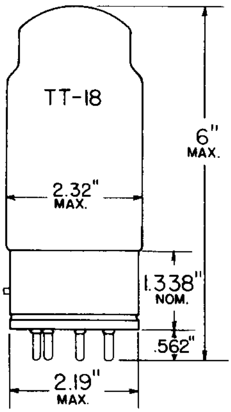
TUNG-SOL

TRIODE



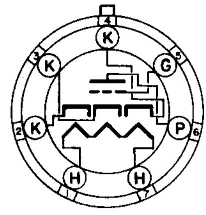
GLASS BULB

HEATER

6.3±10% VOLTS 7.5 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

GIANT WITH CERAMIC INSERT 7 PIN BASE

THE 7241 IS A LONG LIFE, HIGH POWER TRIODE DEVELOPED ESPECIALLY FOR USE AS A PASSING TUBE IN THE SERIES REGULATED POWER SUPPLIES. FOR THIS SERVICE, A TUBE MUST BE ABLE TO PASS LARGE CURRENTS OVER A WIDE VOLTAGE RANGE AND STILL EXHIBIT A LOW INTRINSIC VOLTAGE DROP WHEN OPERATED "WIDE OPEN". THE 7241 ADEQUATELY MEETS THESE REQUIREMENTS. ONE TYPE 7241 CAN PASS MORE THAN ONE AMPERE AT 100 WATTS PLATE DISSIPATION.

THE 7241 FEATURES ONE LARGE ZIRCONIUM COATED GRAPHITE ANODE, WITH THREE SEPARATE GRID-CATHODES STRUCTURES. THIS ANODE, WHILE LIGHTER IN WEIGHT THAN SIMILAR METAL ANODES, REMAINS WARP FREE DURING LIFE AND PROVIDES ONE OF THE BEST GAS "GETTERING" MEANS KNOWN. THE ANODE IS SUPPORTED BY CERAMIC INSULATORS. THE USE OF THESE INSULATORS AND THE HARD GLASS ENVELOPE PERMIT THE TUBE TO BE OUTGASSED AT HIGH TEMPERATURES DURING THE MANUFACTURING EXHAUST PROCESS. THIS ALLOWS THE TUBE TO BE RUN AT HIGH TEMPERATURES DURING OPERATION, WITHOUT THE EVOLUTION OF HARMFUL GAS FROM THE TUBE PARTS.

MASSIVE CATHODES PROVIDE ADEQUATE EMISSION CURRENT RESERVE. GOLD PLATED MOLYBDENUM WIRES ARE EMPLOYED IN THE RUGGED GRID STRUCTURE. THE TUBE MOUNT IS BUILT ON A RUGGED BUTTON STEM, AND IS SUPPORTED FROM THE BULB BY MEANS OF FLEXIBLE METAL VIBRATION SNUBBERS.

IN MANY CIRCUITS, ONE 7241 CAN REPLACE FOUR TYPE 6080WA OR 6AS7G REGULATOR TUBES. FOR EVEN HIGHER LEVELS OF CURRENT OR POWER, SEVERAL 7241 TUBES CAN BE PARALLELED AS EXPLAINED IN THE APPLICATION NOTES.

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TUNG-SOL

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ELECTRICAL DATA

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT (E_f = 6.3 V.)	7.5	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE	40 000	μMHOS
AMPLIFICATION FACTOR	2.7	
PLATE RESISTANCE	67	OHMS

MECHANICAL DATA

MOUNTING POSITION (IF TUBE IS TO BE MOUNTED IN A HORIZONTAL POSITION IT IS RECOMMENDED THAT IT BE MOUNTED SO THAT THE BASE LUG KEY BE EITHER DIRECTLY UP OR DIRECTLY DOWN)	ANY	
BULB	TT 18	NONEX
BASE	GIANT 7 PIN WITH CERAMIC INSERT, JETEC #A7-17	
SOCKET	E.F. JOHNSON #122-237 OR EQUIVALENT	
AVERAGE NET WEIGHT	6.0	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	450	G
MAXIMUM VIBRATION RATING (10 TO 25 CPS)	2.5	G

