Dec. 9, 1958 A. A. NEMET ET AL 2,864,004

BUCKY-GRID X-RAY APPARATUS

Filed Oct. 29, 1954 2 Sheets-Sheet 1

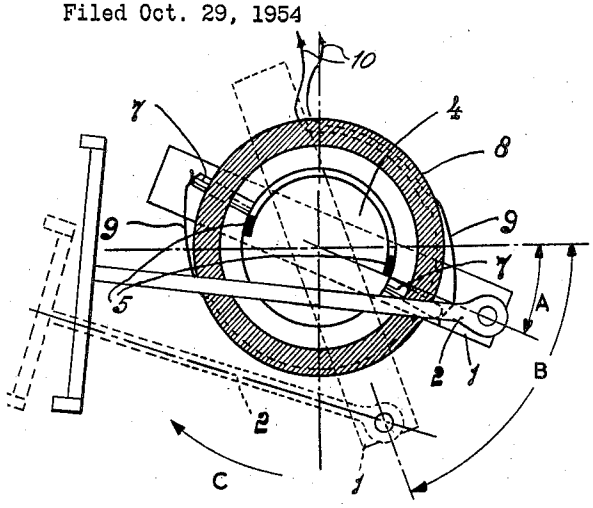


Fig. 1

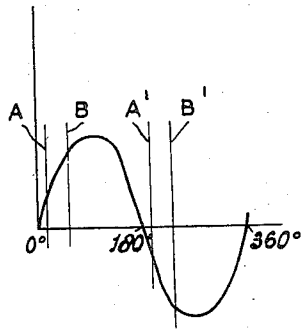


Fig. 2

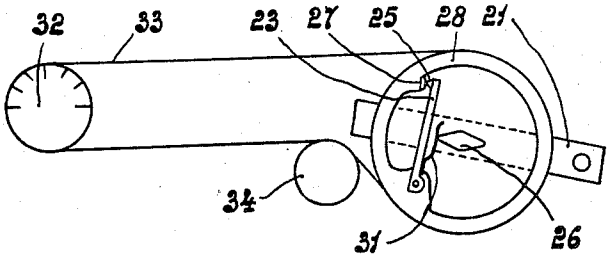


Fig. 3

INVENTOR
Anthony Antal Nemet
William Frederick Cox
Colin Leslie Bennett
BY
AGENT

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BUCKY-GRID X-RAY APPARATUS

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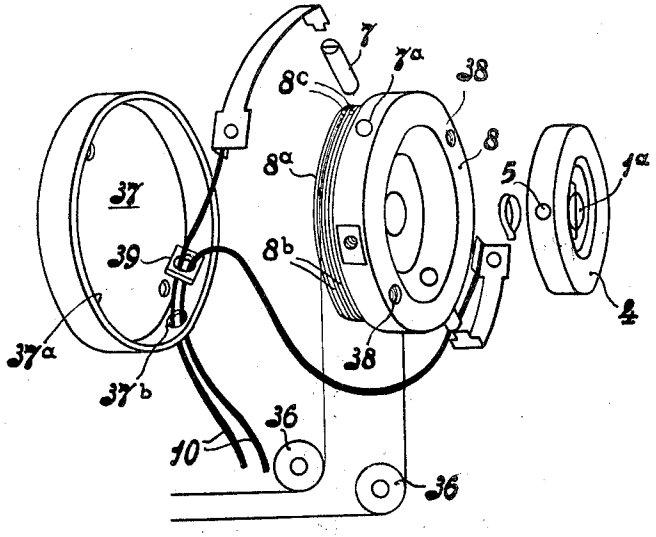


Fig. 4

INVENTOR
Anthony Antal Nemet
William Frederick Cox
Colin Leslie Bennett
BY
AGENT

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BUCKY-GRID X-RAY APPARATUS

Anthony Antal Nemet, Richmond, William Frederick Cox, London, and Colin Leslie Bennett, Wallington, England, assignors, by mesne assignments, to North American Philips Company, Inc., New York, N. Y., a corporation of Delaware

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Claims priority, application Great Britain November 2, 1953

4 Claims. (Cl. 250—62)

This invention relates to apparatus for producing X-ray photographs and more particularly to apparatus incorporating a so-called Potter-Bucky diaphragm or grid, hereinafter referred to for brevity as a Bucky grid.

As is well-known, such grids are employed to reduce secondary radiation reaching the photographic film or plate. It is known to provide a Bucky grid with a linear or reciprocating motion in order to prevent an image or shadow of the metal portions of the grid being formed on the photograph. Where the X-ray tube is operated from an A. C. or pulsating supply, the speeds of such motion should be chosen as far as possible in such manner as to prevent or reduce strobe effects arising in connection with the supply frequency and causing grid shadows to appear in the photograph.

