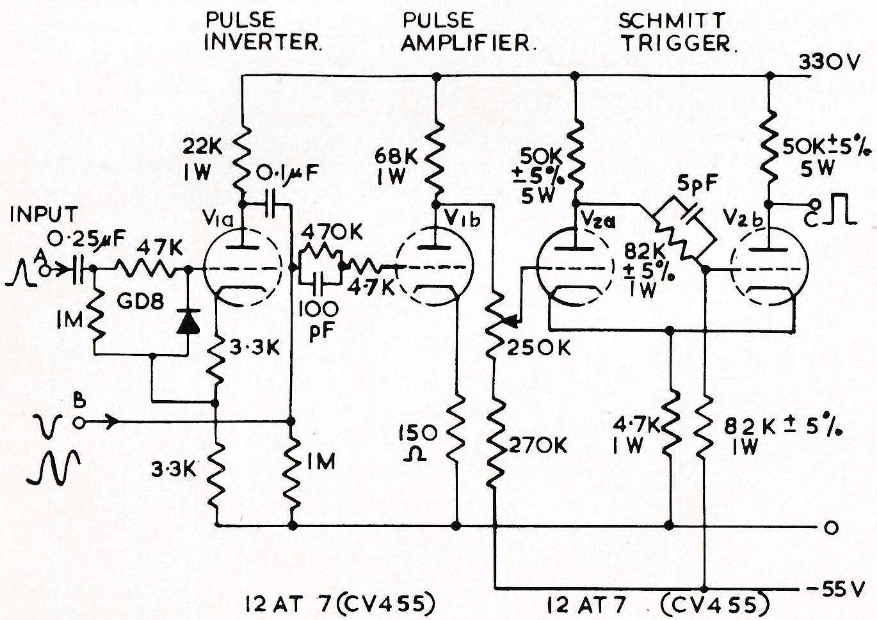
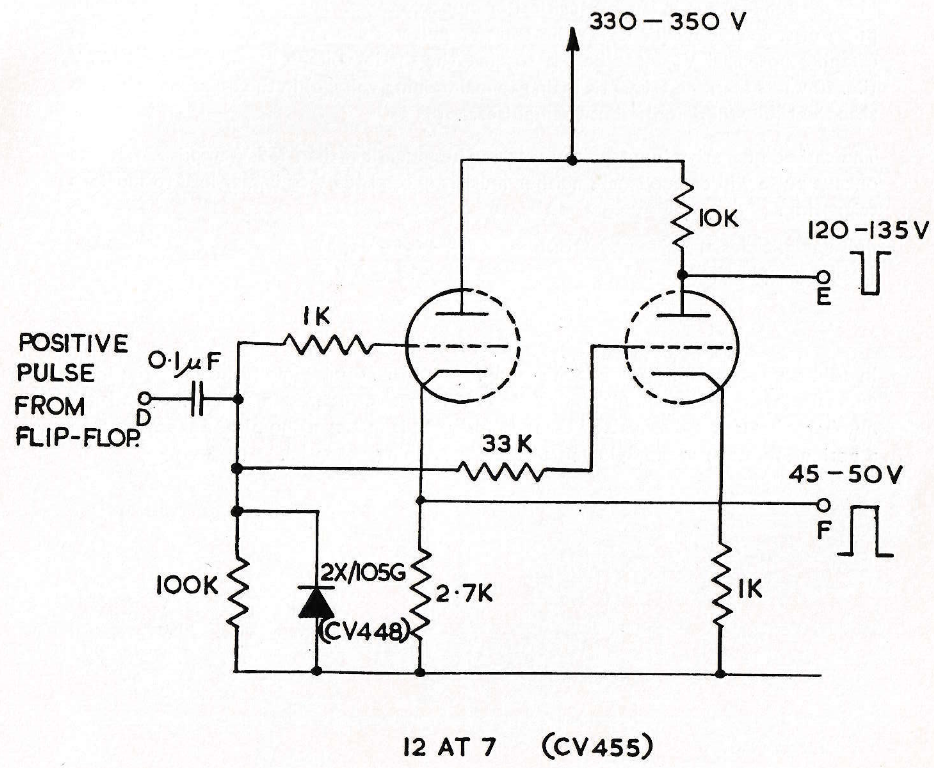


Fig. 9b Pulse Shaping Circuit.

5.3 DRIVER STAGE (Fig. 10)

The circuit illustrated uses a double triode so that one section gives the negative pulse to operate the first Nomotron, while the other acts as a cathode follower to provide the positive pluse to drive succeeding hard-valve coupling stages and also to delay the discharge of the first Nomotron cathode capacitors if the type of operation outlined in Section 4·4 is required.

A gating stage may be inserted between the pulse shaping circuit and the output stage. Alternatively, the double triode may be replaced by a suitable pentode paraphase amplifier, and gating performed by the application of suitable waveforms to the suppressor grid. Precautions should be taken to ensure that gating action does not occur *during* a transfer pulse.



N.B. The 2X/105G has been re-coded GD8.

Fig. 10 Driver stage.

5·4 COUPLING CIRCUITS (Fig. 11)

(a) Hard Valve Circuit (Fig. 11a)

The positive input pulse is gated by a diode coincidence circuit so that the coupling valve conducts only if the discharge is on (but just about to leave) cathode 9 of the previous Nomotron. By using additional coincidence diodes (as illustrated) it must be arranged that the coupling valve conducts only if the discharge is on (but about to leave) the 9th cathode of all previous Nomotrons. To achieve this requirement it is necessary to use minimum capacitance in cathode 9 circuits to avoid double gating.

(b) Cold-cathode Trigger Tube Circuit (Fig. 11b)

This circuit enables a multi-stage Nomotron unit to be constructed without any valve heater supplies, but it is more critical of input voltages. It requires a negative input pulse of the same frequency as the transfer pulse of the first Nomotron stage. The catching potential V_c must be set to that the anode voltage does not exceed 165 V (i.e. 10 V less than the G1/371K main gap maintaining voltage) in the quiescent state, so that the tube will deionise between pulses.

