BBC

ENGINEERING DIVISION

MONOGRAPH

NUMBER 21: NOVEMBER 1958

Two New BBC Transparencies for Testing Television Camera Channels

by G. HERSEE, A.M.Brit.I.R.E.
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(Part I)
and
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(W. R. Royle and Son Ltd)
(Part II)

BRITISH BROADCASTING CORPORATION

PRICE FIVE SHILLINGS

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No. 21

TWO NEW BBC TRANSPARENCIES FOR TESTING TELEVISION CAMERA CHANNELS

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G. Hersee, A.M.Brit.I.R.E.
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BRITISH BROADCASTING CORPORATION

FOREWORD

THIS is one of a series of Engineering Monographs published by the British Broadcasting Corporation. About six are produced every year, each dealing with a technical subject within the field of television and sound broadcasting. Each Monograph describes work that has been done by the Engineering Division of the BBC and includes, where appropriate, a survey of earlier work on the same subject. From time to time the series may include selected reprints of articles by BBC authors that have appeared in technical journals. Papers dealing with general engineering developments in broadcasting may also be included occasionally.

This series should be of interest and value to engineers engaged in the fields of broadcasting and of telecommunications generally.

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CONTENTS

PREVIOUS ISSUES IN THIS SERIES

No.	Title	Date
1.	*The Suppressed Frame System of Telerecording*	JUNE 1955
2.	*Absolute Measurements in Magnetic Recording*	SEPTEMBER 1955
3.	*The Visibility of Noise in Television*	OCTOBER 1955
4.	*The Design of a Ribbon Type Pressure-gradient Microphone for Broadcast Transmission*	DECEMBER 1955
5.	*Reproducing Equipment for Fine-groove Records*	FEBRUARY 1956
6.	*A V.H.F./U.H.F. Field-strength Recording Receiver using Post-detector Selectivity*	APRIL 1956
7.	*The Design of a High Quality Commentator's Microphone Insensitive to Ambient Noise*	JUNE 1956
8.	*An Automatic Integrator for Determining the Mean Spherical Response of Loudspeakers and Microphones*	AUGUST 1956
9.	*The Application of Phase-coherent Detection and Correlation Methods to Room Acoustics*	NOVEMBER 1956
10.	*An Automatic System for Synchronizing Sound on Quarter-inch Magnetic Tape with Action on 35-mm Cinematograph Film*	JANUARY 1957
11.	*Engineering Training in the BBC*	MARCH 1957
12.	*An Improved 'Roving Eye'*	APRIL 1957
13.	*The BBC Riverside Television Studios: The Architectural Aspects*	JULY 1957
14.	*The BBC Riverside Television Studios: Some Aspects of Technical Planning and Equipment*	OCTOBER 1957
15.	*New Equipment and Methods for the Evaluation of the Performance of Lenses for Television*	DECEMBER 1957
16.	*Analysis and Measurement of Programme Levels*	MARCH 1958
17.	*The Design of a Linear Phase-shift Low-pass Filter*	APRIL 1958
18.	*The BBC Colour Television Tests: An Appraisal of Results*	MAY 1958
19.	*A U.H.F. Television Link for Outside Broadcasts*	JUNE 1958
20.	*The BBC's Mark II Mobile Studio and Control Room for the Sound Broadcasting Service*	AUGUST 1958

SUMMARY

When testing camera tubes for use in a television service it is necessary to check the spectral response and also the overall performance of the tubes and the camera channels in which they are to work.

In order to provide simple, speedy, and accurate facilities for carrying out these check tests, the BBC has recently introduced two new camera channel test transparencies, known as Nos. 50 and 51. These new transparencies are described in Part I of this monograph and information is given on their design, use, and the results obtained.

The manufacture of transparency No. 51 presented several interesting problems, the solving of which called for considerable ingenuity and skill to ensure that the result was satisfactory for its intended purpose. Part II of the monograph details the methods used in producing the final transparency, describes the difficulties encountered, and the steps taken to overcome them.

PART I

REQUIREMENTS, DESIGN AND USE OF THE COLOUR RESPONSE, AND THE GRADATION AND RESOLUTION TRANSPARENCIES

1. Introduction

When testing television camera tubes one of the parameters to be examined is the spectral response of the photoelectric conversion. In practice a fairly rough check is all that is required, as tubes fall into two main categories which are clearly distinguishable: tubes which have good colour-rendering properties from the viewpoint of programme departments, and those which are rejected for a processing fault during manufacture. The search for a quick and simple means of checking the category to which a particular tube belongs has resulted in the design of 'BBC Test Transparency No. 50', of which details are given in Section 2.

A further requirement was for a test chart which allowed the overall performance of the camera tube and the channel incorporating it to be rapidly assessed, even by non-technical persons, but which at the same time contained information permitting accurate measurement to be carried out if necessary. 'BBC Test Transparency No. 51' is a new test pattern designed by the BBC's Planning and Installation Department and recently brought into use to meet this need. Although this transparency has been produced specifically for testing image orthicon tubes, it is also suitable for testing other types of camera tube.

A transparency is used in order to provide the large contrast range necessary. Experience has shown that the majority of tests on a camera channel should be carried out with the controls left at one setting. It is inadmissible to adjust the controls for the best results on individual tests. It was therefore desirable to have a test transparency which would permit the optimum settings of the controls to be reached quickly.

The remainder of Part I of this monograph is concerned with the design and use of the two new transparencies, whilst Part II provides detailed information about the manufacture of 'BBC Test Transparency No. 51' since, being the more complicated of the two, its production presented several interesting problems.

2. BBC Test Transparency No. 50

This transparency was designed and made for checking the spectral response of the tube and its associated channel, and is illustrated in Fig. 1.

2.1. *Design*

Since only a relative check is required to ascertain whether a tube is acceptable, i.e. within the 'approved' limits, a transparency using the three primaries RED, GREEN, and BLUE is used. These occupy approximately one-third of the picture area of 10 in. × 7½ in. in a 12-in. × 10-in. glass slide. The unused area is made opaque, and used for labelling, etc., while standard gelatine filters, selected for density, provide the colour areas.

Inset into each area of colour is a section of a step-wedge having 0·15 density steps so that the response of the tube to each colour patch can be measured relative to the steps on the wedge. It is advantageous to surround each wedge with colour as the relative modulation can then be checked on a picture monitor without having to use a waveform monitor.

2.2. *Use*

The transparency is set up in front of a suitable light-box, and the camera is focused on it. The measurement can then be made in one of two ways.

Either the modulation depth of the colour patches can be compared with the step-wedges using a waveform monitor (preferably of the line-strobe type), or the brightness of a picture monitor can be reduced until each colour patch is just appearing as a very dark grey. It is then easily possible to decide which step on the wedge has a similar modulation depth. Alternatively the camera-channel lift can be reduced to give the same result.

