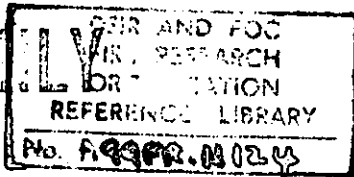


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F.R. Note No.124/1954.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

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SUGGESTED APPARATUS FOR MEASURING THE
FLAMMABILITY OF CARDED FIBRES

by

D. I. Lawson, C. T. Webster and M. J. Gregsten

July, 1954.

Fire Research Station,
Station Road,
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The following note describes the apparatus used in the measurement of the flammability of carded webs, and has been prepared at the request of the Fire Offices' Committee. The information given here has been extracted from F.R. Note No. 107 - The Flammability of Fabrics.

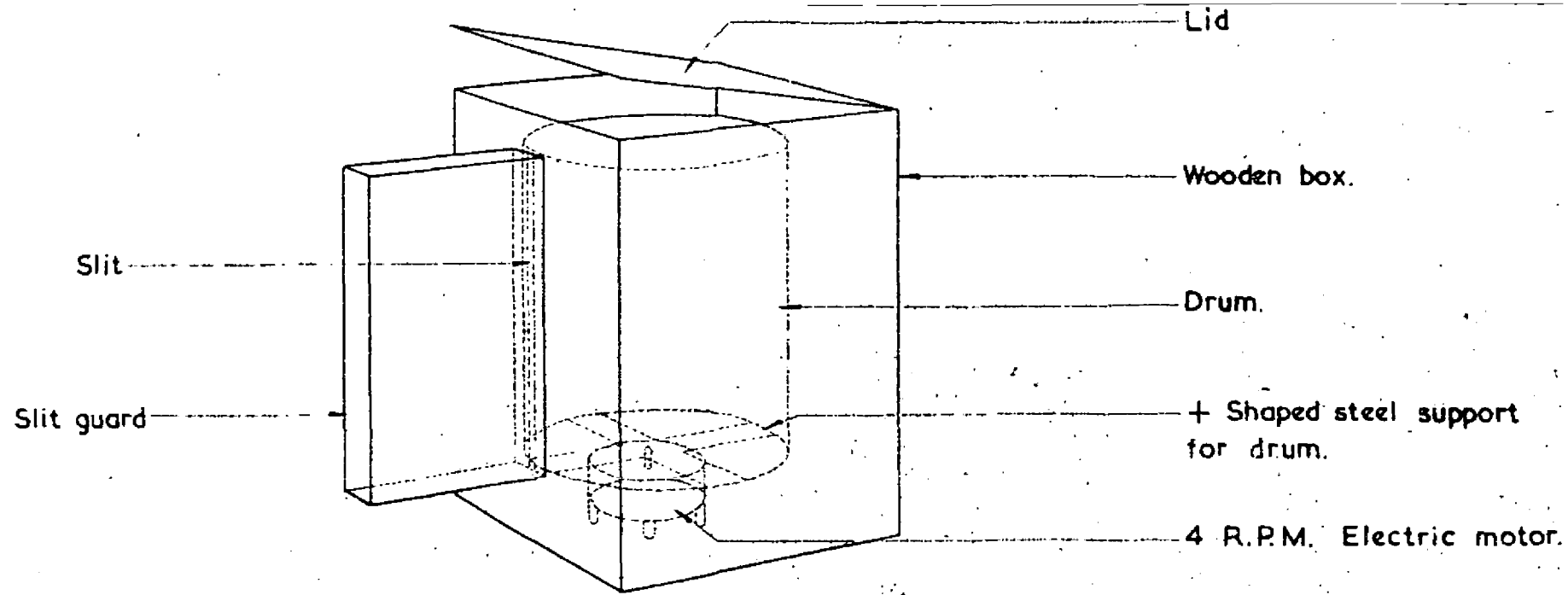
The sample size 72 in. x 4 in is suspended on a torsion balance (Figure 1) consisting of a steel wire 0.036 in. diameter and $7\frac{1}{2}$ in. long tensioned between the arms of a U-shaped casting. The balance arm is fitted with an adjustable counterweight and a small concave mirror, galvanometer type, is fixed at the fulcrum (Figure 2). A parallel beam of light is directed at the mirror and focussed on photographic paper (1) which is wrapped round a 7 in. diameter drum 10 in. high in the camera. The camera drum is supported on a synchronous motor which rotates it at a speed of one revolution every 15 seconds. A continuous trace is left on the photographic paper as the drum rotates thus the movement of the mirror on the torsion wire is recorded. Before each sample is burned the apparatus is calibrated by hanging weights on the balance arm at the position to be occupied by the sample. A trace is obtained for each weight so that the photographic paper is subdivided by horizontal lines each corresponding to a particular weight. The sample is suspended on the balance arm and a trace obtained for its initial weight. It is then ignited at the lower end and a record of the loss of weight during burning obtained. A typical example is shown in Figure 3. The oscillations on the trace are due to lack of damping of the torsion balance and the mean position of the trace is taken as indicative of the weight during burning. From the photographic record a graph is plotted of the weight of the sample as a function of time. The rate of loss of weight, which is the slope of the trace in Figure 4, must equal the speed of the flame front V multiplied by the weight per unit length of the strip while burning. Thus, if the strip has a length l and an initial weight w_1 , and the weight of the residue after burning is w_2 , then