If sinusoidal or approximately sinusoidal reciprocating grid motion is employed, e. g. as may be obtained with crank or eccentric drive, the speed of the grid will vary throughout the whole cycle of motion or during most of such cycle. In such circumstances it may be possible to select a portion of each cycle of motion within which the grid moves at such speed or speeds as to produce little or no strobe shadows on the photograph.

The selected portion must not be in the region of the slowest speeds, that is when reversal takes place and momentarily the grid is stationary, as this will give a stationary grid pattern, which must be avoided.

According to the present invention phasing control means are provided for use in a system in which sinusoidal or approximately sinusoidal reciprocating motion is applied to a Bucky grid by a crank and connecting rod, eccentric, cam or like mechanism, such phasing control means being adapted to be associated with said mechanism for causing an exposure to be initiated at a selected instant.

The phasing control means may be arranged to initiate the exposure, leaving its termination to be set by an adjustable timing device.

For exposures extending over one or more grid motion cycles it is not important at what point in the grid cycle the exposure commences. However, the shortest exposures, e. g., .06 sec. or less, extending over a small part of the grid cycle must not be made when the grid is in or near its stationary or dead centre position but can otherwise be made within a large part of the grid cycle. For exposure times of the order of ¼ to ¾ cycle the starting phase angle at which exposures begin is more critical and should be adjusted so that the fraction of the total exposure time during which the grid is nearly stationary is as small as possible. With an oscillating grid motion having a stroke of 50 m./m. and a period of 0.4 sec. the optimum starting phase angle was found to be 70° following grid reversal or dead centre position, for exposure times between ¼ and ¾ of a grid cycle.

For practical purposes it is desirable that all exposures should begin at the same phase angle and when this is 70° the shortest exposures occur near the peak grid velocity as desired.

Usually there is an appreciable delay between switching on an X-ray tube and X-ray radiation appearing, and this delay varies with different tubes and sets. By rendering the control means adjustable, apparatus according to the present invention may readily be used with different X-ray sets having different delay times.

In a preferred embodiment, the phasing control includes a pair of electric contacts which are opened and closed by a rotating switch or cam driven by or with the driving mechanism, the contacts being connected in series with the hand switch normally provided so that the actual exposure is initiated by the motion of the Bucky grid drive and not by the hand switch.

The contacts in the grid mechanism are momentarily closed twice in each grid cycle by a crank or eccentric shaft which oscillates the grid. The grid oscillates continuously and to make an exposure the hand switch contacts are closed in the normal way and this is followed by closing of the grid contacts which initiate the exposure. As the hand switch is operated at random with respect to the phasing of the grid cycle, the delay between closing of the hand switch contacts and the closing of the grid contacts may vary between zero and one half of a grid cycle, and in the case of the preferred embodiment this maximum delay may be 0.2 sec.

The momentary closing of the grid contacts operates a relay provided with holding contacts to keep the circuit closed after the grid contacts open. The exposure is then terminated by a timer in the X-ray set.

To take into account the aforementioned delays in the X-ray system, the contacts are arranged to close before the preferred 70° position to suit the particular delay characteristic of the X-ray set with which the Bucky is to be used. Since these contacts can be set at will to allow for the delay characteristic they constitute in effect a phasing device which can be operated in any convenient manner and causes radiation to start at the desired instant.

Two specific examples of phasing control devices will now be described with reference to the accompanying diagrammatic drawing.

Fig. 1 illustrates a phasing control embodying the invention.

Fig. 2 is a velocity diagram for Bucky grid motion controlled by the device shown in Fig. 1.

Fig. 3 illustrates a second embodiment of the invention.

Fig. 4 is an exploded view of the structural details of the embodiment of Fig. 1.

Referring to Figures 1 and 2, the Bucky grid (not shown) is oscillated by a crank **1** rotating in the direction of arrow C, and a connecting rod **2**. One cycle of this motion is represented by the grid velocity diagram of Figure 2. A disc **4** of insulating material is coupled to the crank **1** for rotation therewith and carries a pair of diametrically opposite contacts **5**. A corresponding pair of brushes **7** is carried in a housing **8** which can be rotated (by means not shown) for adjustment of the switching angle to suit different delay times as aforementioned. The brushes **5** are inwardly spring-urged by contact springs **9** through which they are connected to flexible leads **10**.

The crank **1** is shown in dotted lines at a preferred switching angle "B" of 70°. However, it is assumed in this example that the delay time of the X-ray set employed corresponds to about 48° of rotation, and therefore the crank is also shown in full lines at an advanced angle "A" of about 22° from dead centre and the contacts **5** are shown just reaching the brushes **7** at this angle to switch on the X-ray equipment. Owing to the delay, radiation will appear later, i. e. when the crank has reached the 70° position.

