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A Survey of the Control of Stage Lighting

By J. T. WOOD

Progress prior to 1939

As we know, theatrical performances have existed for many centuries, and in all countries commenced in the open air, relying on daylight to enable the audiences to see the actors. No doubt with the decrease in time available for leisure and also in certain countries due to the vagaries of the weather, the performances had to take place at night and indoors so it became necessary to use artificial light to replace daylight and in the early times the use of this light was merely functional in that it was used to provide light on the acting area.

At first also little scenery was employed, the actual atmosphere being indicated by the text and costume. Later when scenery as we know it today was added, this was painted in very great detail to give the effect required and the great spectacles which filled the theatres tended to be mechanical. Several examples still exist of this machinery, of which the Royal Theatre in Drottningholm, Sweden, has an outstanding equipment which enabled the scenery to be changed in view of the audience by means of an elaborate system of ropes, levers and pulleys. The actual scenery still exists and the clouds, waves, etc., were beautifully painted in perspective and, although the movement imparted to them was rather stilted, the marvels of the mechanical systems must have been as much heralded as the modern systems of projection etc. are today and the system of floating clouds and rolling waves as important a feature of the old theatres as are the electrical effects and flying machines for the Rhinemaidens in the modern Opera Houses. Equally the thunder machines, a sort of wooden skittle alley, down which cannon balls were rolled, to fall finally with a resounding crash into a reinforced receptacle, have long since given way to the tape recorder and loudspeaker.

Although the Drottningholm Theatre used oil for its lighting, it is interesting to note that thought had been given to the conrol of lighting and arrangements provided to swing the wing lighting off stage, thus providing a dimming effect when required.

The oil lighting in due course gave way to gas and although we find apologies for smell and heat in some of the early playbills of the Opera House, Covent Garden, this new illuminant allowed much more dramatic use to be made of light and complete central control was obtained of the lighting. Equally arrangements were provided for "plugging in" side floods in much the same way as we would plug in a flood today. It is also interesting to note that the firm of Clémançon in Paris, who are responsible for installations in L'Opéra, the Comédie Francaise and most French theatres, had started in business making Gas boards and that the French word for switchboard. "jeu d'orgue," derives from the organ-like construction of these gas controls.

The first fully electric installation recorded in England was made by Mr. Siemens, who was then in England, in the Savoy Theatre in 1881 for Richard D'Oyley Carte. This was replaced in the 20's by a more modern installation which is at the moment being renewed. We have no record of the details of this installation, but we know that the early installations consisted of footlights and battens and the high-lighting was obtained by arc lights replacing the old lime lights, Sir Herbert Tree's production of *Drake* using forty of these.

The first dimmer was, of course, the liquid dimmer and although the last complete installation of liquid dimmer pots was removed in London last year, there are still many examples to be found in operation in Italy and elsewhere. One of the first important installations of this type in London was that at the London Coliseum which

was installed in 1904, but Siemens had constructed a multicontact resistance dimmer with a fairly good load ratio, which was installed in the London Opera House (later known as the Stoll Theatre in Kingsway) and many continental theatres. These wire dimmers, of course, did not give such good load variation as the pot dimmer, which by judicious adjustment of the quantity of salt could be made to handle almost any required load and can be best compared with the variac of today. Both the liquid and Siemens resistance were drawn from a central control by means of tracker wire suitably counterweighted and this method is still employed in its many variations to this day.

In England and America after the 1914/18 war the liquid dimmer with its tracker wire control was replaced by the dead front panel control using multicontact resistance dimmers and combining all switching and fusing in one unit. This naturally led to rather large controls and the pure mechanics of moving a quantity of these resistances by hand limited the number as also did the space available on stage. These limitations did not apply to such an extent on the continent as the mechanical inertia of the system was overcome by the counterweight and so very compact control boards could be constructed. In England development was rather obstructed by the retention of D.C. in many theatres and although between the wars A.C. was available, in the larger cities, especially those with tramways, there was a reluctance on the part of the supply companies to shed the D.C. load of the theatres, particularly in view of the amount of money they would have to pay out for replacement of specialised equipment.