$$V = \frac{V (w_1 - w_2)}{l}$$

thus the velocity of the flame is given by

$$V = \frac{l \cdot ?}{(w_1 - w_2)}$$

(1) Kodak Bromide Paper W.S.M.1.S 20 in. x 25 ft. cut in pieces by operator to fit camera.



THE CAMERA.

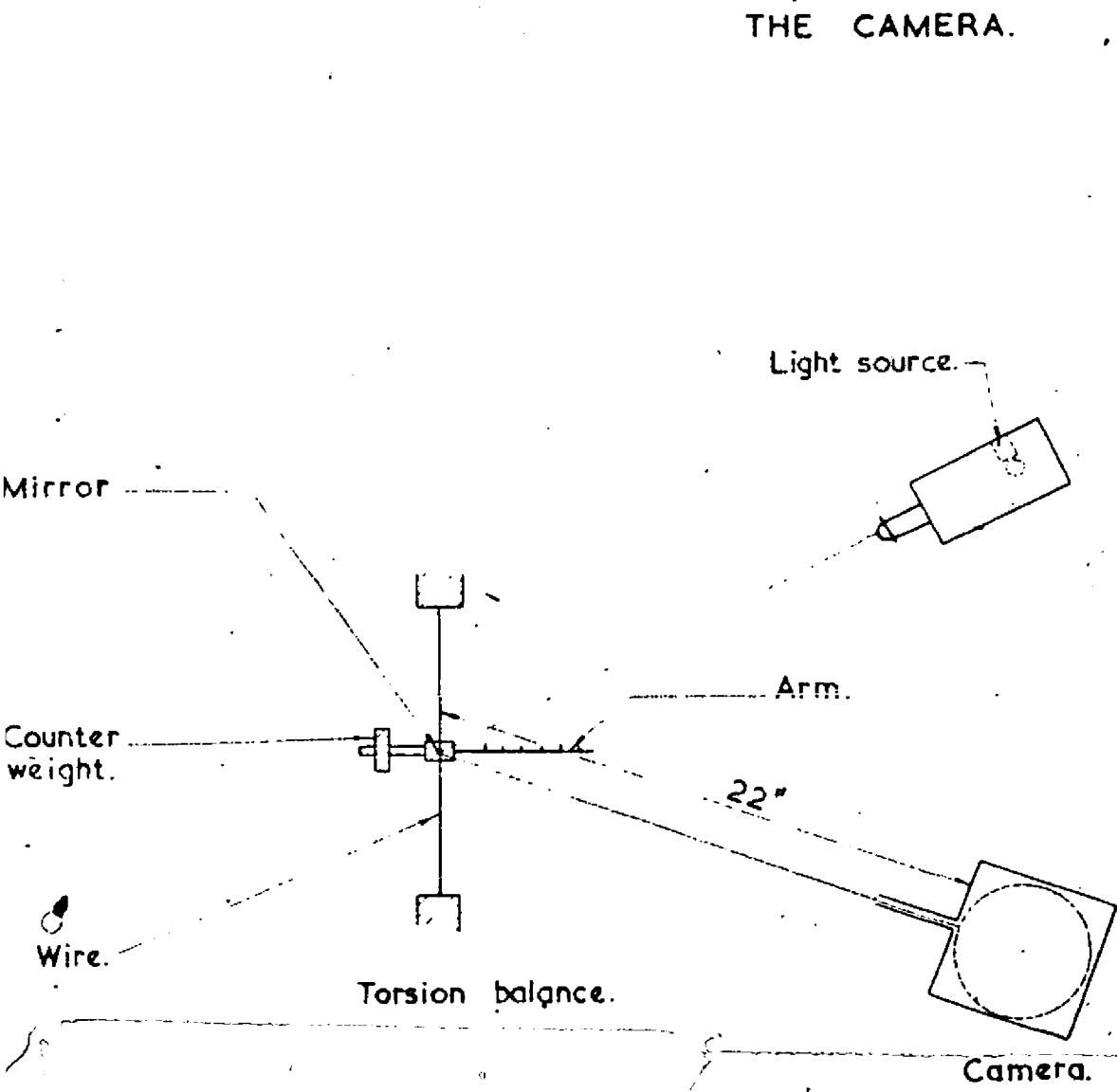
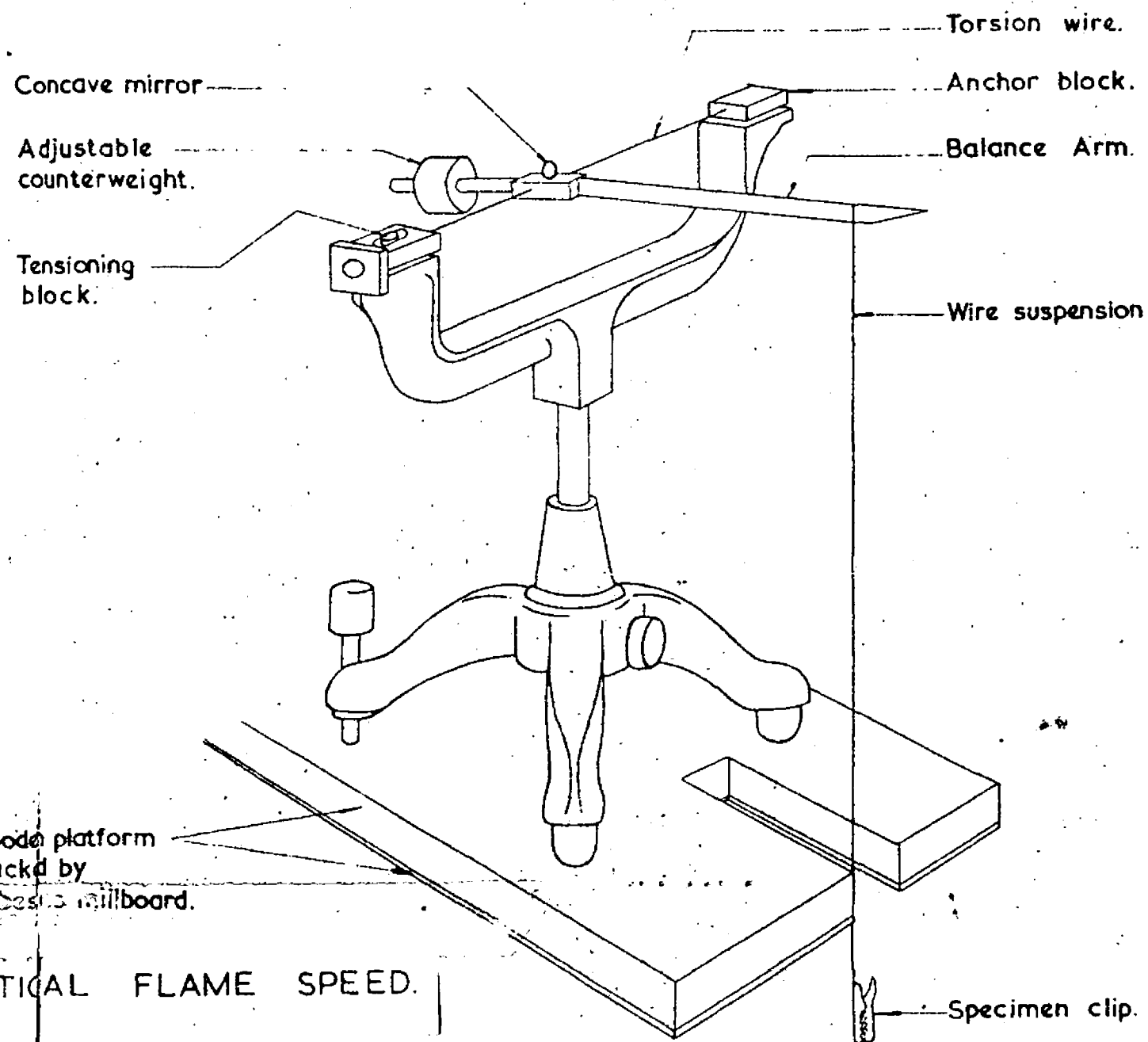


