INTERNATIONAL
TV TECHNICAL REVIEW

JANUARY 1964, VOL. 5, No. 1 • Two Shillings and Sixpence

3
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1

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Australia . . . . 4 sets of 10-kilowatt and 2 sets of 6-kilowatt transmitters with their associated equipment

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NEC

Nippon Electric Company Limited

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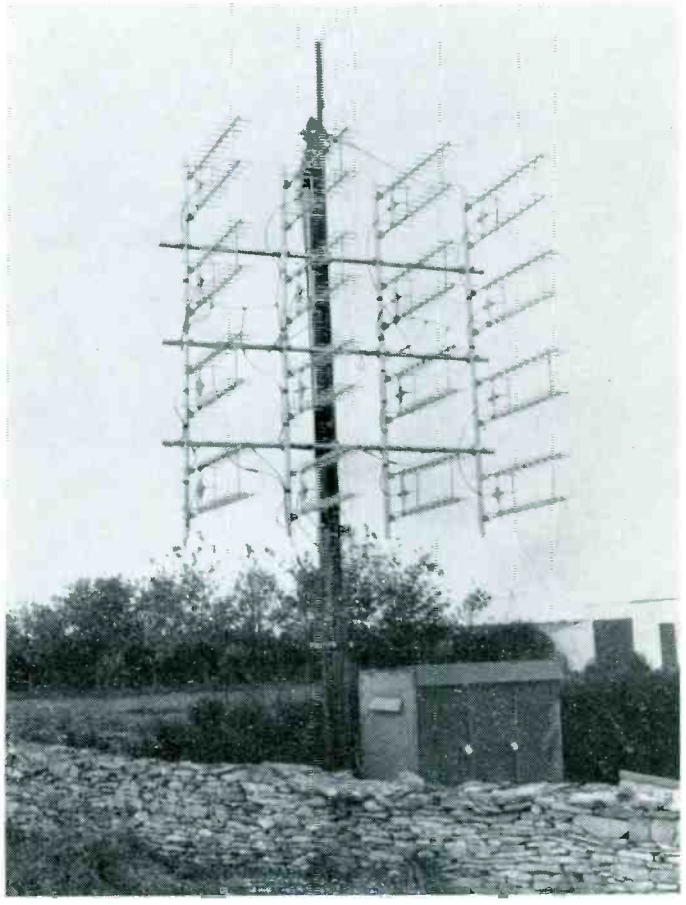


Due to the use of the specially designed master receiving aerial photographed here, and Ferranti's new parametric amplifier which have been erected and installed at Southampton, Rediffusion subscribers on Monday, April 20, 1964, will be able to see BBC 2.

For the Rediffusion story see page 7.

IN THIS ISSUE:

The annual subscription (including postage) is £2 sterling

trends

By John Dickson, PhD

'EFFICIENCY' is a word we do not hear over-used in many technical circles. Electronics is sometimes described as a rather hit-or-miss science, and provided the job is done precisely with every pulse and line in place, the question of efficiency does not always arise.

Yet in the general world, with the advent of automation, increased productivity and a more critical approach to cost efficiency, many organisations are becoming increasingly concerned with the efficient exchange of data and control information between a central or control station and a number of remote stations.

This has created a demand for a telemetry, telecontrol and tele-alarm system which is sophisticated in design and flexible enough to cope with the increasing complexity of electronics.

For this reason, a small group of television experts recently witnessed with unusual interest a demonstration in a Cambridge laboratory of a system for remote control and supervision of TV transmitter and communication systems. This interesting telemetry system has now been put into operation in—of all places—the island of Cyprus. While military and political tensions mounted on the island republic, television engineers were busy testing the first TV-telemetry system of its kind in the world. And I draw attention to this pioneer system on this Trend page not specifically to describe the system in detail (for an INTERNATIONAL TV TECHNICAL REVIEW Special Correspondent has just flown home with the full technical story), as to point out this tendency towards TV-telemetry.

As it happened, in the actual Cyprus experiment, two broadcast transmitting stations, each comprising two sound and two vision transmitters (with their common programme input equipment) are controlled and supervised from a central studio. The transmitters are located on mountain-tops, and because of difficult access and prevailing bad weather conditions the stations are remotely controlled from a central point.

Since land-lines would be unreliable under these conditions, programme information is normally carried on micro-wave link, and duplex VHF radio links are employed for the supervisory and control data.

By telemetry, information regarding the condition of some twenty-three points at each transmitter is continuously displayed at the control station; and, by selection, twenty control functions concerned with the tuning-up, shut-down and change-over of the transmitters and the associated equipment can be obtained at each station from the control point. In this instance the remote control and supervisory equipment is based on digital techniques which are used in similar telemetry systems developed by Pye Telecommunications at a Cambridge laboratory, and in this instance the telemetry is such that all supervisory points are continuously scanned and the information updated every 1·15 seconds. For control purposes, digital command codes in binary form are transmitted automatically when the appropriate key is depressed.

The trend here is obvious. Television engineers who so far have tried to fight shy of computer technique will now have to face the added intricacies of data-transmission techniques.

As it happens, most telemetry systems fall into two broad categories—analogue or digital. And it is in the digital field where the most significant advances have been made. Missile and outer-space research programmes, together with high-speed digital computers—have created a demand for miniature components possessing long life and high intrinsic reliability. The telemetry equipment design engineer has obviously benefited from this research.

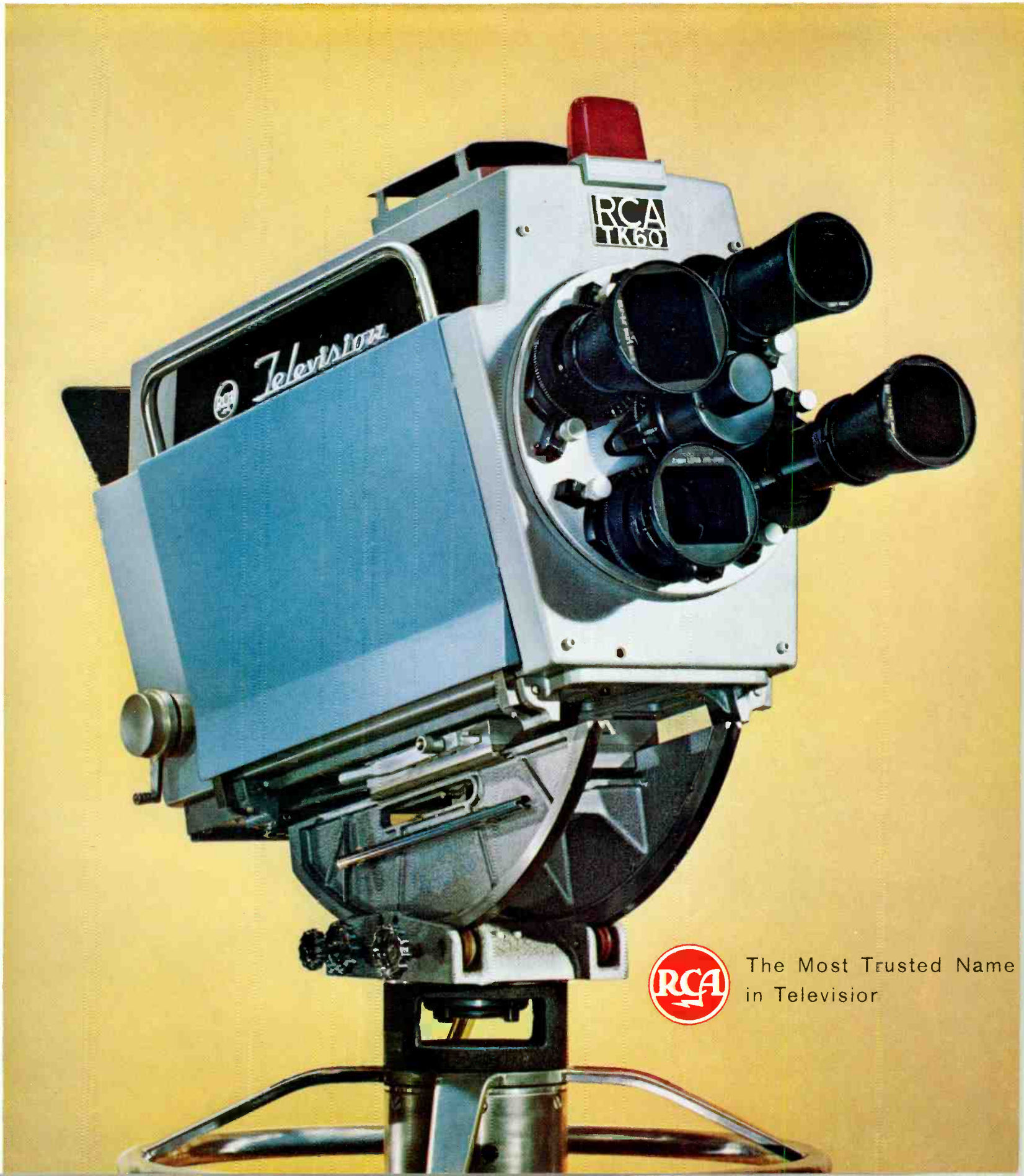
For television telemetry, the system developed at this particular Cambridge laboratory is based on digital techniques. A digital system provides a great flexibility, is easily extended, is fast in operation, can provide direct digital readout and printout, is economic in channel bandwidth requirements, can use self-checking or error-correcting codes, and so far as one can see is suitable for all current television or other industrial electronic needs.

In the system towards which this trend is taking us, codes are transmitted from the master station to interrogate out-station meters, and alarm points sequentially. This is carried out automatically by a programmer giving a display of the various readings on demand or at predetermined intervals.

Naturally this is not the first time telemetry for television transmitters has been successfully accomplished, and the Marconi Company, to take only one instance, have a different telemetry technique which is in use at certain transmitters throughout the world. There is ample scope, too, in a complex nation-wide network—as in Britain itself—for telemetric examination of switching, amplifier and relay functions throughout the whole network.

Some of the trends we review on this page month by month are on the distant horizon. But telemetry is here, now.

RCA TK-60 Mark of Deluxe Television



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Architects of Television

by Jonathan Chambers

"Round the clock and around the world . . ."

CITY Company meetings are usually stuffy, pompous. Their reports make dull reading as a rule. But not so when Mr. John Spencer Wills, Associated-Rediffusion chairman, spoke out bluntly at an annual general meeting of A-R some time ago.

'The main shareholders in Associated-Rediffusion,' he asserted, *'have been engaged in the provision of public services for two-thirds of a century—ever since 1896. I myself have been so engaged for forty years. Railways, tramways, trackless trolleys, radio and TV stations, the generation and distribution of electricity, manufacture and distribution of coal-gas, airlines, wired radio, wired TV. . . . All these activities, not only in the United Kingdom but in countries all over the world, have been our life. . . . Is it surprising that we should have been entrusted with the task of furnishing television programmes to the largest city in the Western Hemisphere . . .?'*

This mammoth group, of which 'A-R Television' is only one facet, is controlling a world-wide radio and TV network, and in turn has influence from the great road, rail and air group, British Electric Traction. In our own sphere of electronics, in television all the way from A-R, from Wembley's giant Studio Five, out to the latest TV network run by Rediffusion in Malta, this is an edifice of which any television architect could be proud. . . .

Yet its beginnings were modest, and even slightly curious.

One of the trio who began Rediffusion, over thirty years ago, was a distinguished pilot, former Hendon Air Pageant race-winner. Another was a do-it-yourself radio ham who made loudspeaker units.

Even the very word 'Rediffusion' is not a word of the English language, but was coined by the trio of pioneers who sat down in 1928 to form Rediffusion Ltd. to operate broadcast relay systems.

During the early years nobody thought it necessary to protect the name and, therefore, today there are in different parts of the world one or two companies which have 'Rediffusion' in their title although they have no connection at all with the vast radio and TV giant.

Who were the grand originals behind Rediffusion? For the complete story we have to go farther back than the meeting around the table of the three pioneers. Back in the 1920s, 'wireless' was not so much a business as a hobby. Hams built their own sets, constructed loudspeakers, wound coils and transformers. They picked up faint signals from Marconi's 2MT station (see INTERNATIONAL TV TECHNICAL REVIEW, June 1962), from PCJJ in Holland and —if their sets were powerful enough—from KDKA in the United States.

One of these do-it-yourself amateurs who grew to become head of a firm producing loudspeakers was Beverley Hamilton Lyon. He was, when our story opens,

director of a company called Wireless Music Ltd., which at one time had a very interesting board—Dudley Joel (son of the famous Solly Joel), Sir George Grossmith, W. W. Wakefield, and, of course, Beverley Lyon; in other words, a strong combination of sport, finance and the theatre. 'Wireless Music' aimed to produce a high-quality radio set, in the days when crystal detectors and horn speakers held the stage. They gave their set the name 'The Magic Box' —curiously enough the name which Nigerians gave to their TV sets when a Rediffusion company brought them television thirty years later.

Then, in 1928, it became obvious to a number of far-seeing people that even radio over the ether had its limitations. Just as we are discussing merits of Pay-TV and Toll-Vision today, so in the 1920s experts could see the merits of nation-wide HF networks, taking radio by wire. *And three men with similar views sat around a table at lunch to hammer out a new plan for wired-radio for Britain. From this lunch meeting came all the TV, radio and electronic marvels of Rediffusion, of A-R and the rest of the structure.*

Historical meeting

First of the three at the historical meeting was Beverley Hamilton Lyon. In his younger days he was captain of the Gloucestershire County Cricket XI, spoken of as a possible England captain. Educated at Rugby and Queen's College, Oxford, member of the MCC, Vincents, the Bath Club. High ranker in the list of England's squash players. Soccer player for Derby County. Sportsman, forceful, vigorous; the sort of man to whom broadcasting and wired-radio was a challenge.

Second man at the meeting was to become a revered head of British broadcasting, member of a famous family who made their mark in Marconi's and the BBC, in music and in electronics, the late P. P. Eckersley, MIEE, Fellow IRE.

His brothers Roger and T. L. followed a conventional course at the BBC and Marconi's respectively, but it is true to say that at the moment Peter Pendleton Eckersley accepted Lyon's offer to meet at lunch, more controversy circled wildly above his head than is the case today with Pilkington or Telstar !

Captain Peter Eckersley, busy on Army and Air Force wireless research until 1919, working with Marconi's until 1923, became one of the principal architects of the BBC, was the BBC's first Chief Engineer from 1923 to 1929, was the founder of the 'Regional' scheme producing the first BBC network from 2LO London to Manchester and the North . . . and then suddenly in a flurry of controversy this creator of the then all-important Regional Scheme on which British broadcasting depended *resigned from the BBC*.

This brilliant engineer, controversial, much-criticised, has never hit back at his critics. He will go down into history as one of the founders of public-service broadcasting in Europe . . . and that is why he wanted to meet Beverley Lyon.

Third man at the historic lunch meeting has already been named. W. W. Wakefield . . . one day to become famed as Lord Wakefield, MA, MPS, MP.

Curious fact is that he was invited to the meeting not only for the facets of his character which have since brought him distinction in politics and world affairs . . . *but also that at the time he was, among other things, concerned with a wood-working company, able to make loudspeaker cabinets which, of course, are an essential in a radio relay concern !*

The part Lord Wakefield later played in the development of the vast Rediffusion group compels us to turn a closer gaze on this adventurous and courageous man. North-countryman (though not by birth), he was educated at Sedburgh, and took an engineering degree at Pembroke, Cambridge. When the first war broke out, he flew in the RNAS, later in the RAF, was mentioned in despatches. Flying was his passion, and after winning a Hendon Air Pageant race in 1924 he continued flying around the world —over many of the areas now served by his radio and TV network—and only gave up his pilot's certificate recently owing to pressure of work.

When the sirens wailed in 1939, Wavell Wakefield was flying fighters again, eventually going to the Air Ministry as Parliamentary Private Secretary to the Under Secretary of State for Air, and becoming director of the Air Training Corps.

These, then, were the three originals who founded Rediffusion Ltd.—the radio expert, the ex-BBC Chief Engineer, and the air ace who ran a woodworking business.

By 3rd March, 1931, they were planning an all-Britain wired radio network. Their dream has come true, for piped-radio subscribers in the United Kingdom now exceed 672,000. Overseas subscribers number more than 345,000. Rediffusion also operate broadcasting services overseas, with transmitters covering a population of 12,500,000.