On the continent, however, the Bordoni transformer made its appearance in 1929 and was adopted by Siemens, whilst a rival patented by Ing. Salerni of the Rome Opera was eagerly adopted by A.E.G.. Both types enabled one or more brushes to be moved along the winding of a transformer and the form of construction enabled a direct replacement to be provided for the older type resistance units.

In consequence the mechanical side of these controls was developed to a high degree of perfection and the later models had in effect a full scene preset. Each control lever possessed a three-position locking knob which either freed the lever from the master shaft or caused the lever to move downwards by means of a clockwise or upwards by anticlockwise turn. Each lever was provided with adjustable trips for each direction and by setting these limits and the knobs as required, one operation of the shafts all the levers moved to the desired position. The size of these controls was also reasonable as the levers could be accommodated at $1\frac{3}{4}$" spacings with 14" between the rows.

Parallel with these developments considerable progress was made in the production of tungsten projector lamps and, whereas in the days of Tree forty or fifty circuits might well have covered the control of the footlights, battens and floodlighting equipment, the forty arc lamps were being replaced by tungsten lamps all requiring dimmers. In consequence the need for more and more control circuits became apparent.

In England and America theatres rarely belong to those who present the plays and so the tendency in these countries was for the control equipment to be of a portable nature, but in the continental theatres the size of the controls increased, one hundred or more circuits being commonplace, whereas in America and England the number of theatres so equiped could be counted on the fingers of one hand.

The equipment manufacturers, however, were aware of the needs and two methods of approach were used to enable this object to be achieved by the provision of controls for over one hundred circuits which could be operated by one man. In 1934 the specification for the Royal Opera House, Covent Garden, called for one hundred and thirty-four circuits and apart from the consideration of space, the size of the existing manual controls made their use impracticable. The existing multicontact dimmers were unsuitable for tracker wire operation and this form of control had always been unpopular due to maintenance troubles if the cable run was at all complicated, and in this case an existing building did not help. The invention by Mansell of the electro-magnetic clutch provided the solution and the dimmer bank was placed in a remote position, but

the shafts were driven by hand by means of a fast and slow capstan wheel mounted on the perch platform.

The coupling and uncoupling of the individual dimmers by means of the clutches was accomplished by means of a two-way and off switch, above which was mounted a voltmeter giving a reading showing the position of the dimmer. This installation is still in full working order, and, although due for replacement, is in use nightly.

From this the Light Console (Bentham 1935) was a logical conclusion and this design which harnessed the electric organ console to the control of lighting was a unique step forward in the search for a means of controlling large numbers of circuits from a small console. The hand driven shafts of the Covent Garden system were easily replaced by motor driven shafts and the coupling of each circuit to the action was effected by the "stopkeys," which possessed the advantage of group control from the normal keyboard preset piston, permitting prearranged groups to be brought into operation at will.

The keyboard or "notes" became the operational centre of the control and by pressing the appropriate key the groups of dimmers could be raised, lowered, turned on or blacked out with ease. Moreover, the duplication of many of the general controls for foot operation freed the hands for setting up future arrangements. The drawback to the system was the fact that it was designed for direct operation by a lighting specialist and did not cater for the repetition of exact dimmer settings, as required today. For music hall, ice show, revue and large spectacles, however, it is still without rival and many large installations, such as Drury Lane with two hundred and sixteen circuits, bear witness to its efficiency.

