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Topic: MULTIVIBRATOR CIRCUIT

Class: First BPTh

Subject: FUNDAMENTAL OF ELECTROTHERAPY

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MULTIVIBRATOR CIRCUIT

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MULTIVIBRATOR CIRCUIT

- **The Valve Interrupter**
- **Various circuits incorporating valves may be used to produce an interrupted current. Their action is illustrated by the multivibrator circuit. There are certain principles underlying the working of the circuit.**
- **ACTION OF THE TRIODE VALVE. If a triode valve is connected into a circuit so that the anode is positive in relation to the filament, and the filament is heated, current will pass across the valve.**
- **The grid lies between the filament and the anode.**
- **If it has no charge it has no effect on the current passing across the valve.**

MULTIVIBRATOR CIRCUIT

- **If it is given a negative charge it reduces or, if the charge is strong enough, stops the flow of current across the valve, while if the grid has a positive charge it causes an increase in the intensity of current.**
- **As the grid lies closer to the filament than does the anode, a variation in the grid charge has more effect on the intensity of current flowing across the valve than does a variation in the anode voltage.**
- **Thus if a sufficiently strong negative charge is applied to the grid the current across the valve ceases, while if the grid loses this negative charge the current flows again. Thus the valve can act as a switch in the circuit.**

MULTIVIBRATOR CIRCUIT

- **C.R. TIMING CIRCUITS.**
- **If a condenser is connected to a source of supply it will be charged. If it is then disconnected from the supply, and a circuit made between the plates, it will discharge through the circuit.**
- **When the switch is in position A the condenser is charged from the cell.**
- **When the switch is moved to position B the condenser discharges through the resistance.**
- **The time taken for the condenser to discharge depends on the capacity of the condenser and the magnitude of the resistance.**

MULTIVIBRATOR CIRCUIT

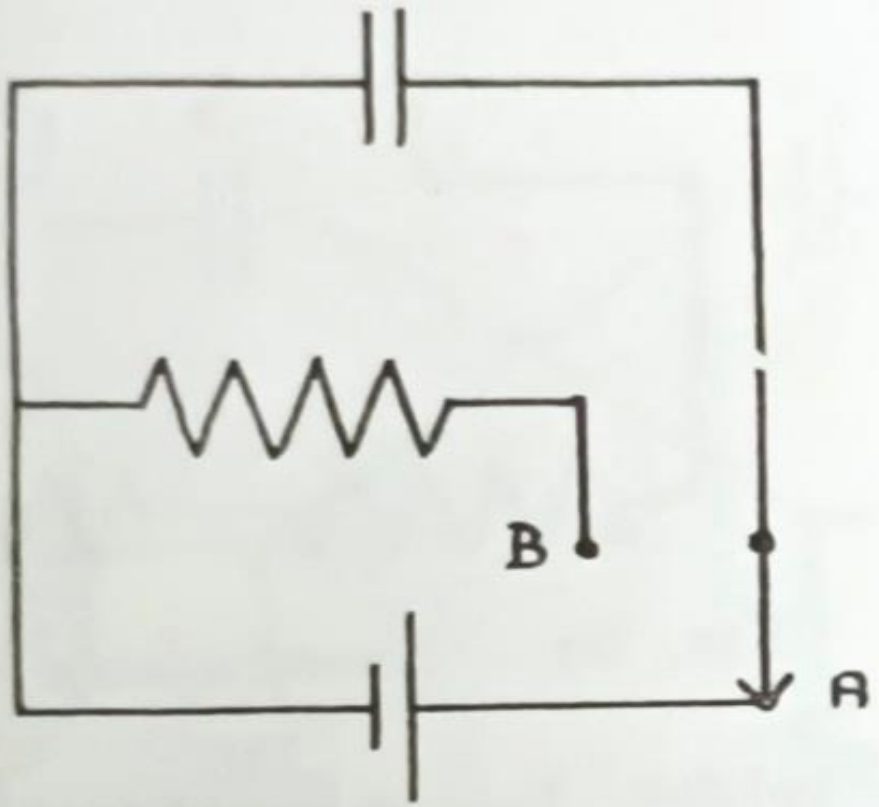

FIG. 86.—CIRCUIT TO SHOW CHARGE AND DISCHARGE OF A CONDENSER.