'It was clear,' one of the founders told me, 'that once the system had proved itself in Britain, a large and virtually untapped market existed in many oversea territories. In 1935 Rediffusion extended activities to Malta. Our relays through loudspeakers installed in air-raid shelter caves helped to keep morale high in the George Cross island

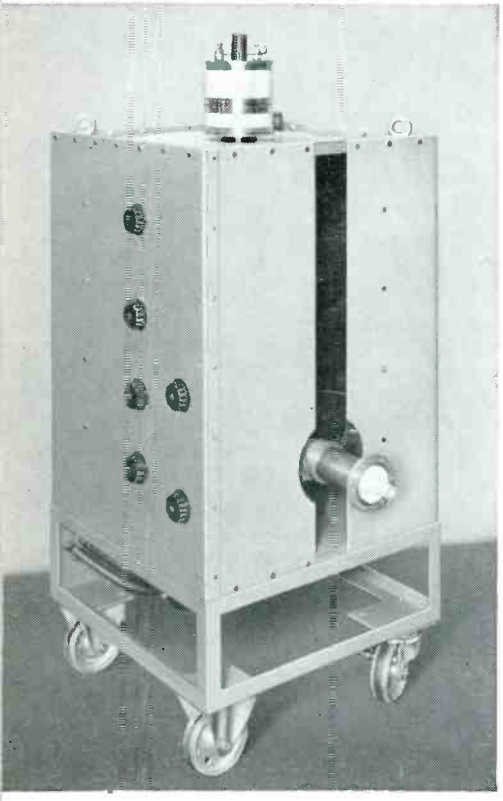
Rediffusion had a stand at the month-long exhibition held last year in Hong Kong. Each evening, Rediffusion (Hong Kong) Ltd. arranged special Chinese television transmissions and this created enormous interest among the visitors

'ENGLISH ELECTRIC'

UHF POWER

25 kW KLYSTRONS

for bands IV and V television



R. F. power for bands IV and V television transmitters is provided by the latest EEV klystrons K376 and K377.

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K377 klystron in circuit assembly K4055.

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during its greatest hour. Rediffusion wired broadcasting later came to Barbados, Ceylon, Orlando and Singapore.

'In British Guiana, Liberia and Nigeria, radio programmes were wired, and in Jamaica and Trinidad our companies both broadcast and relayed originated programmes; in Barbados, Hong Kong, Kuala Lumpur, Malta, Penang and Singapore, where Rediffusion did not provide an aerial broadcasting service, special programmes were originated for transmission by wire to subscribers. In Hong Kong, TV programmes were also wired.'

Manufacturing facilities set up by Rediffusion in 1932 to build and service piped-radio equipment underwent rapid expansion in the years before the war; and from 1939 to 1946 Redifon Ltd. (the major manufacturer within the group) made a great contribution to victory and peace, being big suppliers of communications and electronic equipment to the Armed Forces. Nowadays, Redifon transmitters and receivers sell at home and abroad.

Redifon, at a Crawley factory, produce flight simulators. There is also a TV and research laboratory in the group. At Wandsworth, Redifon produce communications gear. Of course, thousands of TV sets are needed for the growing relay-TV chains, and these are produced in factories in Surrey and Lancashire by Rediffusion Vision Service Ltd. They make conventional TV receivers, too, and the reliability of wired vision services owes much to the rigorous quality control exercised by Rediffusion Vision Service.

'A considerable part of the whole group's activities in research and engineering development are devoted,' I was told, 'to adapting existing systems for 625-line and colour-TV. Certain technical aspects of Subscription-TV as they apply to wired systems have also been under investigation.'

Up to seven years ago, Rediffusion Research Ltd. was based at Wandsworth, but later research relating to wired-radio and TV was transferred to Coombe, Kingston, Surrey.

Set in quiet, country surroundings, this converted mansion houses nearly all the laboratory, model shops, drawing and technical offices in a self-contained research department. However, the whole Rediffusion group is growing so rapidly in TV that even Coombe is no longer quite self-contained, and TV receiver research is now done in new separate laboratories such as those at Chessington, Surrey.

This sort of research can be costly. How much can even a multi-million group like Rediffusion spend on TV research? *Believe it or not, the amount to be spent is worked out on a computer—every week!*

'Relation,' I was told, 'between the cost of a development project and its economic value to the group is carefully considered at the outset, and a weekly system of cost analysis provides a continual check on progress and financial expenditure once the work is under way. . . .'

This is the only way to keep an element of sanity in the unexplored realms of TV research. realms which as some other great TV companies have found, can be a bottomless pit when capital is recklessly poured in. Solidity of Rediffusion is paralleled in the car industry, where fortunes can also be lost in experimental racing, and where the stolid Sir Henry Spurrier of Leylands who bought up a car firm bluntly said: *'We don't make mistakes—we make Leylands!'*

Rediffusion, making no mistakes, used one of their electronic labs. to develop the 'Instantaneous Broadcast Audience Counting system' officially abbreviated to IBAC.

IBAC provides a permanent record of the viewing or listening selection of a group of subscribers, and is a development of Rediffusion's Audio and Control section. Other activities of this department include design of amplifiers for overseas tropicalisation use, protective gear, and research into technical aspects of piped-TV.

Improving the existing wired radio system is the concern of one research section. Investigation into field problems, improvement in the design of existing repeaters, and adapting existing TV networks to 625-line are all part of that section's job. Then there is a section responsible for the quality of the cables employed, trunk routes and feeder networks. Specialised instruments to measure cable faults were developed at Coombe, including an impedance irregularity measuring set, and a device for measuring cross-view; instruments like these, pioneered and developed by Rediffusion, are now used by major cable manufacturers the world over.

Other sections are working on 625-line systems, and colour, as a result of which trunk feeder repeaters have been developed to accommodate the increased bandwidths, and to minimise installation work. One of the specialised test instruments from Coombe, of great value in 625-line tests and colour is a time-relay measuring device capable of an accuracy of *one five-thousand-millionth of a second.*

Experimental transmissions

Using BBC experimental colour transmissions, and signals derived from their own Cintel colour slide scanner, Coombe are investigating the effects of long lengths of trunk cabling and repeaters on the colour picture, and the merits of different colour transmission systems.

Heads of vast combines are naturally proud of achievement, but do not like to talk of near-failures. This is not the case, however, with Mr. John Spencer Wills who made a sharp disclosure after the bitter criticism of certain ITA services by the Pilkington Committee.

'The main criticism hurled against us,' he said, 'is that the State does not take a sufficient share of our profits. Let us examine the figures for the year. . . . The Associated-Rediffusion's group gross revenue was in excess of £21,000,000. From this the State takes (including a substantial part of our payment to the Independent Television Authority) £5,000,000, and our 50,000 shareholders will receive £2,250,000. Had the Television Advertisement Duty been in operation during the year, the State would have taken another £1,470,000.

'Our shareholders took the risk of losing all their investment. At one stage, in 1956, they had in fact lost the enormous sum of £3,250,000. The State took no risk at all. If the Company had gone into liquidation, the State would not have lost one penny. . . .'

Hint of this enormous TV loss of over £3,000,000 is certain to excite the interest of all TV technicians who believe you have only to hire a studio, buy an image-orthicon camera chain and—in the words of Roy Thomson —'print your own money'. For a moment, therefore, we will diverge from the main theme of the technical story of Rediffusion to see how Associated-Rediffusion TV came

Who pioneered VIDEO TAPE?

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on the air, how it lost £3,250,000, built what was for a time to become the largest TV studio in Europe . . . we will consider a story which has the almost incredible beginning *—a unanimous resolution of the Rediffusion board, on 9th January, 1953, that it would not be in the interests of the company for commercial TV to be introduced in Britain!*

But if there were to be commercial TV, Rediffusion obviously could not be left out, so Mr. W. F. Brooks, Secretary of Broadcast Relay Service Ltd. (of which Lord Wakefield had been chairman in 1931) wrote a cautious letter to the Postmaster-General: 'We understand you may be prepared to consider the issuing of licences for certain sponsored broadcast operations in this country, and we shall be grateful if you will let us know the terms and conditions under which such licences are to be issued, so that we may consider whether or not we should make an application. . . .'

After that, because the cost of a sole venture into commercial TV seemed beyond the financial capacity of Rediffusion, there were several contacts with various companies, most promising being an approach from the late Stuart McLean, managing director of Associated Newspapers (the *Daily Mail* group).

The historic and fantastic events which then transpired, and which moulded the whole course of British television, have been recorded by John Spencer Wills, and the following is an abbreviated account of the true inner facts disclosed to me.

The approach (says Mr. Wills) led to a luncheon meeting on 21st April, 1954, at Warwick House, Lord Rothermere's London residence, at which Lord Rothermere, Mr. McLean and I agreed that if either company decided to go in for commercial TV, it would only do so in partnership with the other company.

'Several months later, Mr. McLean, Mr. Paul Adorian and I agreed that, even under the onerous terms of Government legislation, it would be a reasonable speculation to seek a TV contract. Rediffusion decided to invite the British Electric Traction Co. Ltd. to share equally their 50 per cent participation. With considerable help from Mr. McLean the partnership procured from the ITA the award of the contract for provision of independent TV programmes from London from Mondays to Fridays inclusive.

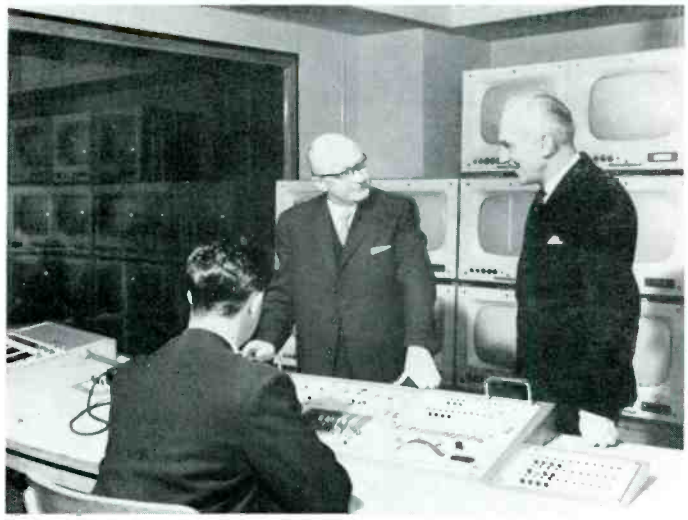
'The difficulties and trials and tribulations we had in commencing our public broadcasts on 22nd September, 1955, do not form part of this story. *Suffice it to say that by July 1956, after only ten months of TV broadcasting, we had lost the staggering figure of no less than £2,700,000.*'

At this very time, when the affairs of Associated-Rediffusion seemed to be at their lowest ebb, came a series of momentous meetings. . . .

(What transpired was that by September 1956, the Daily Mail *group, scared of further fantastic losses in this new TV medium, sold out to A-R and British Electric Traction.)*

The deal was done in August 1956 (says Mr. John Spencer Wills) in the course of a vacation of Mr. (later Sir Neill) Cooper-Key, a director of Associated Newspapers, at Burnt Wood, Battle; of Lord Rothermere at his house at Lewes, and of myself at Beech Farm, Battle.

'It started at lunch at Burnt Wood. Cooper-Key and I were alone at the table after our wives had left the dining-room, and he asked me what I thought of the prospects



Commander E. N. Haines (right), Managing Director, Central Rediffusion Services Ltd., the designers and consultants to Associated Rediffusion Ltd., talking to Mr. C. Metcalfe (left), Managing Director, EMI Electronics Ltd., in one of the control rooms of Studio Five, Wembley

of A-R in view of its enormous losses. I replied that I thought the company would start to earn as from next January. He asked, if I was so optimistic, would I care to buy Associated Newspapers' holding. I replied that I would certainly be prepared to recommend my board to do so, at a price.

'A few days later my wife and I were invited to dine with the Cooper-Keys. The only other guest was Lord Rothermere. When the ladies had left us after dinner, Lord Rothermere said without any preamble: 'Are you still willing to buy us out?' When he pressed me, I said I would be prepared to recommend my boards to do so at 25 per cent discount. . . . When my wife and I returned to Beech Farm, I spent a sleepless night: never had I committed myself to such a big deal with so little negotiation! In the course of two visits to Lord Rothermere at his house at Lewes, I settled with him the exact terms of the bargain. . . .'

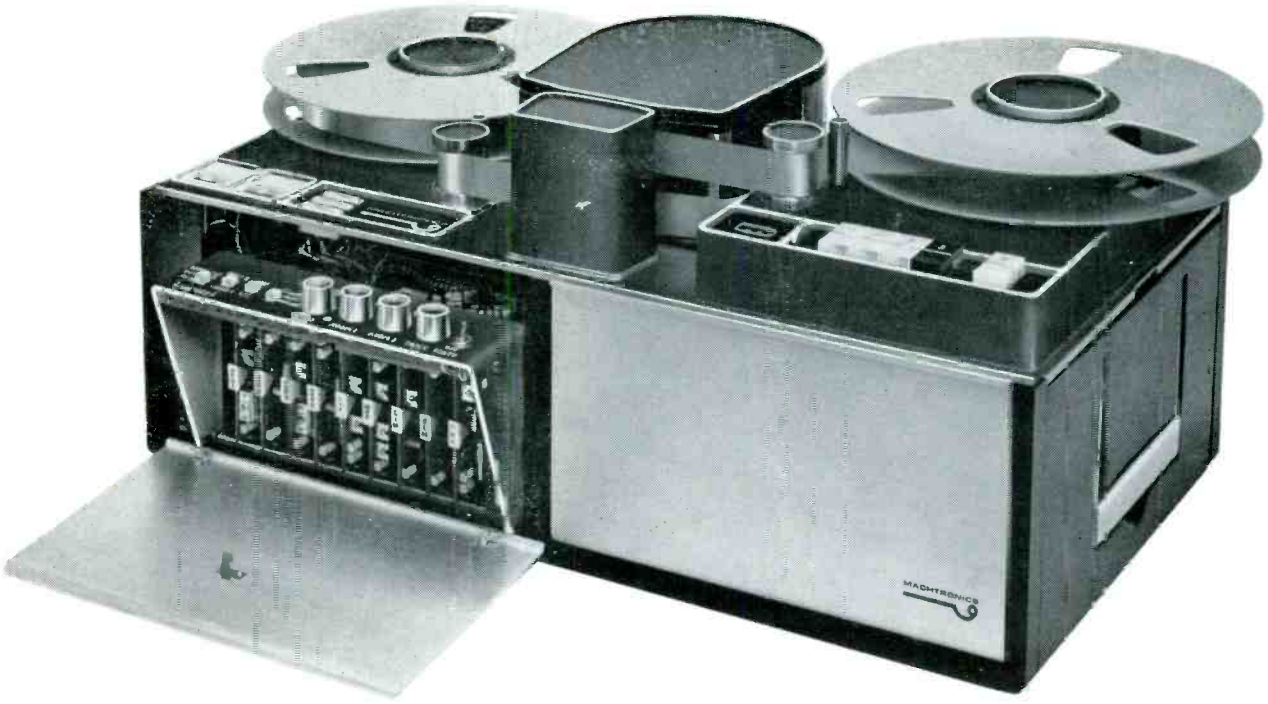
This deal was approved and ratified by both the Rediffusion and British Electric Traction boards at their September meetings. It involved the cash payment of £1,650,000 for the purchase of 200,000 shares and £2,000,000 of unsecured loans and loan stock. The Rediffusion board, always conscious of the extreme difficulty of raising new capital, decided not to take up its full entitlement. . . .

Of the nineteen individual shareholders who could have asked to take up their relative participations of shares, *only four had sufficient confidence to do so.*

They were Mr. W. F. Brooks, Mr. Kenneth E. Garcke (grandson of the founder of BET), Mr. W. T. James and myself.

'The ITA gave their consent, and the purchase was completed. *We continued to lose money until we had reached a total loss of £3,250,000.* . . .

'From the end of 1956 we come to the end of 1957 and the early part of 1958. The corner had been turned,



This look like that 78 pound TV tape recorder you've read about? It is... and it's the new Machtronics MVR-15, a completely self-contained broadcast model available for 50 or 60 cycle use. For remote or studio operation, it improves your programming flexibility in many ways.

It's wired for remote control, comes with two audio tracks, has a unique circuit for dubbing, and audio only capability among its features. Whether you are already television tape equipped or not, it can help you. We would be pleased to demonstrate it at your station and show you what it can do.

MACHTRONICS

185 EVELYN AVE., MOUNTAIN VIEW, CALIFORNIA, U.S.A.

independent TV was earning big profits and Associated Newspapers had found an opportunity to become large-scale shareholders in Southern Television. The ITA would agree to this only if Associated Newspapers would undertake to divest themselves of the 10 per cent holding in A-R. . . . We were very sorry to lose our Associated Newspaper colleagues but parted on most amicable terms. Thus it happened that by 30th April, 1958, the BET and Rediffusion and a number of individuals became the complete owners of Associated-Rediffusion.'