The tubes which are acceptable all give responses which spread over three steps of the wedge, i.e. $X \pm 1$ where X is the number of the step counted from the highlight end. Unacceptable tubes give responses which are several steps

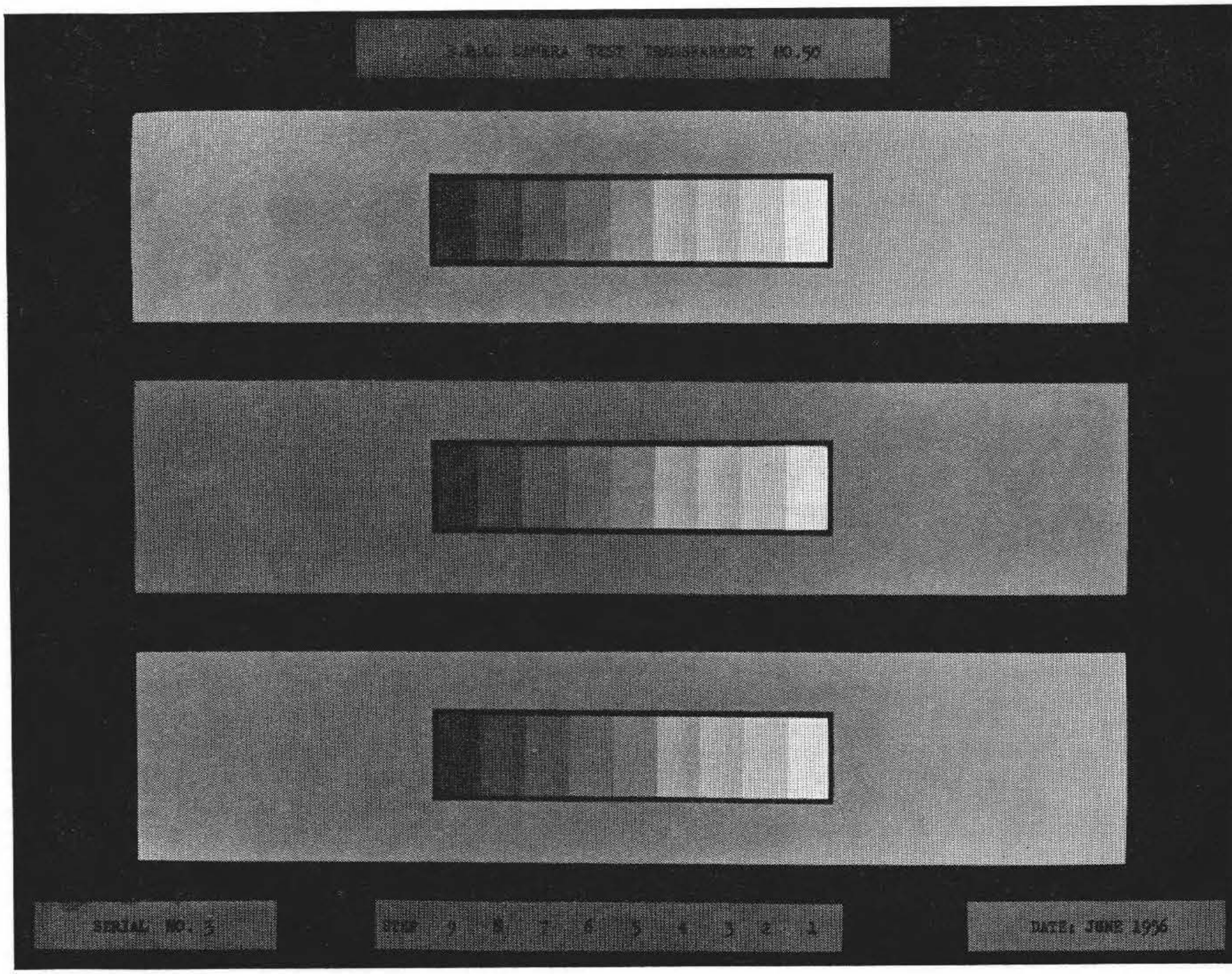


Fig. 1 — *Photograph of BBC Test Transparency No.* 50

away from X. Naturally X varies for the three patches and for different types of illumination. Fluorescent lamps give a lighter value to the blue patch, and are recommended for such use in preference to tungsten lamps, as can be seen from Fig. 2 and Fig. 3. When being used for routine tests, all except the three 'pass' steps of each wedge are covered, so that inspectors do not have to count the numbers of the steps.

3. BBC Test Transparency No. 51

This transparency, a photograph of which appears in Fig. 4, page 9, was designed for testing the overall performance of camera tubes and the channels incorporating them.

3.1. *Design*

Image orthicon camera tubes do not behave properly if presented with large areas of plain light. It is therefore necessary to break up the background to give what is termed an 'a.c. signal'. This is done in the well-known Test Card 'C' by means of the white grid lines, but it was felt that a picture would be of greater use in the new card.

3.1.1. *Picture*

The use of a picture would give a finer pattern to the background of the technical information and, if chosen with care, would facilitate both the setting up of the camera channel and the assessment of its performance by non-technical people. For the latter purpose faces are best, as the human eye seems particularly sensitive to the accuracy of facial tones. A search was carried out for a suitable picture, with a face prominent, good detail on which to focus, and a tonal range of about 30 : 1. All cameras must reproduce this range accurately, although they should make some attempt to reproduce a much larger range.

Eventually a suitable picture was found, and through the courtesy of Ilford Ltd, the BBC has been granted the

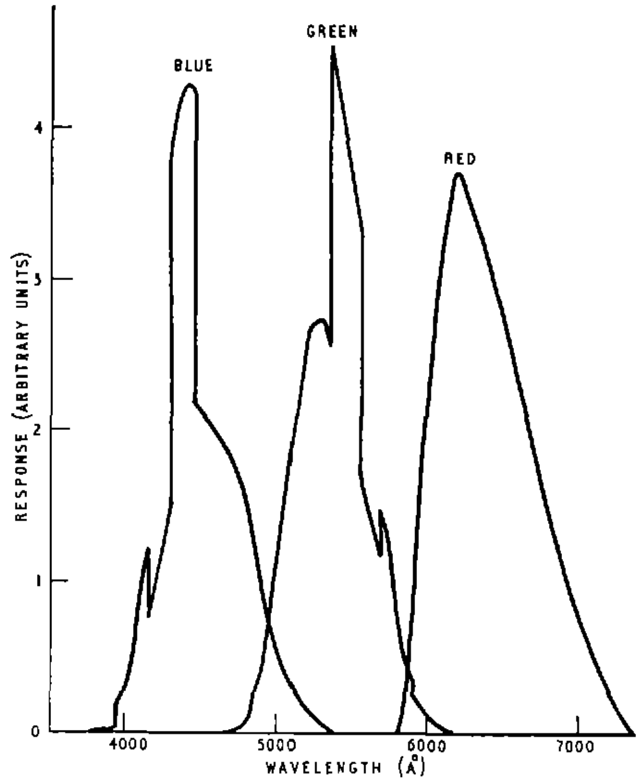


Fig. 2 — Combined response of fluorescent tube (Atlas 'Northlight') and BBC Test Transparency No. 50

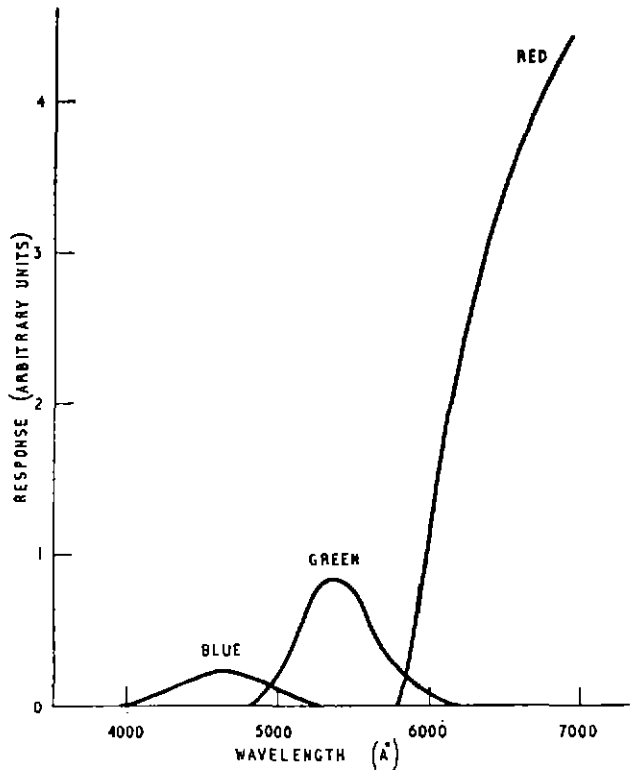


Fig. 3 — *Combined response of incandescent lamp at* 2600°*K and BBC Test Transparency No.* 50

copyright of its use for technical purposes upon condition that it is not normally transmitted during advertised programme hours. The chosen picture had several other desirable features, including both highlight and shadow detail, clear demarcation of focused and unfocused areas, no essential detail which would be obliterated by the technical information to be added, and good detail for accurate optical and beam focusing (the check skirt).