Whilst this progress was made in England, the Americans were pursuing another line of thought with the introduction of the all-electric remote controlled dimmer system at the Radio City Music Hall in 1933. The use of a saturable reactor for control current had been well established, but the heavy saturating current required had prohibited its use for stage purposes although a simple reactor system had been installed in the Metropolitan Opera House, New York. The advent of the thyraton provided the means of controlling the saturating current from small potentiometers and led to the design of a control board by the General Electric Co. of America in conjunction with Kliegl Bros. which was installed at the Radio City Music Hall. Similar installations were supplied to the City Center and through the B.T.H. Company to the Odeon, formerly the Alhambra in London. These installations are of great importance as they provide the first examples of the all-electric multi-preset board. That at Radio City has five full presets enabling five cues to be preset and the lighting to be changed from one preset to another at any desired speed. These five presets are in addition to a master or rehearsal board which enables the lighting to be set up in the usual manner. This installation, which was for three hundred and fourteen circuits consisted of a large reactor room in which the dimmers were housed together with the fuses and main switches, and a control desk situated behind the conductor in the auditorium. The operator faced the stage and the five preset panels were at his back. As many know, the Music Hall is open for some fifteen hours a day, giving five performances on the stage lasting approximately one hour each. A new show is presented monthly and has to be rehearsed and lit during the night. In consequence it is quite usual to find that these monthly shows are planned to use six major lighting changes to suit the limitations of the board. The installation suffers from the main defects of the saturable reactor in that a considerable time lag occurs between the action taken at the control desk and the resulting operation of the lighting.

From the foregoing, it is clear that by 1939 there was already a definite trend in the development of preset and remote control of stage lighting, dividing into two clear-cut paths the all-electric system of America and the electro-mechanical system, either by clutch or tracker wire, of Europe.

Post War Development

At this point we must again consider the lighting technique which was changing rapidly and which was to have a marked effect on the future. In Germany, where

the large theatre, fully mechanised, was the order of the day, running expense has never been a problem and in consequence, although many lighting units were designed for cyclorama effects, the spotlighting had remained under the control of individual operators from bridges, galleries or front of house positions, which resulted in the need for fewer sources of light. In England and America, where wages were either too low to attract suitable labour or too high to be economical, the trend was towards the use of a large number of spots controlled from the board. The necessity for touring also helped this trend in that the lighting could be positioned on arrival and large numbers of technical personnel would not be necessary during the performance. In consequence, at the end of the war the demand was definitely existing for control boards with a larger number of circuits than ever before and the space required became another problem.

As always during wartime, many developments were hastened by the unlimited money available for research and so at the end there were many new tools available for the theatre.

The first change of importance came from Sweden, where the simple reactor was investigated and due to the availability of high quality steels an efficient magnetic amplifier was produced, which consisted of two stages with feedback and required only small currents for its control. Moreover a load variation of 30 to 1 was obtained and with more recent models 50 to 1 or more. The first installation of some thirty circuits was installed at the studio theatre in Malmo and in 1950 the National Theatre in Oslo was completed with over one hundred circuits, followed by the Folkteatret in the same city with one hundred and eighty circuits.

At the same time George Izenour at Yale University and the author in England were working on the idea of dropping the reactor used in the Radio City installation and operating the lighting directly by means of thyratons. The Izenour method used two tubes back to back, producing single phase A.C. and the first installation was at Yale University where he was working, and consisted of forty-four circuits with ten full presets. The author's system used a simple three phase rectifier system producing D.C. which had the advantage of spreading the load evenly over the phases at all times and was provided as standard with one scene preset. The first fully operational installation was at Reykjavik in early 1950, followed closely by those at the Old Vic, Stratford-upon-Avon and many others.

As these two systems are examples of important principles in the construction of remote controls, it is worth emphasizing the essential differences in layout, as this affects the whole consideration of the subject.

The Izenour system consists of two essential components, a rehearsal desk, which is in effect a normal stage board in miniature, and a preset panel containing ten small levers for each circuit on the rehearsal panel, four hundred and forty for a forty-four circuit board etc. The rehearsal desk has a master crossover fader with switching facilities to permit any one preset to be faded to any other. It should be noted that the term "fade" is used here as in sound technique and denotes the blending of one setting into another and not the passing through a blackout position.