Courage and vision

'And,' recalls John Spencer Wills in this abbreviated account of the mammoth TV deal, 'it is an interesting sequel to a major gamble that the annual profits of A-R are now double the combined annual profits of the BET and Rediffusion at the time the project started.'

While all this high-level board-room dealing was going on, a little group of men in A-R had courage and vision. Even in 1955, at a time when aspects of independent TV were running dangerously into the red, plans were on hand for *the largest TV studio of its kind in Europe.* It was going to cost a million, at least.

Said Captain T. M. Brownrigg, CBE, DSO : 'A-R believes that it has a first-class staff and that, given the tools, they will produce first-class productions. A-R therefore believes that the capital expenditure of nearly £1,000,000 on this new studio will be well justified by the standard of production which viewers will receive in the summer of 1960.'

This site of Studio Five was one of the most historic in British pictures, having been the first British Talking Pictures sound-stage in 1925, when 'talkies' were still a novelty. In 1928 one of the first major sound films was produced at Wembley, *Dark Red Roses,* starring Stewart Rome, and later came the first musical, *City of Song,* in both English and German versions. By 1934 the studios were bought over by 20th Century Fox, and in the spring of 1936 Gabriel Pascal was making £6,000-budget pictures. From 1942, the studios became the centre of the Army Kinema Unit, and in early 1955 A-R took over, converted the studios into a TV centre, and many of A-R's first major studio productions were televised live from Wembley.

An interesting technical point is that in the early days of movie-making, overhead battery lighting was used for the sets. The idea went out as the film industry developed, but now it has come back with TV. Studio Five was soon to have the most modern overhead lighting system anywhere.

To diverge for a moment, there was a private lunch held in October 1959, at a time when Central Rediffusion Services Ltd. (a company in the Rediffusion group) had ceased to act as designers and consultants to A-R. Arising out of this, A-R's Captain Brownrigg and his principal officers gave a lunch to CRS's Commander E. N. Haines, DSC, and other officials.

The two groups had first worked together in November 1954, in an almighty technical rush to get A-R on the air on that first ITV day of 22nd September. Brownrigg said that without CRS it would have taken another six months, and probably been only half as good. 'E.N.' (Haines) and Ralph Gabriel did so much to get the studios working, and all the technical facilities at Adastral House, now renamed Television House, Kingsway.

'CRS has rendered invaluable service, saved untold amounts of money,' said Captain Brownrigg. 'But all the time A-R were growing up; and, like children, were now impatient to do it themselves. . . .'

So under 'E.N.', CRS advised A-R on the technical plans for Studio Five, Wembley, and were finally responsible for its overall testing before handing the huge studio and technical facilities over to A-R.

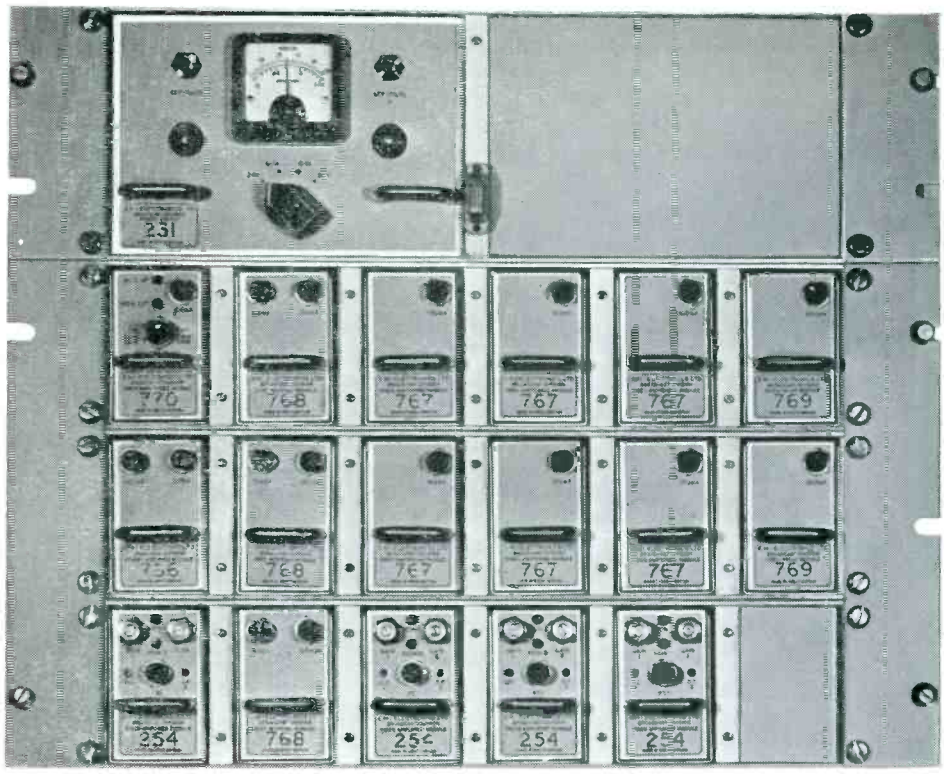
On 7th May, 1959, Sir Irvone Kirkpatrick, then chairman of the ITA, laid the foundation stone for Studio Five, followed by a dedicatory prayer by the Vicar of St. Martin-in-the-Fields, the company's religious adviser. *The 150 or so VIP guests saw a casket buried during the ceremony. It contained a set of plans for the studio, a copy of the Studio Five booklet, the programme schedule for the day, and a current copy of the* TV Times. . . .

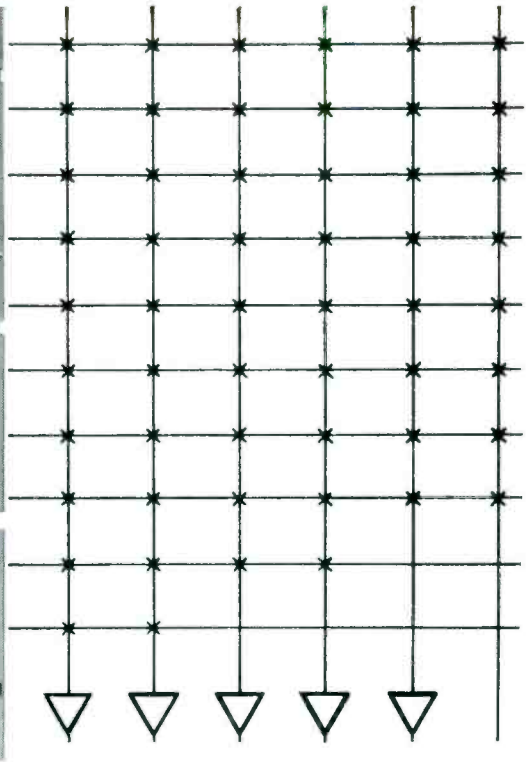
Brick by brick, girder by girder, this largest TV studio began to take shape.

'E.N.' had told how it was planned to divide the giant Five into an A and a B section, with double doors, thirty feet high, lowered from the roof in thirty minutes to seal each half. The main door has 45-ton leaves.

Kenneth Farms, of Farms & Partners, architects for the Studio Five project, was faced with unusual difficulties. The main studio is 140 feet long and 100 feet wide, yet for smooth long-track camera runs the floor has to be perfectly level to a tolerance of only $\pm\frac{1}{8}$ in. in 140 feet ! This monster area of structural concrete floor slab varies by $\frac{1}{2}$ in. in length with day-to-day temperature fluctuations, yet no crack may show or camera dolleys would bump.

The Western Nigerian Broadcasting Service has been equipped with Redifon transmitters, and the illustration shows the VHF programme link equipment at Abafon. The racks contain, not only FM receivers, but amplifiers and test equipment





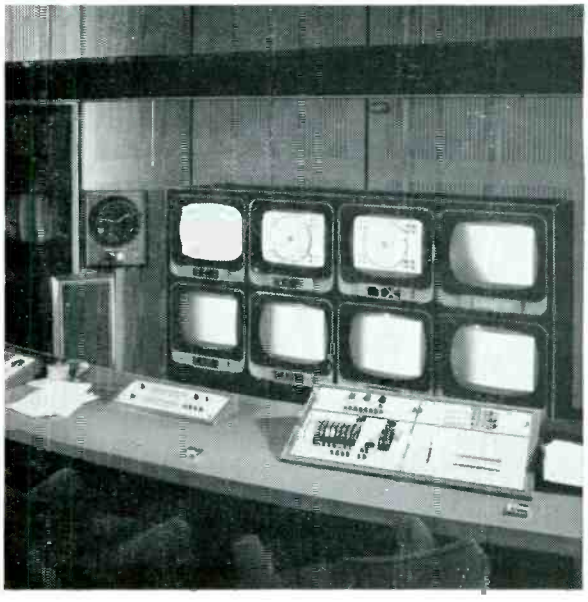
EMI

SEMI-CONDUCTOR VIDEO SWITCHING EQUIPMENT

The new EMI semi-conductor system outdates relay and electro-mechanical switching equipment and provides increased flexibility in system design with very good reliability and performance.
The system comprises a series of plug-in modular units of standard size. Six units can be fitted in a mounting frame and accommodated in a 19-inch (480 mm) rack or an EMI standard case. Frames can be bolted together to form any required size of switching matrix.

IMPORTANT FEATURES

- Modular construction provides complete flexibility in studio system engineering
- Greatly reduced rack space requirement due to new design techniques
- High performance specification suitable for use on all television system standards, both monochrome and colour
- Ability to switch during vertical blanking interval
- High degree of inter-channel cross-talk isolation
- Increased reliability resulting from exclusive use of semi-conductors



EMI

Further details will gladly be provided on request.

EMI ELECTRONICS LTD

BROADCAST & RECORDING EQUIPMENT DIVISION · HAYES · MIDDLESEX · ENGLAND · TEL: HAYES 3888
EXTENSION 2544 · CABLES: EMIDATA LONDON · TELEX: 22417

EE295

Cooling was another problem for the architects, as the ventilation of the huge studio necessitates 6½ complete air changes every hour, and thirty-five changes an hour in the dimmer room supplying the lighting banks. Full technical details of A-R studio were given in the issue of INTERNATIONAL TV TECHNICAL REVIEW covering the memorable opening in the summer of 1960, so need not be repeated here. However, among the many contractors proud to have equipped A-R are EMI who supplied an impressive bank of ten 4½-in. image-orthicon camera chains.

EMI supplied all cameras and video equipment, and were responsible for all technical wiring and installation of all technical equipment in the studio. Strand Electric produced an entirely novel system of lighting control, and Marconi's Wireless Telegraph Co. provided Wembley with the very latest in sound-control desks.

As John McMillan, A-R's Controller of Programmes, said: 'In the minds of the men and women who make the programmes, Studio Five is dedicated to the proposition that there is always a better way of doing something. We believe that television must not stand still if it is to remain a significant social force. . . .'

This means not only continuing technical resources and capital investment throughout the entire Rediffusion group, but also new hands. New brains. New skills. Rediffusion is facing this problem by attracting graduates straight from University, a two-year apprenticeship scheme being started some years ago; this gives selected youngsters wide experience in Rediffusion's workshops and laboratories prior to their acceptance in the various sections—Redifon, Reditune, A-R or whichever it may be of the many.

Newly-appointed Rediffusion and A-R maintenance engineers and technicians are trained at the group's technical training school at Poulton-le-Fylde, and existing staff go back there for refresher courses.

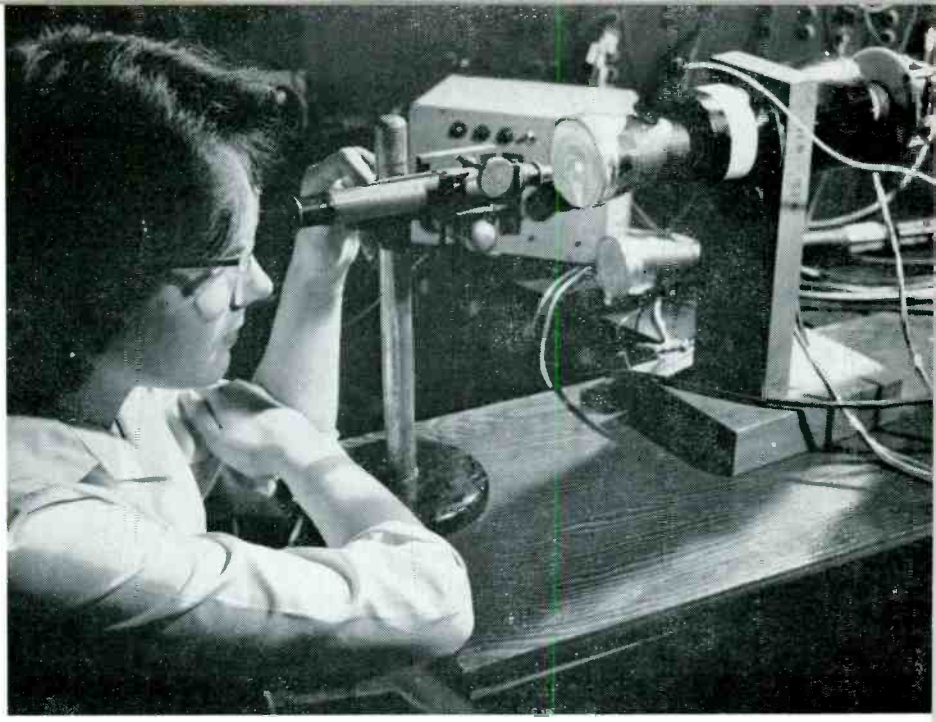
I have tried to tell this story not as a complete record of the vast Rediffusion group, nor that of A-R, but chiefly to show a hitherto little-known facet of Britain's television service of which this great British group forms a powerful part.

It can all be effectively summed up by the TV-film script which the Chairman, Mr. John Spencer Wills, himself wrote for the recent occasion when a screened documentary was prepared to celebrate the number of Rediffusion subscribers throughout the world reaching the total of one million.

'The operations of the Rediffusion group,' he said over the movie microphone, 'are many and diverse. We have manufacturing companies. We have manufacturing companies making television sets, specialised communications equipment and glass-fibre equipment. In addition to the operation of wired relay systems, we provide wireless broadcasting in a number of overseas countries. And now we have one million subscribers, and of these well over half are in the United Kingdom. . . .

'The group's stations, either by wired networks or wireless and television transmissions, bring first-class programmes in a multitude of languages and dialects to many millions of people. It is certainly no exaggeration to speak of Rediffusion "round the clock and around the world" '.

NEW DEVELOPMENTS
review



Examining the raster on a high resolution cathode ray tube developed at the Hirst Research Centre of The General Electric Company Limited, Wembley, Middlesex. The tube has a spot size less than 0·001 in. diameter and the tube performance is such that in a tiny test card 'C' pattern, less than ½ in. wide, the 3 Mc/s per second bars are clearly resolved.

Highest TV towers in Europe planned

THE TWO HIGHEST television masts in Europe will be built for the Independent Television Authority. They will be 1,250 feet high and a contract for the construction of these and one 1,000-foot mast has been signed with EMI Electronics Ltd. This is the largest single contract ever signed by ITA and is valued at over three-quarters of a million pounds.

These masts will be for the joint use of ITA and the BBC at stations that have been designated as sites for future 625-line UHF networks and they will be needed to carry the aerials for these as well as the existing 405-line VHF services.

The 1,000-foot mast will be built at the Authority's Winter Hill station, in Lancashire, and the 1,250-foot masts at Emley Moor, in Yorkshire, and at the new station in East Lincolnshire that is at present under construction for the Authority. Each mast will have provision for 350 feet of aerials, capable of radiating four 625-line UHF services, two 405-line services of the existing type and one FM sound programme.

The type of construction of these masts will also be new. Unlike the usual kind, which is built of a lattice of steel girders, each will consist of a steel tube 9 feet in diameter, with a lift inside to give access to the aerials for maintenance purposes. Although smaller cast iron tubes were used for some of the early wireless masts, this will be the first time in this country that a tubular construction of large diameter will be used for very tall masts.

It is hoped that the new mast and aerials at Winter Hill will come into service in the late Spring of 1965 and those at Emley Moor in the summer of 1965. At both these stations the new masts will take over the present services radiated from the existing 450-foot towers. The East Lincolnshire station is planned to begin programme transmissions in the autumn of 1965.

The sub-contractor for the design and construction of these three masts is British Insulated Callender's Construction Co Ltd.

New amplifiers

TWO NEW DISTRIBUTION amplifiers for use in broadcasting are announced by EMI Electronics Ltd.

Designed specifically for first class colour and monochrome performance, the new video distribution amplifier type 251 is a semi-conductor plug-in module with an integral stabilised power supply. With only 4 watts of power input, the unit provides four isolated outputs at standard level, each into 75 ohms.

