Potter buck moving grids
from

A Manual of Radiographic Equipment

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The grid, generally focused, is mounted in a frame which is made to move across the X-ray beam in a direction at right angles to the grid lines. The grid in its frame and the movement mechanism are known as the Potter-Bucky diaphragm, after the inventors.

Features common to all types of bucky **assemblies (moving grid mechanisms)**

1. The grid movement must start before the exposure commences and continue until after the exposure is completed.
2. The speed and range of grid movement during the exposure must be sufficiently large to blur out the grid lines.
3. The range of grid movement from the central position must not be large or the central ray of the X-ray beam will be di rected too far from the centre of the grid. This will cause radiation cut-off. The range of movement is generally not more than 5 cm, 2.5 cm either side of the centre.
4. The movement must be smooth and con tinuous throughout the exposure.
5. The mechanism providing the grid move ment must be simple.
6. The whole assembly must be as thin as possible so that the object-to-film dis tance is not too large.
7. A bucky assembly is comprised of:
   a. a frame to hold the grid, which in some units is accessible to the oper ator so that the grid of a different ratio can be inserted.
   b. an anti-scatter grid, commonly 43 X 43 cm so that it will cover the 43 x 35 cm film when the long axis is placed along the patient table or across it
   c. the mechanism for moving the grid
   d. a steel cassette tray is generally part of the assembly. It is positioned as close as is practical under the grid. The bucky tray can be removed to allow other devices such as a multisection tomographic cassette to be inserted in its place.

The whole assembly is mounted on bearings which run in a track on the underside of the X-ray patient table. This track allows the assembly to be moved along the length of the table, so that the grid and the film can be positioned under any part of the recumbent patient. This assembly is heavy and must have very positive locks and be counterweighted so that the bucky will hold its position even when the table is tilted.

The type of grid movement selected is controlled by the type of work to be performed, the exposure time, the space available to accommodate the mechanism and the importance of complete blurring of all grid lines. The choice lies between:

1. The simple oscillating movement
2. The reciprocating movement
3. The vibrating or trill movement
4. The single stroke movement — this is not installed in any units purchased today but may well be found in old units and as it can not be used satisfactorily without appreci ation of its method of operation, it is explained in the text.

1. *The simple oscillating movement* The grid oscillates forwards and backwards about its central rest position. The oscillating movement is produced by a simple electric motor. The motor causes a disc which is mounted on a spindle to rotate at a constant speed, a rod-like arm is attached to a point on the outer border of the disc- The other end of the arm is attached to the grid. Each time the disc

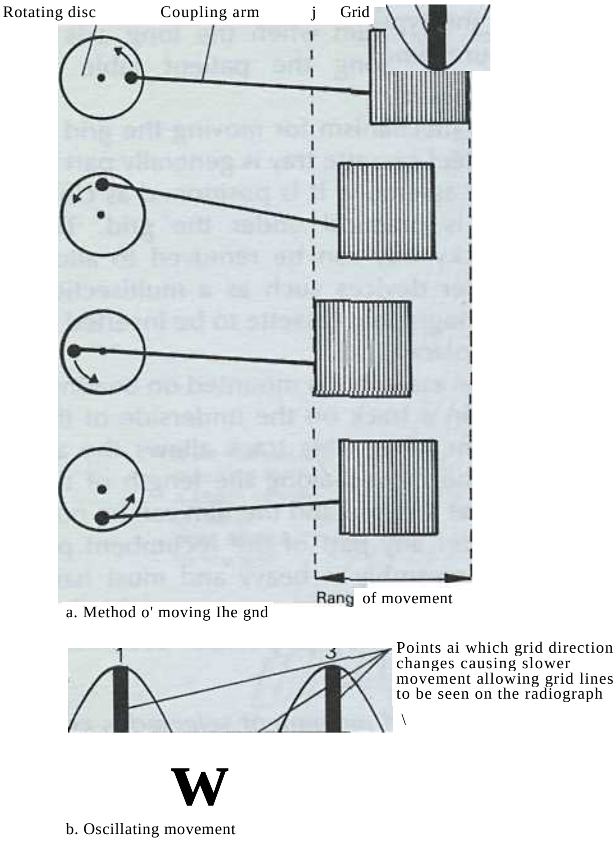


Fig. Simple oscillating grid movement.

turns, the arm pushes or pulls the grid forwards and backwards in a track fixed at the top and bottom of the grid assembly (see Fig. 14.26a). The movement is sinusoidal.