RATINGS
ABSOLUTE VALUES

TOTAL PLATE DISSIPATION	---	100	WATTS
TOTAL PLATE CURRENT DC (IF TUBE VOLTAGE DROP IS TO BE SWUNG MORE THAN 6 VOLTS, THIS CURRENT CANNOT BE REALIZED. SEE PLATE CHARACTERISTICS CURVE)	---	1.2	AMP.
CURRENT PER CATHODE (DC)	---	400	MA.
PLATE VOLTAGE (DC)	0	400	VOLTS
HEATER-CATHODE VOLTAGE (DC)	-300	+300	VOLTS
GRID VOLTAGE (DC)	-300	0	VOLTS
GRID CURRENT PER GRID	---	0	MA.
HEATER VOLTAGE	5.7	6.9	VOLTS
ENVELOPE TEMPERATURE	---	300	°C
ALTITUDE FOR FULL RATINGS (IF COOLING IS PROVIDED TO KEEP BULB TEMPERATURE WITHIN RATINGS, ALTITUDE RATING CAN BE EXTENDED TO 60,000 FT.)	---	10,000	FEET
CIRCUIT VALUES			
TOTAL GRID CIRCUIT RESISTANCE IN REGULATED SERVICE OR WITH FIXED BIAS	500	50,000	OHMS
TOTAL GRID CIRCUIT RESISTANCE WITH CATHODE BIAS ONLY	500	200,000	OHMS
RESISTANCE PER GRID LEG WHEN TUBES ARE PARALLELED	500	---	OHMS

CATHODE RESISTANCE: MINIMUM CATHODE RESISTANCE PER CATHODE LEG SHALL BE 27 OHMS OR THAT RESISTANCE NECESSARY TO PROVIDE 10% OF THE GRID BIAS VOLTAGE, WHICHEVER IS GREATER.

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TUNG-SOL

CONTINUED FROM PRECEDING PAGE

ADDITIONAL TESTS TO INSURE RELIABILITY

RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 30° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (450G/MSEC)

LIFE TEST: 1000 HOURS UNDER PLATE CURRENT TEST CONDITIONS

POST SHOCK AND LIFE TEST END POINTS:

PLATE CURRENT (MIN.)	450	MA
TRANSCONDUCTANCE (MIN.)	27 000	μMHO
HK LEAKAGE (MAX.)	150	μA
GRID CURRENT (MAX.)	−12	μA

RANGE OF VALUES

CONDITIONS: $E_f = 6.3V$, $E_b = 190V$. $E_c = 0$, $R_{k/k} = 200\ \Omega$, $R_g = 50\Omega$ READINGS TAKEN AFTER 5 MINUTES POWER PRE-HEATING.

TOTAL PLATE CURRENT	495	600	MA,DC
AMPLIFICATION FACTOR	2.0	3.4	
TRANSCONDUCTANCE	33 000	48 000	μMHOS
HEATER CURRENT PER TUBE	7.12	7.88	AMP.

CONDITIONS: $E_f = 6.3V$, $E_b = 200V$. $E_c = -100V$, $R_k = 0$

CURRENT PER CATHODE	0	10	MA.