Special design features demanded by modern TV studio operational techniques included highly stable gain and output terminal voltage at all ambient temperatures, and provision for inserting synchronising pulses independently on any or all of the outputs. As an alternative to a variable front panel gain control, the gain of any distribution channel may be fixed by the choice of a gain defining resistor fitted to the particular channel on the rack mounting frame.

A compact assembly, using silicon glass-fibre based printed wiring boards, and an all semi-conductor design permit each unit to be contained in a rectangular aluminium case, measuring only 3·25 in. (82·5 mm.) high, 2 in. (51 mm.) wide and 13 in. (330 mm) deep.

Six units can be accommodated in a rack mounting frame which fits into a standard 19 in. rack. Guide rails ensure that each amplifier slides easily into place and engages accurately into its mating socket at the rear of the frame. Provision is made on the rack mounting frame for cable termination, cable clamping, gain resistor and coiling. Spacing of amplifiers in the rack mounting frame is such that normal rack ventilation is not impeded.

The mains fuse, output monitor point, screwdriver-slot DC set control, and video gain control are on the front panel of the amplifier. The multiway connector plug is at the rear.

Pulse distribution amplifier type 252 is a semi-conductor module which has a similar construction to that of amplifier type 251. It accepts all television pulse waveforms—mixed sync., mixed blanking, line drive and field drive. The pulses are cleaned and amplitude stabilised, and four isolated outputs are provided at standard level, each into 75 ohms.

Field strength indicator

AVELEY ELECTRIC LTD. announce the availability of a small portable UHF Field Strength Indicator type HUZE which is used to measure the field strength of transmitters ranging from 470-850 Mc/s, with an accuracy of ±6 dB. This accuracy is normally sufficient for practical use, because field strength fluctuations, due to surrounding influences, can often produce still larger variations. In consequence, field strength indications are usually taken

as a relative measurement, where extremely high accuracies are not required.

The UHF Field Strength Indicator is particularly useful for monitoring transmitter systems in the TV bands IV/V. This simple method gives a clear picture of the area covered by the TV transmitter, respectively locating the most suitable site for receiving aerials. Naturally, this instrument can also be used to measure the field strength of other commercial transmitters. In addition, the field strength indicator can be used to measure radiation from interference, polarisation and aerial gain, as well as the directional characteristic of transmitting aerials.

In the laboratory it can be used as a sensitive millivoltmeter for multiple measurements.

The UHF Field Strength Indicator type HUZE constitutes a fully transistorised receiver and a logarithmic periodic wide band aerial. The aerial, during measurements mounted on the receiver, can be rotated to any required direction and consequently direction to each polarisation field is possible.

The instrument operates from a gas-tight, built-in storage battery which, fully charged, ensures an operating period of about eight hours.

Further details from Aveley Electric Ltd., South Ockendon, Essex, telephone South Ockendon 3444.

Portable recorder

A NEW PORTABLE broadcast television tape recorder priced substantially below any other broadcast television recorder has been developed by Ampex Corporation.

The new Ampex VR-660 Videotape* recorder weighs just under 100 lb. and is designed for mobile and studio use by network, commercial and educational broadcasters throughout the world. Its price is well below that of any other television recorder of broadcast quality. It is reported to be the only recorder of comparable size which may be used on the air with no additional equipment other than that presently available in most television stations.

The all-transistorised VR-660 has the same basic design as the Ampex VR-1500 closed circuit television recorder but incorporates electronic advances which enable it to produce television pictures which meet broadcast standards without additional equipment. The VR-1500 was introduced last December and is presently in production.

The new recorder will be demonstrated for the first time for broadcasters in New York in mid-September. Deliveries will begin early in 1964.

Ampex foresee widespread use of this recorder for remote recording of news, sports and public service events by commercial stations and for educational broadcasting. Stations equipped with one or more VR-660s can record broadcast-quality pictures and replay them promptly without processing. In addition, tapes originally recorded on VR-1500 closed-circuit recorders may be played on the air with the VR-660.

The VR-660 is available in both a 60 c/s version for operation in the US, Canada and certain other nations and a 50 c/s version compatible with power standards elsewhere in the world. Both offer substantial operating and maintenance economies. The 60 c/s version offers the lowest tape consumption of any broadcast recorder on the market. It operates at a tape speed of 3·7 inches per second and can record up to five hours of continuous programme material on a single 12½ inch reel of standard 2 inch broadcasting tape.

The VR-660 is the third all-transistorised Videotape television recorder introduced by Ampex in the last nine months. Ampex introduced the first television tape recorder in 1956 and has since supplied broadcasters and educational and military users the world over.

* *Ampex Corpn. TM.*

The Waveform equipment

Wave Generator

AVAILABLE FROM LIVINGSTON Laboratories Ltd., England, is the Model 403B Sine and Square Wave Generator manufactured by Waveforms, Inc.

The instrument provides sine or square waves over the frequency range 1 c/s to 100 Kc/s and has a frequency response which is flat within 0·5 dB above 10 c/s and within 2 dB below. Frequency stability is better than ±0·005 per cent short term and the dial calibration accurate to 2 per cent above 10 c/s. Sine wave distortion is 0·1 per cent and square wave risetime approximately 0·3 microseconds. The maximum output available into a 600 ohm load is 10 volts RMS for sine waves and 10 volts peak-to-peak for square waves. The output may be attenuated more than 80 dB. A separate sync. output provides a constant voltage independent of the attenuator setting for scopes, counters, etc.

The wide frequency range of the 403B makes it a very useful tool not only in the audio, but also the sub-audio and servo fields.

The price is £148 exclusive of duty.

Crystal converter

PERFECTONE WAS SHOWING for the first time in England the 50 VA Crystal Converter producing 125 or 220 volt AC at 50 c/s at the Earl's Court Industrial Photographic and TV Exhibition. This was designed originally for the new Eclair 16 mm. silent camera to provide sync. pulse working with a Perfectone ¼ in. tape recorder. No interconnecting cables are necessary between camera and recorder. Moreover, any number of cameras can be run synchronously, each one driven by one of these battery crystal packs.

The Crystal Converter technique depends on the accuracy of crystals to hold the output frequency to very close limits. Each camera has its own crystal unit which consists of a small neat package, having its own 12 volt battery supply and producing 125 volt or 220 volt single phase. These units are contained in a leather case with strap and are light enough to be carried on the shoulder. The problem of multi-camera working such as, for instance, covering a football match, is how to provide slating for the start of each camera. A radio link is being developed which not only gives communication between camera positions but also a marking code to the Perfectone recorder. This information arrives in the form of coded pulses of 1,500 c/s and is recorded by the pulse head.

In the recorder there is also a plug-in crystal unit generating 100 c/s. All crystals are matched, giving an accuracy of ·001 per cent. In terms of film this means synchronisation to within one sprocket hole in 400 feet between cameras and recorder. Even for single camera operation where the recorder may be far removed from the camera, this method of synchronisation has great advantages.

The EP6A Mk. II appears in a larger case made by Evershed Power-Optics. It has a sloping front which gives easy vision for the modulation meter in either an upright or reclining position. The additional features of the Mk. II against the standard

model are two microphone inputs with pre-amplifiers including a sensitivity switch on each channel, a new type output amplifier with a switch giving various output impedances and the facility of taking the crystal controlled pulse plug-in unit. All cables are side entry which enables the recorder to stand on damp ground.

There are now in existence eight types of crystal converter ranging from small 50 VA single phase up to 1,200 VA three phase. The outputs vary according to the application and can be obtained either as square wave or sine wave.

In addition there were the usual transistorised Perfectone motors on show for Arriflex and Cameflex cameras.

The rack mounted 35 mm. magnetic recording machine recently arrived from Switzerland, created a great deal of interest. The layout and construction of the mechanism is to a very high standard giving excellent wow and flutter figures which are maintained after a long period of use. The amplifiers are the plug-in cassette-type and the main switch panel has the facility of working either from mains or from the synchrostart.

New tube

A NEW 5-INCH cathode ray tube has been developed by English Electric Valve Co. Ltd. for use in wide-band, high speed oscilloscopes.

The special features of this tube are:

(1) Deflection sensitivities in the Y and X directions of 3 volts/cm. and 9 volts/cm. respectively.

(2) Excellent brightness enabling high writing speeds to be employed.

(3) Good sensibility due to the small spot size (typical line width 0·4 mm.).

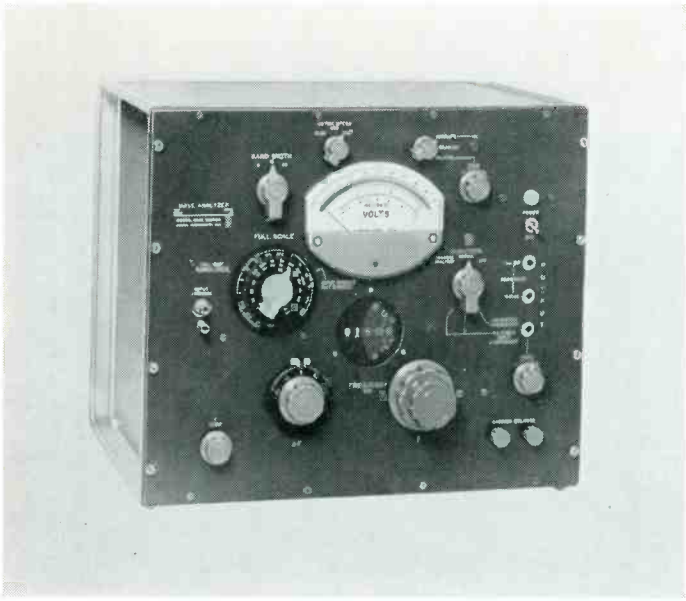
These features are achieved by the use of a post deflection accelerator mesh positioned a few millimetres from the phosphor screen, and an improved gun design.

Since the region between the mesh and the screen in which the beam is accelerated is short, raster distortion is kept to a minimum while an improved X deflection sensitivity is achieved by having a large X plate to mesh spacing.

A further advantage of this position of the mesh is the improved stability in X and Y deflection sensitivity with changes of temperature.

The deflection sensitivity of the tube makes it particularly suitable for use with deflection circuits employing transistors.

The tube is available with two phosphors: T948H—blue green afterglow (phosphor equivalent to P31) and T948N —yellowish green afterglow (phosphor equivalent to P2). Both versions have medium short persistence.



General Radio's new Type 1900-A Wave Analyser, which features switch selection of 3-, 10-, or 50-cps bandwidth

Safety blocks

A NEW TYPE of Sala Safety Block has been developed for use in television studios. In these studios, spotlights are suspended from the roof by telescopic devices and lowered into position as required. Any failure of the telescopic device can cause serious accidents, and, as the spotlights are often suspended close to personnel or to other equipment, there is little safety margin.

The new block works on the same principle as the standard Sala Safety Block and during raising and lowering of equipment will stop a fall within about 12 inches. As soon as the equipment is in place a safety catch on the top of the block locks the mechanism. As shock loads from falls of equipment are much greater than those from persons falling, the block is mounted on a spring as shown in the photograph. When the safety catch is in position the movement of the equipment is limited to the compression of the spring and accidents are completely eliminated.

Apart from this special use, the new block is ideal for handling other types of equipment, provided the weight is less than 200 lb.

New cables

TWO NEW LOW-LOSS television downlead cables for aerial-set connection have been introduced by Cable Division of Associated Electrical Industries Ltd. Designed specifically for 625-line broadcast reception, the cables, types 75/R/12 and 75/R/9, are of a single coaxial construction with a conductor of soft plain copper wires, insulated with cellular polythene, braided with plain copper wires, and sheathed overall with brown pvc polythene.

Cable type 75/R/12 is a general purpose cable and suitable for use in all areas of reception, while type 75/R/9 is a slightly larger cable with a lower loss, making it suitable for 'fringe' areas where signal strength is particularly weak.

Technical details :

			Type 75/R/12	*Type 75/R/9*
Nominal impedance	ohms		75	75
Nominal capacitance	pF/ft.		17	16
	pF/m.		56	53
Velocity ratio			0·81	0·81
Nominal attenuation:				
dB/100 ft.		200 Mc/s	2·8	2·3
dB/100 m.			9·2	7·5
dB/100 ft.		600 Mc/s	4·7	4·4
dB/100 m.			15·4	14·4
dB/100 ft.		800 Mc/s	5·8	5·3
dB/100 m.			19·0	17·4
Conductor size	in.		1/·056	1/·064
	mm.		1/1·42	1/1·625
Dia. over polythene	in.		·245	·295
	mm.		6·22	7·49
Nominal overall dia.	in.		·325	·385
	mm.		8·25	9·8

Television downlead cables are available from AEI Cable Division, 51-53 Hatton Garden, London, E.C.1.

Wave Analyser

SWITCH-SELECTION OF 3, 10, or 50 cps bandwidth is one of the many features of General Radio's new Type 1900-A Wave Analyser, a precise heterodyne voltmeter covering the frequency range from 20 cps to 50 Kc/s. The ability to select bandwidth lets the user choose the detail of a narrow analysis, the speed of a broader analysis, or a compromise bandwidth. Full-scale voltage range is 30 μv to 300 v, with 1-megohm input impedance on all ranges.

Several outputs are provided: 100 Kc/s and 1-ma DC outputs for recording, a 'restored-signal' output at the frequency of the input signal, and a 'tracking-analyser' sine-wave output at the indicated centre frequency. The availability of these various outputs makes the wave analyser a complete system for response measurements on a wide variety of networks and devices.

Other features of the new analyser are a built-in voltage-calibrating system, a precise, linear frequency scale, and AFC. Used with the companion Type 1521-A Graphic Level Recorder, the analyser becomes a sensitive, high-resolution, automatic spectrum analyser with a dynamic range of 80 dB.

The Type 1900-A Wave Analyser is priced at $2,150.00, f.o.b. West Concord, Mass., USA, and is available in both rack and bench versions.

For further information, contact General Radio's representative in the United Kingdom, Claude Lyons Ltd., Valley Works, Hoddesdon, Herts., or write to General Radio Overseas, Helenastrasse 3, Zürich 8, Switzerland.

Colour projectors

A £16,500 ORDER has been placed with Rank Cintel, a division of the Rank Organisation, for Colour Television Projectors Mk. II for use in conjunction with redifon flight simulators of the type which present the pilot with a high quality visual presentation of his normal view out of the cockpit window.

This is part of a contract for the supply of six Colour Projectors Mk. II to be used in conjunction with Redifon colour visual systems on flight simulators. The projectors include models for operation on the American 525 lines TV systems and the British 405/625 line systems.

Those using the American system are to be operated by NASA and Western Airlines of Los Angeles. The British equipments are for BOAC VC10 simulators and also for the Royal Navy.

Particular requirements for this application are the provision of remote controls and a compact optical unit. In order to meet these requirements the Rank Cintel instrument is constructed in three separate units; Projection Unit, Electronics Cubicle and Remote Control Box.

The addition of a projected visual display to a modern sophisticated flight simulator enables training for the critical bad weather break-out phase. Also the instrument approach through cloud can conclude with a visual approach and overshoot, according to the training required.

technical abstracts

General

1095 KENDALL, J. T. The Future of Transistors.

Journal IEE, Vol. 9, 508-510, Dec. 1963.

The author, of Edwards High Vacuum Ltd., discusses the implications on transistors of the further development of integrated circuits. The effect of semi-conductor devices on circuit design can bring about radical increases in productivity and reliability and therefore reduce the cost to the consumer of many electronic components. Diags., photo.

1096 LARKIN, M. W. and THOMAS, P. R. A Decade of Transistorisation.

Electronic Equipment News, Vol. 5, No. 8, 64-69, Nov. 1963.

The authors, of Texas Instruments Ltd., Bedford, review the progress of the transistor since 1952, the year in which serious consideration of its use in electronic circuitry was first given. After discussing significant events in its development, they then outline some major areas of application. It is concluded that the next ten years will see almost as spectacular developments as in the last decade. Graph, 19 bibliog. refs.

Colour TV

1097 MELCHOIR, G. and RAGOT, C. The SECAM Decoder.

Electronic Engng., Vol. 35, No. 428, 642-650, Oct. 1963.

The transmission of colour television signals by the SECAM process is the subject of detailed study in European laboratories. The inherent stability obtained by the use of frequency modulation will enable a high quality service to be maintained. This article describes the demodulation circuits used in receivers and decoders—the outcome of work on the first 100 experimental equipments. Sundry improvements under development are described to show future trends. Authors are with Compagnie Française de Télévision. Diags.

1098 MIKTON, R. Europe's Colour-TV Competition Gets a New Entry from Germany.

Electronics, Vol. 36, No. 31, 22-23, 2nd Aug., 1963.

Telefunken's PAL (phase alternation line) is a strong new contestant in Europe's search for a colour-TV standard system. Freedom from path distortion is claimed. A brief description is given of its principles.