3.1.2. *Technical Information*

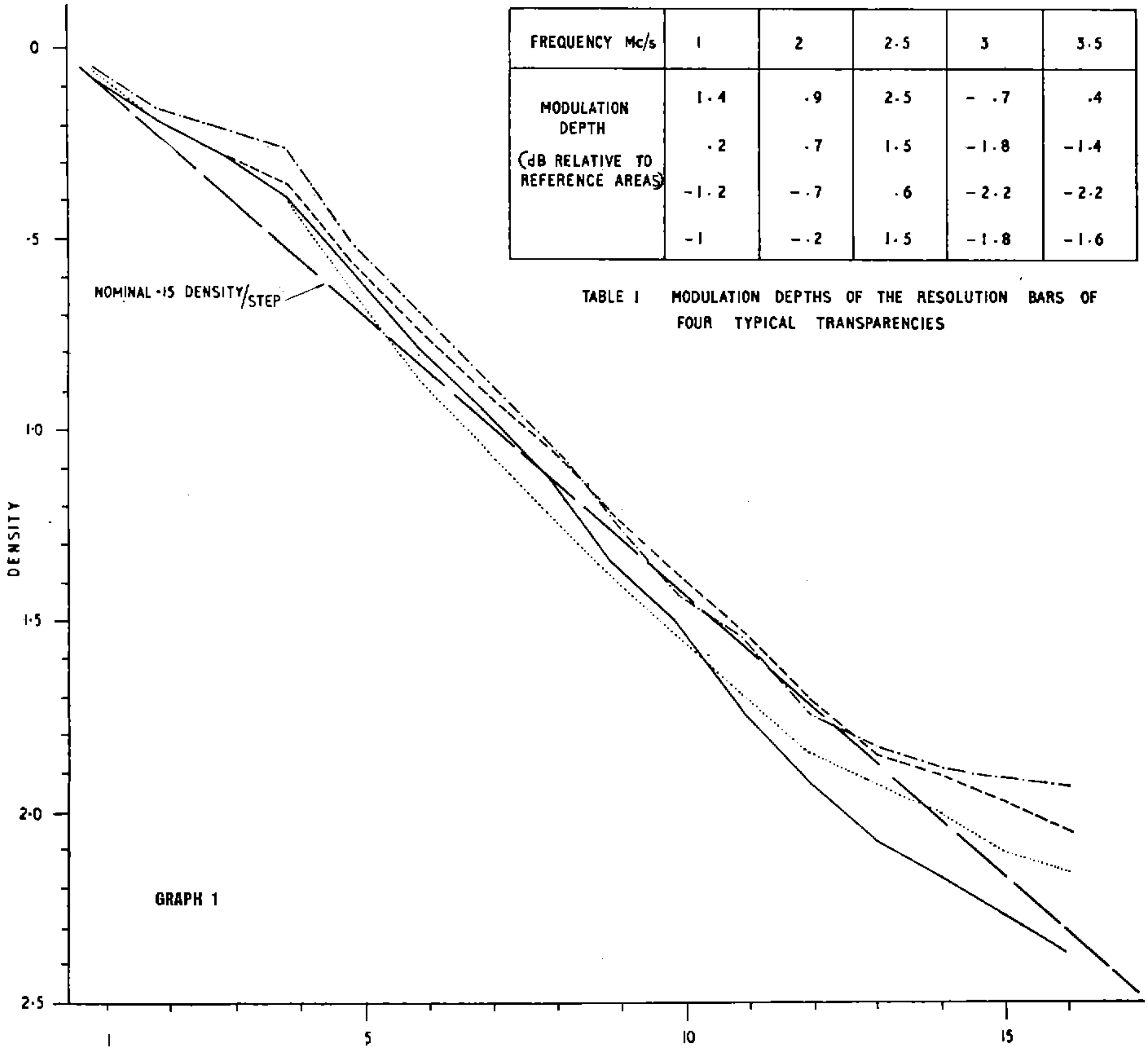
The picture having been selected, a copy negative was prepared, the technical information detailed, and its position decided. Experience had shown that image orthicons should be tested for resolution by means of gratings which compared the resulting modulation depth with a black/white transition between large areas. To use as a reference some medium frequency, say 1 Mc/s, introduces errors. Some test charts use resolution wedges, and are intended to be used with a picture monitor. The position where the resolution is just visible is noted. This is very inaccurate, and also relies too much upon the picture monitor. The BBC prefers the more objective method of measuring, with a waveform monitor, the modulation depth of gratings giving fixed frequencies. Therefore the gratings were chosen so as to generate frequencies of 1·0, 2·0, 2·5, 3·0, and 3·5 Mc/s when scanned on the British 405-line system. The upper limit of the video band is 3 Mc/s and so this grating was put near the centre of the transparency. The others, and the reference patches, were disposed so that a line-strobe waveform monitor could indicate all of them in one line.

All previous test charts had used gratings consisting of ruled black lines on a white background. These, on a transverse light/distance plot, gave a rectangular cross-section. After conversion by the bandwidth-limited camera channel the harmonics had been severely reduced in amplitude and changed in phase. For example, it is obvious that a rectangular waveform at 3 Mc/s passed through an ideal low-pass filter with a cut-off at 3 Mc/s is bound to be distorted. In fact, Fourier analysis of a rectangular waveform shows that the fundamental component is $\frac{\pi}{4}$ times larger than the original rectangle. Hence the amplitude of the grating as normally measured is $\frac{\pi}{4}$ times too large. This could easily be allowed for, but owing to the different amplitudes and phases of the various harmonics left by the camera channel, the signal is not the pure fundamental but a very distorted form whose amplitude of fundamental is difficult to assess. It was therefore decided to attempt to make the gratings on the new chart as nearly of sine-wave cross-section as possible so as to measure the response at a known frequency, without serious errors due to bandwidth-limited amplifiers. This was finally achieved to an acceptable standard as shown in Fig. 9, page 15. The gratings have some harmonic content, but it is small compared with the fundamental and so causes insignificant errors. The amplitude of these gratings has been kept low so as to reduce errors caused by the non-linear characteristic of the camera channel. Likewise they have been set in the mid-grey region to avoid the worst of the non-linear regions. Similar patches of the 3-Mc/s grating and the grey patches corresponding to the peak modulation depths were placed towards the picture corners. Two black/white rectangular transitions having a bar width equal to a 2T pulse, 0·33μs, were included for checking by step-function methods.

The contrast range and law tests of the channel were catered for by inserting a step wedge having 0·15 density steps. The picture highlights were pegged one step down this wedge, so that any tube differentiating between the 'super-white' and 'picture-white' steps would not be short of beam current, which shows as white crushing. The range of the picture is indicated on the step-wedge by the steps with larger area. Those extending further into the black region tend to be smaller than 0·15 steps due to the extreme range called for from the photographic process. Nevertheless, the total range exceeds 100 : 1.