The cathode negative input pulse must not be much less than 155 V amplitude or the output pulse will be too small, neither must it exceed 165 V or it may lead to spurious triggering.

Pulse amplitudes are given by $V\,out = V\,in - V_c - Va(m)$

Inserting typical values : $= -160 - 40 + 180$ V

$= -120$ V

In either type of coupling circuit the catching potential source impedance must be small compared with all the coupling valve anode resistors considered in parallel. For a large number of stages a d.c. biassed cathode follower is more economical on power than a potientiometer for supplying an adjustable catching potential.

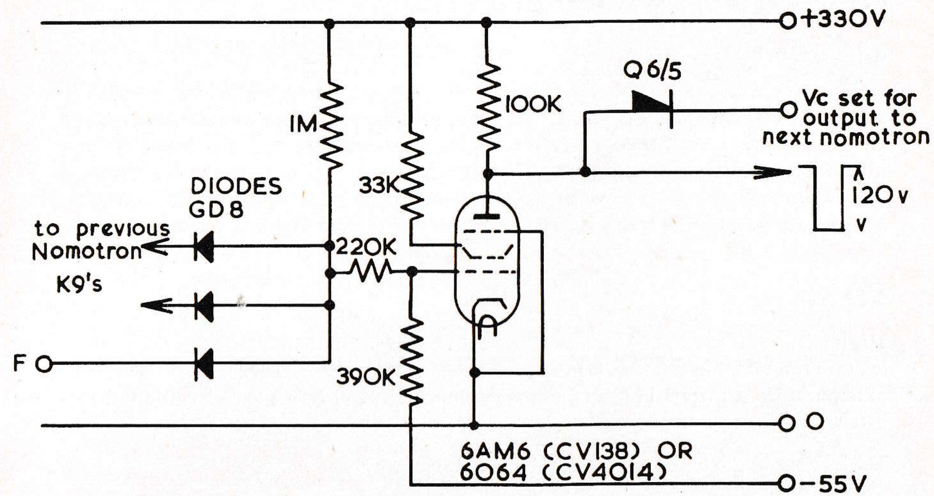


Fig. 11a Coupling circuit using hard valve.

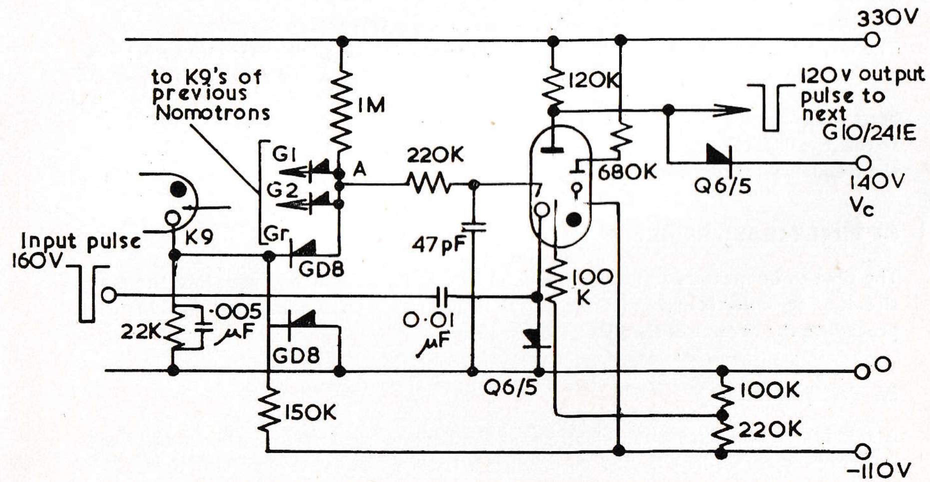


Fig. 11b Coupling circuit using cold-cathode trigger tube.

6. APPLICATIONS

6·1 COUNTING

Counts of large numbers of pulses may be made by a Scaler consisting of several Nomotron stages coupled together, the first counting unit pulses, the second tens of pulses and so on. Two typical circuits of 3-stage scalers are given at the end of this report ; figure 19 shows a scaler using hard coupling valves operating in the manner described in section 5·4 (a) and figure 20 a scaler using cold-cathode coupling tubes as described in section 5·4 (b).

6·2 BATCHING

The fundamental concept of batching is that after a given number of impulses have been fed into the batching counter, it initiates a terminating action which cuts off the source of impulses (e.g. material objects passing a photo cell) and resets it to count another batch.

The number in the batch may be set in one of two ways :—

(a) The Nomotron discharges may be re-set to zero cathodes, and rotary switches used to select the appropriate cathode of each Nomotron which will open the coincidence gate to allow the terminating action to occur.

(b) The Nomotron discharges may be re-set at the cathode digits which form the difference between the number in the batch and the maximum number to which the Scaler can count. The terminating action is then initiated when the discharge in the final Nomotron reaches the zero cathode.

6·3 FREQUENCY MEASUREMENT

The waveform to be measured is fed into a pulse shaping unit and thence into a Nomotron Scaler which has been set at zero.

Start and stop pulses, spaced by an accurately known interval, are fed into a gate circuit so that the final reading of the Scaler is the number of cycles in the time interval. Hence the frequency may be determined.

6·4 TIME MEASUREMENT

The time to be measured must be bounded by two pulses which are fed into the gate circuit. The Scaler is driven from a source of accurately known frequency making the procedure the reverse of that described in 6·3.