MULTIVIBRATOR CIRCUIT

- **If the capacity is large the condenser holds a larger quantity of electricity, when charged to a certain voltage, than if the capacity is small.**
- **So the large capacity condenser takes longer to discharge than the small one, and the duration of the discharge varies directly with the capacity of the condenser.**
- **If the resistance of the circuit is high the intensity of current produced by a given voltage is less than if the resistance is low.**
- **If the intensity of current is small the condenser takes longer to discharge than if it is great.**
- **Thus the higher the resistance of the circuit, the longer the duration of the discharge.**
- **So the duration of the condenser discharge is proportional to CxR, where C-capacity of the condenser measured in farads and R-resistance of the circuit measured in ohms.**

MULTIVIBRATOR CIRCUIT

- **The action of the triode valve and the C.R. timing circuit are the essential principles underlying the action of the multi vibrator circuit, but before considering the working of the circuit it is advisable to revise certain points connected with the wiring of resistances in series.**
- **If resistances are wired in series the potential drop across each is directly proportional to its resistance.**
- **Fig. shows two resistances, R1 and R2, wired in series with each other.**
- **If their resistances are equal, and a P.D. of 100 volts is applied to the circuit, there will be a P.D. of 50 volts across each of them, as each offers half the total resistance of the circuit.**

MULTIVIBRATOR CIRCUIT

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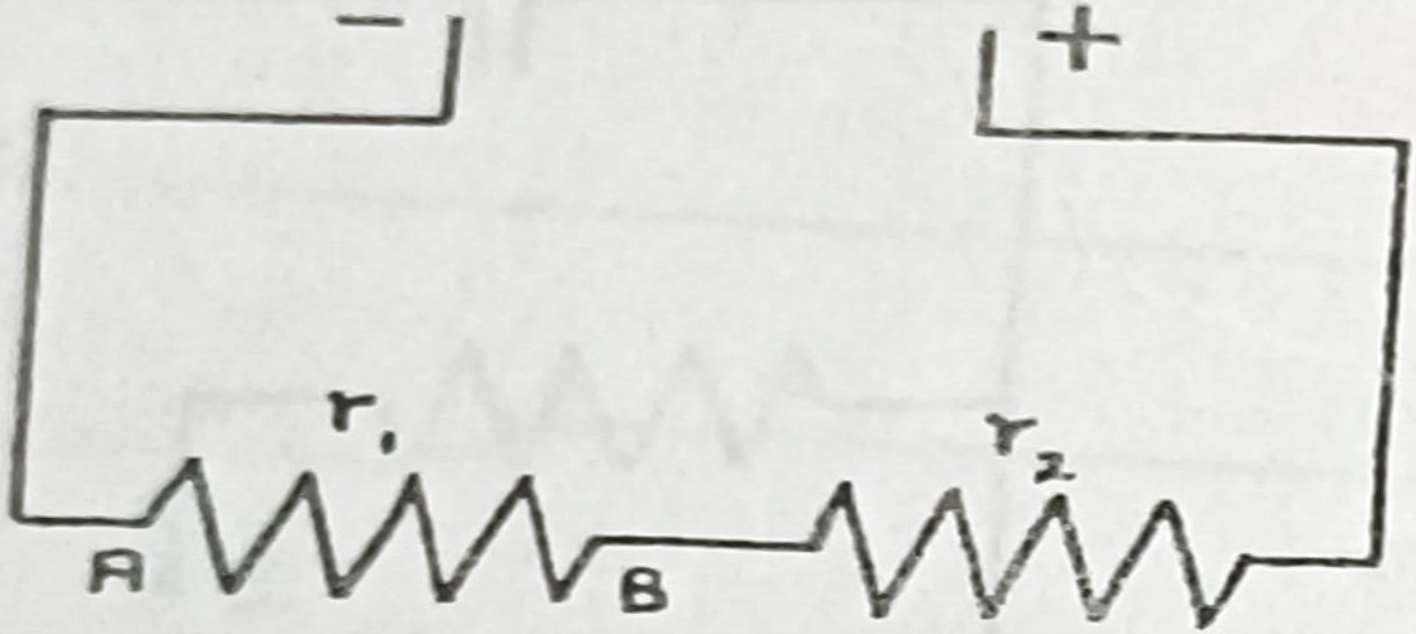

FIG. 87.—RESISTANCES IN SERIES.