FIG. 1. APPARATUS FOR DETERMINING VERTICAL FLAME SPEED.
 SKETCH PLAN OF APPARATUS.



THE TORSION BALANCE.

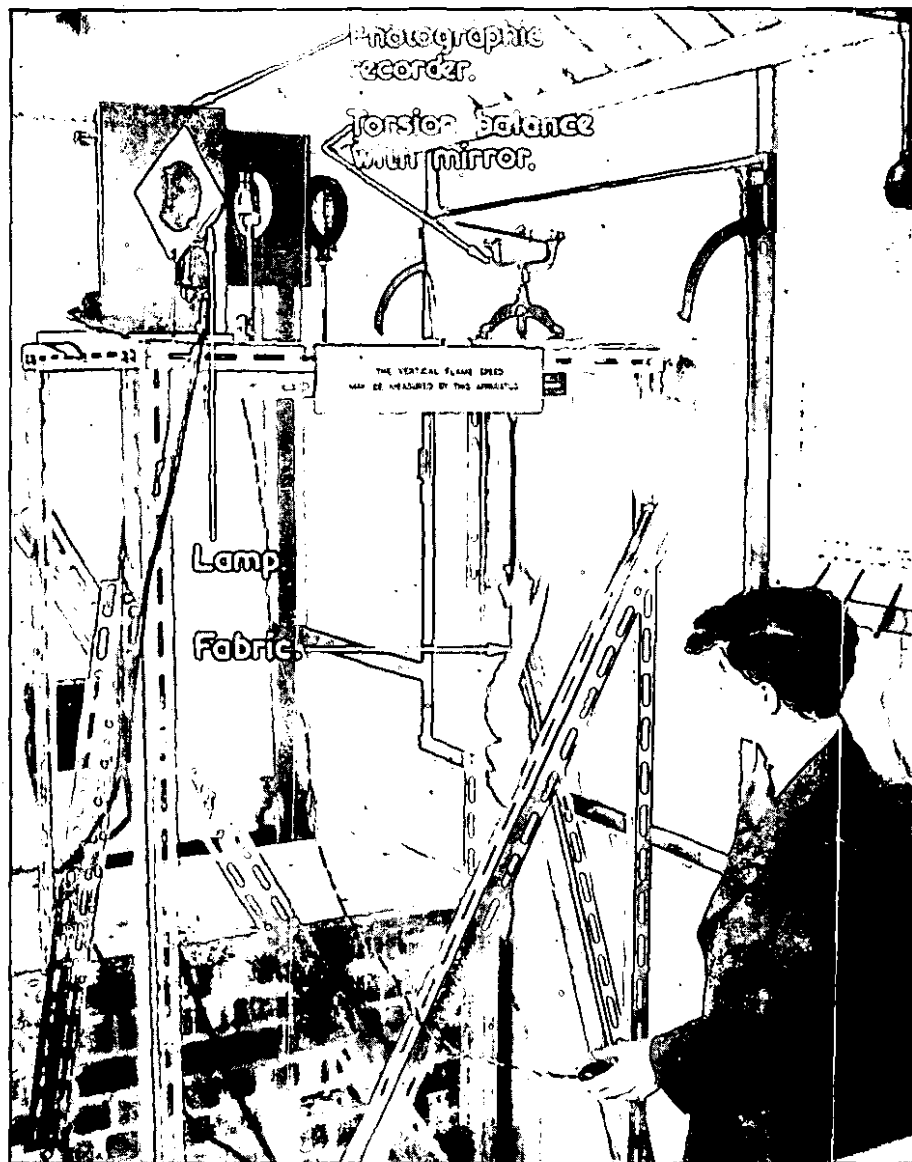


Fig. 2. Vertical Flame Speed Apparatus.