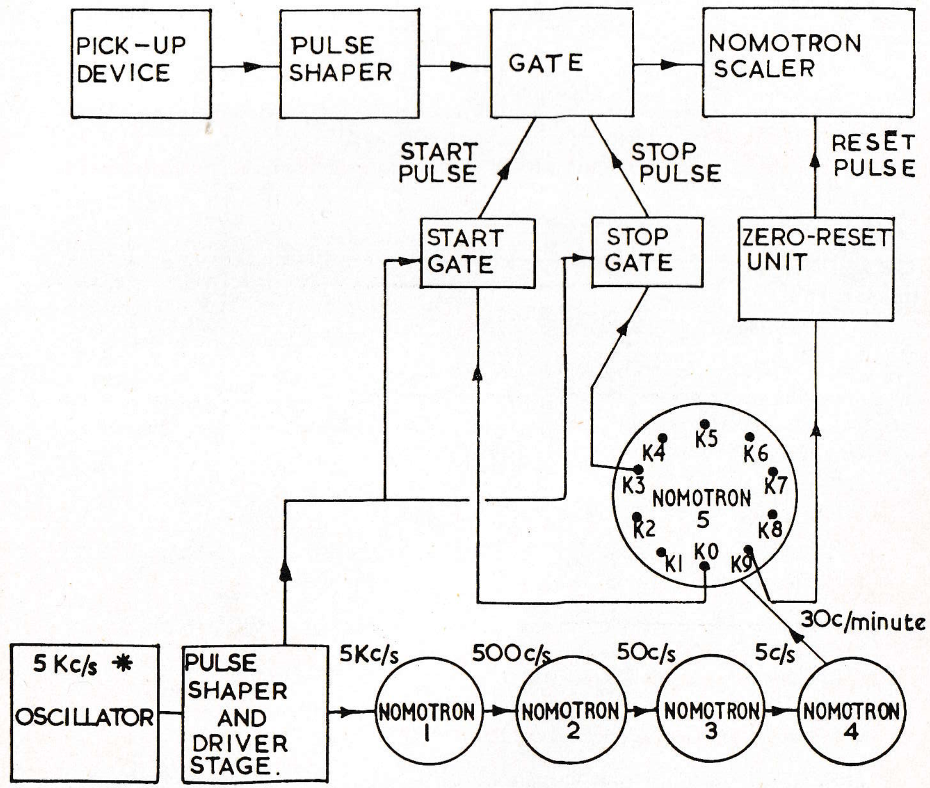
6·5 TACHOMETRY

A suitable device (such as an electromagnetic pick-up or a lamp and photo-cell, (e.g. *SenTerCel* type PG50A,) is used to produce a known number of waves or pulses per revolution.

The pulses are counted by a Nomotron Scaler over a period fixed by start and stop pulses fed into the gate circuit.

The start and stop pulses may be accurately timed by initiating them from a crystal-oscillator-operated count-down circuit using Nomotrons.

If there is adequate delay between the stop and re-set pulses the rate of revolution may be read directly from the Scaler.



N.B. For diagrammatical simplicity, the essential connections from the 9th cathodes of nomotrons 1 to 4 to the start and stop gates have been omitted.

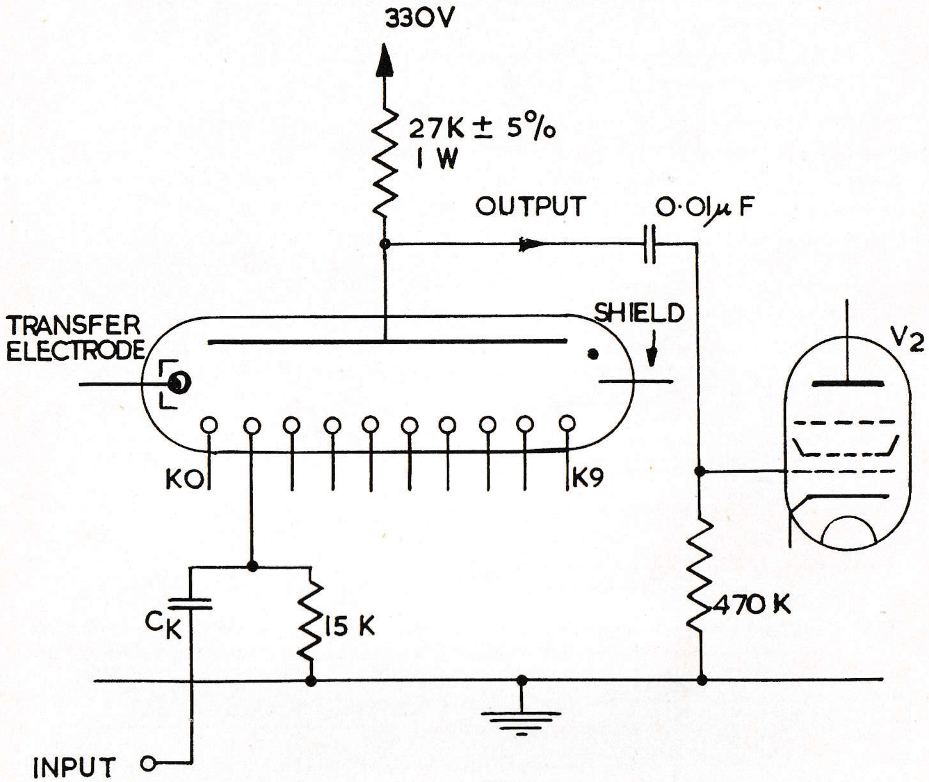
Nomotron 5 serves the dual purpose of helping to time the interval between start and stop pulses and timing a ten second delay before the scaler is re-set to zero.

*An STC quartz crystal Type 4024 may be incorporated.

Fig. 12 Schematic diagram of a tachometer.

6·6 SEQUENTIAL MONITORING APPLICATIONS (e.g. Telemetry)

As the Nomotron has a comparatively low a.c. resistance, signals fed in at a cathode may be observed at the anode without serious attenuation. Various signals fed in at different cathodes may be sampled in turn by sweeping the glow in the normal way. A basic circuit is illustrated in Fig. 13.



N.B. For transfer electrode and shield circuits see Figures 5 or 6. Circuits of cathodes not required for monitoring are as Figures 5 or 6.

Fig. 13 Basic circuit for sequential monitor applications.

