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REMOTE CONTROLLED TV STUDIOS

GRANADA TELEVISION created in 1956 the first British composite television centre in Manchester and have continued to develop this centre as their regional television headquarters.

It is Granada's policy to make all their major television productions at the tv centre in the North region they serve—Granadaland.

To provide good coverage of news and current affairs, it was found necessary to have a further regional studio in Leeds, on the east side of the Pennines, and a studio in the centre of London. The purpose of these two studios is to enable Granada to transmit news and current affairs reports with minimum delay and to permit interviews with people who cannot reasonably or quickly make the journey to the main Manchester tv centre.

THE REQUIREMENTS

Both studios had to be instantly available at any time to reporters and interviewers. To maintain a permanent crew at each studio would have been uneconomic for, by their nature, their use would be intermittent and irregular. Obviously it was not possible, in view of the distances involved and the need for immediacy where news reports were concerned, to send crews out from the tv centre when the studios were required. A decision was therefore taken completely to control both the studios from the Manchester centre.

The types of programme to be catered for were carefully analysed showing that, with control of camera movement from Manchester covering the range of shots normally used with a single reporter or a two- or three-handed interview, then single cameras, fitted with zoom lenses, would be suitable.

In view of the distance involved between these remote studios and the main TV centre, it was desirable to use a single GPO telephone circuit for all control purposes. Granada considered methods of achieving analogue control of camera movements, i.e. panning, tilting and changes in the focal length of the zoom lens. Although this mode of control was technically possible, the equipment required was expensive and involved a considerable amount of special development work.

A digital command system, where a series of push-button controls actuated a series of commands at the remote studio, was technically an easier exercise as similar command systems have been developed for other applications. It was decided that commands sent to the remote studios in this way could be arranged to switch on the equipment and lights, and also select a number of preset camera shots using a shot-box technique. With this system the camera, fitted with a servo-controlled zoom lens, is mounted on a servo-controlled pan and tilt head, a shot being chosen by selecting any one of a number of preset potentiometers, which are set to define a particular position of the pan, tilt and zoom servo systems.

A two-camera studio with both cameras operating on this principle, but controlled from an adjacent room, was closely studied.[1] The opportunity was taken to conduct simple tests on this equipment and it was found that the main difficulty in using the shot-box technique, with a single camera, would be to obtain a smooth pan, tilt and zoom when changing from shot to shot. With constant-speed servo systems a change in shot, involving a small tilt and a long pan, will be seen 'on air' as an L-shaped movement and obviously unpleasant to watch. The studio being investigated overcame this problem by changing shots on the camera that was not 'on air'. For a single-camera studio it was obviously necessary to devise a system employing constant duration of the camera movements irrespective of the distance to be travelled between shots.

Fig. 1. The latest remotely controlled, unmanned studio, in operation at Golden Square.

At the time this scheme was under consideration, there were several other remote-controlled studios in existence,[1, 2] but where long control lines were involved, the operation of the studios was limited to a fixed camera shot.

EQUIPMENT

Choice of equipment for the proposed studios had to be carefully considered as it was necessary for all the units to be stable and retain their set-up between periodic maintenance visits. Despite some initial preference for a vidicon camera to fulfil this requirement, an image orthicon camera was specified for the following reasons:

(i) The picture quality matched that of the studios in Manchester enabling signals from remote studios to be inserted in programmes originated in Manchester without change in picture quality.

(ii) Vidicon cameras tend to smear on panning shots.

(iii) Low light levels are required for the image orthicon tube so less heat had to be dissipated in the small studio areas available in Leeds and London.

(iv) The advent of non-stick Elcon tubes minimized the problem of warm-up and sticking which otherwise would have been a serious problem. Experience of Marconi Mark IV image orthicon cameras, in the Manchester tv centre, has shown they are sufficiently stable to be left unattended and without adjustment over the required period.

Other equipment necessary in the studios included dual synchronizing pulse generators, a sound channel with a limiting amplifier, voltage regulators, lighting and communication equipment.

As the aim was to operate the studio over a single telephone circuit for control and communication purposes, the specification for this equipment was defined as follows:

(a) There should be a telephone between the Manchester tv centre and the performer in the remote studio with call signals in both directions.

(b) The performer should have an earpiece to receive talk-back from the control room in Manchester.

