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PICTURE TELEGRAPHY.
SIEMENS—KAROLUS—TELEFUNKEN SYSTEM.

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THIS article deals chiefly with the particular photographic equipment and methods employed at the P.O. installation, G.P.O. (West), London. An article describing the general systems of Phototelegraphy (Belin, Bell and Siemens-Karolus) was published in this Journal in October, 1928, and a description of the London Official Station was given in last April issue.

In phototelegraphy the ideal transmission condition is to reproduce all the tones and half tones which may be present in the original to be transmitted.

DESCRIPTION OF DARK ROOM AND APPARATUS.

The present apparatus is designed for dish development by time and inspection methods.

Entrance to the Dark Room is by a specially curtained doorway, giving free entrance and exit at any time without permitting white light to enter. The outer and inner curtains are arranged on runners so that they can easily be drawn aside and close the opening again when released. The interior of this entrance chamber is painted dead black, but the dark room itself is in the usual colours used for office decoration, cream and blue-grey.

The floor is asphalte, covered with strips of lino. This latter has proved to be unsatisfactory when wet and will be replaced with fluted india-rubber matting.

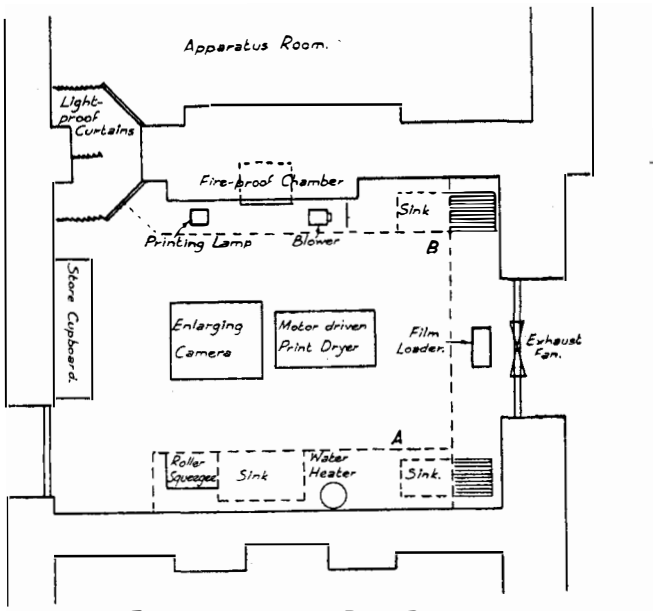

FIG. 1.—LAY-OUT OF DARK ROOM.

Making a tour round the dark room, the bench on the left has drawers in which are kept the various grades of printing paper. Suspended above this bench is the lamp used for making exposures by contact in a printing frame. This lamp is fitted into one of the standard type of

dark room lamps and the intensity of the light can be reduced readily by using one or more sheets (10 × 8) of opal or ground glass. When exposing a gaslight paper the direct light is used. By this means the exposure for various negatives and papers may be kept within reasonable limits, *i.e.*, not too fast for a soft bromide or too slow for a gaslight paper.

Sunk into the wall just above the bench is a sheet steel chamber fitted with a drop shutter. This contains the stock of unexposed celluloid films.

FIG. 2.—PRINT DRYER.

To the right is the apparatus used for drying the developed film. It consists of an electric air blower, giving hot or cold air, such as is used for drying purposes; in principle it is the same as the machines used for " Hair-drying," but is much more robust. The heater and fan are designed to deliver 600 cu. ft. of air per minute at a temperature of approx. 50°F. above room temperature.

The film (which is unbacked) to be dried is pinned upon a board placed in front of the fan. The exposed prints are developed at position B (See Fig. **1**), where the developing dish, hypo bath and sink are together. Over the hypo bath is suspended a white light for close inspection of a print.

The automatic film loader is shown below the ventilating fan. In this part of the room the stock of developers is prepared from raw materials.

On the bench at the right, development of the film is carried out. On the right hand side of the sink is the developing bath and on the left the special hypo bath and hardening bath.

The warm water used for the rapid washing of films and prints is drawn from a thermostatically controlled water heater affixed to the wall to the left of the large lead lined sink, in which the washing operations are carried out.

At the end of the bench is a roller pattern squeegee machine used in the glazing process for prints.

In the centre of the room is the enlarger and, alongside, the print dryer. The enlarger is of the vertical condenserless type capable of taking negatives 12″ × 10″ in the carrier and is fitted with a 12″ focus Cooke Aviar lens F4.5.