The leads **10** will be connected together by the switch

system **5**, **7** twice during each rotation of the crank, as indicated in Figure 2, and this is advantageous in that it reduces the average waiting period after the operator has actuated the hand-switch.

In the arrangement of Figure 3, a movable switch contact **25** is carried at the free end of a rocking arm **23** mounted on a housing **28**. A corresponding fixed contact **27** is also carried by the housing.

The arm **23** is actuated twice per revolution by a cam **26** driven by the shaft of crank **21**, such movement being imparted through a leaf spring **31** secured to the arm. Rotary adjustment of the housing **28** is effected by rotation of a graduated hand control **32** coupled to the housing by a Bowden cable or like loop **33** with tensioning wheel **34**.

In Figure 4, the control parts, of the embodiment of Figure 1, are shown more particularly, with the parts in exploded view. The disc **4**, which is a hollowed out member, is keyed on to the crank shaft end **1***a* by means of a pin, as shown. It carries contact studs **5** which pass through the rim of the disc **4** and form part of a conducting strip running round the internal periphery of the disc. As shown in Figure 1 the contact studs are situated at diametrically opposed positions on the disc. The outer concentrically disposed housing **8** is rotatably mounted on, or about, the crank shaft end **1***a*, and at its inner side, i. e. the side facing the crank, has a reduced part which forms a drum **8***a* on which a cable **35** is wound for rotating the housing. The cable passes round pulleys **36** which direct it to the drum so that it passes round the latter within two grooves **8***b*. Two adjacent holes **8***c* pass, one from each cable groove, to the interior of the housing so that one end of the cable can be passed from one groove, through the hole therein to the inside of the housing, through the adjacent hole and out into the adjacent groove and back over one of the pulleys **36**. The other end of the cable passes round a somewhat similar drum at the control end so that the housing **8** can be operated from any suitable remote position.

Two holes **7***a*, only one being visible in Figure 4, pass from the periphery to the interior of the housing for supporting the brushes **7**. To the outside face of the housing **8** is secured a cover **37** by means of screws passing through holes therein into screw threaded holes **38** in the housing **8**.

The cover **37** has a flanged rim **37***a* which supports, on its internal surface, ends of contact springs **9** to which are secured the leads **10**. The free ends of the springs press against the outer ends of the brushes **7** which protrude from the holes **7***a* sufficiently for this purpose.

The flange **37***a*, as well as projecting laterally sufficiently to permit the springs **9** to engage properly with the brushes, is of sufficiently large diameter as to provide space between itself and the periphery of the housing **8** to accommodate the springs **9** and the leads **10**. The

latter pass through an aperture **37***b* in the cover flange and through a washer **39** having a bevelled opening so as to permit the leads to pass easily through the opening **37***b* in the cover when pulled towards the spring ends but have a restraining effect when there is a tendency for the leads to pull back through the aperture.

From the above description it can be seen that when the housing **8** and cover **37** are rotated the phase angle between the point in the cycle at which the grid starts to move and the moment of switching on the X-ray tube, can be varied to suit any particular operating conditions such as may be involved in the speed of operation of the grid, the type of X-ray tube used and the time of exposure.

What is claimed is:

1. An X-ray photographic device including a Bucky grid diaphragm comprising a source of electrical energy, a system comprising a driving mechanism for applying at least approximately sinusoidal reciprocating motion to the Bucky grid, a phasing control means including a rotating part operatively connected to said driving mechanism, a pair of contacts in series with the source of electrical energy for producing the X-ray tube discharge current to be initiated, and a housing mounted for limited rotation about said rotating part, said housing carrying at least one contact of said pair of contacts.

2. An X-ray photographic device as set forth in claim 1 wherein the contacts comprise studs removably fixed to said rotating part of the phasing control means, a plurality of brushes mounted on said housing and intermittently co-acting with corresponding contacts, said rotating part including an insulated disc, means for securing said disc on the shaft of said driving mechanism, a hand switch, and a pair of leads connecting said brushes to said hand switch.

3. An X-ray photographic device as set forth in claim 1 wherein both contacts are carried by said housing, a pivoted arm operatively driven by the rotating part of said driving mechanism, one of said contacts being mounted at the free end of said pivoted arm and the other contact being fixed on said housing, said contacts being made upon the predetermined movement of said pivoted arm to a selected position thereof.

4. An X-ray photographic device as set forth in claim 1 wherein said housing is provided with a laterally projecting circular part concentrically disposed about the rotating part of said driving mechanism, a cable passing around at least a part of said circular part for remote control operation of said housing.

References Cited in the file of this patent

UNITED STATES PATENTS

2,205,209	Kunz et al.	June 18, 1940
2,504,864	Morgan et al.	Apr. 18, 1950