Signals may be injected on the earthy side of the cathode capacitor, e.g. by means of a cathode-follower. Unless the resistance between the input terminal and earth is very much smaller than 15 kilohms it should be shunted by a capacitor of such value that, considering it in series with C_k the effective capacitance exceeds the critical minimum for adequate cathode time constant. Low frequency signals may be more conveniently injected into the cathode circuit by transformer coupling. It will be noticed that the anode load by-pass capacitor should be omitted.

The input signal should not exceed 10 V peak-to-peak, so that the operation of the Nomotron stepping mechanism is not impaired. The impedance of a typical Nomotron anode/cathode gap varies with the frequency of conducted signal, as shown in Figure 13(a).
A high stepping speed may be achieved by the method indicated in section 4·4.

The cathode capacitor used should have the smallest value consistent with the time constant requirements, since this gives the squarest anode and cathode waveforms with the longest flat top. This is the most useful portion of the waveform on which signals may be superimposed without appreciable distortion. Time constants are compared for different frequencies in Fig. 14.

Telemetry switching and the extension of a single beam oscilloscope to a multi-channel device are two examples of the above technique.

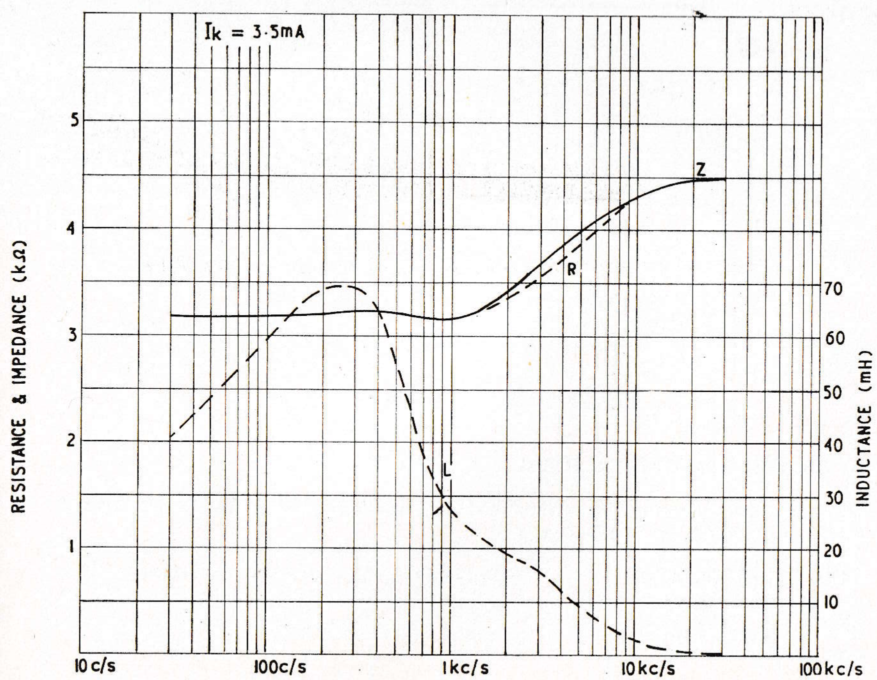
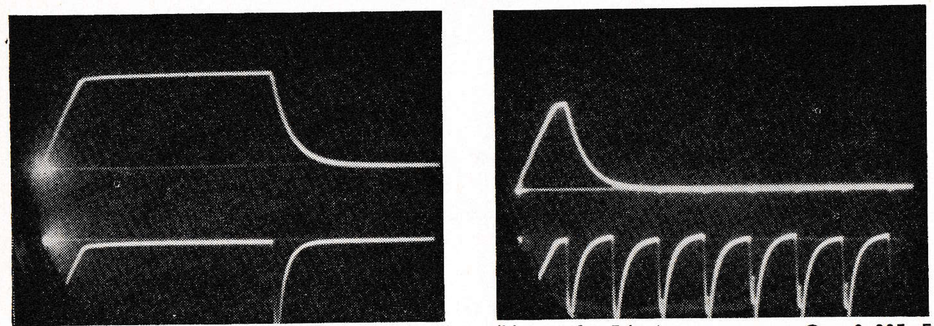


Fig. 13(a) Typical Impedance/Frequency Characteristics of G10/241E

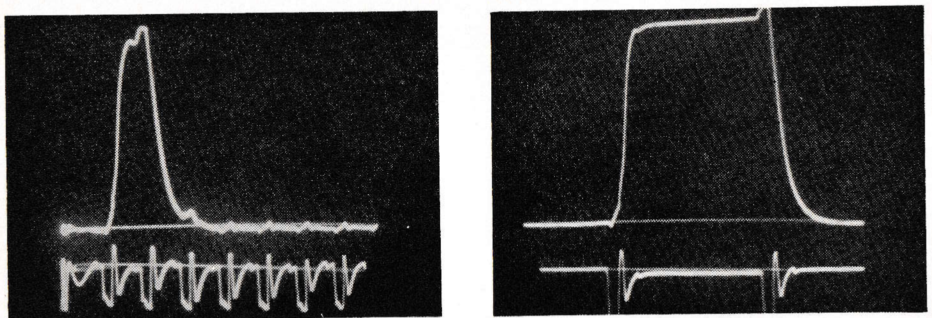
(Average of 10 discharge gaps).

Circuit as Fig. 5



(a) p.r.f.=1 kc/s C_k=0·005μF   (b) p.r.f.=5 kc/s C_k=0·005μF

Circuit as Fig. 6



(c) p.r.f.=20 kc/s C_k=0·001μF   (d) p.r.f.=5 kc/s C_k=0·001 μF

N.B. In each oscillogram, the upper curve is the cathode waveform and the lower curve the anode waveform.

It should be noted that the voltage and time scales in (a) and (b) differ from those in (c) and (d).