The illuminant is a mercury vapour arc in the M form tube contained in a lamp house, the diffusion sheets of opal or ground glass being fixed between this and the negative.

The negative carrier in the horizontal position is convenient for taking wet films. The M.V. lamp is operated by an automatic starter; this saves much time and enables accurate exposures to be made.

Graduated scales fitted to the vertical supports and the camera of the enlarger facilitate the copying, reduction or enlarging of a negative.

The print dryer, Fig. **2**, is of the rotary type, consisting of an endless canvas band which passes over a rotating drum, containing two electric heating elements. The speed of rotation and temperature of the drum can be regulated from a small switchboard on the machine.

When in use, the general illumination comes from two ceiling reflector lamps, 12 × 10, one dark red and the other deep orange; the latter is used generally, but not when film loading or negative developing is being carried out. At convenient points are situated smaller safelights, 7″ × 5″, and the switches controlling these are readily reached from the developing positions.

Two low temperature radiators of 3 kW capacity fitted with three heat control switches are situated under the benches. By means of these the room can be readily maintained at a temperature of 75°—78°F., which is the normal working temperature. A recording thermometer is situated in a position to register the temperature variations.

Ventilation is provided by an exhaust fan fitted within the framework of the window, which is boarded to exclude all white light. The fan has a capacity of 30,000 cu. ft. per hour, and is fitted with a speed regulator. Whilst this is more than ample for general ventilation, it is necessary to remove as quickly as possible the formaldehyde given off by the hardening baths and during the glazing process.

All sinks are fitted with spray nozzles on swing arms and separate $\frac{1}{2}$" bib cocks. In the large sink is a $\frac{3}{4}$" tap fitted with an " antisplash " used for the rapid washing of films.

A timing clock having a large dial (see Fig. 3)

FIG. 3.—DEVELOPING FILMS.

and a swinging pendulum, which rings a bell each second, is used for the timing of exposures and operations.

Cupboards with sliding doors are fitted beneath the benches and shelving is provided for bottles and solutions, etc.

DESCRIPTION OF OPERATIONS.

The film used by the Department is supplied by a well known British firm manufacturing photographic materials and is similar to that used by many of the newspapers who employ phototelegraphy.

The particular film used is single coated (*i.e.*, minus gelatine on the back). The celluloid base is 18.4 × 27.2 cms. and 5/1000 inch thick and the emulsion is rated at 500 H and D.

To load a receiving cylinder the dark slide containing a cylinder is placed in a carrier which slides on the rails of the special loading machine, Fig. 4. By moving the carrier with a sliding motion the cylinder engages on a tapered cone

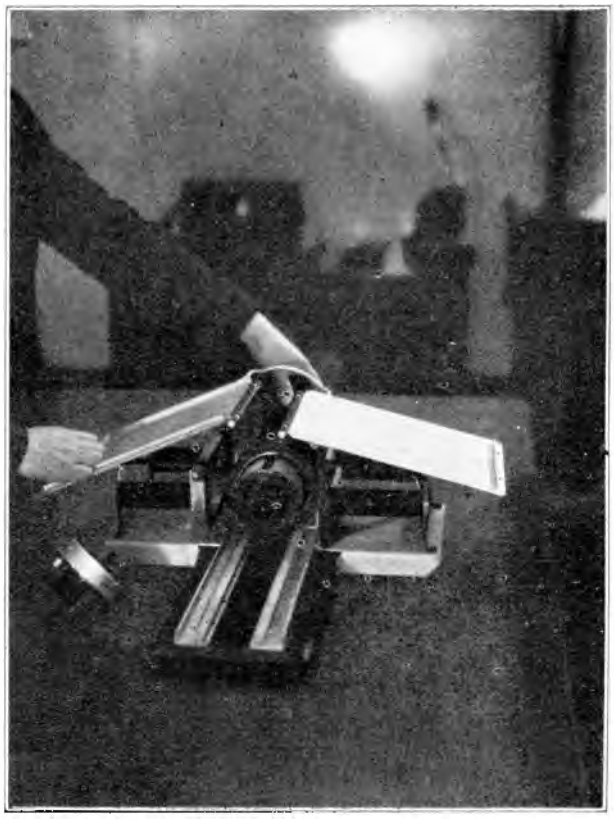

FIG. 4.—PREPARING TO LOAD RECEIVER CYLINDER WITH UNEXPOSED FILM.

mandril, which is the same size and shape as that on the receiver spindle, and the outer dark slide passes along to the end. One end of the film is clipped to the cylinder and, by turning a milled head fitted with a ratchet, it is wrapped round the cylinder and the end is then clipped on to the latter. By this means, handling of the film is avoided.