Transmission

1099 KAJIKAWA, M.; SAKURAZAWA, A., *et al.* Results of Locomotive Measurement of Radio Waves from Hitachi UHF-TV Satellite Experimental Station.

Rev. Radio Res. Lab., Vol. 8, No. 38, 464-472, Sept. 1962. IN JAPANESE.

The variation of field strength, fading range and fading rate with the distance covered of radio waves from the Hitachi

UHF-TV experimental satellite station on the radio horizon in the winter of 1962 are reported together with their picture qualities examined by UHF-TV converter (diode mixer type).

1100 KAZAMA, K.; ISHINO, T.; SHUDO, K. and KUMAKURA, K. TV Dissolve Wiper.

Electronics, Vol. 36, No. 36, 40-42, 6th Sept., 1963.

A special-effect amplifier combines scenes without a sharp transition edge. This television dissolve wiper shapes the transition-region video scenes and overlaps them to give an indistinct border needed in drama and musical shows. The key factor is a gating signal consisting of a ramp connecting two constant voltages. It is obtained by clipping the top and bottom of a sawtooth waveform. Diags., photos.

1101 KOJIMA, T. and HARA, H. Wideband Amplifier Tube Life.

Rev. Elec. Commun. Lab., Vol. 10, Nos. 7/8, 363-368, July/Aug. 1962. IN ENGLISH.

Four important factors which determine the life of wideband amplifier tubes (6R-R8) have been studied, i.e. decay of total cathode emission, growth of cathode interface resistance, growth of cathode oxide layer resistance, and increase of amplification factor. The growth of cathode oxide coating resistance was measured by a novel method and it was confirmed that this was an important factor to cause the decay of mutual conductance.

1102 KRAMER, C. and BALDER, J. C. Delta Modulator Codes Television Waveguide Link.

Electronics, Vol. 36, No. 31, 50-52, 2nd Aug., 1963.

When transmitting a high-quality television signal over waveguide, where the distance between repeaters is 25 km. or more, distortion due to dispersion of the signal may result. The tunnel-diode circuit described permits 100 Mc/s clock rates, eliminates distortion and lowers quantising noise. Diags., graph, photos., bibliog. refs.

1103 MESSERSCHMID, U. Die Erzeugung von Umrissbildern beim Fernsehen durch Umformung des Videosignals. (The Production of Outline Pictures in Television by Shaping the Video Signal).

Rundfunktechn. Mitteilungen, Vol. 7, No. 3, 160-171, June 1963. IN GERMAN.

It is possible, by differentiating the video signal and subsequently, push-pull rectification, to produce pictures that contain only the outlines, but no longer the grey tints, of the original picture. It is necessary to differentiate in the horizontal as well as the vertical direction. A detailed description is given of a supersonic delay line, by means of which the video signal is delayed by the period of one line, which is necessary for the vertical direction of differentiation. Diags., graphs, photos., bibliog. refs.

1104 STRASSER, J. GaAs Laser Transmits Wideband Data.

Electronics, Vol. 36, No. 42, 24-25, 18th October, 1963.

General Electric demonstrated a system that transmits data with a gallium-arsenide laser. Bandwidth of up to 12 Mc/s was the broadest to date but future systems would operate at many times this figure. Spectral response is 9,000Å. Diags, photos.

1105 SUGURI, Y.; IKUSHIMA, K., *et al.* TV Transmission by Communication Satellite.

Rev. Radio Res. Lab., Vol. 8, No. 37, 304-314, July 1962. IN JAPANESE.

With respect to the Telstar relay projects, the available average time is calculated for communication between the Japanese station

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at Kashima and European stations (at Goonhilly, Pleumeur, Bodou and Raisting) as well as the North American stations at Andover and Mojave. Then the quality of received pictures and the equivalent noise temperature of the whole system of the receiving ground station are estimated on the assumption of zero elevation angle.

Cameras and Tubes

1106 DILLENBURGER, W. and ZSCHAV, H. Studio-Fernsehkamera für 4½"-Superorthikon. (Studio Television Camera for the 4½" Image-orthicon Camera Tube).

Rundfunktechn. Mitteilungen, Vol. 7, No. 3, 146-159, June 1963. IN GERMAN.

The mechanical construction of the camera was based on the KOD 3 in. camera with necessary modifications. Stability and reliability were the main requirements of the camera circuitry. Transistors were used where possible. There is a discussion of the possibility of scanning to improve the visible signal-to-noise ratio and the design of amplifiers connected with it. In particular when using image-orthicon tubes with low storage capacity, line noise degrades the visual signal-to-noise ratio by at least 2 dB. Diags., graphs, photos., bibliog. refs.

1107 KURODA, H.; TAKAYAMA, H. and KOBAYASHI, H. Gas Sorption Properties of Barium Getters for TV Picture Tubes.

NEC Res. & Dev., Nos. 4/5, 56-64, April 1963. IN ENGLISH.

One of the most important causes for failure in oxide cathode electron tubes in operation is the decay of emission current of the cathode by the attack of poisonous gases. To minimise this, flashed barium film getters are commonly used to clean up the atmosphere. To obtain practical information on commercial barium getters, the measurement of sorption power of the evaporated barium film for various common gases in a TV picture tube has been performed at the pressure range closely connected with that of the actual operation of the tube under the condition of constant pressure on the film by means of a capillary method. Diags., graphs, photos, bibliog. refs.

1108 OKAZAKI, M.; KANO, K. and KIDA, M. On Reduction of Size of Three-image-orthicon Camera and its Optical System.

NEC Res. & Dev., Nos. 4/5, 77-85, April 1963. IN ENGLISH.

Presented at the First International Television Symposium, 1961, Montreux, Switzerland. The reduction in size and weight of the colour television camera and the improvement of its optical characteristics had remained unsolved for a long time. In this paper, the problems and their solutions by miniaturising the optical system and improving its characteristics in the new optical system designed by NEC, are discussed and the NEC colour camera with the new optical system is described. Diags., graphs, photos., bibliog. refs.

Receivers

1109 LONGHURST, C. E. Elimination of Switch-off Spots in TV Receivers.

Mullard Tech. Commun., No. 66, 170-171, Aug. 1963.

It is desirable that a television receiver should not exhibit a spot at switch-off. This is best achieved by ensuring a rapid discharge of the e.h.t. capacitance and is most conveniently accomplished by using the picture tube as a discharge device. It is essential to ensure that the timebases provide some scan during the discharge time. Three methods of achieving spot suppression at switch-off, using a minimum of components, are given. These precautions, however, do not afford protection under fault conditions. Diags.

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Mobile Units

1110 ARAKI, T.; OKUDA, T., *et al.* Transistorised Television Mobile Units.

Toshiba Rev., Vol. 17, No. 12, 1329-1347, Dec. 1962. IN JAPANESE.

Several kinds of transistorised television mobile unit have recently been developed, of which two are described. One, having a van of 4·7 m. in length, has been designed for Yamanashi Broadcasting System, and the other, 7·0 m. in length has been delivered to NHK. Detailed description is given of (1) IK-22A image orthicon camera; (2) MTKO-5 image orthicon camera; (3) synchronising generators; and (4) video switching equipment.

Applications

1111 COHEN, C. Presenting Radar Targets in Colour.

Electronics, Vol. 36, No. 42, 54-55, 18th Oct., 1963.

A radar display that shows moving targets and fixed targets in different colours on a television receiver is being developed at Tokyo Shibaura Electric Company's Central Research Laboratory. One colour displays the plan-position-indicator map and another shows moving targets. The unused gun can display alpha numeric information. A storage tube is used to convert the radar ppi sweep into a conventional TV raster. Diag., photos.

1112 LEWIS, R. J. Television and Diagnostic Fluoroscopy.

Electronic Equipment News, Vol. 5, No. 9, 52-56, December 1963.

The author, of Marconi Instruments, Ltd., discusses in general terms the applications of television as an aid to fluoroscopic X-ray diagnosis. He gives a brief summary of the lines along which this development has taken place and some of the problems involved. Both vidicon and image orthicon tubes are mentioned and their relative virtues discussed. An outline of the Marconi system is provided and there is a brief reference to industrial applications. Diags., photo., bibliog. refs.

1113 MAGUIRE, T. Modulated Beams Build Microcircuits.

Electronics, Vol. 36, No. 45, 26-27, 25th Oct., 1963.

Molecular amplification, or selective deposition by manipulation of surface energies, is under investigation for microcircuit fabrication. An electron-beam modulation system controls deposition by scanning a diagram with a TV camera. Diag., photos.

1114 O'NEILL, W. J. Stereoscopic Television System.

Nuclear Instruments & Methods, Vol. 24, No. 1, 45-48, July 1963.

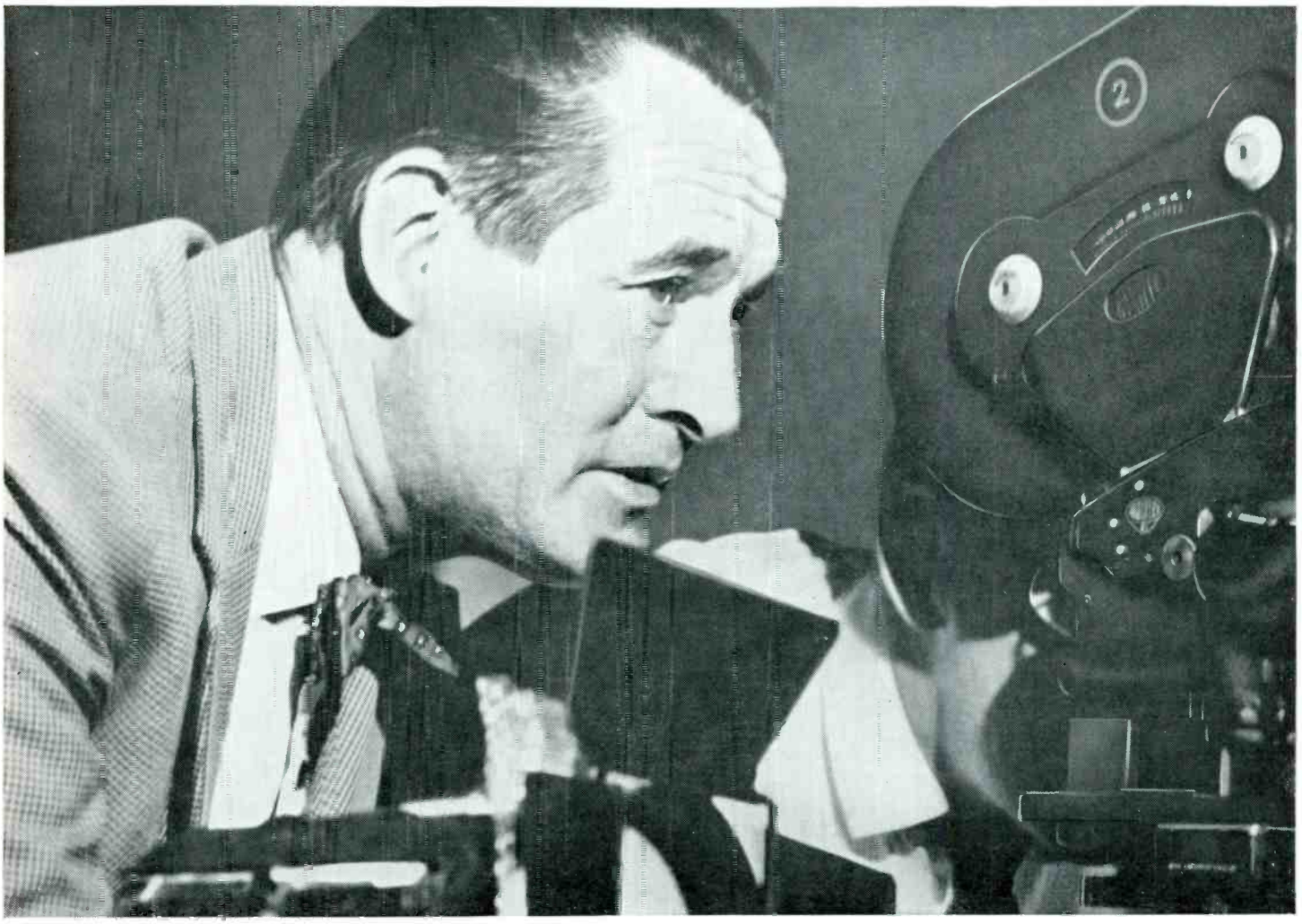
A high resolution stereoscopic television system has been developed for remote viewing applications requiring depth perception. Two camera chains are used, their video outputs being displayed on two miniature kinescopes. The latter are viewed as binoculars to provide the separate perspective images for the two eyes. Many of the difficult problems encountered in the development of stereoscopic television have been overcome. In particular, it avoids the requirement of closely matched components. The resolution obtained is 500 lines for each perspective image. A lower resolution multiple-observer system used in conjunction with the binocular device is suggested. Diags.

1115 Positioning to Micron Accuracy.

Measurement & Control, Vol. 2, No. 8, 315-320, August 1963.

Numerical co-ordinate positioning system operated by push-buttons or punched tape reduces machining times on a jig borer by up to 30 per cent. The position control accuracy is ± 1 micron. Displacements are measured by scales and graticules which are scanned by television tubes to give electrical pulse signals. Diag., photos.

ILFORD interviews JO JAGO



Ilford interviewed Jo Jago—for the last six years chief cameraman of World Wide Television Film Services Ltd. Jo has made commercials for all types of product in every kind of setting. In 1961 he won the Television Mail Award as Cameraman of the Year: in 1963 World Wide TV commercials won the Palme d'Or at Cannes for their overall standard and quality. Jo Jago relies on Ilford FP3.

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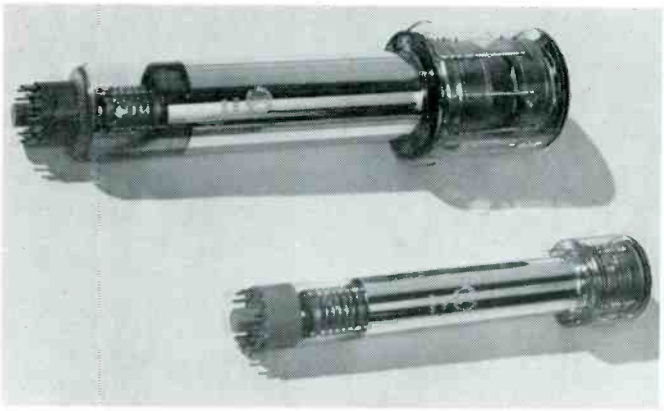
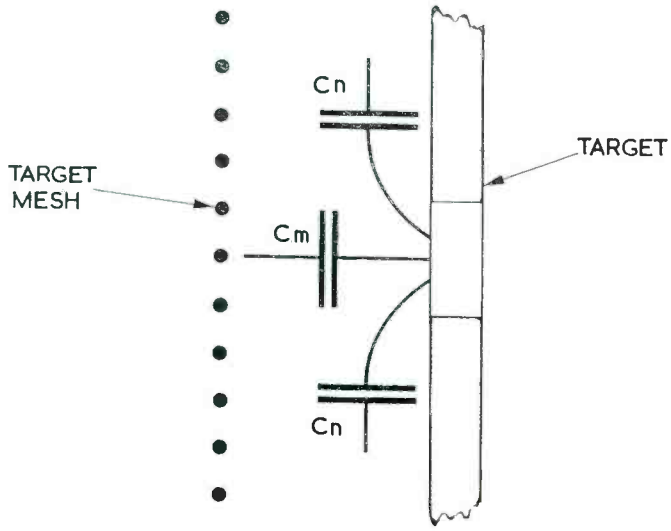