(c) The system should allow the use of message-writing equipment with a transmitter in Manchester and a receiver in the remote studio to write out messages sent to the performer before or during the transmission. This equipment utilizes a band of audio tones, representing x and y co-ordinates, utilized to move a pen across paper at the receiving end.

(d) Communication facilities should operate over the same line as the command equipment.

OPERATION

The two studios, designed by The Marconi Company to meet the Granada specification, are now in regular use, providing the news and current affairs department of Granada with a daily service. An example of the use of these studios is the ability to transmit from Manchester topical interviews with politicians in London, giving an undertaking that they will be in and out of a television studio, in the centre of London, in 10 minutes.

TECHNICAL DATA

Control panels for both remote studios are installed in two control rooms in the Manchester tv centre. Engineering control panels have buttons controlling the following operations:

(i) Equipment on
(ii) Lights on
(iii) Uncap camera
(iv) Telephone call.

It was made impossible to send the 'uncap' command before the 'equipment on' command had been operated in order to prevent possible damage to the camera tube.

The 'equipment on' command switches power to the rack of equipment and starts the ventilation plant for

cooling the racks and studios. In the London studio it is also necessary to perform a remote sound and vision line switching operation, as these lines are reversible circuits used, when the studio is not in operation, for incoming programmes.

The director in each Manchester control room has a control panel with a telephope call button and nine preset camera shots. Initially these nine shots were chosen to cater for an interviewer with seats on either side. A small display table is placed in front of the group so that when required the objects under discussion can be seen. Although it is possible for producers to change the shots in the studio, nine shots were initially chosen.

(a) A close-up shot of each of the three positions
(b) A 'wide' shot of the three seats
(c) Medium 'two shots' of the interviewer and one of the seats to his left or right
(d) Close-up of the table
(e) A shot of an identification clock used at the opening of each sequence.

To give the director some control over production techniques provision has been made for a choice of two speeds of camera movement, controlled by a button on the director's control panel.

COMMAND EQUIPMENT

On initiating any command from Manchester, two tones are sent out for a period of 250 msec. A detector at the transmitting end senses that the correct tones are leaving and illuminates the control button on the panel. During this 250-msec period, conversation on the telephone or talk-back is not possible, but in practice a 250-msec break in conversation does not impair intelligibility. The command always takes preference over all other services.

The command tone consists of one of four frequencies available in each of two audio-frequency bands. The receiving equipment is designed to reject a signal containing more than one frequency in either band or when a signal does not contain simultaneously a frequency in both bands. Further, both tones have to be continuously present for more than 80 msec. These precautions are designed to ensure that the receiver equipment is not triggered by random noise or speech although, in practice, no false operation of the command equipment has occurred. The message-writing equipment can transmit two tones and although one of the frequencies, starting at 2 kHz per second, is higher than either of the bands employed in the command receiver, an inhibit circuit is employed to bar the output of the receiving equipment whenever a frequency higher than 2 kHz is received. This circuit acts as an additional safeguard against unwanted operation by any cause.

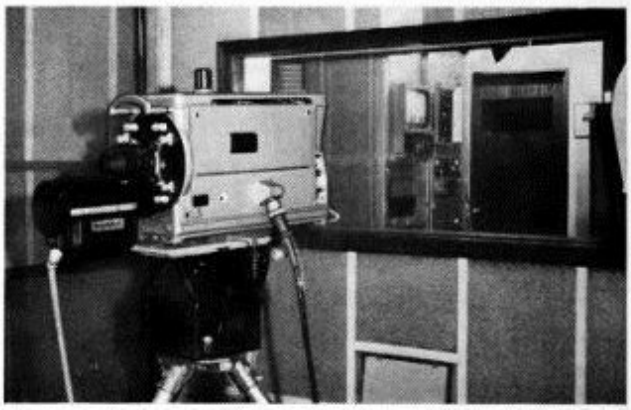

Fig. 2. A Mk IV camera with servo controlled pan and tilt head. The zoom lens is controlled in a similar manner.

Telephone calling to the studio utilizes one of the command channels, but to call from the studio to the TV centre, a special oscillator transmits tone which is received and detected at the Manchester end. This call tone from the remote studio is above the 2 kHz frequency of the inhibit circuit in the receiver. To ensure that incoming commands are not inhibited by simultaneous telephone calling from the studio end, a narrow 'hole' is left in the inhibit circuit at the calling frequency.