Assuming that exposure has taken place, the film is unclipped, and the top right hand corner

turned up and creased. This serves two purposes, identification of direction of running, etc., and provides a means of lifting the film from the solutions.

Development is carried out in a dish using a metol - hydroquinone developer. Experiments have shown the following composition to be suitable for these films :—

Metol	1.75	grams.
Hydroquinone ...	4.0	,,
Sodium Sulphite ... (Anhydrous salt).	75	,,
Sodium Carbonate ... (Anhydrous salt).	35	,,
Potassium Bromide ...	1.5	,,
Water to	1000	,,

This formula compares favourably with many well balanced M.Q. developers, with the exception that the alkaline content—Sodium carbonate —is a little higher, which quickens the developer.

At a temperature of 75° the Watkin factor for this developer is 4.5 to 5 and complete development normally takes place in 1.75 minutes. When developing black and white transmissions the Watkin factor is increased to 6½ to give greater density.

After a brief rinse in running water the film is transferred to a rapid acid fixing bath, composed of :—

Sodium Thiosulphate ...	200	gm.
Potassium Meta-bisulphite .	25	,,
Ammonia Chloride ...	35	,,
Water to	1000	cc.

With continued rocking, the emulsion is cleared in about 1½ minutes. This time clears the film, but does not necessarily "fix" the emulsion, as there are left double salts of silver and ammonia, but these in no way effect the density of the deposit.

The film is then washed for two minutes under the full jet of water from the tap in the large sink. During this period the major portion of the thiosulphates is washed from the film.

Hardening the gelatine film is done by immersion for 1½ minutes in the following solution :—

Formaldehyde 40% solution..	1 part.
Water to	9 parts.

When not in use this bath is kept in a covered case to prevent inconvenience caused by the irritating vapour of formaline.

A further washing of two minutes is given, finishing with warm water, when the surplus moisture is removed from the gelatine by means of a pad of chamois leather.

If a print only is required, the film negative is squeegeed to a glass support, and the positive is made by means of the enlarger. The major portion of the received work is of a topical pictorial character for press agencies and newspapers, who require the delivery of the actual film. In these cases the wet film is pinned upon the special drying board and the hot air blast started, Fig. 5. Drying is usually completed in 4½-5 minutes.

Fig. 5.—Fixing Film for Drying.

It is necessary to make two copies for record purposes from all films delivered and this is the next step.

The following procedure applies to both methods of printing, *i.e.*, through the enlarger or by contact in a printing frame.

The negative is viewed and, according to its density and contrast, a suitable printing paper is used for the positive.

The stock of printing papers, which all are "Glossy," consists of soft, normal and hard bromide emulsions and soft and vigorous chlorobromide (silver chloride) emulsions, supplied by well-known makers.

The type of negative obtained depends upon:

1. Voltage on receiving lamp.
2. Voltage on Kerr Cell.
3. Setting of Nicol prisms.
4. Black and white original transmitted without compensation.
5. Tone scale original transmitted with various compensations.
6. Photographic treatment of exposed emulsion.

1, 2, 3 and 6 are variables, which are controlled at the receiving end and are adjusted within certain limits to suit the type of film used.

Where the original is black and white in character (or devoid of any half tones) it is transmitted without compensation and advantage is taken of the characteristic curve of photographic emulsions. The resulting negative has only two tones, one very light and the other of full density. Any short-range printing paper is suitable for printing from such a negative.

If too little or too much compensation is given distortion of the tone scale results. Too little has the effect of producing a hard negative and loss of low shadow tones, whilst over compensation produces a flatness similar in effect to "over exposure" in ordinary photography.

This flatness may to some extent be corrected by using a suitable printing paper having a short exposure scale.

By alteration of the electrical circuit arrangement of the picture and compensation photo cells, "Positive" reception can be made when the receiver drum is loaded with a sheet of rapid bromide paper in place of a negative film and, by the usual development, a positive print is obtained direct.

Provision is made in the switching arrangement of the apparatus for the following conditions:—

Transmitted.	*Received.*
Positive Print.	Negative Film.
,, ,,	Positive Print.
Negative Film.	,, ,,
,, ,,	Negative Film.

Experiments show that three types of film emulsion and three kinds of bromide printing papers will cover all the required conditions on the photographic side.

The developer used for printing paper is that suggested by the makers of the particular paper.