The method of operation is to find the necessary light settings on the rehearsal board and then transfer these to one of the presets. Thus for each cue one preset is required and it is assumed that by providing ten it would be possible to reset if necessary in order to maintain continuity.

The author regarded the problem in another way. From observation of the operation of large manual boards it became clear that at times the facilities were not sufficient and so the object of the design was twofold, first to reduce the size of the desk so that one person could reach the number of dimmer levers with ease, and secondly to add to the facilities already existing by providing a second fully operational panel with a cross fader: thus the simpler cues could be carried out normally and, when necessary, the other panel be brought into use, as opposed to the preset to preset arrangement of Izenour.

Both systems have the inherent disadvantage that when cross-fading from one preset to another all those circuits which are

to remain in the same position have to be set to the same position on every preset. Parallel with these developments, Mr. Bentham, who had in his light console retained the important feature of the old mechanical boards which enabled dimmers to be unlocked while retaining their status quo, introduced full dimmer presetting to the mechanical system. An extremely sensitive polarised relay enabled the clutches to be de-energised when the dimmer reached the position preset on the desk, so that full dimmer presetting was now possible using the well-tried resistance or transformer dimmer (1955).

Up till this period the German theatres had been re-equipped with the prewar systems already described, but the two large manufacturers were not idle and, as was to be expected, one (A.E.G.) produced a two tube Thyratron control and the other a magnetic amplifier, both with very interesting developments at the desk. It must be clear to all that, providing the design is adequate, there is no operational difference between the magnetic amplifier and the thyratron dimmer. In both of these solutions multipresets were added. The former system provided two desks as in the author's design, but in addition each dimmer unit, which was removable; contained a neat arrangement of six mechanical presets operated by cams. Two of these were arranged to give full-up and zero, the remainer being available for presetting to any desired positions. In order to record the settings found at rehearsal it was only necessary to turn all the levers back to zero by means of a master wheel. The cam, however, only moved as far as the lever, so that on reversing the process the lever was returned to its original position. In operation, cue 1 was operated on the left-hand board and this was faded into cue 2 on the right. The blackout preset control then brought all levers on panel 1 to zero and preset 1 brought them back to the settings recorded. This board gave the same possibilities as the Izenour system from two sets of levers (two hundred in the case of a one hundred way control, instead of one thousand with the Izenour system).

The other system was developed as an exact replica of the original Bordoni type control, but with a miniature control desk having four or more motor-driven shafts, the adjustable limits and all the facilities of the old type. Instead, however, of the reversing gear used on the large system, use was made of magnetic clutches to attach the individual dimmers to the shaft. Under pressure of the competition of the eight preset system, an additional preset panel was introduced, incorporating the appropriate number of channels, each of which had a cleverly designed potentiometer unit with four concentric levers: these could be preset one at a time to the desired positions. In operation any preset could be coupled via polarised relays to the main panel, when the operational levers could be driven to their new positions by means of the motorized shafts. The system was operationally similar to the Bentham polarized relay system, except that there was no form of memory for the channel selection and therefore the locking and unlocking of groups of dimmers at random from two hundred to three hundred was not so easily accomplished and, as the clutches etc., were situated at the desk, this became larger.

Summary of equipment available today

At the beginning of 1959 there were available three main types of dimmers and two main types of control desks and we should now summarise the position.

Dimmers (1) Resistance and/or Transformers

These can be called old and trusted friends. The resistance is often much maligned as wasteful, but the following points should always be considered:—

(a) At the full-on and at the full-off positions the standing losses are nil.

(b) At the worst position the watts dissipated in the dimmers only amount to 37%.

(c) By using special winding techniques dimmers may be wound to cater for loads varying by plus or minus one-third, and thus are satisfactory for the majority of theatre uses.

Auto transformers are well known and, although there is always a small loss, are extremely efficient. The price, however, is high compared with the resistance.