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TUNG-SOL

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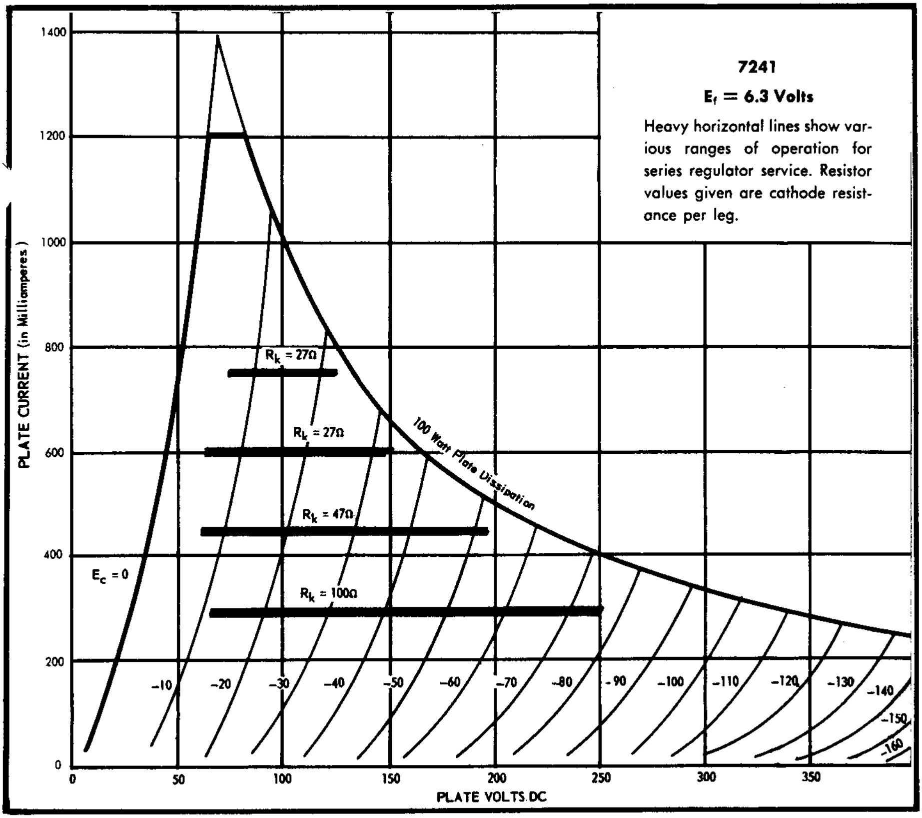
APPLICATION NOTES

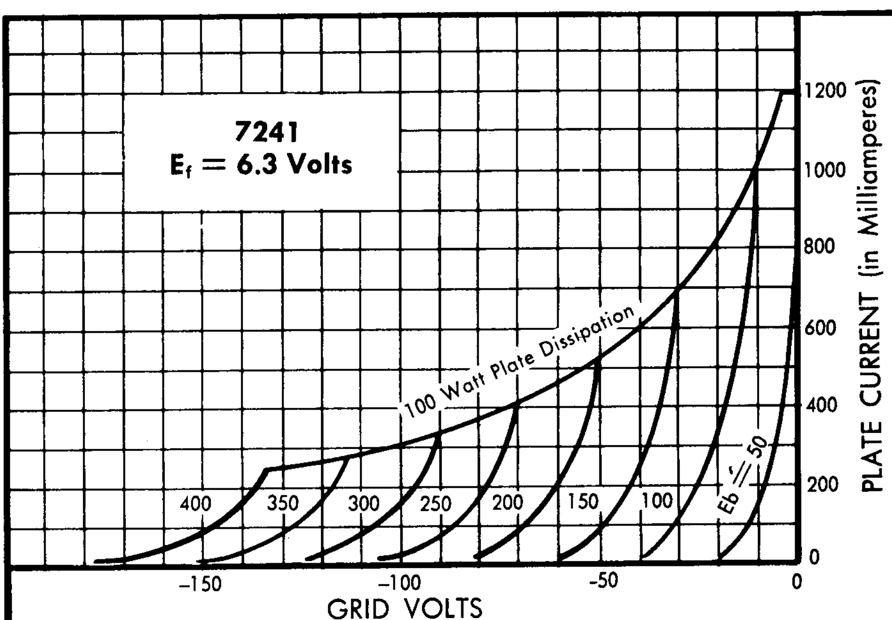
THE 7241 IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CONTROLLED POWER SUPPLIES BECAUSE OF ITS HIGH TRANSCONDUCTANCE AT RELATIVELY LOW PLATE VOLTAGES. TO PROVIDE THE DESIRED OUTPUT CURRENT, MANY TRIODE SECTIONS CAN BE PARALLELED. IF TUBE SECTIONS ARE TO BE PARALLELED, HOWEVER, THE DESIGNER IS STRONGLY URGED TO USE SUFFICIENT RESISTANCE IN EACH CATHODE LEG TO EQUALIZE CURRENT DIVISION AMONG THE TRIODE SECTIONS. RECOMMENDED VALUES FOR VARIOUS OPERATING CURRENTS ARE SHOWN ON THE PLATE CHARACTERISTICS CURVE. IF THE OUTPUT CURRENT OF THE SUPPLY IS NOT FIXED, USE THE RESISTANCE INDICATED FOR THE LOWEST CURRENT THAT APPROACHES THE MAXIMUM PLATE DISSIPATION LINE. CATHODE RESISTANCE IS SUPERIOR TO ANODE RESISTANCE BECAUSE IT PROVIDES MORE BIAS ON THE SECTIONS TAKING GREATER PLATE CURRENT. A CATHODE RESISTOR NEED BE ONLY ONE FOURTH THE VALUE ($\frac{R}{U+1}$) OF A PLATE RESISTOR, AND THEREFORE WILL DISSIPATE ONLY ONE FOURTH THE POWER. IN ANY CASE, THE ONLY LOSSES INCURRED IN USING A RESISTOR IS THE INSERTION LOSS OF THE RESISTOR ITSELF (ABOUT TWO WATTS) AND THE ADDITIONAL VOLTAGE (LESS THAN 10 VOLTS) NECESSARY FROM THE UNREGULATED SUPPLY. A CATHODE RESISTOR ADDS A SMALL ADDITIONAL LOSS BY CAUSING THE PASSING TUBE TO WORK WITH HIGHER BIAS AND HENCE WITH GREATER TUBE DROP.