The print, after development, is transferred, after washing for a brief period, to an acid fixing bath and vigorously agitated for a few seconds, to stop the action of the developer. Inspection is then made with a white light and, if necessary, reference is made to the negative to ascertain that a reasonably correct exposure has been made.

It has been shown by Warwick that, providing a print is vigorously agitated in a fresh fixing bath, fixation takes place very rapidly and is of the order of 30 seconds.

Following a washing in a turbine pattern washer, the print is transferred to a bath containing a glazing solution. This bath is composed of formaline, oxgall and water. The positive is then transferred to a ferrotype glazing sheet, 14 × 10, previously swabbed with the glazing solution and, after being squeegeed by hand, is placed between fluffless blotting sheets and passed twice through the roller squeegee to remove the surplus moisture and ensure even contact between the print and the glazing support. After passing through the print dryer, which takes about seven minutes, the print is stripped off the ferrotype sheet and is ready for enclosing in an envelope for delivery in the usual way.

The following table indicates the time taken to produce (1) a finished film and (2) a finished print:—

(1)	Development	2 minutes.
	Washing	5 seconds.
	Fixing	1½ minutes.
	Washing	2 ,,
	Hardening	1½ ,,
	Washing	2 ,,
	Drying	5 ,,
	Total	14 mins. 5 secs.