MULTIVIBRATOR CIRCUIT

- **If now R1 is removed and replaced by a resistance which has one-third of the resistance of R1, R2 will have three times the resistance of the new R1, that is three-quarters of the total resistance of the circuit.**
- **So the P.D. across R2 will rise to 75 volts, i.e. three-quarters of the total EMF, while that across the new R1 will be 25 volts.**
- **If now R1 is removed completely and a gap left in the circuit, no current will flow.**
- **The resistance of the gap is infinite and compared with it the resistance of R2 is negligible.**
- **So there will be the whole P.D. of 100 volts across the gap and none across R2.**
- **That is, the point A in the circuit is at the same potential as the negative supply line to which it is connected, while the point B is at the same potential as the positive supply line.**

MULTIVIBRATOR CIRCUIT

- **WIRING OF THE MULTIVIBRATOR CIRCUIT : Two triode valves (V_1, V2) are wired in parallel with each other across the supply lines. A resistance is placed between each anode and the positive supply line (Ra1 Ra2). In parallel with each valve are a condenser and a resistance, in series with each other (C1R1 C2R2). One plate of each condenser is connected to the anode of one valve (A1, A2), the other to the grid of the other valve (G2 G1).**

MULTIVIBRATOR CIRCUIT

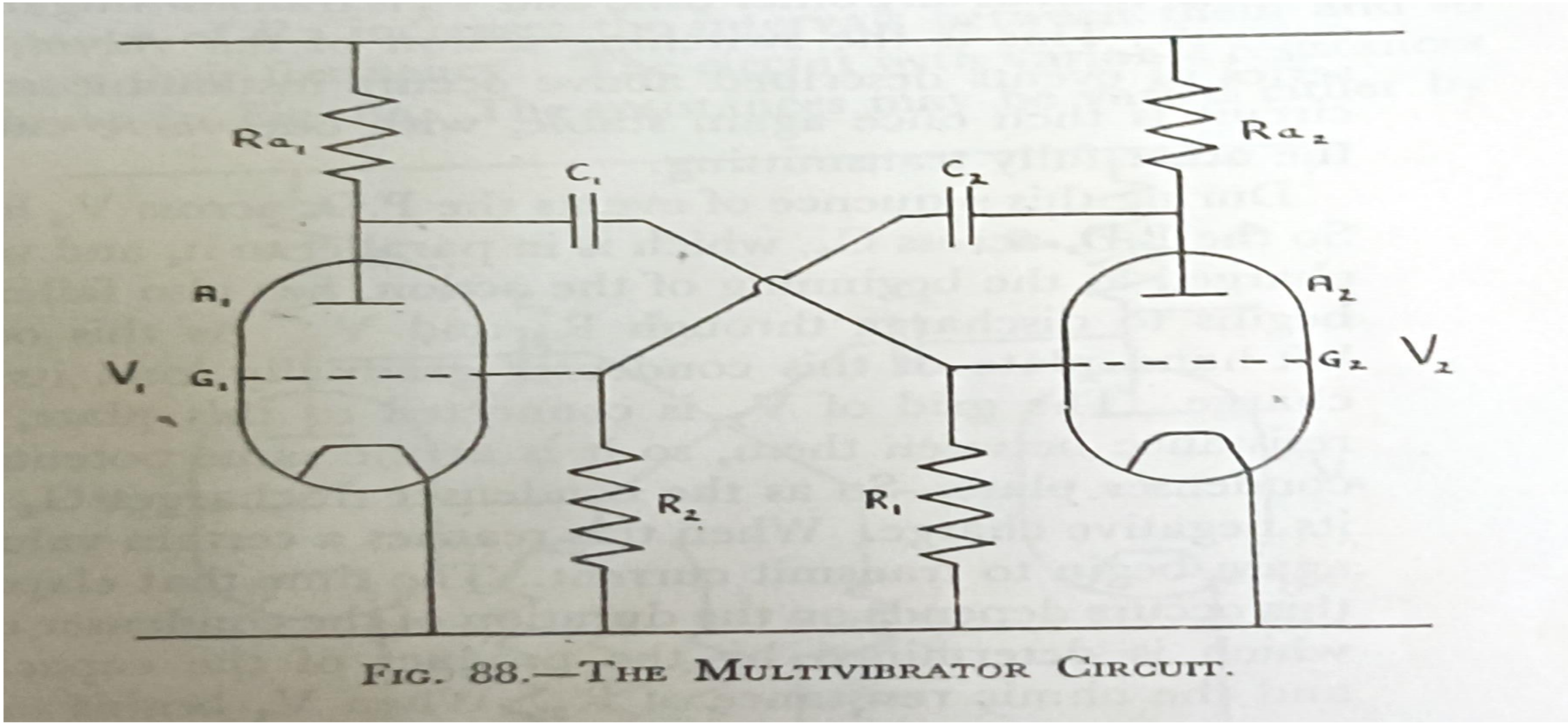

FIG. 88.—THE MULTIVIBRATOR CIRCUIT.