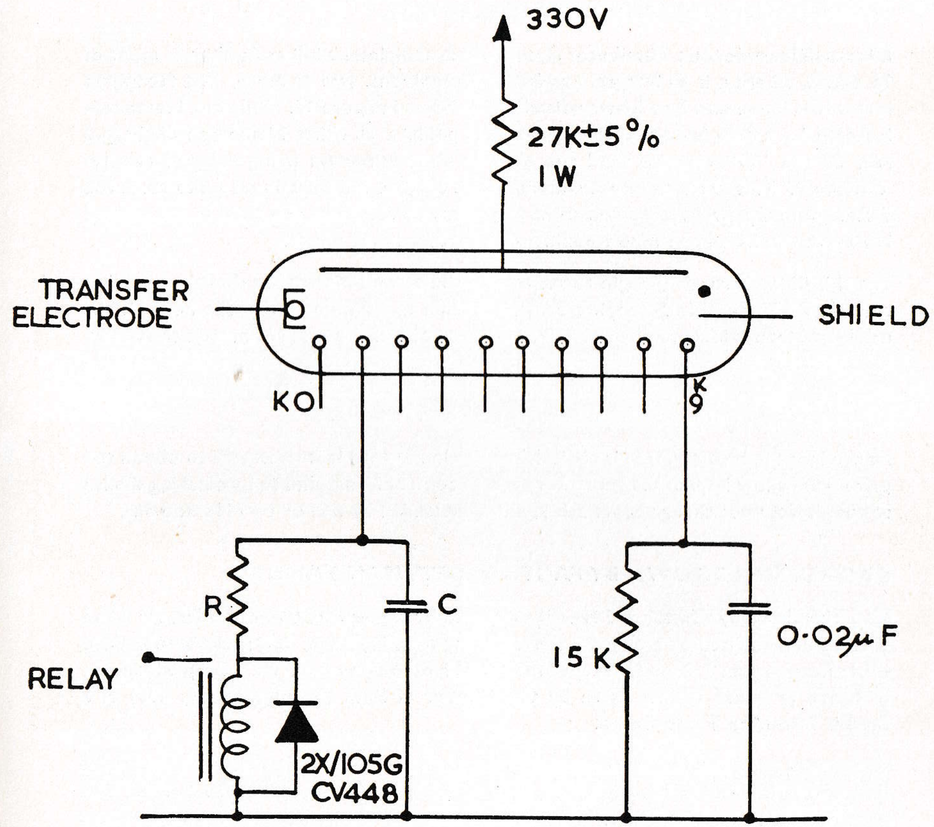
Fig. 14 Typical Waveforms

6·7 ELECTROMAGNETIC RELAY OPERATION (Fig. 15)

The current carrying capacity of the Nomotron enables it to operate electromagnetic relays connected in the cathode circuits.

Relays should be chosen in which the coil resistance approaches 15 kilohms as nearly as possible. Satisfactory operation can be achieved with STC Midget Relay Type 4193.AA (which has 2 change-over contacts) or STC Relay Type 4600 limited to one change-over contact.

As the coil inductance reduces the effective time constant a larger cathode capacitor must be used to compensate. A damped oscillation ensues when the discharge moves to another cathode unless a diode is connected across the relay. Such an oscillation would cause the cathode to swing negative and so encourage spurious back-stepping of the glow.



N.B. For transfer and shield circuits see Figure 5. Cathode circuits not incorporating a relay will be as for K9. The 2X/105G has been re-coded GD8.

Fig. 15 Basic circuit for magnetic relay operation.

Relay Type	Coil* Resistance (ohms)	Recommended values C(μF)	R(ohms)
STC Midget 4193.AA	6·8 K	0·1	8·2 K
STC Type 4600 Post Office Type 3000	6·5 K	0·5	2·2 K

*Please specify when ordering

6·8 COUNTING DOWN BY MULTIPLES OF 9

It is possible to devise a distributor circuit which completes a full cycle after an input of 9n pulses, where n is an integral number of Nomotrons, two or more. The technique involved is illustrated by a 27-way distributor shown in figure 16. Only one Nomotron is stepped at a time (except at the change-over point) ; all other Nomotron discharges rest on the "O" cathode until the glow in the Nomotron being stepped reaches cathode 9. This gates the next coupling tube so that the next input pulse steps the discharge in the first Nomotron to k0 (and thus to rest) and the glow in the second Nomotron to k1 to continue stepping with further input pulses.

The third Nomotron will begin to step when the second Nomotron discharge reaches cathode 9. The chain of stepping continues from one Nomotron to the next. If the nth Nomotron is followed by the driver trigger tube of the first Nomotron the circuit becomes a ring counter with an output from any one Nomotron cathode once in every 9n pulses. An essential feature of the circuit is that each trigger tube (T) is gated by every Nomotron except the one which it drives.

As the input pulse amplitude is critical (see section 5·4 (b) it is necessary to obtain the pulse from a low impedance generator, and to control its amplitude by catching diodes so that it does not change appreciably, whether loaded by one or two Nomotrons.

6·9 COUNTING DOWN BY FACTORS BETWEEN 9 AND 5

Counting down by a factor of 5 is easily achieved by connecting two cathodes, say 4 and 9, to a common circuit which gates the following coupling stage. It is possible to achieve other factors, e.g., 9, 8, or 7, except in the first Nomotron stage. An example is shown in figure 17 which counts down by the number of lines per picture (i.e. 405) of a British Television Transmission.

The second and third Nomotrons are each made to do a double step for one input pulse between cathodes 4 and 6, by feeding back an extra gate pulse from each cathode 5 to each respective coupling tube. If more than one cathode in a single Nomotron feeds back extra gate pulses they should not be adjacent ; for example, if counting down by 8 is required, it is better to feed back pulses from cathodes 3 and 5 than from cathodes 4 and 5.

7. REFERENCES

1. Some Recently Developed Cold Cathode Glow Discharge Tubes (Part 3). G. H. Hough and S. D. Ridler. Electronic Engineering, June 1952, p. 272.
2. Decade Counter used as a Beam Switch. G. P. Tonkin. Electronic Engineering, July 1955, p. 318.
3. A Multi-Trace Cathode-ray Tube Display. K. E. Wood and T. C. Keenan. Electronic Engineering, March 1956, p. 105.
4. Batching and Counting using Gas-filled Decade Tubes. W. Grimmond and W. H. P. Leslie. Electronic Engineering, April 1956, p. 138.
5. An Improved Circuit for Reliable Operation of Nomotron Counter Tubes. T. M. Jackson, Electronic Engineering, July 1957, p. 324.