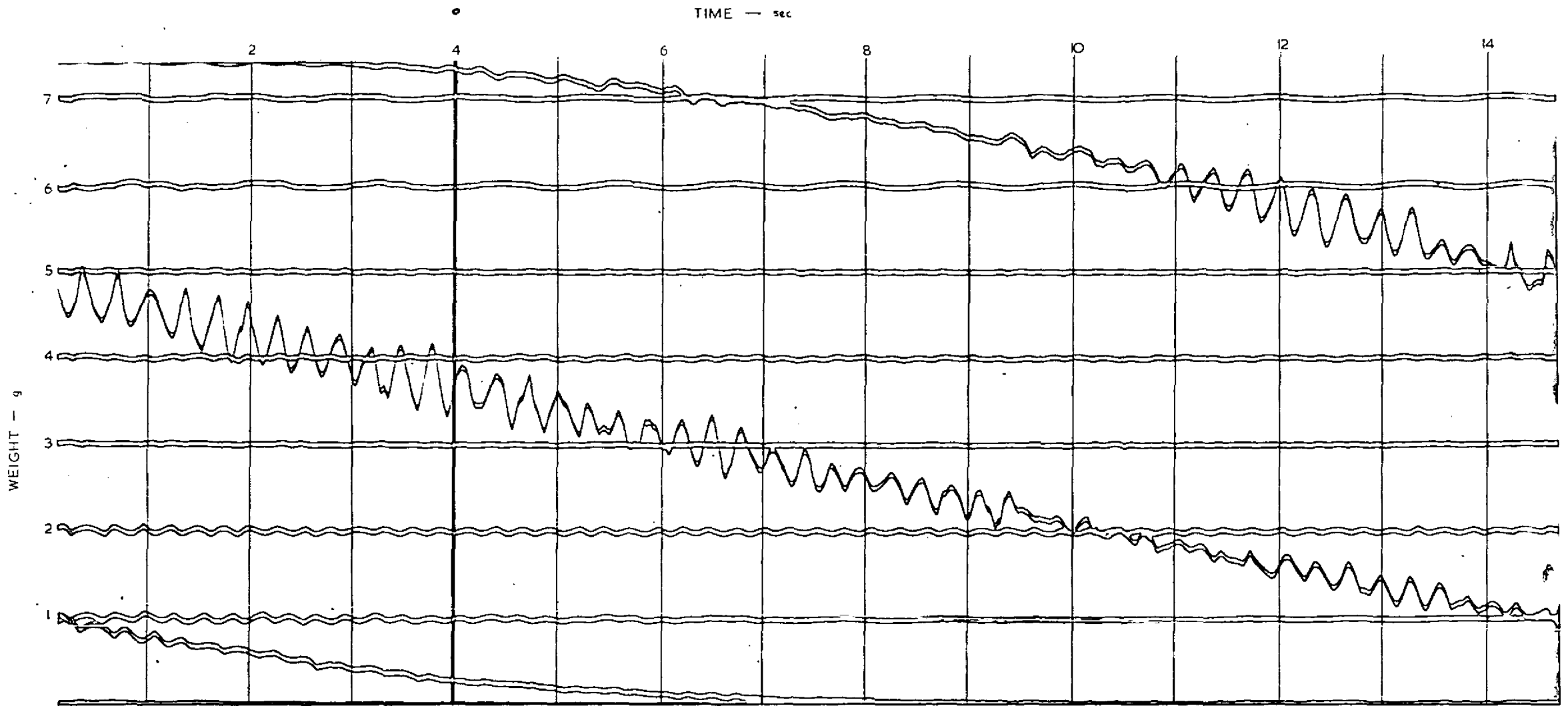
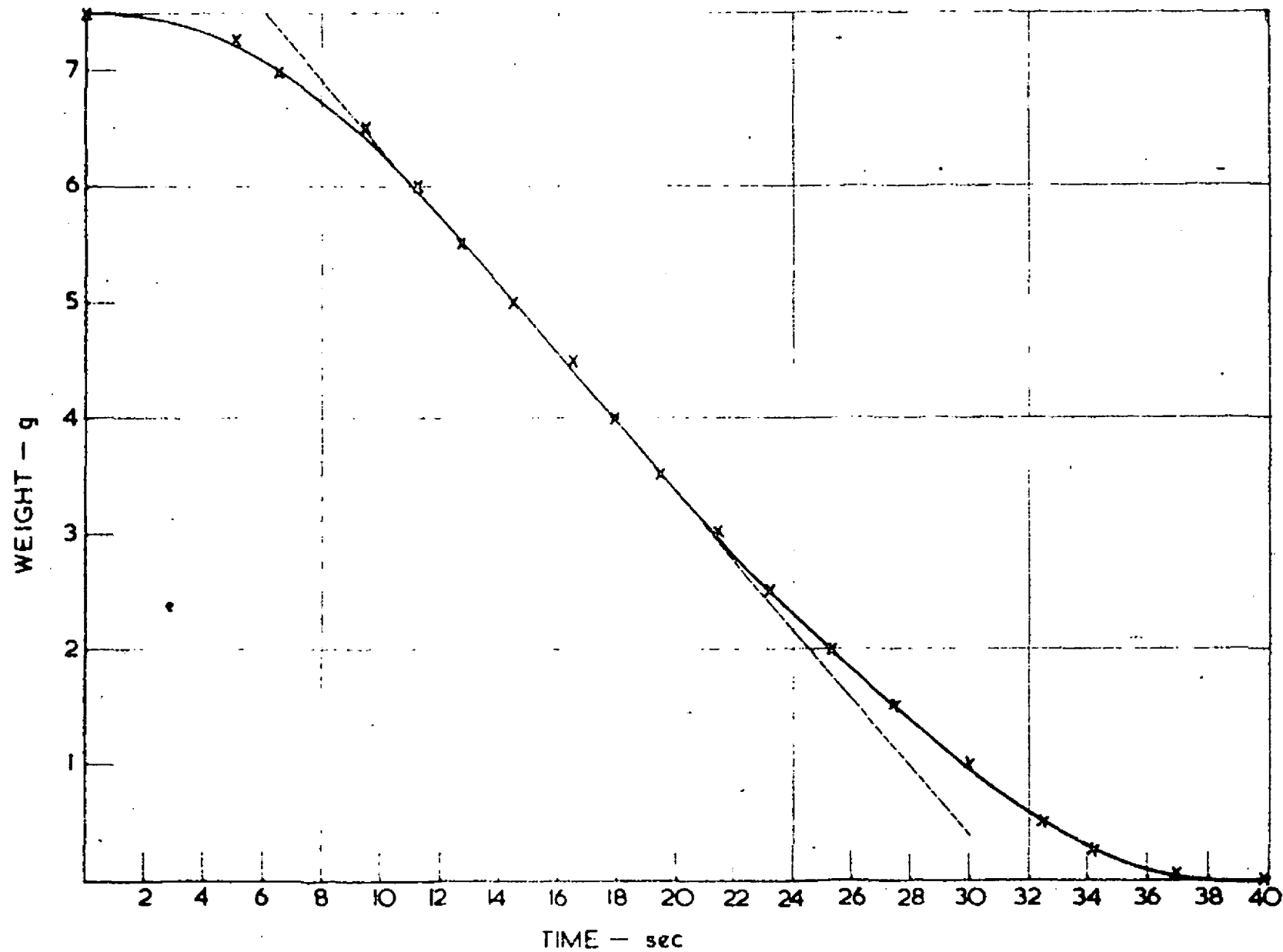


FIG. 3. TYPICAL PHOTOGRAPHIC RECORD FOR COTTON FABRIC.



Slope of Linear Portion of Curve
 $= r = 0.30 \text{ g/sec}$

Initial Weight of Specimen
 $= w_1 = 7.5 \text{ g}$

Weight Carbon Residue
 $= w_2 = 0 \text{ g}$

Initial Length of Specimen
 $= l = 72 \text{ in.}$

Vertical Flame Speed

$$\begin{aligned}
 = v &= \frac{r \cdot l}{w_1 - w_2} \\
 &= \frac{0.30 \times 72 \times 2.54}{7.5} \\
 &= 7.3 \text{ cm/sec}
 \end{aligned}$$

FIG. 4 GRAPH OF PHOTOGRAPHIC RECORD IN FIG. 3 SHOWING CALCULATION OF VERTICAL FLAME SPEED.