Examination of the trace of the grid movement shows that at Points 1, 2, 3 and 4, where the grid is changing direction, the rate of movement is at a minimum and may be slow enough to allow an image of the grid lines to become evident, because the'grid is virtually a stationary grid for part of the exposure and during this time the grid lines are produced on the film. This effect is more likely to occur when a 2-pulse generator is used since the electric motor speed is tied to the Ac supply making a stroboscopic effect possible. If the frequency of grid oscillating cycle peaks at the time as the radiation peak

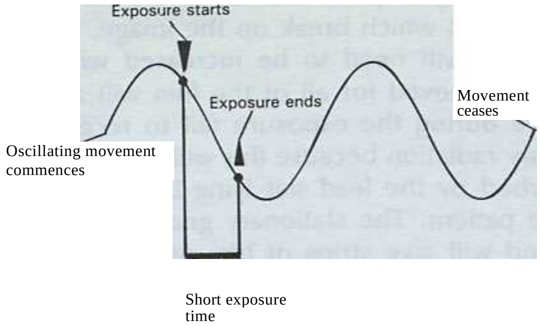


Fig. Grid movement showing the position of maximum speed where a short exposure could be made with effective blurring of grid lines.

voltage the grid line image will be more obvious. The stroboscopic effect will be explained more fully after the single-stroke bucky has been described.

By careful setting of the exposure contacts in relation to the grid's position, it is possible to arrange that short exposures take place when the grid is moving at its greatest speed. Figure 14.27 indicates the point at which a short exposure will start.

2. The two-speed reciprocating movement A grid operated by a reciprocating mechanism moves rapidly in one direction and returns more slowly to its start position. The movement is brought about by a solenoid and a strong spring set on either side of the grid. The solenoid when energised produces a strong attractive force which draws the grid very rapidly towards itself. The spring attached to the other side of the grid is under high tension when it is fully stretched by the movement of the grid towards the solenoid so when the solenoid is de-energised the spring pulls the grid back to the start position. Therefore if the solenoid is regularly energised and de-energised, the grid will move forwards and backwards at regular intervals of time. With the two-speed reciprocating movement, the time taken to move forward is shorter than the time to return and because of the tension of the spring and rapid de-energisation the change of

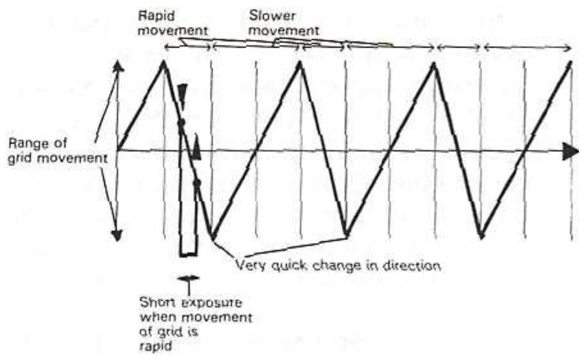


Fig. Two-speed reciprocating **movement.**

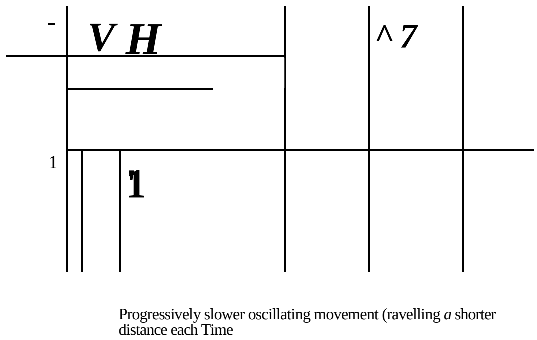


Fig. The trill (vibrating) movement.

direction is very rapid leaving no time for grid lines to be imaged. Examination of Figure 14.28 shows the trace of movement of the grid operated by a two-speed reciprocating mechanism.