CIRCUIT DIAGRAMS

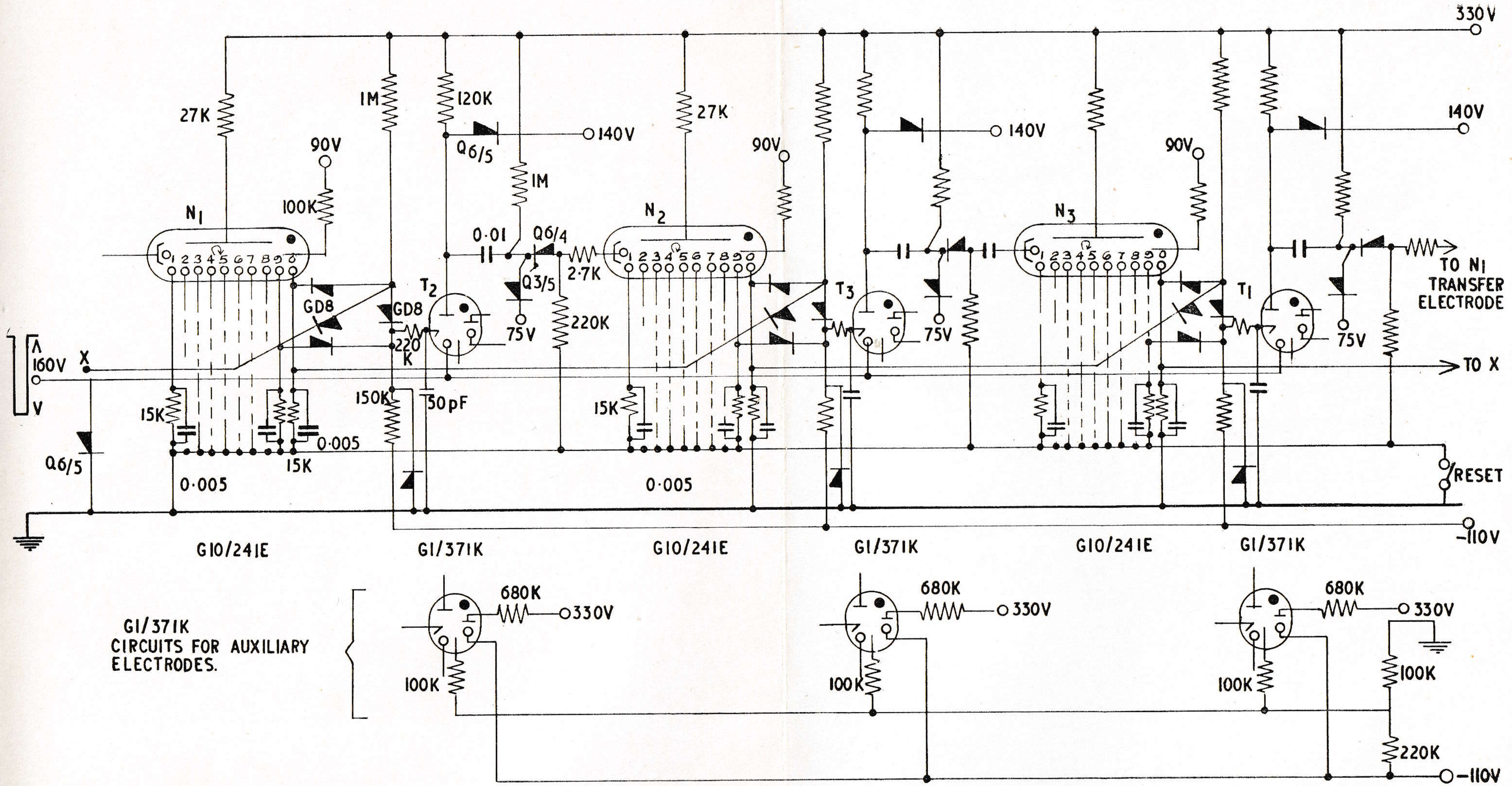


FIG. 16 27-WAY DISTRIBUTOR (VL 4614)