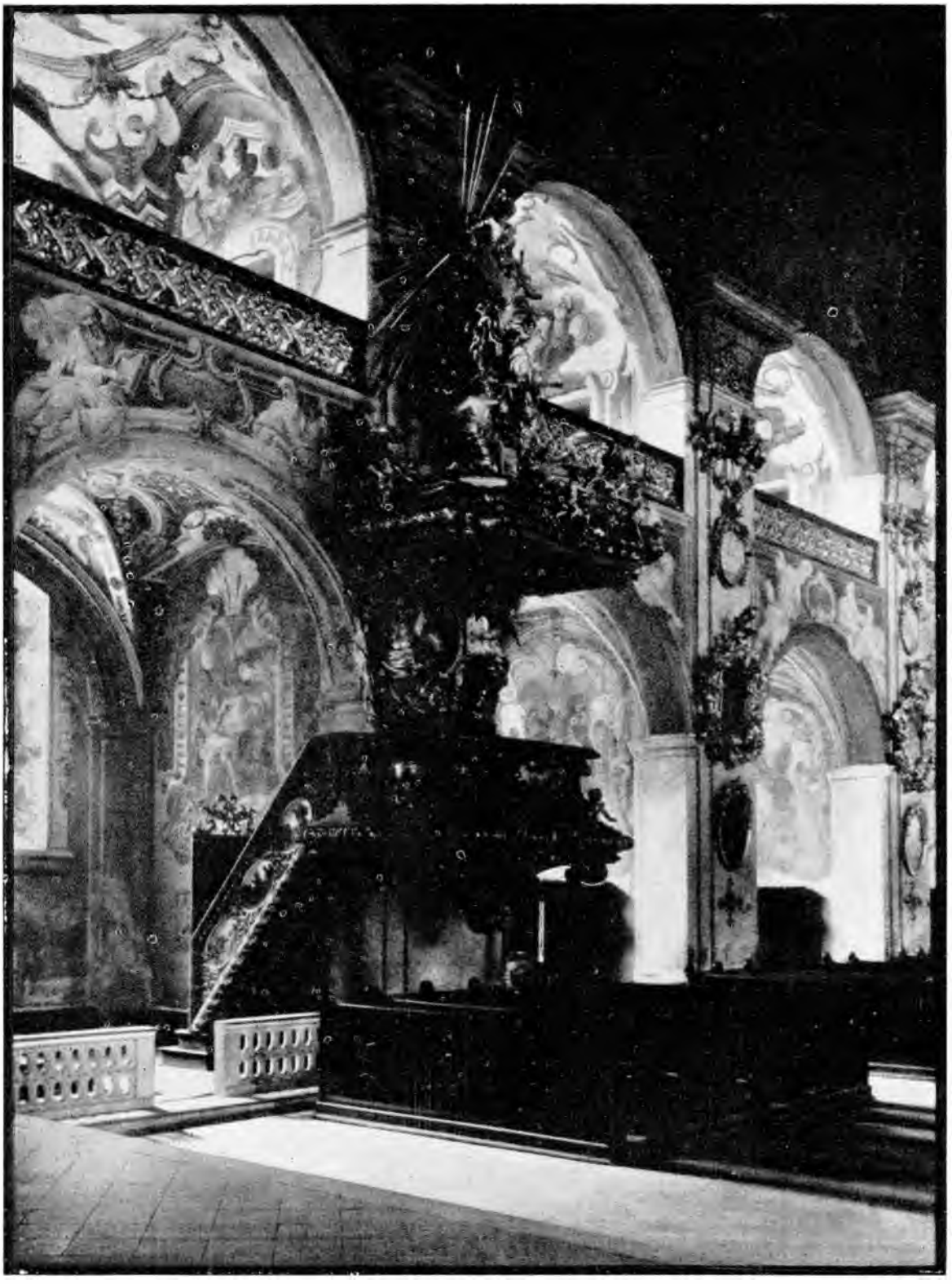

FIG. 6.—SPECIMEN OF RECEPTION, LONDON-MUNICH.

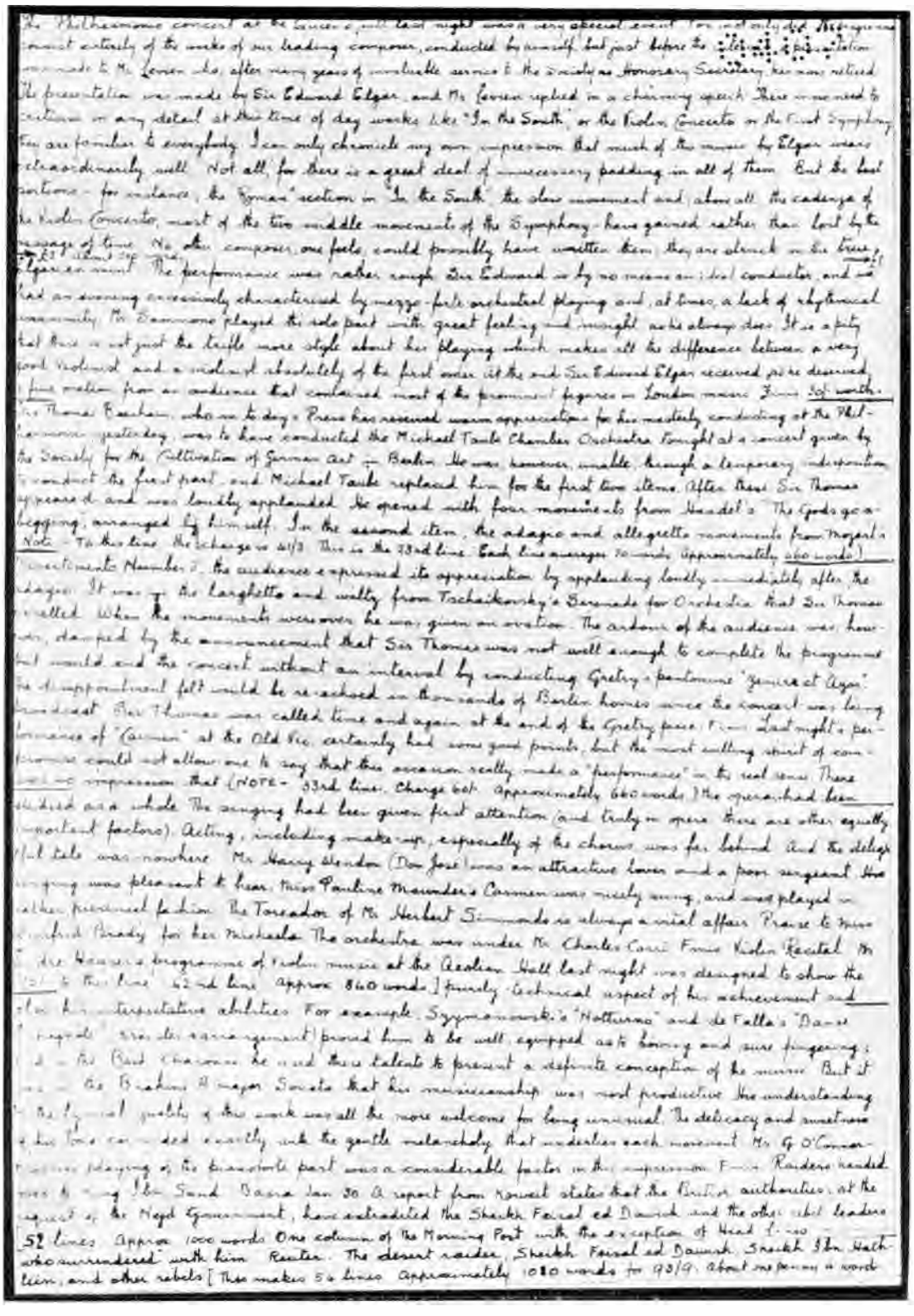

FIG. 7.—SPECIMEN OF RECEPTION. A COMPETITOR TO HAND AND MACHINE TELEGRAPHS.