MULTIVIBRATOR CIRCUIT

- **WORKING OF THE MULTIVIBRATOR CIRCUIT.**
- **Suppose current to be passing equally across both valves.**
- **Such a circuit is easily influenced by electron disturbances, similar to the interference observed with television reception.**
- **So almost immediately some electron disturbance will cause a variation in the current across one of the valves.**
- **Suppose this is a decrease in the intensity of current across V_1.**
- **This corresponds to an increase in the resistance of V_1.**
- **In accordance with the principles of resistances in series, the potential drop between the supply lines is divided between V1 and Ra1, in direct proportion to their resistance.**
- **So if the resistance of V_1 rises the P.D. across it rises, and that across Ra1 falls. So the P.D. between A1 and the positive supply line is reduced, and A1 becomes more positive.**
- **This positive charge is transmitted through C1 to the grid of the other valve (G_2).**
- **This causes an increase in the current across V2, which corresponds to fall. in resistance of this valve.**

MULTIVIBRATOR CIRCUIT

- **So the P.D. across V2 falls and that across Ra2 rises.**
- **Thus the difference of potential between A2 and the positive supply line is increased and A2 becomes less positive, i.e. more negative.**
- **This negative charge is transmitted via C2 to G1, making it more negative and further reducing the intensity of the current across V1. As before, this causes A1 to become more positive, the charge is transmitted to G2 resulting in a further increase in current across this valve.**
- **A2 becomes less positive and the negative charge on G1 is again increased.**
- **This process continues until G1 is so more negative that V1 ceases to conduct.**
- **When this occurs A1 is at the same potential as the positive supply line, so G2 is more positive than at any other time and V2 is transmitting maximum current.**
- **This is the switching action of the valves, and the series of events described above occurs instantaneously.**
- **The circuit is then once again stable, with one valve cut off and the other fully transmitting.**
- **During this sequence of events the P.D. across V2 has fallen. So the P.D. across C2, which is in parallel to it, and which was charged at the beginning of the action, has also fallen.**
- **So C2 begins to discharge through R2 and V2.**
- **As this occurs the left-hand plate of this condenser gradually loses its negative charge.**

MULTIVIBRATOR CIRCUIT

- **The grid of V1 is connected to this plate, with no resistance between them, so it is at the same potential as the condenser plate.**
- **So as the condenser discharges, G1 also loses its negative charge.**
- **When this reaches a certain value V1 will again begin to transmit current.**
- **The time that elapses before this occurs depends on the duration of the condenser discharge, which is determined by the product of the capacity of C2 and the ohmic resistance of R2.**
- **When V_1 begins to transmit current the switching action is again brought into play, this time cutting off V2 and causing V1 to transmit maximum current.**
- **This state lasts until the discharge of C1 through R1 results in the reduction of the negative charge on G2 and permits the passage of current through V2, i.e. it is controlled by the product of C1R1.**
- **Thus the current passes first through one valve, then through the other. The duration of the flow through V2, during which V1 is cut off, depends on C2R2. The duration of the flow through V1, during which V2 is cut off, depends on C1R1**

MULTIVIBRATOR CIRCUIT

- **CURRENT AVAILABLE FOR THE PATIENT.**
- **Suppose the patient is wired in parallel to Ra2.**
- **An interrupted current is flowing through this resistance and will also be supplied to the patient.**
- **The periods of current flow occur when V2 is transmitting and so their duration is determined by C2R2.**
- **The intervals occur when V2 is cut off and so their duration is determined by C1R1.**
- **By using variable resistances for R2 and R1 the duration of the impulses supplied to the patient, and their frequency, can be adjusted.**