The movement repetition rate has to be chosen to suit the shortest exposure time which may be required to ensure that even with this time the grid is moving fast enough to blur out the image of the grid lines. When selecting a reciprocating form of grid movement the shortest exposure time that may be used with the radi-ographic techniques to be undertaken on the equipment must be determined so that the correct motor can be installed which will drive the grid at a speed to satisfy the demands of the very short exposure. For example, radiography of small children using rare-earth screens to reduce radiation dose will almost certainly necessitate a faster than average grid movement.

The two-speed reciprocating movement is certainly more efficient than the simple oscillating movement, but it is more costly to produce and requires a more complicated mechanism to operate it which is more bulky than the simple oscillating mechanism.

3. *The trill (vibrating) movement* The trill movement is an oscillatory movement which differs from the simple oscillatory movement described previously: its repetition rate is not regular, it gets progressively slower and the magnitude of the movement diminishes with time. A trace of the movement is shown in Figure 14.29 illustrating the variation in speed and magnitude.

This is an ideal grid movement as it is cheap and easy to produce, allows a wide range of exposure times to be used without risk of grid lines on the film and the mechanism is compact and simple. Short exposure times are made when the grid is moving quickly and there is no risk of stroboscopic effects as there is no exact repetition in time of grid movement during the whole period of its movement. The grid movement takes up to 15 seconds to die away, so allowing for very long exposure times as well as the very short.

The grid frame is attached to two pairs of flat springs as shown in Figure 14.30. The grid is drawn off-centre before the exposure commences by energising a solenoid which attracts the grid in its frame because of a soft iron disc attached to the frame. The movement of the frame places one pair of springs under tension and the other pair under compression. When the exposure sequence commences the solenoid is de-energised so that the grid in its frame oscillates between the two pairs of springs. At first the springs have energy causing the oscillations to be large and rapidly recurring, but progressively the energy stored in the springs reduces caus-

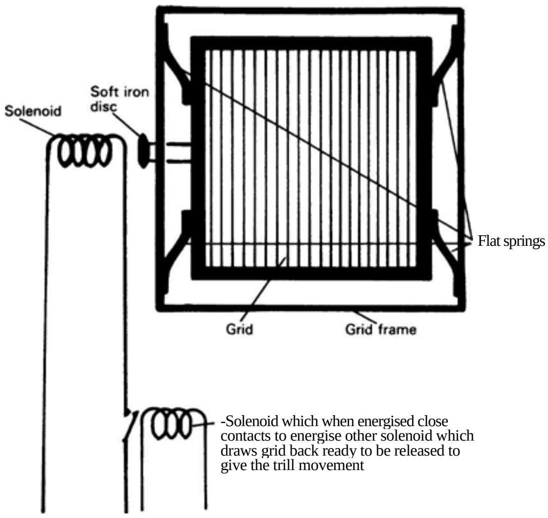


Fig. Mechanism producing the trill movement.

ing the movement to become less and much slower. The whole sequence of energising the solenoid, drawing back the grid and de-energising the solenoid precedes every exposure even if some residual movement of the grid remains.

4. Single stroke movement Although this method of moving the grid is obsolete, it is important to understand the operation since the radiographer must set the controls properly if the full radio-graphic exposure is to be delivered and no grid lines are to be visible. All the other forms of grid movement merely require the radiographer to select them.

In a single stroke movement, the grid moves in one direction only, travelling at a constant speed which has to be selected by the radiographer to match the exposure time. The grid is manually drawn back to the start position before every exposure and then is released electrically just before the exposure starts. Throughout the exposure the movement must continue; if the movement is complete before the exposure time is over, the radiation is prematurely terminated by the unit. The movement is about 5 cm, 2.5 cm on either side of the central position, therefore if the exposure time is long, the speed of grid travel has to be much slower than that needed for a short exposure. Figure 14.31 shows the relation of grid movement to exposure time.