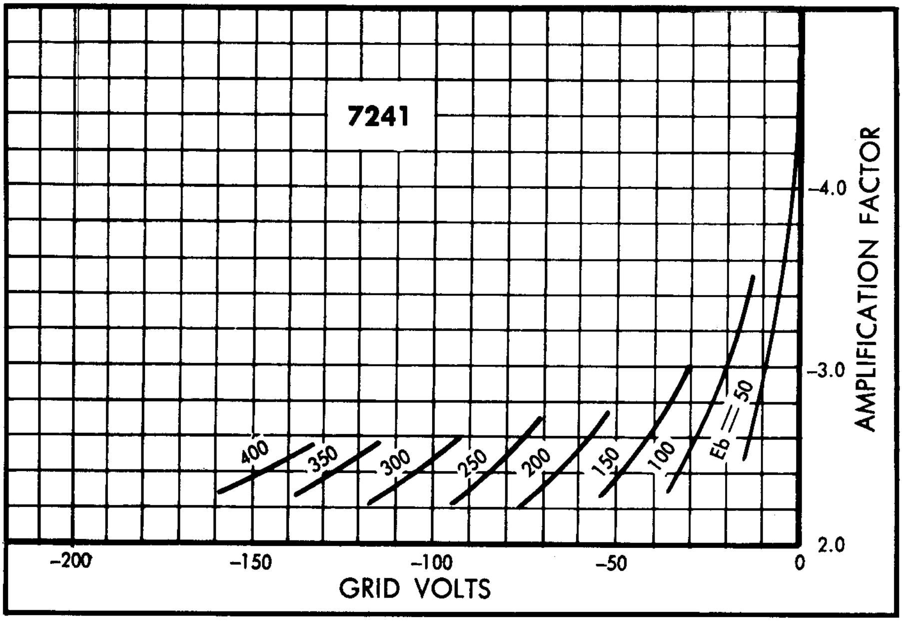
A THIRTY SECOND CATHODE WARMUP TIME IS RECOMMENDED BEFORE THE PLATE VOLTAGE IS APPLIED. THIS IS ESPECIALLY NECESSARY IN CIRCUITS WHERE THE AMPLIFIER TUBE PLATE RESISTOR IS RETURNED TO THE PLATE SIDE OF THE PASSING TUBE, AS ILLUSTRATED IN THE SIMPLIFIED CIRCUIT IN FIGURE 1. IN THIS CASE DURING WARMUP THE AMPLIFIER TUBE DRAWS LITTLE CURRENT, THERE IS LITTLE IR DROP ACROSS THE RESISTOR, AND THE GRID OF THE PASSING TUBE IS EFFECTIVELY, TIED TO THE PLATE. THE PLATE WILL ATTEMPT TO DRAW EXCESSIVE CURRENT FROM THE PASSING TUBE'S CATHODE AND MAY SERIOUSLY IMPAIR TUBE LIFE. THE CIRCUIT IN FIGURE 2 IS PREFERABLE FROM THE CONSIDERATION OF THE SAFETY OF THE PASSING TUBE BOTH DURING WARMUP AND IN THE EVENT OF TROUBLE IN THE AMPLIFIER CIRCUIT OR IF THE AMPLIFIER TUBE IS REMOVED FROM ITS SOCKET. IT HAS THE ADDITIONAL ADVANTAGE OF PROVIDING A CONSTANT VOLTAGE FOR THE AMPLIFIER CIRCUIT. HOWEVER, IF THE REGULATOR OUTPUT IS LOW (BELOW 250 VOLTS) IT WILL BE NECESSARY TO PROVIDE ADDITIONAL NEGATIVE VOLTAGE FOR THE REFERENCE TUBE CIRCUIT. ALSO, IF THE REGULATED OUTPUT VOLTAGE IS TO BE VARIABLE, IT MAY BE NECESSARY TO FOLLOW FIGURE 1.