Figure 2: English Electric Valve Co. Ltd. 3 in. and 4½ in. Image Orthicons



$$C_T = C_m\left(1 + \frac{C_n}{C_m}\right)$$

Figure 3

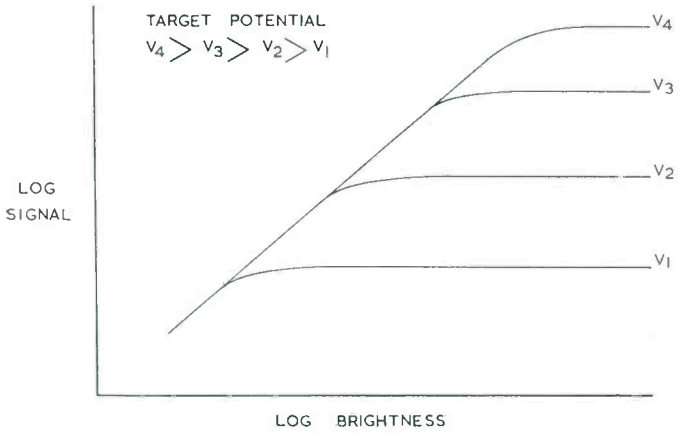


Figure 4

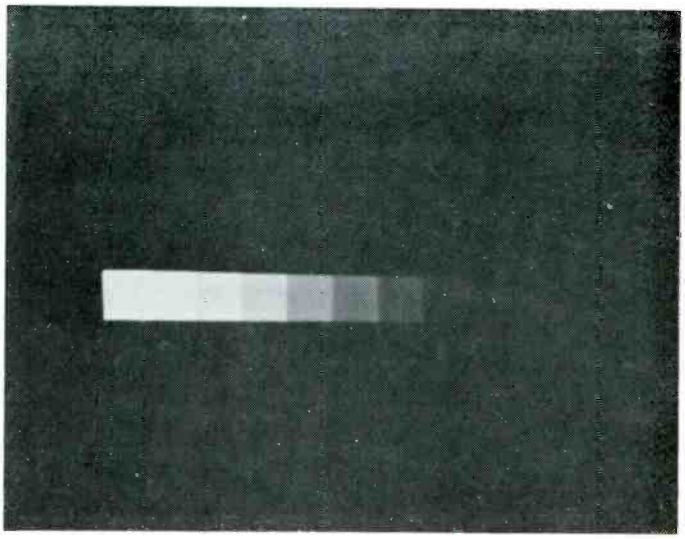
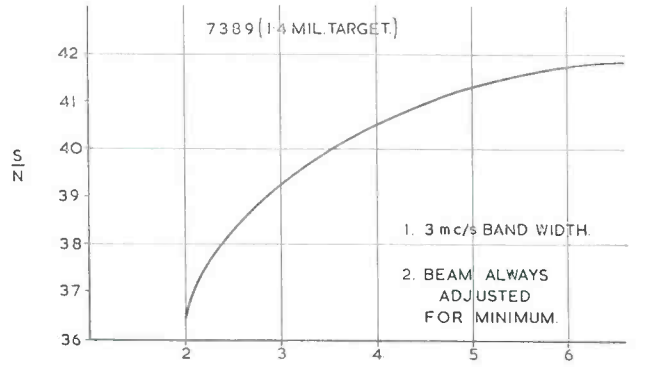
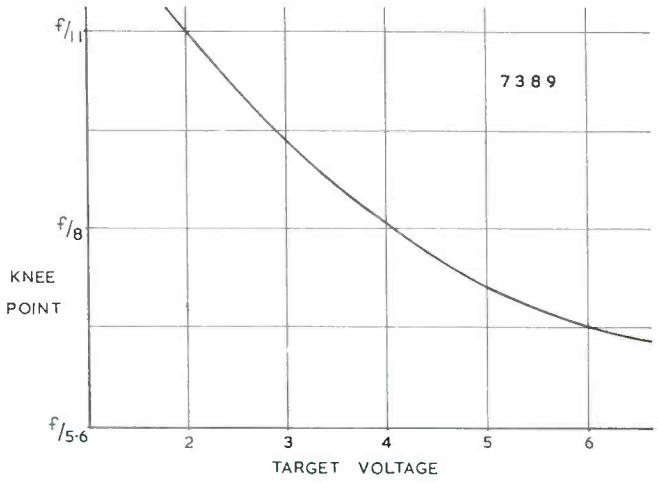


Figure 5



VARIATION OF SIGNAL TO NOISE RATIO WITH APPLIED TARGET VOLTAGE

Figure 6



VARIATION OF SENSITIVITY WITH APPLIED TARGET VOLTAGE

Figure 7

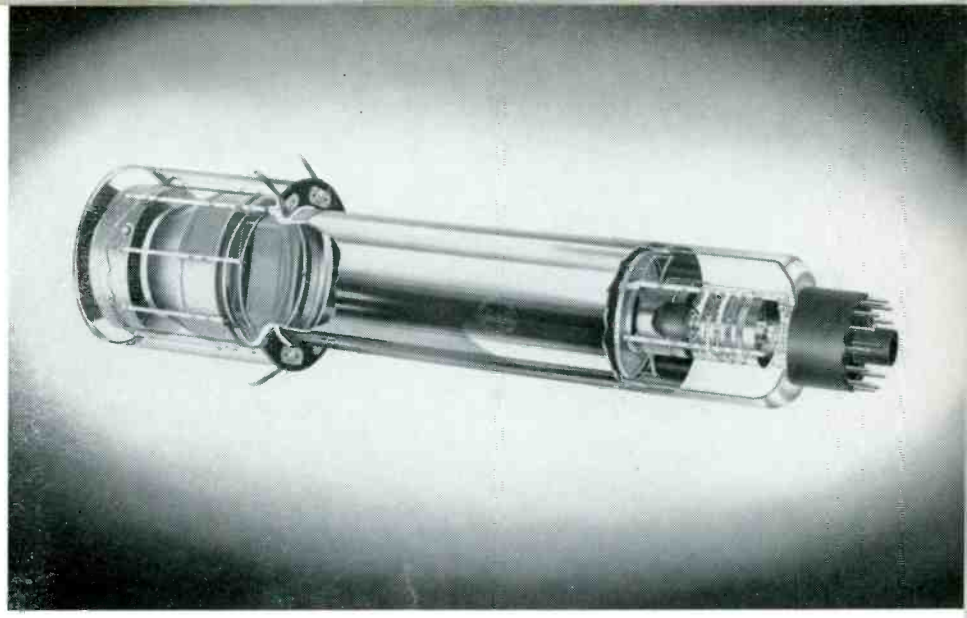


Figure 1: Artist impression of EEV 4½ in. Image Orthicon cut away to show electrodes structure

SOME OPERATIONAL FEATURES OF THE 4½-INCH IMAGE ORTHICON

by W. E. TURK

MORE and more broadcasting authorities are recognising the fine picture producing qualities of the 4½ in. image orthicon and it is the purpose of this paper to take a brief review of these and to present some new thoughts upon its mode of operation.

The fundamental advantage of the 4½ in. tube over the smaller versions lies in its larger target which is approximately three times the area of that customary in the 3 in. envelope. Of necessity the volumes of both the image section and the scanning section have had to be increased to satisfy the changed electron-optical requirements, but the photo-cathode diameter of the 3 in. tube is retained so that conventional and proved optical systems may be used. The field mesh is energised separately from the beam focus electrode, thus removing the need for an additional grid as used in the 3 in. tube to suppress the secondary electrons produced there by the scanning beam. Figure I is a cut-away diagram of the tube.

It has been argued that this increased bulk of the 4½ in. tube cannot be justified by its relative performance to the smaller and supposedly more convenient 3 in. version. (Figure II shows the two tubes together.) There can be no dispute, however, that the working capacity of a larger target must be greater than that of a smaller one, and it is to the working capacity of a pick-up tube that one must look for higher quality pictures.

Quality is, of course, subjective and, perhaps it is as well to define what is meant by a high quality picture. It is that quality which has become accepted by established chemical photographers and their clients over many years. It is a flattering exact image of the original. It has no artificial features. Above all—the observer likes it.

It is an easy task for a television receiver in a cosy home to achieve most of this since it must be remembered that with the visual image is coupled a 'situation' complex, verbally stimulated, and imaginatively held. Small picture inaccuracies, as in the cinema, tend to be overlooked. However, for good 'TELEVISION', as distinct from 'VISUAL RADIO', the artificial must be completely removed from the receiver image, and it is in this context that the 4½ in. image orthicon is vastly superior to its elder but smaller brother.

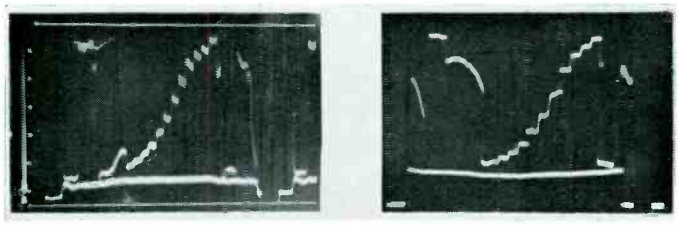
Leaving aside philosophy, the picture making qualities of a television pick-up tube are largely a function of the capacity of its storage target.

By referring to Figure III we see that, to a first approximation the working capacity, CT, of an image orthicon target element, can be said to be represented by

$$C_T = Cm\left(1 + \frac{Cn}{Cm}\right)$$

where Cm and Cn are the capacitances of a picture element to the target mesh and to the neighbouring elements respectively. The formula shows that Cn is of least significance when Cm is large and, more important, when Cm is large relative to Cn. Cn is only operative at the borders of information on the target and is responsible for emphasised edges, the second knee, over modulation, etc., and if these spurious signals are to be minimised then Cn must be small. Since Cn is proportional to L and Cm is proportional to L^2 then Cm/Cn is dependent on L, the linear dimension of a picture element, obviously directly proportional to target size.

Due to its larger capacity target, the 4½ in. image orthicon has a higher signal/noise ratio due to the higher stored charge, a higher true resolution due to the relative unimportance of the transverse capacity, and a much more



3 in. tube $4\frac{1}{2}$ in. tube

Figure 8

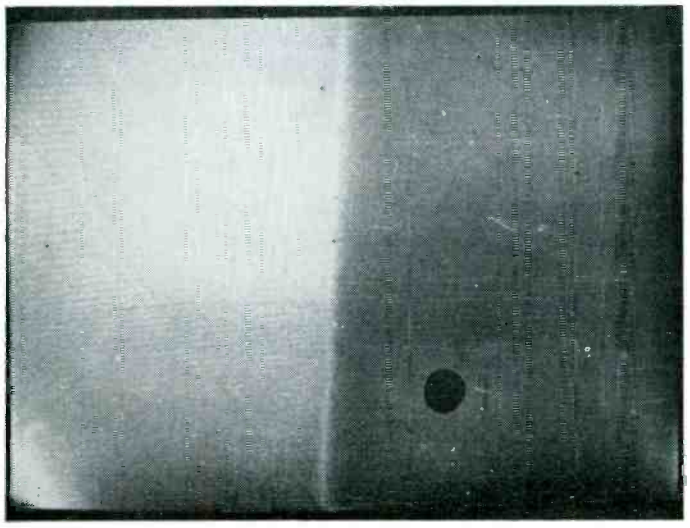
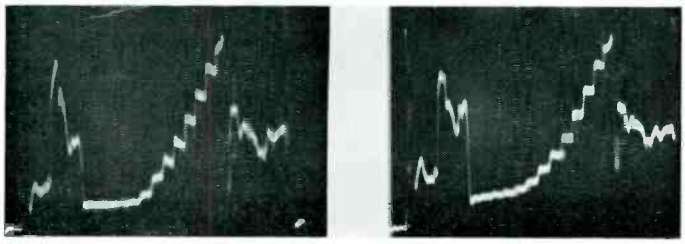


Figure 9



A B

Figure 10

reproducible transfer characteristic. A transfer characteristic is so much dependent upon the effects of redistributed electrons and this, the redistribution of those target secondary electrons which are not collected by the target mesh, is determined only by the charge pattern on the target and the target spacing. The areas affected by spurious signals such as halo, edging, etc., will consequently have smaller relative values in a larger target.

Closely connected with the redistribution effect of target secondary electrons is the question of target voltage and it is convenient to enlarge upon this subject and discuss some recent investigations.

To a first approximation one can apply the conventional electrostatic condenser formula to the target system of an image orthicon, where the elemental target change is equal to the product of the capacitance ascribed to a target picture element, and the voltage applied to the target mesh.

From this relationship it may be seen that as capacitance or voltage increase then charge stored must also increase. Alternatively, the relation indicates that as charge is increased then either capacitance or potential or both must also rise if the relationship is to be preserved.

In pick-up tube practice these relationships can be actually measured by plotting input brightness against signal output. These are proportional to target charge and potential respectively. Figure IV shows a typical set of curves.

It is thus seen both theoretically and practically that, having fixed a target capacitance and operating voltage, one obtains an increasing signal from an increasing light input—up to a certain value—a point commonly called the knee. For brightness above this point no appreciable signal increase is obtained. The onset of this point is seen to be a function of target voltage for a given capacitance. It can be further raised by using a higher capacitance target. It is also clear that increase of target capacitance and voltage enables a higher contrast range of brightnesses to be accommodated before signal saturation occurs.

A high contrast handling ability is considered a distinct asset in a television pick-up tube so the question arises, what prevents tubes of maximum capacity for operating at high target voltages being used? The answer lies in the mechanism of scanning off the signal charge on the target —the reading beam.

As is well known the scanning system in an image orthicon is of the low velocity type, the beam being incident upon the target at substantially zero velocity. Under these conditions the beam is very much influenced by the charge situation at the target.

For high target potentials resulting from either high mesh potentials or high target/mesh capacitance, the beam has insufficient forward energy to avoid being pulled towards high charge areas away from neighbouring areas of lower charge. This results in the familiar ballooning effect seen in Figure V.

High target potentials also encourage any tendency for microphony to develop into unacceptable levels.

On the other hand high target potentials give high signal to noise ratios. This is illustrated in Figure VI.

In dealing with the case of maximum target capacitance one meets a different problem. A fully charged high capacitance target cannot be discharged in one scan by the reading beam due to the latter's inability to supply enough electrons in the permitted time and a carry over of information from one frame to the next occurs. At the lower end of the grey scale high capacity targets give rise to such small potential rises that the scanning beam discharge efficiency is extremely low and again residual information is left for the next scan. Throughout the whole range of brightness, then, a high capacity target leads to incomplete erasure of information and we get picture lag or smearing.

Assuming then that one has the need for, and the ability to fully use a high contrast ratio attendant upon a high target mesh potential and/or high target capacity, it is clear that upper limits are imposed by the considerations of signal read out.

The determination of a minimum value can, in theory, be calculated, but the physical parameters involved are so indeterminate that, once again, an empirical evaluation is more appropriate. Originally the mesh was intended only to collect the secondary electron stream from the storage

Vinten camera mountings, tripods, cranes and pedestals are used in television studios all over the world. This photograph by courtesy of JODX-TV Japan illustrates the Vinten 'Heron' mechanically operated, hydraulic traction Television camera crane at the KTV Studios, Osaka.

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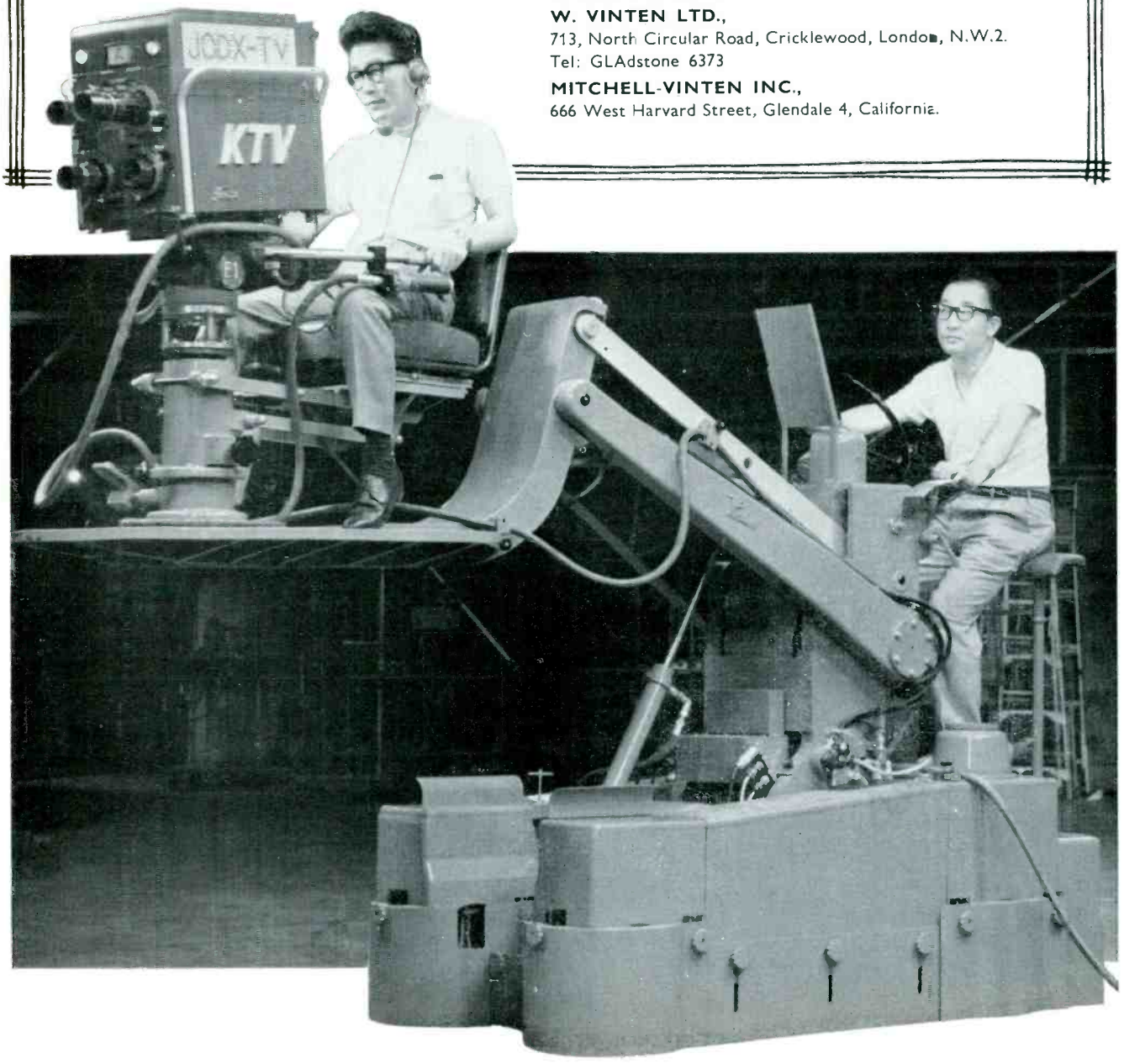


target generated by the incoming photo-electron picture. That it also provided a control for the resultant potential rise was an additional benefit. In order to achieve satisfactory collection of the target secondaries a potential only slightly positive was thought necessary but, in the light of recent work, it is now felt that other factors are involved. Of these, the most important is probably the need to suppress the low velocity electrons generated by the photo-electrons at the mesh. These have the same effect on the target information as the uncollected, or redistributed secondaries generated at the storage target itself, namely the cancellation of wanted information. Edge effect, halo, sawtooth reproduction of grey scales, and general distortion of picture gamma are all a function of signal cancellation by low velocity electrons.