FREQUENCY Mc/s	1	2	2·5	3	3·5
MODULATION DEPTH (dB RELATIVE TO REFERENCE AREAS)	1·4	·9	2·5	-·7	·4
	·2	·7	1·5	-1·8	-1·4
	-1·2	-·7	·6	-2·2	-2·2
	-1	-·2	1·5	-1·8	-1·6

TABLE 1 MODULATION DEPTHS OF THE RESOLUTION BARS OF FOUR TYPICAL TRANSPARENCIES



GRAPH 1

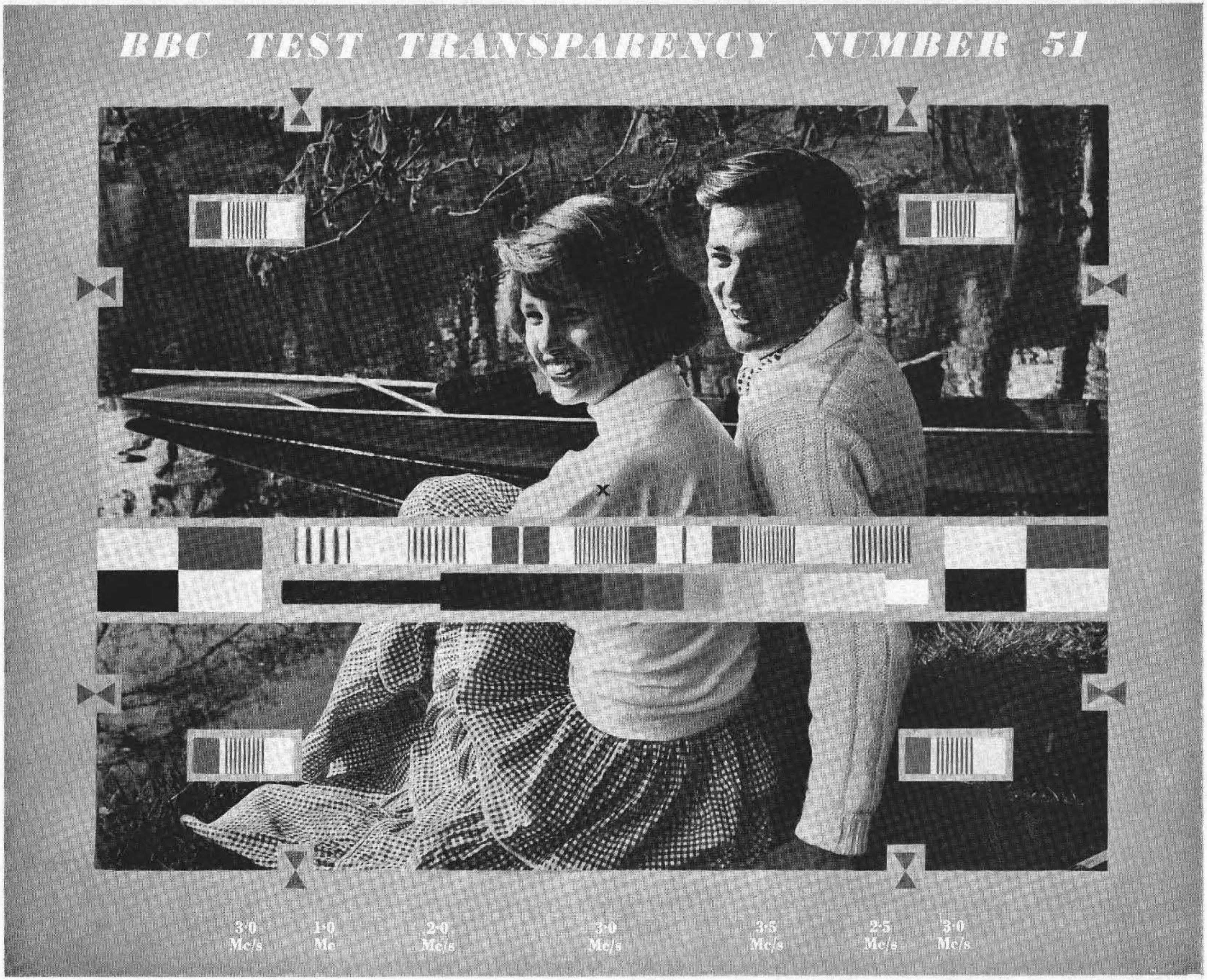


Fig. 4 — The final composite transparency No. 51

Fig. 5 — The picture positive

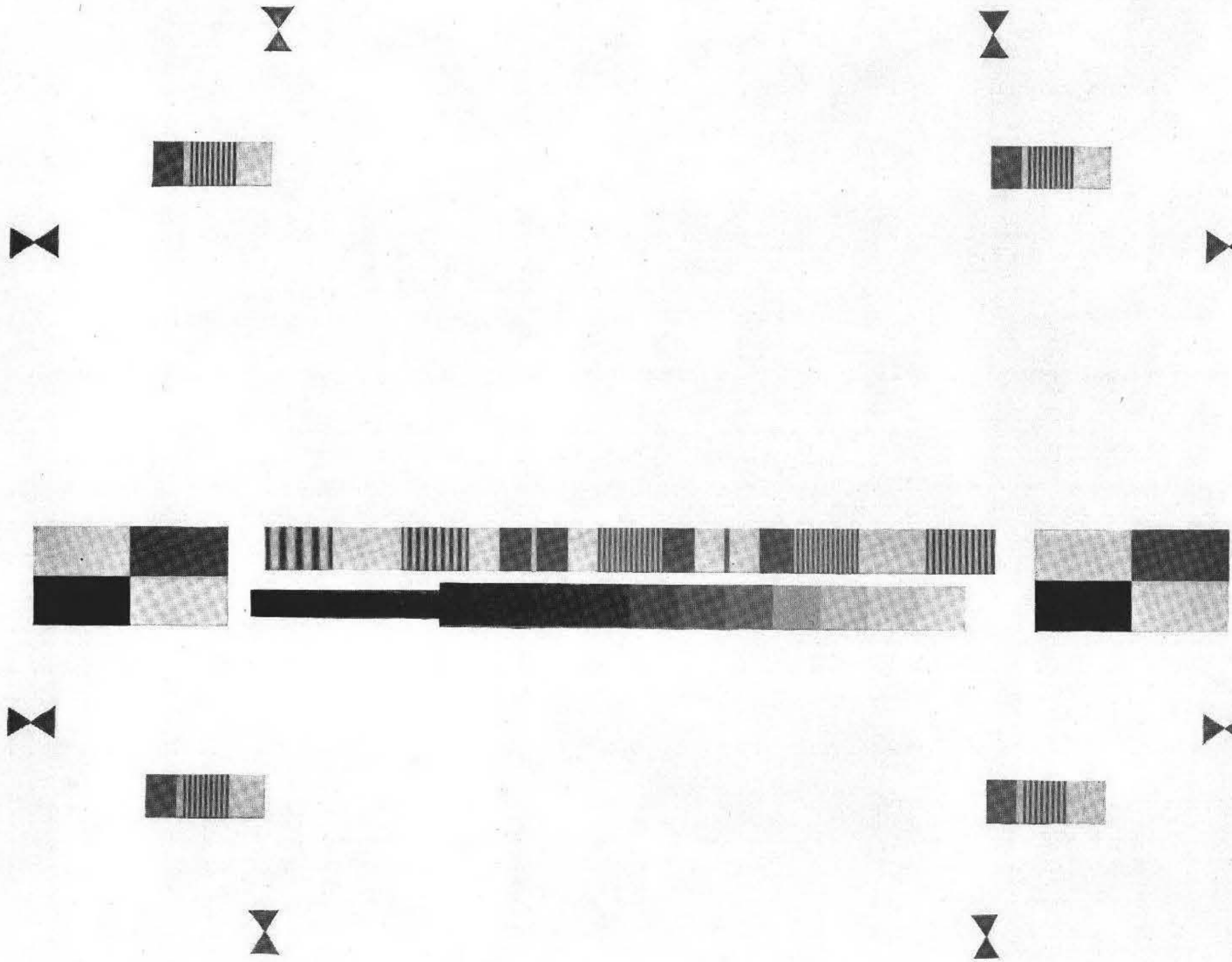


Fig. 6 — The technical positive

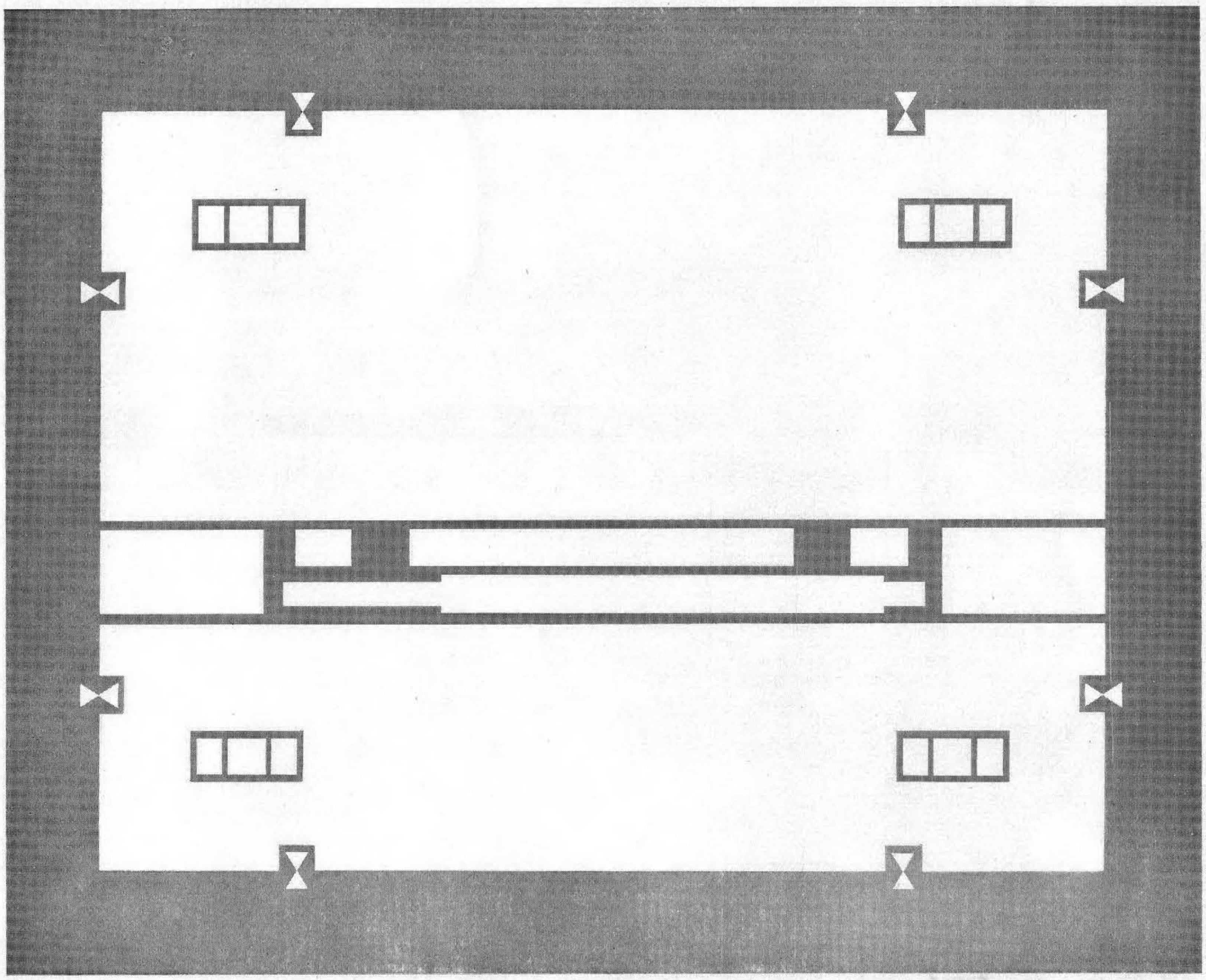


Fig. 7 — The background positive

All the technical information and the image area is surrounded by a neutral density such that it gives approximately 50 per cent modulation depth which is also the mean value of the transparency. Darts were placed at the edges to show the correct setting of scan amplitude when viewed on a picture monitor.

3.2. *Design Tests*

3.2.1. *Method*

The densities of the picture, the step-wedge, and the various patches were easily checked using a diffuse-density densitometer. But even the smallest spot size on this instrument could not measure the cross-section of the sine-wave gratings. However, if a camera channel is used with the transparency brought so close that the equivalent frequency is only some few hundred kilocycles per second, many of the harmonics will be in the pass-band and so distortion will show. Care must be taken to use an image orthicon working below the 'knee', i.e. in the linear region. When comparing the modulation depth of the gratings, noise is a large source of error. However, as the equivalent frequency is low, and the noise spectrum is flat, i.e. not frequency dependent, a low-pass filter of suitable cut-off frequency will reduce the noise considerably.

In this way the shape and modulation depths of the gratings were checked, and compared with the grey reference patches.

3.2.2. *Results*

After approval of the prototype transparency, a batch of eight was made, and a few weeks later a further batch of twelve. These were all tested as described above, giving indications of the variation between transparencies in a batch as well as between batches.