FIGURE 17

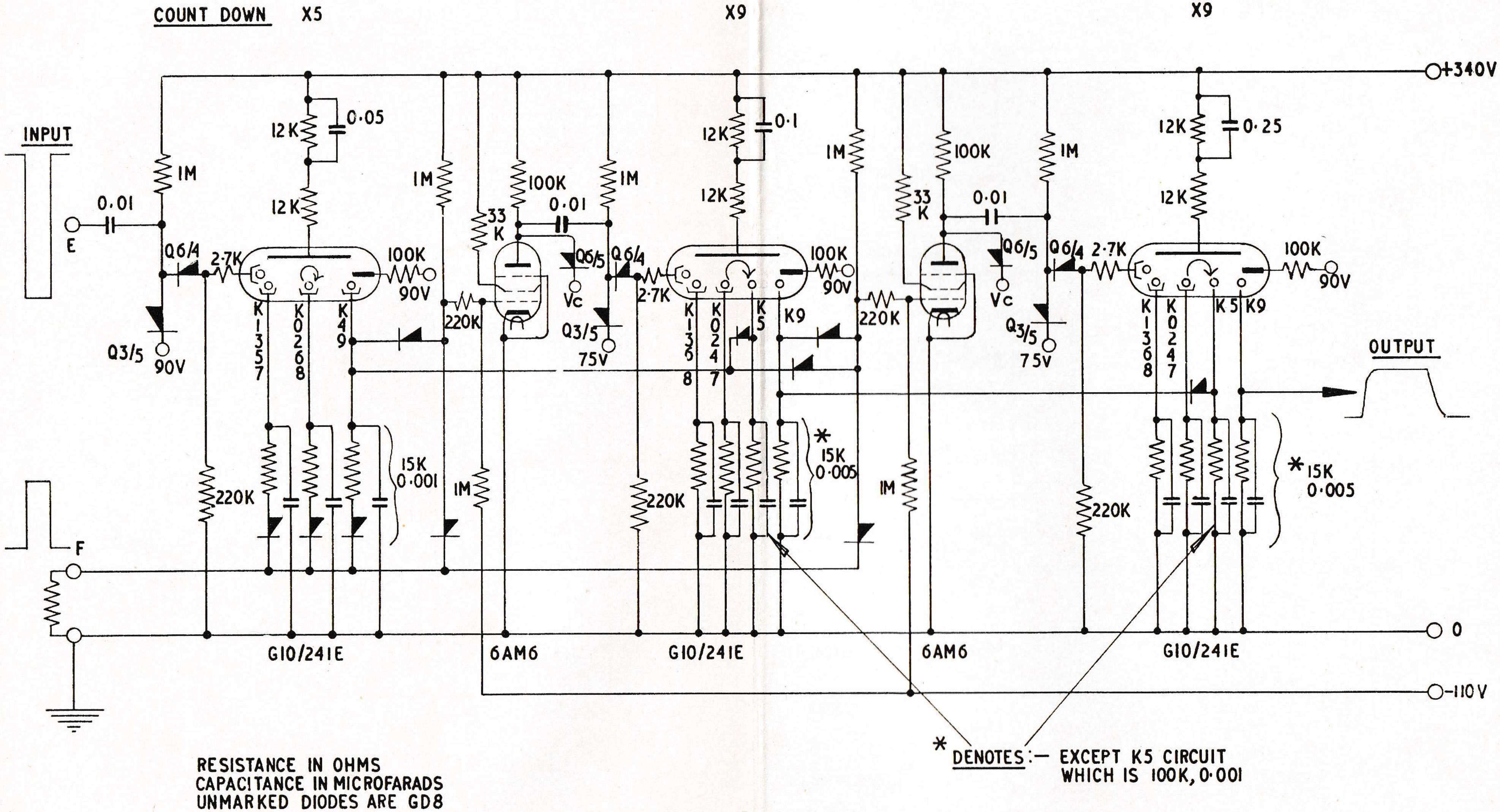


FIG. 17 20,250 C/S TO 50 C/S COUNT-DOWN CIRCUIT (VL 4615)

FIGURE 18

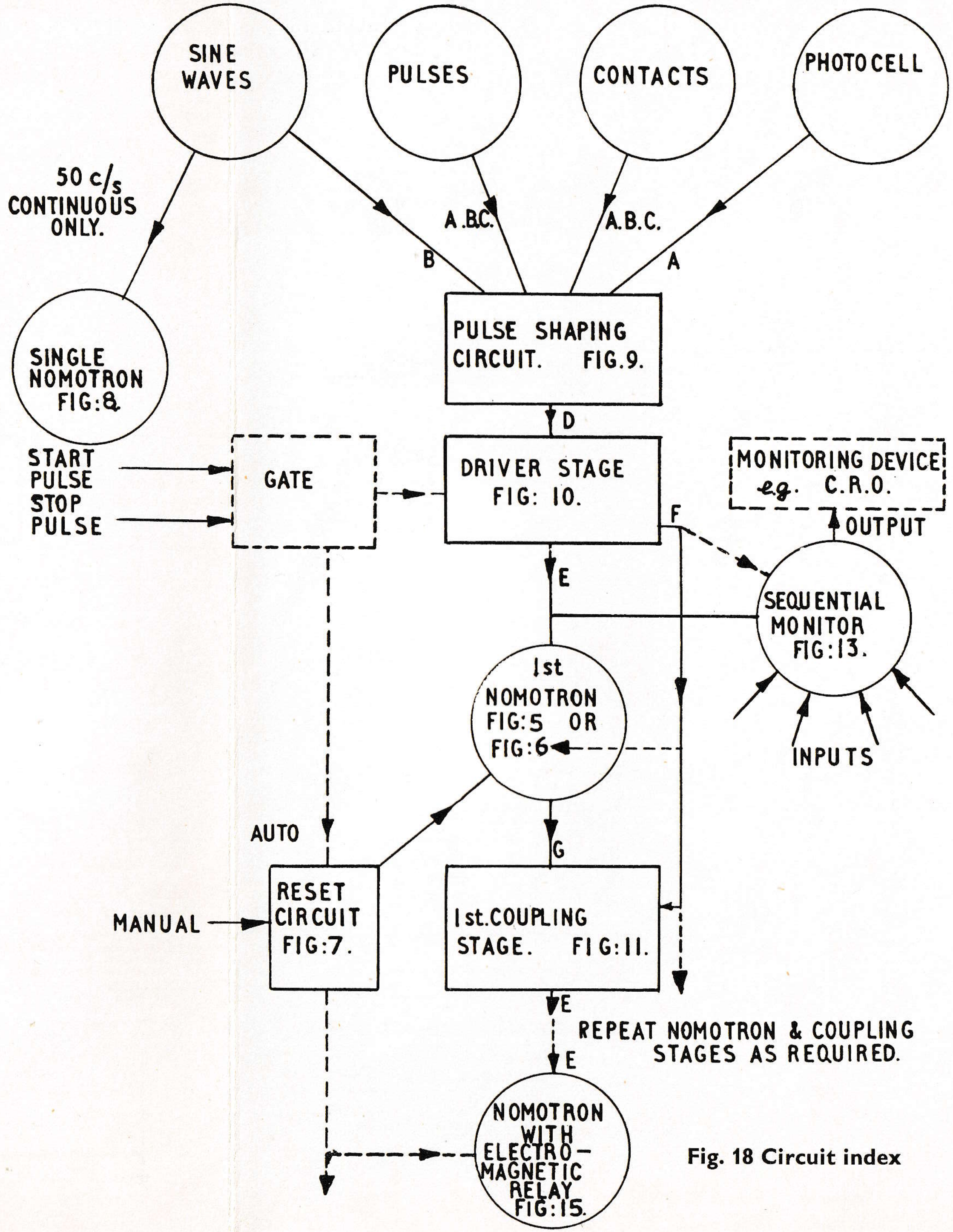
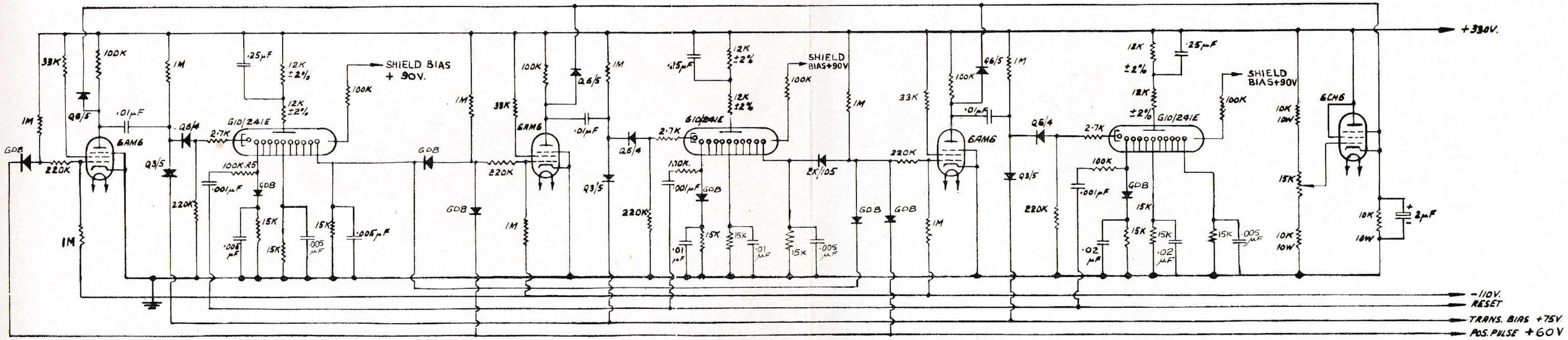


