

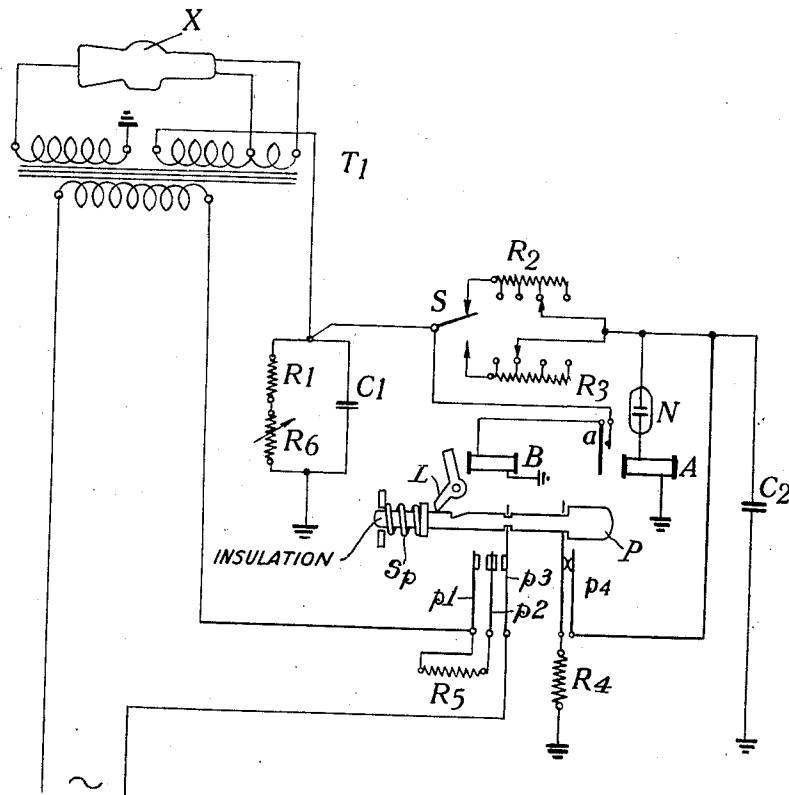
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APPARATUS FOR TIMING X-RAY EXPOSURES

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APPARATUS FOR TIMING X-RAY EXPOSURES

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This invention relates to apparatus for timing X-ray exposures. These exposures, particularly for photographic purposes, are usually timed by means of a clockwork mechanism, the clockwork being set in operation simultaneously with the closure of the tube circuits and serving to operate a switch to extinguish the discharge at the conclusion of the desired period.

Such mechanically operated time switches have several disadvantages. They are usually noisy in operation, and the release of the mechanism often causes the patient, who is usually in a highly nervous condition, to jump and thus spoil the film. The timing apparatus must be capable of being set for exposures of widely varying duration and is usually set to operate for times up to ten seconds. For short exposures a small movement only of the indicator is necessary and it is thus difficult to set it accurately.

To avoid these disadvantages we make use of the principle of regulating the exposures by means of the time necessary to charge a condenser up to the breakdown voltage of a gaseous discharge tube.

Such apparatus is silent in operation and is capable of being set accurately for both long and short exposures.

Preferably the charging current for the condenser is made dependent upon the emission of the cathode of the X-ray tube, thus ensuring that the correct exposure is given independently of variations in the intensity of the X-ray emission due to fluctuations in the supply voltage and the like.

The nature of the invention will be better understood from the following description of one embodiment thereof taken in conjunction with the accompanying drawing.

Referring to the drawing, the necessary voltage between the anti-cathode and cathode of an X-ray tube X is supplied from the secondary of a transformer T₁. This secondary is divided into two halves, one end of the left-hand half being connected to the anti-cathode of the tube and the other end being grounded, for example, through the transformer core. A portion of the right hand half of the secondary of transformer T₁ supplies the filament of the tube X with current and the end of this half remote from the connections to the filamentary cathode is connected through resistances R₁ and R₆ to ground. The primary of transformer T₁ is connected to the A. C. mains through contacts p₁p₂p₃ of a switch. This switch is operated by means of a push button P in such a way that

contacts p₂ and p₃ first close, connecting the primary of T₁ to the mains through a resistance R₅ and afterwards contacts p₁ and p₂ close, short circuiting resistance R₅. The push button P is operated against a spring SP and held in operated position by a latch L connected to the armature of a relay B.

The electron current between the cathode and anti-cathode of tube X flows through resistances R₁ and R₆ and the voltage thereby developed across these resistances is applied to a condenser C₂ through either resistance R₂ or resistance R₃. The condenser C₂ is shunted by a neon tube N and a relay A in series.

The values of the resistances R₁ and R₆ are preferably chosen so that the potential across them under normal operating conditions is about 1½ times the discharge voltage of the neon tube N. These resistances are shunted by a condenser C₁ to smooth out surges. The resistance R₂ is variable in steps, each step representing a charging time of one second before the neon tube flashes and the resistance R₃ is variable in steps, each step representing a charging time of 0.1 second before the neon tube flashes. The two switches for selecting the fractions of resistances R₂ and R₃ respectively to be connected in the circuit of condenser C₂ are gauged together so as to be operated together by movement of a pointer on the outside of the casing moving over a scale. Either of the two resistances may be placed in circuit by means of a switch S.

On the voltage across the terminals of condenser C₂ rising to a predetermined value, the neon tube N will discharge through relay A, which energises, and closes by means of its contacts a circuit for relay B, which in turn energises and mechanically trips the latch holding push button P in operated position. Contact p₁ p₂ and p₃ are opened, and contacts p₄ closed the latter causing any residual charge of the condenser to flow off through resistance R₄.

It will be seen that an excessive emission current in the X-ray tube will produce a correspondingly greater voltage across resistances R₁ and R₆ and the exposure time will be correspondingly less. On the other hand, reduced emission will mean increased exposure time so that radiographically the exposures tend to approach equality irrespective of substantial variations in emission current.

What is claimed is:

1. Apparatus for timing X-ray exposures comprising an X-ray tube having a discharge path, connections for supplying operating potentials to said X-ray tube whereby current is caused to

- flow through said discharge path, means for producing a voltage proportional to the current through said discharge path, a condenser, a variable resistor, connections for charging said condenser through said variable resistor from said voltage proportional to the current through said discharge path, a gas-filled discharge tube connected to said condenser so as to be ignited when the voltage across said condenser reaches a predetermined value, and means operable in response to the ignition of said discharge tube for opening said connections for supplying operating potentials to said X-ray tube.
2. Apparatus as claimed in claim 1, in which said connections for supplying operating potentials to the X-ray tube include a manually oper-

able switch for closing the operating circuit of the X-ray tube, a latch for maintaining said switch in closed position, and electromagnetic means for tripping said latch in response to the ignition of said discharge tube.

3. Apparatus as claimed in claim 1, further comprising a second variable resistance ganged together with said first mentioned variable resistance but having a different rate of variation, common means for actuating both said variable resistances, and selective means for selectively connecting either one or the other of said resistances into the circuit for charging the condenser.

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