HIGH-POWER PHOTO-FLASH TUBES

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IT is of very great advantage to be able to extend to cinematography, involving ultra-rapid exposures (less than 10^{-4} sec. duration) repeated at the requisite frequency over a long working time, the type of flash-tube which hitherto has been limited to use in simple photography with single exposures or with exposures taken at long intervals. This extension, however, presents entirely new problems in regard to the construction of such tubes. When flashes, each dissipating energy $W = \frac{1}{2}CV^2$ (energy of a condenser discharge), are repeated at the frequency n per sec., the average power dissipated over the working time t of the tubes is $\frac{1}{2}nCV^2$ watts. Flash tubes as at present constructed dissipate powers of less than 20 watts; for example, those giving a maximum of one flash of 100 joules every 5 sec.

We have made some progress in developing high-power tubes, which will operate, for example, at some hundreds of watts for a long working time, or at some kilowatts over a period of a few seconds. The following are the main principles of the design:

(1) The general dimensions, particularly the tube cross-section, are very large in order to permit adequate cooling.

(2) Instead of using internal electrodes, the electrodes form part of the envelope of the tube. The Kovar electrodes are joined to the glass (Moly glass) forming the rest of the tube by means of a gas-tight solder seal. The external surface of the electrodes is cooled by direct contact with the outside air; the cooling may be improved by the use of fins, or by the circulation of compressed air or water.

(3) When the tubes are used as optical sources, it is nearly always necessary to locate the light source in some definite position. This result is obtained by means of an axial canalizing tube (Fig. 1) of small section. This tube is made of quartz because of the high temperatures it has to withstand; and its diameter, of a few millimetres, is chosen so that the current density may attain values corresponding to the maximum light efficiency. In order that the discharge should pass only through this canalizing tube and not through the annular space between it and the envelope, the canalizing tube is extended by two bell-shaped ends B_1 and B_2 inside which each electrode projects towards the inside of the tube. This arrangement, which makes the discharge path through the canalizing tube shorter than any path passing through the annular space, was found to be completely efficient.

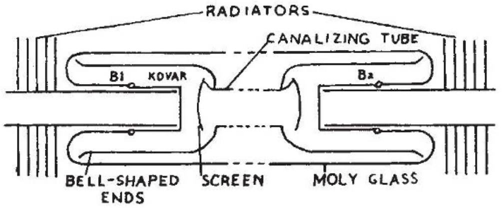

Fig. 1

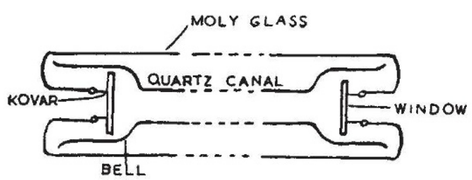

Fig. 2

(4) Intense pulverization of the cathode occurs in these high-power tubes, so producing an opaque deposit on the walls of the canalizing tube, which should be kept transparent. Owing to the fact that the metallic particles shot off from the cathode travel in straight lines, the canalizing tube can be kept transparent by placing a screen between it and the cathode, or by bending the tube at the cathode end.

Figs. 1 and 2 show two models of high-power flash-tubes which have been constructed in accordance with the above principles. That of Fig. 1 is used to make moving pictures, and operates for prolonged periods with an input power of 500 watts at the rate of 50 flashes/sec. (two flashes for one image). In the other model (Fig. 2) the extra high brilliance of the emitting tube at its end can be utilized, and in this case the cylindrical electrodes are sealed by Moly glass soldered to the metal by high-frequency heating[1]. This tube has made possible, for the first time, cinematography of living non-stained preparations with a phase-contrast microscope. The energy of a flash is about 10 joules, so that the tube must operate with an input of 1 kilowatt for a series of exposures at the rate of 100 images per sec.[2].

[1] Laporte, M., *J. Phys.*, **11**, 41 (1950).
[2] Laporte, M., Roerich-Goussu, O., and Dejean, J., *C.R. Acad. Sci., Paris*, **232**, 394 (1951); *Le Vide*, No. 31, 926 (1951).

LEARNING ABILITIES OF BIRDS

A COMPREHENSIVE and meritorious survey of existing knowledge of the learning abilities of birds and their relation to the theory of instinctive behaviour has been set out in two recent articles by W. H. Thorpe (*Ibis*, **93**, Nos. 1 and 2; January and April 1951). It is pointed out that the concepts of instinct and of learning are intimately related as complementary aspects of total behaviour, and that one cannot be understood without the other. Besides the definitions necessary for the description of instinctive behaviour and of learning itself, Thorpe also suggests definitions for certain other terms like reflex, kinesis, and taxis which are necessary for the full description of behaviour. The following is a summary of Thorpe's main conclusions.

Habituation is considered to be, in many respects, the simplest type of learning, and is one which is almost universal in animals. It is shown to be of vital importance in the process of adapting behaviour to generalized environmental stimuli (for example, sudden sounds, shadows and movements) which may be precursors of danger, but which experience has, in fact, shown to be harmless or of no significance. Habituation is thus caused by some stimulus or situation which puts the animal into a given mood but fails to lead to the release of a particular consummatory act. The more closely linked a stimulus situation (sign stimulus) is with a specific instinctive act, the less likely it is to be the subject of habituation.

The classical conditioned reflex is shown to be an artificially isolated part of a whole learning process and is only intelligible biologically as part of such a process. As with habituation, it is primarily one of the methods by which innate receptory correlates of