The control of movement time is normally a small circular dial with a range of times scribed upon it, and the operator selects a time on this dial which is slightly in excess of the exposure time they have selected. It is essential to choose the correct time for too fast a grid movement will cut the exposure short and too slow a movement will result in a film with the image of grid lines upon it. With this regular movement there is considerable risk of stroboscopic effect. The movement is controlled by an oil dashpot mechanism which is bulky and liable to malfunction. Not surprisingly this system with all its in-

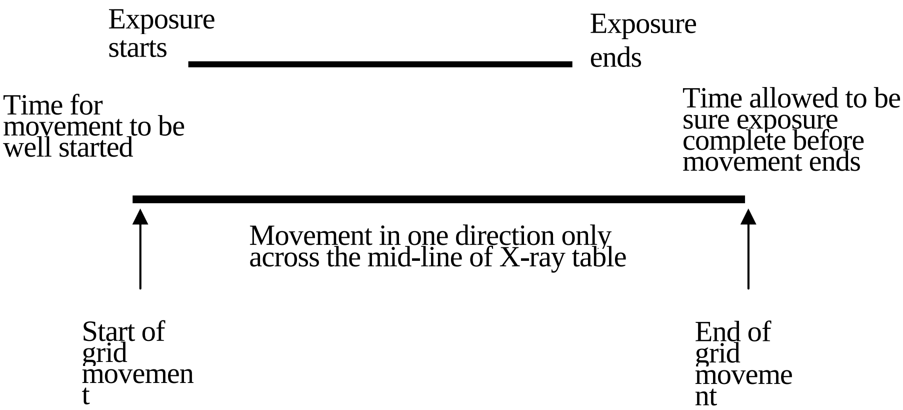
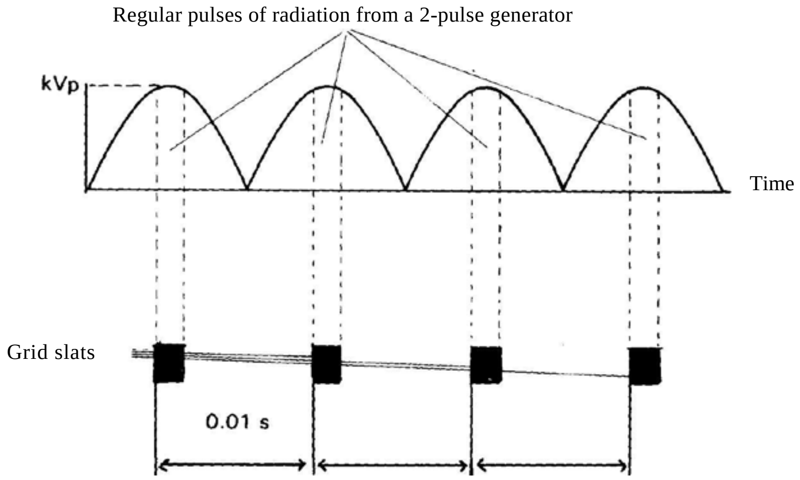


Fig. Single-stroke movement — relation of the exposure of the grid movement.



Stroboscopic effect.

herent problems is no longer produced so the detail of its mechanism has not been included in this text.

The stroboscopic effect. A stroboscopic effect will arise when two sequences of periodic occurences coincide. In this radiographic application the two sequences are the pulses of radiation and the movement of the grid slat. Figure 14.32 shows the regular pulses of radiation generated by a 2-pulse generator and below it the grid slat moving over the film regularly covering, and uncovering the film beneath it. If the speed of the grid movement causes a lead slat to cover the same strip of film every time the radiation pulse is generated, the coincidence of these two actions will imprint the grid's image on the film as if the grid was stationary although it is in fact moving throughout the exposure. This effect is most likely to arise with a simple oscillating grid where the motor moving the grid and the generator producing the radiation are supplied from the 50 Hz alternating electrical mains supply. A single stroke grid movement may show this effect when by chance the grid movement coincides with the radiation pulses and this problem is easily overcome by a slight adjustment in grid speed.