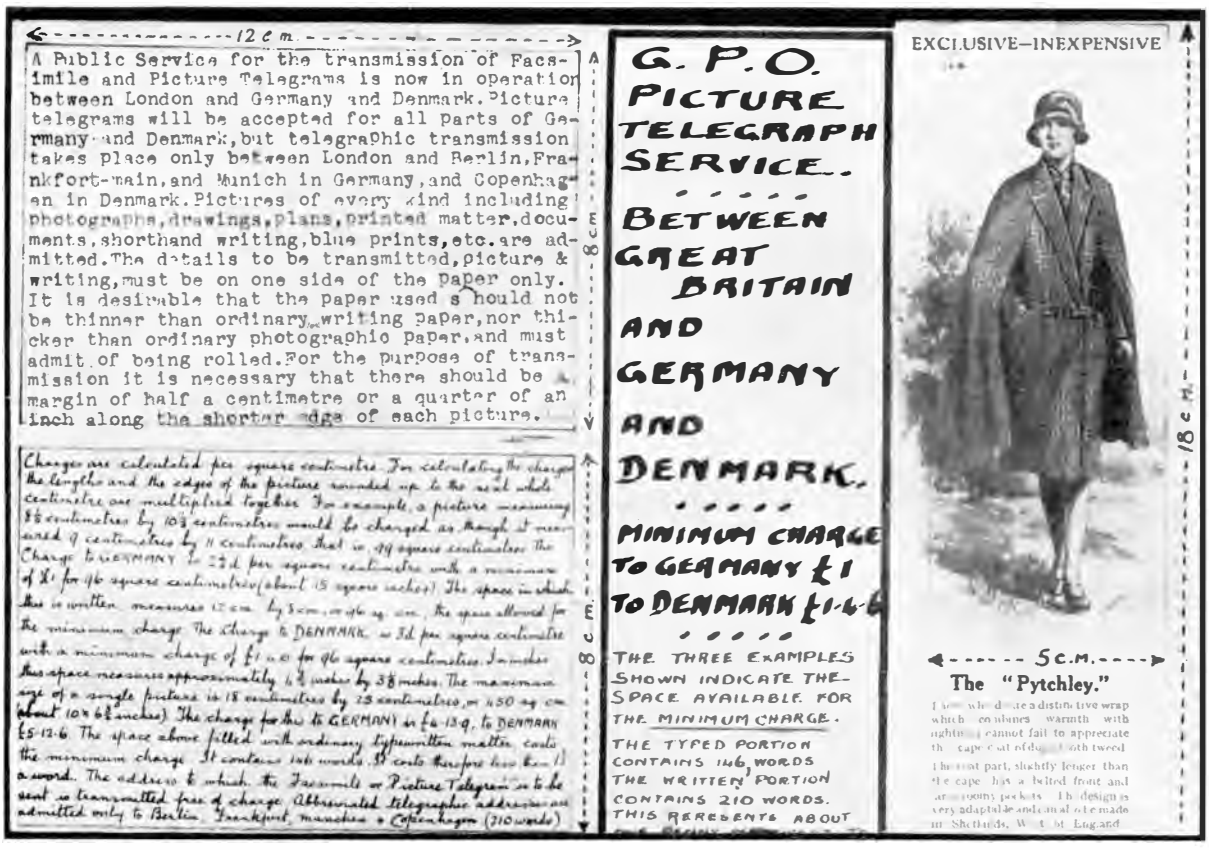

FIG. 8.—SPECIMEN OF RECEPTION, INDICATING POSSIBILITIES OF SERVICE.

(2) Printing either by enlarger or contact	3	minutes.
Developing	2	,,
Fixing	1	,,
Washing	2	,,
Hardening	10	,,
Glazing		
Drying		
Extras, etc.	3	,,
Total	21	,,

Celerity is the chief factor in the production of these films and prints, and consequently permanency is not closely studied. Nevertheless, films and prints made two years ago under similar conditions during the experimental trial of the system do not show any signs of deterioration. Samples of experimental work are shown in Figs. **6**, **7** and **8**.