Examples of the readings obtained are given in Graph 1 and Table I. Whilst both these show divergences from the ideal it is surprising that the step-wedges approximate to it so closely. Variation in the printing light, exposure time, developer-bath temperature and time of immersion, emulsion sensitivity, and drying rate of the finished transparency can all affect the rendering of the step-wedge.

Under accurately controlled laboratory conditions (i.e. thermostatically controlled baths, electronic exposure control, etc.) it might be possible to improve the consistency of results, but under normal processing conditions the present results are good. The whole process has been one of tonal reproduction on a linear scale, consequently any bend in emulsion characteristics will cause distortion. This will explain the consistent 'humping' of the graph around steps 3 and 4, and also the crushing of the steps at the other end of the scale. Asking a photographic process to reproduce contrast ranges of over 100 : 1 in a linear manner is very demanding.

Similarly, the resolution bars vary, and as small differences can be important for these bars, it may be necessary to calibrate individual transparencies when required for precise work.

3.3. *Use of Transparency*

The transparency is illuminated from behind by a light-box, modified from a commercial X-ray film viewer, and the camera is focused. Care has to be taken that the lens axis is normal to the centre of the transparency which is indicated by a cross, and that the distance is such that the scanned area coincides with that of the picture area.

Then, by using a line-strobe monitor which is strobing through the whole step-wedge, Lift, Gain, and Beam Current can easily be set, as Lift will be shown by the black end of the wedge, Beam Current by the 'super-white' end, and Gain by the overall amplitude (it is assumed that beam alignment and scan linearity have been checked before using this transparency). Examination of a picture monitor will indicate optimum focus, both optically and electrically.