Fig. 18 Circuit index

FIGURE 19

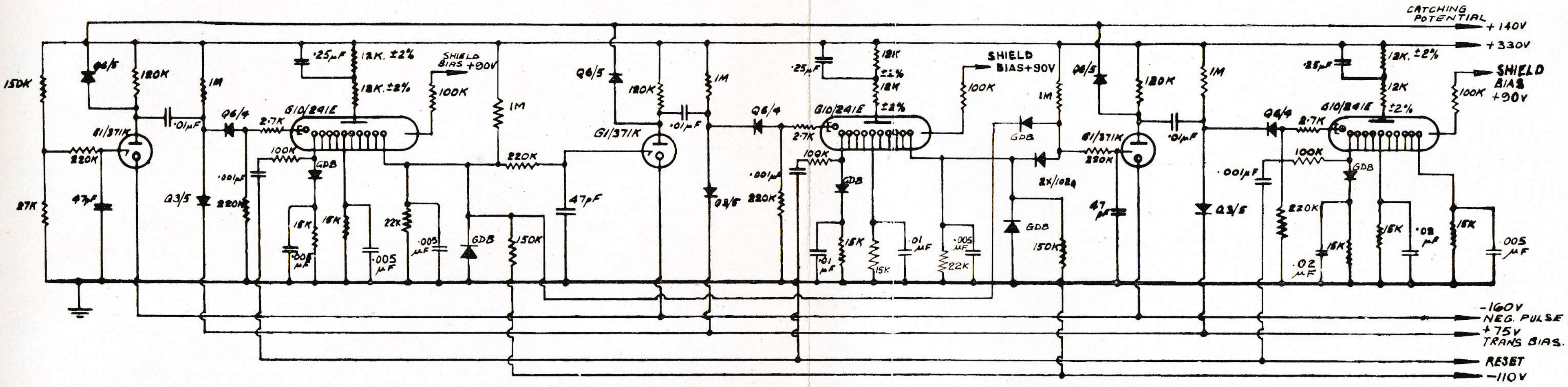


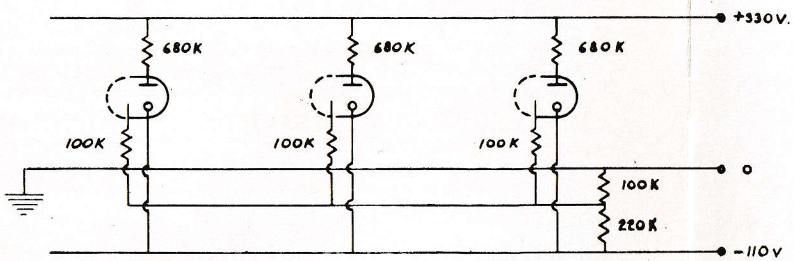
CATCHING VOLTAGE FOR 6AM6 ANODES SET TO GIVE A PULSE OF 120 V AMPLITUDE. INPUT PULSE HAS 16 μSECS WIDTH.

ALL CATHODES OF G10/241E SHOWN NOT CONNECTED HAVE A CATHODE RESISTOR OF 15K±5% AND ARE SHUNTED BY A CAPACITOR OF APPROPRIATE VALUE.

FIG. 19 A TYPICAL 3-STAGE COUNTER USING HOT-CATHODE COUPLING VALVES

FIGURE 20





CONNECTIONS TO PRIMING GAPS AND SHIELDS OF G1/371K

ALL CATHODES OF G10/241E'S SHOWN NOT CONNECTED HAVE A CATHODE RESISTOR OF 15K±5% AND ARE SHUNTED BY A CAPACITOR OF APPROPRIATE VALUE.

FIG. 20 A TYPICAL 3-STAGE COUNTER USING COLD-CATHODE COUPLING TUBES.

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