The generation of low velocity secondary electrons is largely dependent upon the nature of the various surfaces upon which the high energy primaries impinge. Tube manufacturing technique is, at present, unable to ensure perfect and constant uniformity and so, no one fixed minimum value can be given for target voltage—each tube needs individual assessment. For 3 in. tube types it has become traditional to use about 2V above cut-off potential but many operators have the practice of adjusting this value to accommodate particular contrast values in scene brightness and to obtain a desired value of picture gamma.

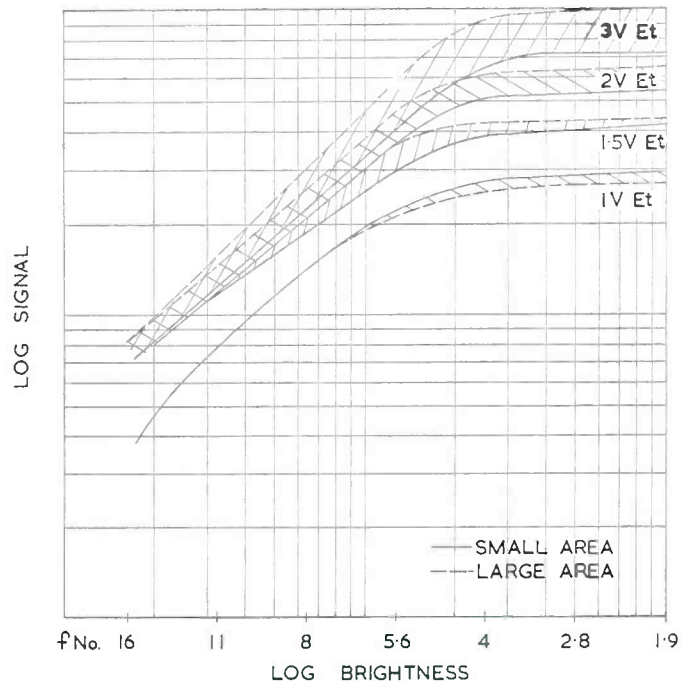
As for the 4½ in. tube, many 'best' formulae for target potential have emerged since much more attention has been given to its setting up procedure. Two types of tube have been examined—the 7295 with its medium spaced target and the 7389 with its close spaced higher capacity target. The former tube is used for lower light levels and, as Neuhauser demonstrated at the NAB Convention of 1962, gives acceptable but 'edgy' pictures with the target at 2V above cut-off when exposed one stop over the knee. The redistribution responsible for the edge emphasis can be reduced by increasing the target potential above 2V. However, higher target potentials lower the 'knee sensitivity' of the tube—Figure VII.

It may also be argued that flexibility of operation derives from well over the knee low target operation, but this, again, is a matter of personal choice.

The higher capacity tube, which has become the standard high quality studio tube, will give faithful pictures from higher contrast scenes with its target at about 3V. One studio is, however, currently employing a set-up procedure which asks for up to 5 volts on the target in order to reduce to an absolute minimum the production of over-emphasised high contrast edges.

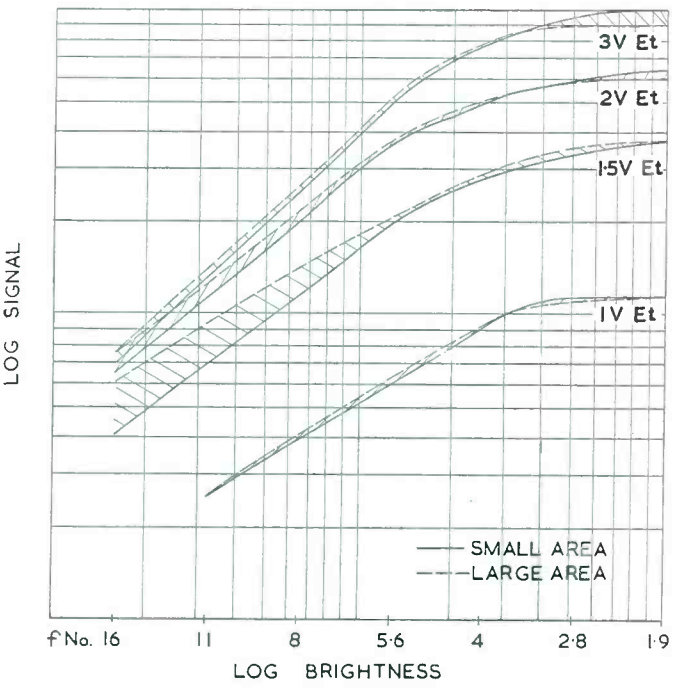
By looking at a grey step wedge an indication as to the effect of varying target capacity and operating potential can be obtained

In Figure VIII a logarithmic step wedge is seen reproduced by a 3 in. tube with a medium capacity target, and by a high capacity 4½ in. tube. It is seen that the sawtooth form of the steps on the 3 in. tube is practically absent from the 4½ in. step waveform. Each tube was exposed according to a particular preferred operating practice to give a required gamma. The 4½ in. tube is seen to produce unequal heights for the equally incremented chips on the test chart. This leads some operators to inject selective amplification at the various signal levels to obtain greater linearity. The low noise level associated with the tube



TRANSFER CHARACTERISTICS 7293 LOW CAPACITY TARGET

Figure 11



TRANSFER CHARACTERISTICS 7389 HIGH CAPACITY TARGET

Fig. 12

ANGENIEUX 10 x 35B Zoom lens for 4½" Image Orthicon TV Cameras: Focal lengths covered 35-350 mm. Aperture f/3.8 T. No. 4.5. Unique minimum focussing distance of 3 ft.

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allows such practices to extend the effective contrast range which it can handle to some 100 to one.

No rigid formulae can be laid down for the attainment of good tonal gradation over this contrast range due to the many variables unfortunately inherent in tube processing. In the main these occur in the electrical characteristics of the various surfaces associated with the charge storage process at the target. It is known for, example, that a variable secondary emission on the photo-cathode side of the target mesh can influence picture level. Figure IX shows the result of using a target mesh with its two halves differently treated on the surface facing the photo-cathode and, consequently receiving the primary photo-electron image.

Low velocity electrons from the mesh will tend to depress adjacent stored charges, while photo-electrons reflected from the mesh will cause charge inflation at points remote from their point of origin. At the present time of writing, incomplete investigations prevent this subject being treated with more detail but it seems to be evident that the signal charge available to the scanning beam is the difference between the charge created by the incident photo-electrons and that cancelled by the low velocity electrons from the target or the target mesh, and which are recollected by the target. For example Figure Xa illustrates a complete loss of signal from the lower greys due to secondary cancellation. Raising the target voltage tends to reduce this black compression, Figure Xb.

It is known also that the area of a piece information affects greatly its position in the grey scale. Two objects of equal brightness but of different area will be reproduced with different signal levels and the difference in level will vary through grey to white but the variation is less with a large target. This effect is seen in Figures XI and XII where, in the 3 in. tube the difference in signal level between large and small areas of equal brightness is much greater than for the $4\frac{1}{2}$ in. tube.

It is felt that redistribution effects are responsible for these anomalies but, as yet, no unshakeable explanation exists. Experiments with additional meshes in the image section may help towards resolving these unknowns.

In considering the basic sensitivity of the $4\frac{1}{2}$ in. tube, compared with the 3 in. tube, the larger target of the $4\frac{1}{2}$ in. tube causes the photo-electron image to be diluted by some three times. Therefore all things being equal a corresponding decrease in sensitivity occurs. However, in practice this is not so because firstly, it happens fortuitously that photo-cathode sensitivities obtainable in the $4\frac{1}{2}$ in. tube are about 15 per cent higher than in the 3 in. tube, and secondly, the photo-cathode voltage is higher. This raises the secondary emission from the target and hence its sensitivity is increased by approximately 50 per cent. Statistically this means that over a wide range the two tubes have equal sensitivities, sensitivity being defined as the input light necessary to reach the knee.

It is interesting to note in passing that image retention is considerably less in a $4\frac{1}{2}$ in. tube operated at the higher photo-cathode potential due to the deeper penetration of the photo-electric primaries into the target. Tube life is extended in consequence. Recent experimental targets have, however, shown that it is possible to delay the onset of sticking almost indefinitely.

Experimental targets have been made which exhibit no change in operating parameters after 2,000 hours of running with the whole of the target fully exposed to the photo-electron stream. Whether this new target material can be made commercially available will depend upon further extended trials.

In summary, then, it may be said that, relative to the 3 in. tube, the $4\frac{1}{2}$ in. tube is capable of giving much better resolution, higher signal-to-noise ratio, and less of those spurious signals arising from electron redistribution. Of the two $4\frac{1}{2}$ in. types available the closer spaced produces more faithful pictures at 3 volts than 2 volts target operation, but if slight edge emphasis is required together with some increase in sensitivity for any particular reason, then the lower capacitance target, working at 2 volts with over the knee exposure is to be recommended.

This paper has, of necessity, been almost entirely empirical in content, due to the extreme difficulty in measuring the minute electron and ion currents present in the image section of the image orthicon. Much of the argument has depended upon the intuitive discussions, and the experience of my immediate colleagues and also of our more distant friends in the television studios throughout the world. It is impossible to name all those who either directly or indirectly helped in the preparation of the paper but particular mention must be made of John Rye, Peter Mouser and Eric Hendry of my own group and of Dr. Beurle, Head of our Research Laboratory and also of Ray Knight of Iris Productions, Teddington, and C. B. B. Wood of BBC Research Department.

I would like to thank also Mr. A. J. Young, Managing Director of English Electric Valve Co., for his permission to read the paper in Montreux and subsequently to have it published.

OBITUARY

W. H. Clarke, OBE

Members of the Cinema, Broadcasting and Film Studios industries will be sorry to learn of the death of Mr. W. H. Clarke, aged sixty-two, a Director of RCA Great Britain Ltd., Sunbury-on-Thames, Middlesex, who died on November 20, 1963, after a short illness.

Mr. Clarke, who joined RCA in 1932, had been continually in charge of the sound recording activities. He was appointed a Director of the Company in 1959, and after the closure of the Recording Studios at Hammersmith in 1962, was transferred to the Sunbury premises where he became head of the Television, Film and Sound Systems Group which included manufacturing, service and sales departments. Mr. Clarke was an expert in all branches of sound systems and during the last war was closely associated with the Crown Film Unit and Special Contracts for the War Office. For his services to the country he was awarded the Order of the British Empire in 1945. The loss of such a well-loved personality will be felt as much within the whole film industry as within his own Company. RCA Great Britain Ltd.

BANISHING DROPOUT

by Kenneth Ullyett, FRSA

EVERY professional television engineer with experience of US networking will tell you there is a general higher standard of broadcasting from video tapes, since so many American stations use dropout compensation.

In October 1963, Associated TeleVision gave many United Kingdom TV engineers the first opportunity of seeing dropout compensation in action, for ATV were using the first experimental compensator produced by the Mincom Division of '3M'—the great international group of Minnesota Mining and Manufacturing Co. The BBC has now had an opportunity of testing the dropout compensation technique, and the London section of Mincom have done UK television a real service in flying over, even for such a brief period of days, the prototype 405- and 625-line version of the compensator.

When I first witnessed the ATV trials of this service, first developed over eighteen months ago by Mincom of "3M" in Los Angeles, there was a natural air of secrecy over the unit, the patent situation no doubt being a little obscure since this was a prototype 'British' version incorporating a number of minor changes to conform to 405-line working.

Now, however, I am able to give a complete picture of the '3M' system, together with basic circuit information. The two '3M' technicians conducting the ATV Foley Street trials gave me most generous and open technical information, and here is a summary of my blunt questions and the official Mincom replies.

In studio slang we talk about 'droppy tapes' when visual flaws show up on a monitor. But most tape surfaces are good, so what do you at '3M' really mean by dropout?

A dropout is a brief reduction of RF carrier amplitude due to irregularities in the tape surface. On the screen the loss appears as a distracting streak. Multiple dropouts appearing in rapid succession can severely degrade the signal display.

As this obviously causes a white 'hole' which spoils one TV line, how can this defect be replaced?

The dropout compensator prevents such effects by replacing the missing information **with stored video from the preceding line.** The reproduced video signal train is continuously stored in the dropout compensator by a delay line having a delay time equal to one scan line.

Does this mean there is complex switching, for good or 'droppy' tapes?

So long as there are no dropouts, the recorder output is the non-delayed video. During a dropout, the delay line supplies the video signal, substituting information from the preceding scan line for the missing information. Because of the similarity between successive scan lines, the viewer will not be aware of the substituted signal.

Then the whole process is automatic, without manual switching?

Yes. The delay circuit supplies the stored video on demand through a fast-acting diode switch. A sensing circuit continuously monitors the reproduced RF, and actuates the switch whenever a dropout occurs. Since the detector is sensitive to loss of RF rather than video, the circuit is not actuated by 'recorded-in' video dropouts. These appear when a duplicate is made from an original tape containing dropouts, unless the compensator was used during the dubbing process to remove them.

Looking at the unit used during the trials at ATV, the whole thing seems to be contained in the one 19 in. by 11 in. box. Is this it—and transistorised, no doubt?

Yes, self-contained and operating from an integral regulated power supply (16 watts, the US version working on 120 volts 60 c/s, the European version available for 50 c/s higher mains voltages), this dropout compensator is completely transistorised, with plug-in printed circuit boards. It is compatible with all colour and monochrome recorders operating under the 525/30 television standard, and the prototype British version applies a similar technique to the different line and field standard.

Before we go into the theory, can you explain the physical operating details?

The compensator corrects for dropouts automatically, with little or no operator attention. After it is installed and set up, it does not require readjustments in normal service. The unit has two basic modes, standby and operate, and two panel light indicators, red and yellow. In Standby, power is applied but the unit is bypassed, and only the red power light is on. In Operate, both lights are on. If input power is lost, neither lamp lights and the compensator is automatically bypassed.

In fact, the yellow lamp is a back-light for the Operate-bypass switch, a double-action button on the front panel. Closing the switch energises the Operate-bypass relay within the unit and causes the lamp to come on, indicating that the compensator is in the Operate mode. Pressing the pushbutton a second time opens the Operate-bypass switch, so de-energising the relay and placing the whole unit in harmony.

Mains power is controlled by a toggle switch inside the case behind the front panel. After initial application of mains, a period of about ninety seconds must elapse before a 4,000-mfd. stabilising capacitor reaches full charge; and, of course, this capacitor remains charged thereafter, in both Standby and Operate conditions.

What other controls are there?

On the detector board is the control labelled DROPOUT SENSITIVITY. This scales sampled RF to amplitude desired for dropout sensitivity range. On the delay line amplifier board is the VIDEO BALANCE control. This matches con-

trasts of delayed video and direct video. The DC BALANCE control on the video switch board matches brightness of direct and delayed video, while there is a VIDEO LEVEL control on the post-amplifier board which scales the amplitude of output video to provide unity gain. There are the power switch and Operate-bypass switch already mentioned, and a conventional voltage control on the regulated power supply.