To prevent difficulty in the unlikely event of power being lost to the receiving equipment, it is arranged that the camera reverts to shot number one when power fails. This can be arranged to be the wide shot of the studio so that the programme can continue with all participants in view.

SERVO SYSTEM

It will be remembered that to obtain smooth changes of shot, all camera movements must have the same duration, regardless of the distances to be moved by the pan, tilt or zoom servo motors.

The position that each driven mechanism adopts is directly proportional to a voltage derived at the wiper of a motor-driven control potentiometer.

Shots, represented by a combination of positions of the three servo mechanisms, are selected by switching preset voltages to the ends of the windings of the control potentiometers. There is one preset voltage for each servo function for each shot available.

When a particular command is received, the correct preset voltages are applied to the appropriate ends of the windings of the control potentiometers and the

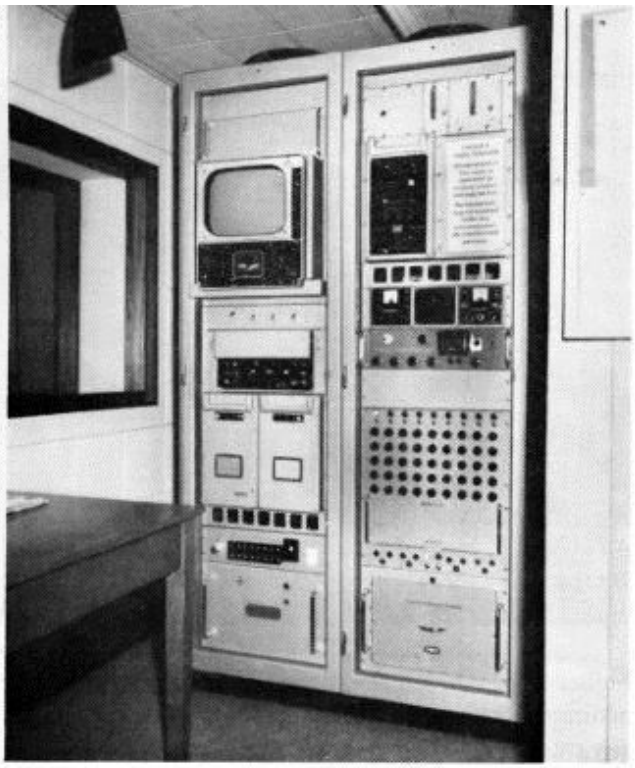

Fig. 3. The compact remote control equipment in the Golden Square studio.

electric motor then drives the wipers of these potentiometers through their full travel. The output of each control wiper therefore changes its voltage by a large or small amount according to the shot selected, this change taking place in the time taken for the motor to drive the wipers through their full movement.

CONCLUSIONS

The studios have been in use for 12 months and the teething troubles, inevitably experienced with an operation of this kind, have been resolved. It may, however, be of interest to outline some of the more mundane difficulties experienced.

As the shots cannot be altered from the tv centre, it is essential that the commentator's chair and other furniture in shot retain exactly the same position as it was when the shot-box was set up by a programme director in the studio. Quite minor changes of position completely upset the centring and framing of the pictures so it is essential to screw down all such furniture firmly to the floor.

It is not possible to use as tight a shot as many programme directors would like owing to slight variations of camera shot brought about by the tolerances to which the servo systems will operate. These tolerances are sufficiently accurate, however, for all practical purposes, provided the framing of close-ups is not too tight.

There will always exist some problem in obtaining consistent pictures where there is no control over the dress of the people being interviewed. A two-handed interview with a person wearing a black suit and another wearing a white dress is a particular problem. The careful choice of a back cloth together with careful lighting has done much to minimize this problem.

Plans for improving reliability in the future include provision for automatic changeover of lighting units in the event of bulb failure, and automatic changeover of pulse generators in the event of any pulse failure.

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REFERENCES

1 "Broadcast Engineering of NHK", 1963.

2 G. E. Waters: CBC Unmanned Television Studios; *Sound and Vision broadcasting*, Vol. 6, No. 1, Spring 1965.