Measurement on the waveform monitor will then give the modulation depth of each step of the wedge. These measurements are usually normalized with white as 100 per cent and plotted as percentage modulation against step No. on log-linear graph paper. The slope of the curve then gives the 'gamma' of the transfer process. The lowest distinguishable step compared with the 'super-white' indicates the total contrast range resolvable by the tube.

By altering the strobe so that measurement is made through the resolution gratings, the frequency response of the complete camera channel can be plotted, and the loss of resolution can be determined for the fixed positions near the corners by comparison.

Similarly, measurement of the modulation depths of the various grey patches can indicate both black and white shading whilst picture is present.

4. Conclusions

The transparency known as 'BBC Test Transparency No. 50' has been found to permit quick and simple tests on the relative colour response of camera tubes. Although the response is in terms of the three additive primaries, it is sufficiently accurate for the purpose.

'BBC Test Transparency No. 51' has been proved to facilitate the setting-up and measurement of camera channels. The sine-wave gratings have justified all the difficulties encountered during manufacture, which are described in Part II of this Monograph, whilst the picture has been found far more useful than a mere background.

At the time of writing, the transparency is only available in 12-in. × 10-in. glass or as a 12-in. × 7½-in. picture. A 2-in. × 2-in. slide version is, however, being prepared, also a similar transparency having different frequency gratings so as to render it suitable for 625-line standards. This 625-line edition will be known as 'BBC Test Transparency No. 52'.

PART II

THE MANUFACTURE OF THE BBC TEST TRANSPARENCY No. 51

1. Introduction

The need for a new type of television camera test transparency containing some technical information, yet permitting rapid and accurate checking of a channel by non-technical staff, has been felt for a considerable time.

The fact that modern cameras give extremely good pictures renders something more than a simple resolution pattern desirable in order fully to measure their capabilities.

It was this need which prompted the BBC's Planning and Installation Department to design the 'BBC Test Transparency No. 51', described in Section 3 of Part I of this monograph.

A completely new idea, using sine-wave resolution bars, was suggested. The aim of this was to eliminate any spurious 'ringing' by harmonics which are inevitably produced when rectangular bars are used, as explained in paragraph 3.2.2. of Part I.

The transparency consists of four basic components. These can be broken up into the following parts:

Picture Positive,	Fig. 5, page 10
Technical Positive,	Fig. 6, page 11
Background Positive,	Fig. 7, page 12
Title Positive,	Fig. 8, page 14

In order to understand the problems encountered in manufacturing the individual transparencies, it must be

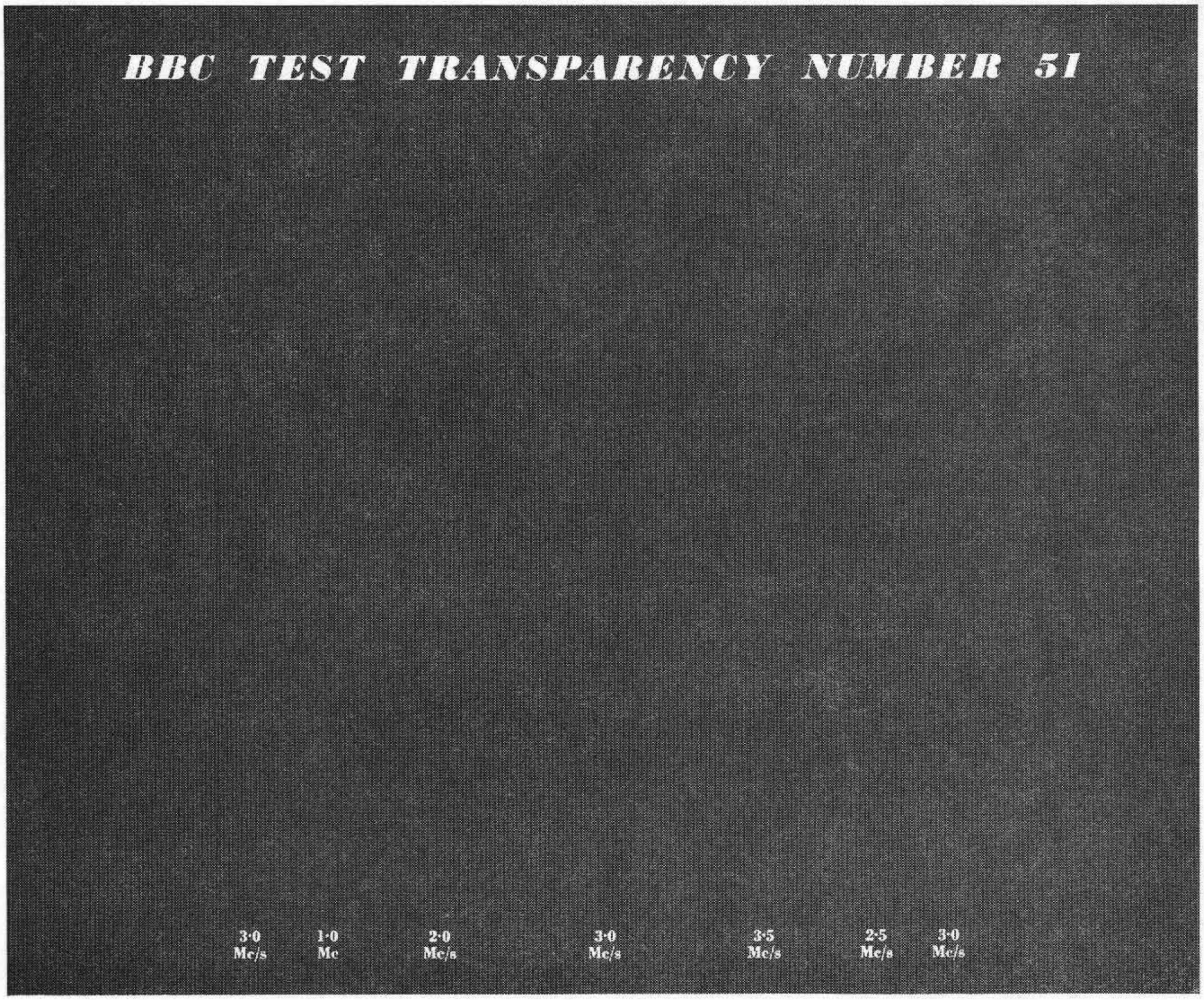
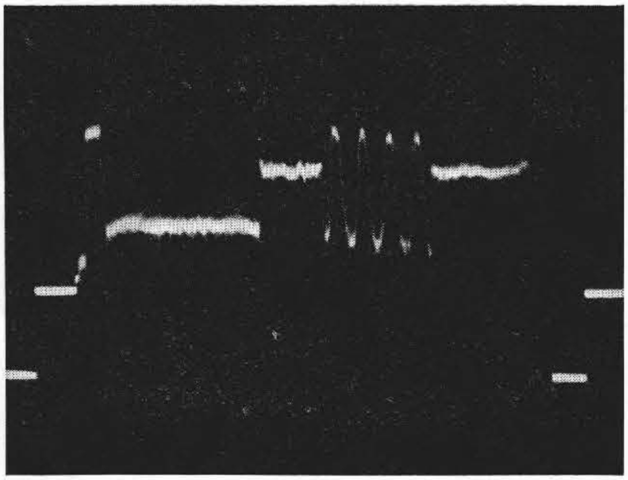
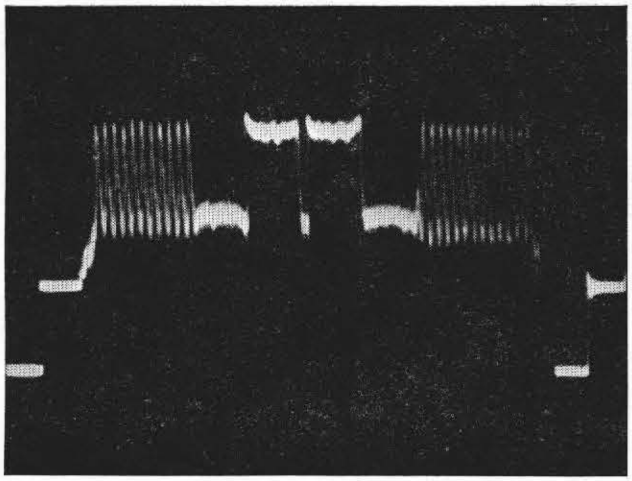