Now I see you do not have any patent objection to the publication of a simplified signal flow diagram. Can you, from this, outline the theory of the Mincom compensator?

Well, you must understand that the design of the '3M' dropout compensator takes two primary concepts into account. One is that a dropout in the RF signal may be sensed early in the playback process, before the frequency-modulated RF carrier is demodulated. The other is that delayed information in the form of the preceding time-adjacent line of video provides a satisfactory substitute for the lost information, subject to appropriate switching and timing control.

As you can see from the simplified signal flow diagram, the RF signal from the video tape recorder switcher section is continuously monitored by the detector circuit. When a dropout occurs, due to the physical condition of the tape, the RF level drops abruptly. The detector senses this, and generates a control signal for the video switch.

How is the delay line used in this technique?

Video data from the recorder demodulator is routed through the auxiliary delay line and applied to the switch via two channels. One channel is for direct video, the other is for delayed. The delayed data is the preceding time-adjacent line of video, which (in the original US version) has been stored for 63·5 microseconds. The switch, a balanced diode bridge, is preset to provide continuity for the direct video signal.

In the absence of a dropout control signal, it provides straight-through routing for video, but if the detector senses a dropout in the monitored RF, it signals the video switch accordingly. The switch then selects the delayed video for routing back to the recorder.

Video intelligence and the switch timing are controlled so precisely that the substitution is not normally perceptible on the monitor screen.

Now what about time displacement errors, and special facilities on some video recorders?

The switch gate permits the dropout compensator to be used with video recorder accessory equipment which corrects for time displacement errors. The switch gate locks the video switch out with a gating pulse for the appropriate portion of such scan line. The functional tie-in requirement where this sort of auxiliary equipment is installed, is shown as the 'front porch switch out' signal from the recorder process amplifier.

This, then, explains why more than one delay line is used?

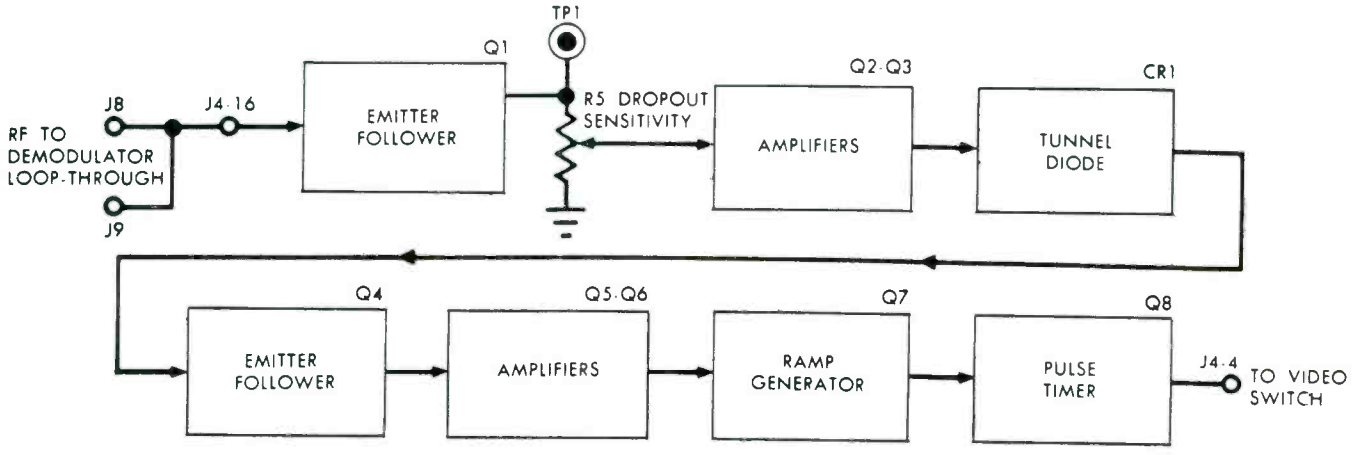
Yes, the auxiliary delay line you see in the signal flow diagram compensates for transit time variations within recorder discriminations. Such variations may be due to differences between models, or field modifications. This auxiliary delay line returns the input video by one microsecond **immediately before the dropout occurs.** Of course, if time displacement error correction equipment is installed this delay line is not used.

By the way, the bypass circuit can be actuated manually or automatically. Manual operation is by a pushbutton switch, and automatic control (or, of course, manual from a remote position) may be obtained by applying a 24 volt signal to the Operate-bypass relay circuit.

Well, it is not difficult to see how the delay line works, but the matter of dropout detection is still rather confusing. Is it possible for us to see even a block diagram of the detector circuit, and to know how it works?

Yes, as we have explained, the detector circuit monitors the RF signal and generates an output pulse whenever a dropout occurs. The RF is routed directly from the recorder switcher to the demodulator via RF loop-through connector J8-J9.

The input signal is coupled via the capacitor C1 to the emitter-follower Q1. Dropout sensitivity potentiometer R5 scales the RF signal train applied to the amplifiers Q2-Q3 and the tunnel diode CR1. This tunnel diode is connected between the signal path and earth. The diode is ideally suited for level detection because of its negative resistance and bi-stable state characteristics. For RF voltage levels greater than a certain point on the diode response curve



Block diagram of the detector circuit in the dropout compensator. This detects changes in RF level, and supplies a pulse

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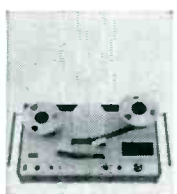

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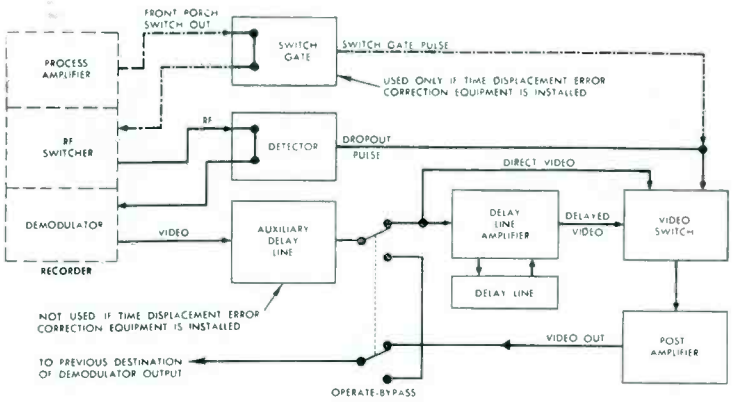

Signal flow diagram of the 3-M Mincom Dropout Compensator. A full description of the various plug-in transistor boards is given in the accompanying text

(that is, *i* plotted against *Vf*) the diode is a high resistance, while for levels below this it is a high current conductor and shunts the signal to earth.

As long as the input level exceeds the firint threshold, the diode provides a constant output regardless of fluctuations. The diode's fast response results in a series of pulses at the RF rate, except when a dropout occurs. The potentiometer R5 regulates the amplitude of the input RF, which in turn determines the voltage level which the diode will sense as a dropout.

The output of CR1 is applied via the isolation stage Q4 and the cascade amplifiers Q5-Q6 to the base of the ramp generator Q7. As long as the pulse train is continuous, the output of the Q7 collector is a low-amplitude saw-tooth, of the frequency of the RF input. When a dropout occurs, the signal train is interrupted and the saw-tooth rises to the value of the positive charge across a capacitor C18. The voltage remains at this value until the RF signal train reappears, at which time Q7 resumes operation as a ramp generator. For the duration of the dropout, the output of Q7 is a high-amplitude flat-top signal which is applied to the base of the pulse-timer Q8.

Charge circuits in the pulse timer extend the signal for about five microseconds after the dropout ends, to assure overlap of the substituted video. The signal appears at the collector of Q8 as a negative pulse and is routed out via a connector.

Is it difficult to set up the unit?

No. From the foregoing it is evident that the contrast and brightness of the delayed or replacement video, and the threshold level for the RF sensing circuit, may be regulated under *dynamic* conditions by variable controls in the compensator itself. These operating conditions and levels regulated are within the compensator exclusively and do not have any effect on the operation of the video recorder.

For example, so far as contrast levels are concerned, the procedure for adjusting contrast consists of fixing the overall gain of unity for the direct video, and then using this value as the amplitude reference for the delayed video. The basic adjustment in this case can be determined by measuring a voltage originating in the recorder. The adjustment is readily accomplished by matching the amplitudes of two traces on the oscilloscope. Accuracy can be increased if there is a low-pass filter connected to the 'scope.

No doubt brightness matching is important, if dropouts are to be fully concealed? How is this done?

As a matter of fact the procedure for matching the brightness of the delayed and direct video under dynamic conditions requires not only a video signal but also a means of switching the diode bridge gates. The brightness balance is a function of the video switch DC balance, and the most convenient source for both inputs is the video recorder itself.

Since tape dropouts are transient as well as random, it is helpful to use a contrived signal which stimulates the dropout, and over which some timing control can be exercised, and the signal obtained by intentional misadjustment of the recorder head switching function has these desirable characteristics.

Synchronous dropouts resulting from this condition are, of course, artificial; however, they have the merit of being controllable, and they represent a more extreme dropout situation than is ever encountered off actual tapes. Also, this way you can use the monitor itself as a sort of 'read-out' for qualitative comparisons which are suitable for brightness matching. Reference is made in the DC balancing procedure to a band covering about one-third of the raster, at the right-hand edge. Although the width of this band is not critical, experience at Mincom seems to show that a wider band can result in an abnormal duty cycle for the video switch, and hence an incorrect setting of the DC balance control. Under normal operating conditions the video switch is biased to pass the direct video.

Dropouts occur ordinarily as transients of a very brief duration, perhaps of the order of a few microseconds. Switching of the diode bridge under typical dropout conditions calls for a relatively light duty cycle, with little or no effect on the average DC level of the diode gates. If the bridge is caused to work on a heavy duty cycle, the average DC level may shift.

Now what about sensitivity setting? A casual review of the whole Mincom technique used in the compensator seems to make this rather a tricky business . . .?

Well, as it happens, establishing a suitable RF sensitivity level presents few problems in practice, although it is true the theoretical considerations seem somewhat involved.

What problems there are relate primarily to noise, either in the tape or in the recorder system. The solutions depend upon a knowledge of the general quality of recording tapes that will normally be used, and exercise of judgment acquired from operating experience. The ideal sensitivity setting is one which compensates for ALL dropouts, large or small, **up to the point where the quality of the replacements video causes an apparent change in the overall picture.**

To the detector circuit, a dropout is simply and solely a reduction in RF. If high sensitivity is desired, the detector threshold is set to a point where a relatively small reduction in the RF level will actuate the compensator. At this setting, any RF signal which falls below the amplitude of the actuating level will result in a video replacement. On the other hand, if the threshold is set for low detection levels, the compensator will be actuated by deep dropouts, but will be insensitive to lesser ones.

If the tape has an inconsistent RF signal level, or if there is noise in the tape or heads, it is better to operate at lower sensitivity.

JANUARY 1963 TO
DECEMBER 1963

INDEX to International TV Technical Review

UNITED STATES PATENTS

Number	Assignee (Inventor)	Title [and brief additional details for clarification]	Date Patented
3,091,659	*Motorola Inc., Chicago, Ill. (A. W. Massman)*	Television Receiver with Transistorised Video Amplifier.	28 May 1963
3,091,660	*Radio Corporation of America, Delaware (W. D. Houghton & R. E. Morey)*	Television Magnetic Tape Reproducing System. [For use directly with a standard television receiver]	28 May 1963
3,091,661	*Constantin Alimanestiano, 2615E 74th Street, Chicago, Ill.*	Entertainment System. [Incorporating a closed circuit television and adapted for use aboard passenger aircraft]	28 May 1963
3,093,704	*Compagnie Française de Télévision, Paris, France (Henri G. de France)*	Colour Television Camera Systems. [Making use of one tube responsive to several elementary colours and of two or more tubes responsive to one elementary colour]	11 June 1963
3,093,705	*General Electric Co., New York (William E. Glenn)*	Projecting System. [Colour and monochrome especially in television]	11 June 1963
3,093,706	*Electronic Measurement Systems Inc., Newbury Park, Calif. (Walter J. Karplus)*	Television System. [For transmitting television signals over power lines without distortion]	11 June 1963
3,095,472	*Ampex Corporation, Redwood City, Calif. (Ray M. Dolby, Louis J. Kabell, H. E. Murphy & H. L. Walsh)*	Video Recording System and Method.	25 June 1963
3,095,473	*Ampex Corporation, Redwood City, Calif. (Joseph Roizen)*	Editing System for Electronic Recordings. [Television programme material]	25 June 1963
3,095,474	*North American Philips Co. Inc., New York, NY (Gerhard Förster)*	Television Receiver with Contrast Control and AGC-controlled Video Amplifier.	25 June 1963
3,095,475	*Technicolor Corporation of America, Maine (David George Brake)*	Smoothing Spatially Discontinuous Images.	25 June 1963
3,096,394	*Crosfield Electronics Ltd., Gt. Britain (Gordon S. J. Allen, David H. Mawby and Donald C. Gresham)*	Flying Spot Scanner Colour Printer with Colour Correction. [Primarily for printing but utilising an electro-optical scanner]	2 July 1963
3,096,395	*EMI Ltd., Hayes, England (Eric John Gargini)*	Velocity Modulated Colour Television Receivers.	2 July 1963
3,096,396	*Paramount Pictures Corp., New York, NY (Emil E. Sanford)*	Colour Television Reception with Polyphase Grid Switching.	2 July 1963
3,096,397	*General Electric Co., New York (Frank R. Stachowiak and Norman Szeremy)*	Audio Muting Circuit. [For a television receiver]	2 July 1963
3,096,398	*National Research Development Corporation, London, England (Dennis Gabor and Peter C. J. Hill)*	Picture Communication Systems. [In which less picture information is transmitted than is normal and to supplement this information at a receiving or relay station with data formed by interpolation between parts of the transmitted information]	2 July 1963
3,096,399	*Radio Corporation of America, Delaware (Lucius P. Thomas)*	Television Receiver Circuits. [For automatically controlling the contrast and brightness of an image reproduced on a cathode ray tube in accordance with the level of light near the viewing surface of the receiver]	2 July 1963
3,097,260	*EMI Ltd., Hayes, England (Ivanhoe John P. James)*	Correction of Transmission Variations in Television Standards Converting System.	9 July 1963
3,097,262	*Uniscan Electronics Corp., New York (Franz F. Ehrenhaft)*	Anamorphotic Television System. [Improved aspect ratio]	9 July 1963
3,097,263	*Lintern Corporation, Painesville, Ohio (James W. Lintern)*	Refrigerated Protective Enclosure for Television Cameras.	9 July 1963

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Number	Assignee (Inventor)	Title [and brief additional details for clarification]	Date Patented
3,097,267	*Ampex Corporation, Redwood City, Calif. (Harold V. Clark, Joseph Roizen and John F. Varnell)*	Tape Recording and/or Reproducing System and Method. [For recording monochrome or colour television signals]	9 July 1963
3,098,118	*Paul Raibourn, Southport, Conn.*	Post-deflection Tube with XYZXZY Sequence. [For colour television with a novel arrangement and disposition of the fluorescent strips on the screen]	16 July 1963
3,098,119	*Jerome H. Lemelson, 43a Garfield Apts., Metuchen, NJ*	Information Storage System. [Using a number of video scanners]	16 July 1963
3,098,120	*General Electric Co., New York (Max H. Diehl)*	Vidicon Camera Input Stage. [Preamplifier circuit]	16 July 1963
3,098,170	*Radio Corporation of America, Delaware (Roland N. Rhodes)*	Power Supply Circuit for Television Receivers.	16 July 1963
3,098,171	*General Electric Company, New York (Robert B. Ashley)*	Transistor Vertical Deflection Circuit. [For television receivers]	16 July 1963
3,098,212	*Philco Corporation, Philadelphia, Pa. (Edgar M. Cuamer)*	Remote Control System with Pulse Duration Responsive Means. [Suitable for television systems]	16 July 1963
3,098,942	*Zenith Radio Corp., Delaware (Sol L. Reiches)*	Magnetic Centering Device for Cathode Ray Tubes.	23 July 1963
3,098,943	*Zenith Radio Corp., Chicago (Sol L. Reiches)*	Cathode Ray Permanent Magnet Beam Positioner. [For a television cathode ray tube]	23 July 1963
3,099,707	*General Electric Company, New York (Robert B. Dome)*	Stereophonic System. [Especially adapted for use in television]	30 July 1963
3,099,708	*Ampex Corporation, Redwood City, Calif. (Stewart L. Smith)*	Magnetic Tape Reproducing System. [Wideband systems using a number of reproducing heads in a sequential fashion]	30 July 1963

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