MULTIVIBRATOR CIRCUIT

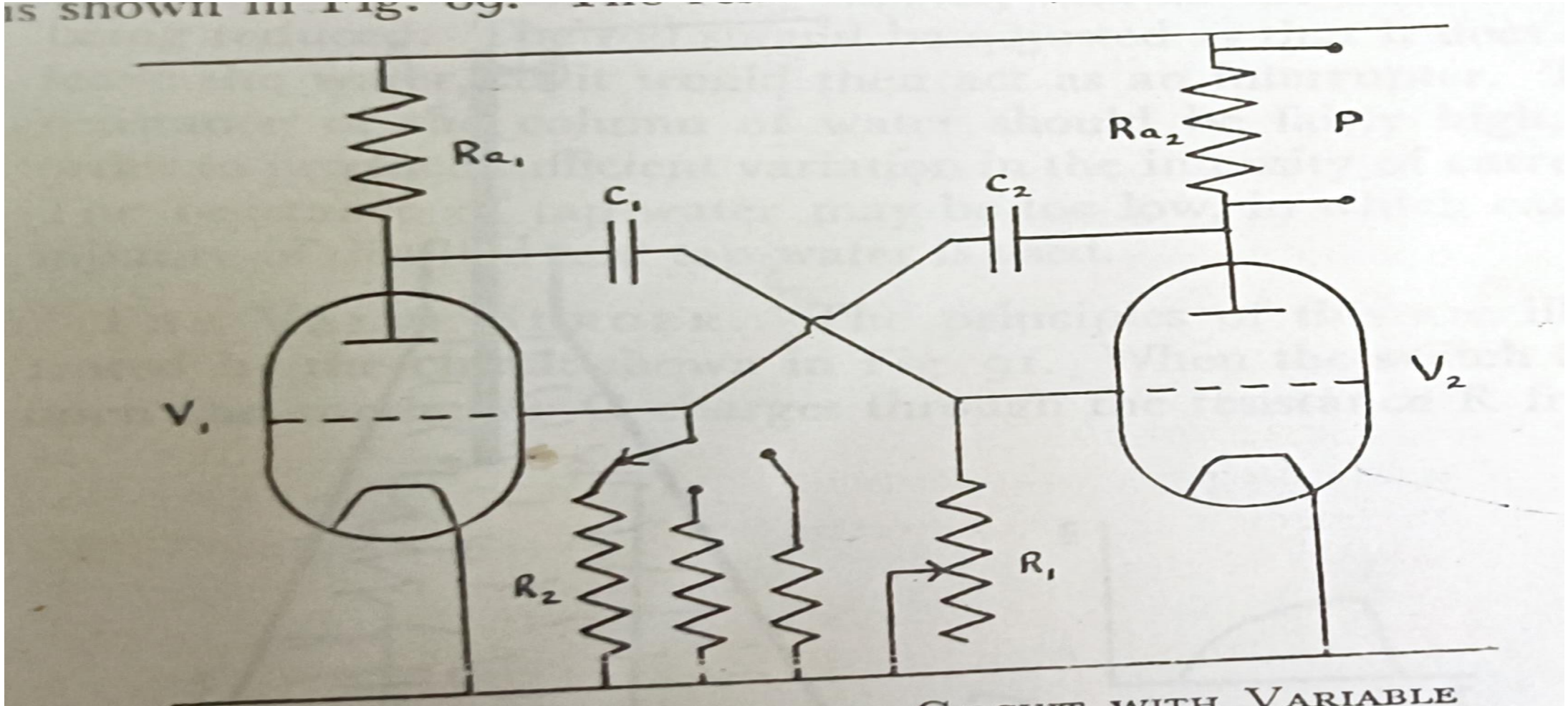

FIG. 89.—THE MULTIVIBRATOR CIRCUIT WITH VARIABLE RESISTANCES.

MULTIVIBRATOR CIRCUIT

- **Increase of the resistance of R2 increases the duration of the stimuli, while increase of the resistance of R1 increases the intervals between them and so reduces their frequency.**
- **The resistances may be varied either by using a series rheostat or by moving a switch so that a different resistance coil is included.**
- **The second of these methods is used for R2, and three different pulse durations would be available.**
- **R1 is shown as a series rheostat and the intervals between the pulses would be varied gradually.**
- **Either method can be used for each resistance, and can be observed in different pieces of apparatus.**
- **In some models definite pulse durations and frequencies can be selected, in others either or both can be varied gradually.**