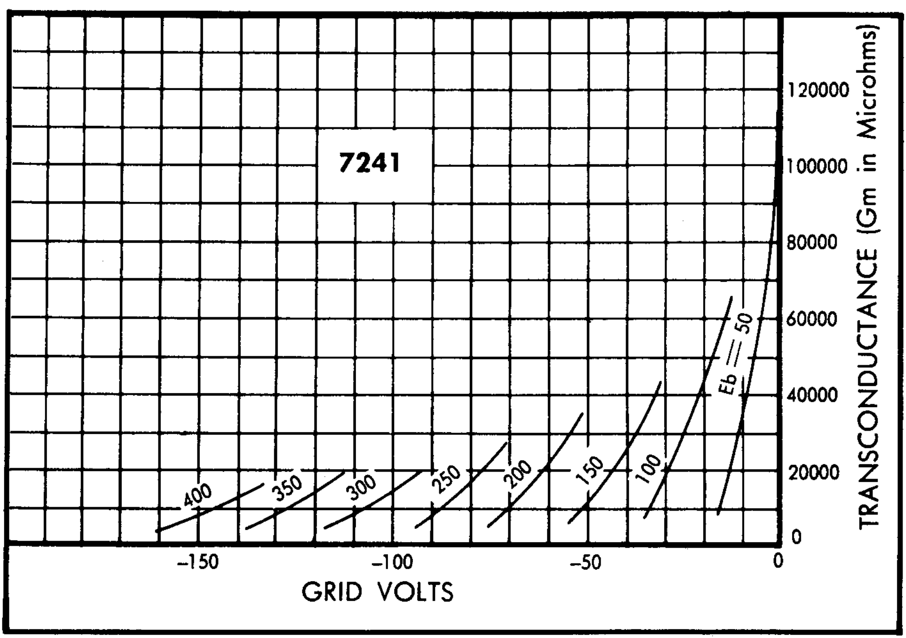
PASSING TUBE OPERATION CONDITIONS SHOULD BE CHOSEN TO PROVIDE AS LOW A TUBE DROP AS POSSIBLE. A SAFETY MARGIN OF AT LEAST 5 VOLTS FROM THE ZERO BIAS LINE SHOULD BE ALLOWED HOWEVER, FOR VARIATIONS OF INDIVIDUAL TUBES. SUFFICIENT BIAS EXCURSION SHOULD BE ALLOWED FOR OVERCOMING RIPPLE. THE AMPLIFIER CIRCUIT SHOULD BE ABLE TO COUNTERACT THE EFFECT OF UNBALANCE DUE TO TUBE AGING.