Fig. 8 — The title positive



(*a*)



(*b*)

Fig. 9 — Waveform of resolution bars when closely examined by a camera
(*a*) 1·0 *Mc/s* (*b*) 3·0 and 3·5 *Mc/s*
(*without band-limiting filter*)

realized that the only component which existed before work was begun on the project was the picture itself. All the other information had to be built up by hand, and it was because of this that it was decided to assemble the pattern in the form of four separate transparencies. Another reason for adopting this method was that the final transparency had to contain a contrast range approximately twice that which could be accommodated on a reflection copy and it would have been very difficult indeed to calculate the component parts of the reflection copy.

2. Method of Production

Since the technical positive was the most complex to manufacture, it will be described first.

(a) *The Step-wedge*

This consisted of a standard Kodak step-wedge with the densities above 2·4 cut off. This cut wedge, with a density range of 2·4 was then ready for mounting on the glass 'key-line' which will be described later.

(b) *Black/White Areas*

These were made by exposing sheets of film to the various densities required. Four of these were necessary, since the contrast range of the sine-wave definition bars is less than that of the step-wedge.

(c) *Rectangular Pulses*

These were cut from the same film as the black/white areas (sine-wave line) and produce a pulse width of 0·04μs. There are two of these pulses, one positive and one negative.

(d) *Sine-wave Resolution Bars*

As the use of sine waves was a new idea, little information was available as to how to produce an accurate sine wave as a variation in density on film. Several methods were tried, the first being to photograph a series of black and white bars of equal mark space rates with the photographic camera out of focus. This method, however, did not produce the required waveform.

The second method tried was to use telerecorded sine waves as a master and then to reduce these photographically to the various spacings required in the transparency (1·0, 2·0, 2·5, 3·0, 3·5 Mc/s). This method was again found to be of no use owing to the difficulty in controlling the various exposures at each camera extension. This resulted in various amplitudes of sine wave which was, of course, useless.

The method finally adopted, which was very successful, was to generate the sine waves electrically, display them on a high-grade picture monitor, and photograph the result. The waveforms of the 1·0, 3·0, and 3·5 Mc/s bars are shown in Fig. 9. Each exposure given was identical, as was the distance between the camera and monitor. The various spacings were obtained by altering the injected sine-wave frequency, at the same time keeping the peak-to-peak value constant. The oscillator was locked to the synchronizing pulses so that the pattern on the monitor tube face remained stationary. The films produced in this way were then cut and mounted on the glass 'key-line' together with the other technical films.

3. The Picture Positive

A negative of the picture to be used was supplied by the BBC after very careful selection of the subject. The main requirements were (*a*) that areas outside the focus should be obviously so and (*b*) that there should also be a 'centre of interest' to the picture.

The use of a picture in this test transparency enables

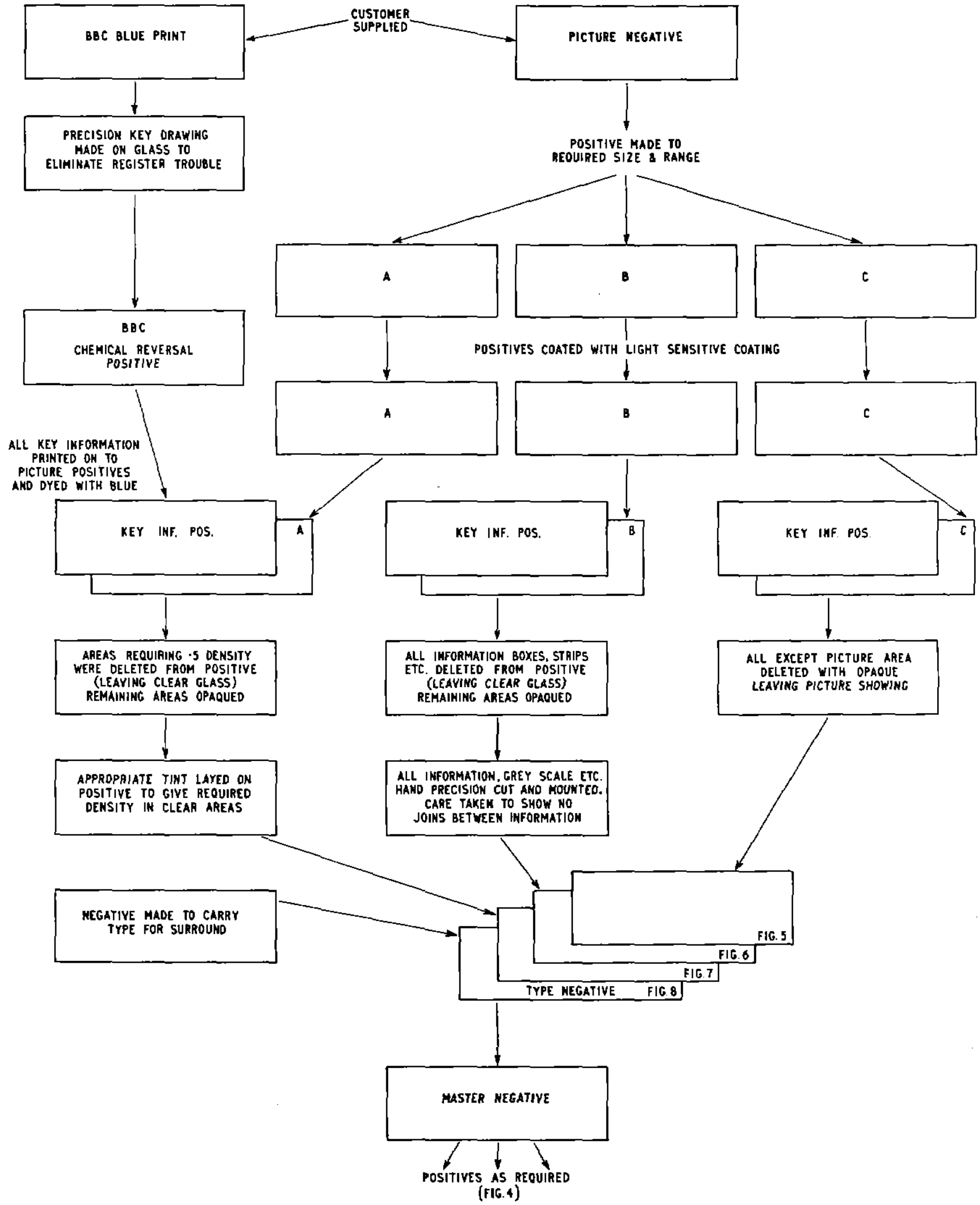


Fig. 10 — BBC Test Transparency No. 51 schematic diagram of manufacturing process

quick appraisals of picture quality to be made if a detailed technical check is not required. The original picture negative supplied measured 4 in. × 3 in. and had a density range of 0·2–1·677. From this negative a positive was made in the camera and enlarged to 10 in. × 7½ in., great care being taken not to distort the contrast range. Several attempts at this were made in order to ensure the most accurate copy possible. The resulting best positive was set aside for use as the 'picture positive'. Fig. 5, page 10.