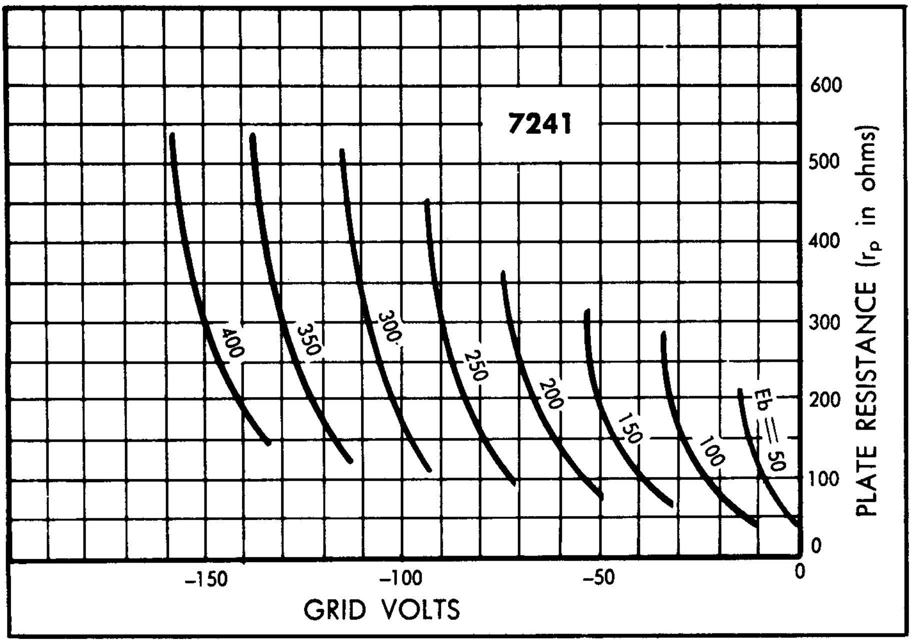
A GRID RESISTOR SHOULD BE USED FOR EACH TRIODE SECTION. THIS SHOULD BE ENOUGH TO PREVENT PARASITIC OSCILLATION BUT NOT LARGE ENOUGH TO PREVENT LOSS OF CONTROL DUE TO A SMALL AMOUNT OF "GAS" GRID CURRENT. A VALUE OF GRID RESISTANCE THAT MEETS BOTH THESE CONDITIONS IS 1,000 OHMS. HEATER VOLTAGE SHOULD BE KEPT AS CLOSE AS POSSIBLE TO 6.3 VOLTS AS MEASURED ON THE TUBE PINS. WHEN CONNECTING MANY HIGH DRAIN TUBE HEATERS ACROSS A SINGLE TRANSFORMER, BUS BARS FEEDING FROM "ALTERNATE ENDS" (FIGURE 3) SHOULD BE USED WITH A STRANDED PAIR FEEDING INDIVIDUAL SOCKETS.


7241
E_f = 6.3 Volts
Heavy horizontal lines show various ranges of operation for series regulator service. Resistor values given are cathode resistance per leg.
PLATE CURRENT (in Milliamperes)
1400
1200
1000
800
600
400
200
0
R_k = 27Ω
R_k = 27Ω
R_k = 47Ω
R_k = 100Ω
100 Watt Plate Dissipation
E_c = 0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
50
100
150
200
250
300
350
PLATE VOLTS DC


7241
E_f = 6.3 Volts
100 Watt Plate Dissipation
400
350
300
250
200
150
100
Eb = 50
PLATE CURRENT (in Milliamperes)
1200
1000
800
600
400
200
0
-150
-100
-50
0
GRID VOLTS


7241
AMPLIFICATION FACTOR
-4.0
-3.0
2.0
400
350
300
250
200
150
100
Eb = 50
-200
-150
-100
-50
0
GRID VOLTS


7241
TRANSCONDUCTANCE (Gm in Microhms)
120000
100000
80000
60000
40000
20000
0
400
350
300
250
200
150
100
Eb = 50
-150
-100
-50
0
GRID VOLTS



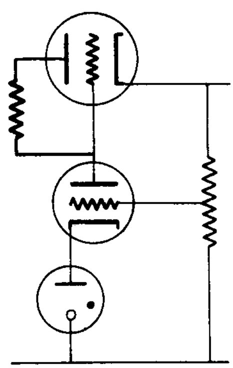


FIGURE I

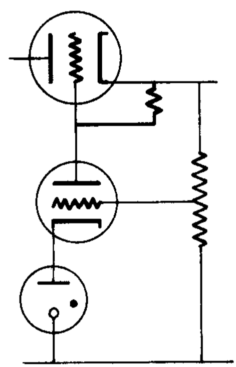


FIGURE 2

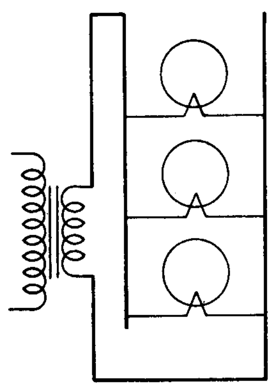


FIGURE 3