Two of the remaining picture positives were used in constructing the 'technical' and 'background' positives, Figs. 6 and 7, pages 11 and 12, the quality of picture being unimportant but the accuracy of size having been maintained.

4. The Master Key Drawing

At this stage some method had to be found to 'print' a key-line on each of the four component positives in order that very accurate registration could be made between them. Only a photomechanical method would ensure perfect registration between the four positives.

The first step was to make a precision key-line negative from the BBC drawing, and this was done by photographing it. This negative was then used as the basis for an extremely accurate drawing. It showed the general outline required and was then corrected by cutting very fine lines into the negative emulsion in the necessary positions, the false lines being obliterated.

At this stage the 'key-line' had to be superimposed on each of the master positives. This was done by coating them with a slow-speed light-sensitive coating and exposing each one through the key-line positive to an arc light.

When developed, the image formed by the key-line positive was dyed with a methylene dye which gave a fine blue line over the existing positive image.

It was these blue lines to which all the component parts on each of the positives were fitted or painted out (see Fig. 10), so that, for example, the technical information areas on the picture positives were removed in order to prevent light passing through and affecting the sensitive photographic plate when the final composite print was made.

After the four positives had been treated in this manner they were contact printed one by one on to another photographic plate, using register marks on each side of the plate to obtain exact register.

This part of the job was the most difficult, due to the exact balance needed between technical and picture negatives, i.e. the picture had to be within the broad part of the step-wedge in range. Several attempts were necessary before the required condition was met. The master negative produced by the above methods was then retouched by the artist and some minor modifications made to it. Further prints were then made from it as required.

5. Conclusions

The combination of a picture and line selector information means that the pattern can be used either for a quick appraisal of picture quality or for very accurate measurements.

This is thought to be the first time that such a comprehensive test pattern has been made and it is hoped that it will become the standard camera test transparency for all studios and manufacturers of camera channels.

6. Acknowledgments

The authors wish to express their thanks to Mr Denzal N. Sherwin of W. R. Royle & Son Ltd for his expert advice and skill in devising the method of production of Test Transparency No. 51 and for carrying out the necessary handwork. Their thanks are also due to Mr D. C. Brothers of the BBC's Planning and Installation Department for his assistance in the design and testing stages; to Mr Ernest G. Archer of W. R. Royle & Son Ltd for the exacting camera work involved, and to the members of the staff of Autotype Ltd who manufactured Test Transparency No. 50.

Summaries of some recent BBC Patent Applications

PAT. APP. NO. 36216/55

TELEVISION SIGNAL BANDWIDTH COMPRESSION

Inventors A. V. LORD and R. F. VIGURS

The statement of invention reads:

According to the present invention means are provided for varying the number of amplitude levels available in the quantizer in inverse relation to the number of significant amplitude changes in the television signal counted throughout predetermined intervals of time.

The invention is a method of generating a television signal to achieve economy of bandwidth and is a modification of the invention described in Patent Application No. 242/55.

PAT. APP. NO. 1126/56

STORAGE TUBE ARRANGEMENT

Inventor A. V. LORD

The statement of invention reads:

According to the invention a method of storing electrical information and reading the stored information comprises the steps of scanning a photo-sensitive surface with a light spot modulated in accordance with the information to be stored thereby releasing electrons from the surface, directing the electrons upon an electric charge-retaining storage screen in such a manner as to produce on the screen a charge pattern representative of the information, scanning the photo-sensitive surface with a light spot and directing the electrons thereby released upon the screen to generate in a signal plate coupled to the storage surface of the screen signals representative of the stored information, lowering the potential of an electrode positioned to collect secondary electrons from the screen, and, while the said electrode is at the lowered potential, illuminating the photo-sensitive surface in such a manner as to establish on the screen a substantially uniform potential approximately equal to the said lowered potential.

The invention described is an information store in which information is applied to the storage surface by the same scanning beam as is used to read off the information. This principle avoids the difficulties of geometric distortion and misregistration.

PAT. APP. NO. 23193/56

BAND ELIMINATION TECHNIQUE

Inventor W. SILVIE

The statement of invention reads:

According to the present invention a circuit arrangement for use in television transmission in a system of the type set forth comprises two synchronous detectors arranged to be driven by oscillations of the sub-carrier frequency in phase-quadrature, means for feeding a luminance signal to these detectors in parallel, circuits coupling the outputs of the detectors through low-pass filters to the inputs of two balanced modulators respectively adapted to be fed with oscillations of the sub-carrier frequency in phase-quadrature respectively, a circuit for adding the outputs of the two modulators and for applying the resultant to a subtracting circuit wherein it is subtracted from the luminance signal and fed to an output terminal.

The invention described is an improved method of eliminating a band of frequencies around a sub-carrier frequency in a composite signal such as that used in the N.T.S.C. Colour Television System.

PAT. APP. NO. 500/57

AUTOMATIC CAPACITY BRIDGE

Inventors C. GUNN-RUSSELL and G. A. HUNT

The statement of invention reads:

According to the present invention a method of comparing the capacitances of two components comprises the steps of charging the two components to predetermined potentials respectively, connecting the two charged components in series in a closed circuit in such a manner that each discharges into the other, and measuring the residual charge therein.

The invention describes an instrument, based on the principle given in the statement of invention, which automatically compares the capacitance of an unknown capacitor with that of a standard capacitor, and indicates the unknown capacitance on a meter display.

PAT. APP. NO. 4158/57

TELEVISION FILM SCANNING USING A STORED FIELD

Inventor A. V. LORD

The statement of invention reads:

According to the present invention there is provided apparatus for televising motion picture film, employing intermittent motion of the film, comprising means for scanning each picture frame in two different fields simultaneously and for deriving a set of picture signals from each of the fields, means for delaying one set of picture signals relatively to the other by a time such that the sets are interlaced with one another in time, and means for combining the two sets of signals.

The invention is an improved method of televising motion picture film. Each film frame is scanned in two fields simultaneously, corresponding to the television lace and interlace fields. The signal representative of one field is delayed relative to the other so that the two fields may be combined to form a standard television picture signal. Since the film frame is completely scanned in the time of one television field, the film may be advanced during the period of the second field.

PAT. APP. NO. 15819/57

NEW TYPE OF SOUND ABSORBER

Inventors N. C. H. DRUCE, C. L. S. GILFORD, and T. SOMERVILLE

The statement of invention reads:

According to the present invention a sound absorber is formed of a plurality of superimposed layers comprising, in the order named proceeding toward the source of sound, alternate layers of soft porous material, and relatively thin sheet material, and thin imperforate covering. The said sheet material may be perforated and the said porous material may be fibrous or sponge-like.

The invention is an improved sound absorber having a high coefficient of absorption at frequencies up to 8 kc/s, and having a smooth continuous surface that can readily be cleaned and decorated.

PAT. APP. NO. 20381/57

NEW TYPE OF LOW-FREQUENCY SOUND ABSORBER

Inventors A. N. BURD and C. L. S. GILFORD

The statement of invention reads:

According to the present invention a low-frequency sound absorber comprises two members forming the major boundaries of a closed air space, the front member comprising two sheets of different materials fixed together over their surfaces by means of an adhesive, the front sheet being of a hard, strong material adapted to be decorated and to resist damage, and the rear sheet being of a relatively soft material with high internal mechanical damping.

The invention is an improved form of low-frequency resonant sound absorber having a covering of a hard strong material which can easily be cleaned and decorated.

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