(2) Direct Thyratron Dimmers

These are load independent and in either version have given good service. They lend themselves well to remote control circuitry but have given rise to difficulties due to ventilation problems, as the mercury thyratrons did not operate at the temperatures quoted by the makers: these have now been improved and can be called satisfactory provided adequate measures are taken to ensure even operational temperature.

The three tube version gives more kilowatts for a given tube size and a better phase balance, but has the drawback that the output is direct current. The two tube version gives sinusoidal output, but has a more complicated control system: both systems are prone to interfere with audio and video circuits in the building.

(3) Saturable Reactors and Magnetic Amplifiers

(a) The simple saturable reactor can best be compared with the resistance, as in the simple form it is not independent of the load. It does, however, permit small control desks to be constructed, but there is a drop of between 10 and 15 volts across the reactor in the full-on position, which may require compensation.

(b) The magnetic amplifier or transductor is load independent over a wide range, requires a small operating current and thus lends itself to preset control. It is, however, expensive and has a volt drop of between 30 and 50 volts, according to type, which necessitates compensation. Both these volt drops are those applying to the 220/250v range.

The magnetic amplifier had the advantage over the thyratron in that it was not subject to the same troubles due to ventilation, although some ventilation was necessary, but the prime cost was very high, due to the special grain orientated steels required to keep the size and weight to reasonable limits.

Types of Control Desk

These can be divided into two very distinct groups, the all-electric and the electro-mechanical.

1. The all-electric desk is distinguished by the fact that one desk is always completely occupied in maintaining the lighting in its present position. In consequence, in order to perform ten cues it is necessary to have ten presets: this, in turn, demands either a large amount of room or small components, which are difficult to adjust accurately.
2. The electro-mechanical desks are those which cause the dimmer to move when required, but the desk supply can then be interrupted and the desk rearranged without upsetting the existing lighting. It should be noted that of the two German systems, the A.E.G. falls into the first category and the Siemens into the second, as, although the dimmer is all-electric, there is an electro-mechanical link between the preset panels and the main or rehearsal desk.

The advantage of the electro-mechanical system is that when it is combined with group selection, as in the Bentham system, it is possible to work several cues without invoking a full change to another preset. As no dimmers move, unless they are coupled, if the change is small but awkward it is easily preset as only a few dimmers have to be changed. These can be altered on the same panel and will move when the coupler keys are operated. Hand control would probably be impossible due to the wide spacing of the levers concerned.

Future Progress

During 1959, however, two major develments have occurred which may well cause a revolution in future design. In America the S.C.R. dimmer has been introduced with success. The Silicon Controlled Rectifier is, in simple language, a solid state thyratron or large capacity transistor, and basically the dimmer can best be described as similar to the two tube thyratron dimmer. It has, however, very great advantages in that the weight is negligible compared with others, the voltage drop is of the order of 2, and the rectifier itself is so small that it has been described as "a cadmium plated bolt head." Unfortunately, at the moment the inverse voltage rating is the main difficulty

and although rectifiers are available now in the 120v working range at a reasonable price, the 230v working types are difficult to obtain and costly. The American units available at the moment are constructed as a sealed plug-in unit and can be obtained in two sizes to control loads from 6 watts up to 4kw and 10kw respectively. From the point of view of the theatre, they can be considered as an all-electric dimmer replacing the thyratron or the magnetic amplifier. Prototypes of the 230v version have been constructed both in England and Germany, but, until the rectifiers are available at a competitive price, development is at a standstill.

The second development was the production in England by Leggett of a fully automatic system to be used in conjunction with the standard electro-mechanical transformer dimmer bank. Due to the large number of circuits being installed in single installations and also to difficulties occurring in the Television studios, where time for recording lighting plots is at a premium, a requirement had arisen for a means of automatic recording and reproducing of lighting plots.

A demonstration was given to television lighting engineers of such a board in March, 1959, the system working with standard Hollerith punching and reading machines. The system was always under the control of the operator, but when once a scene was set, the cue number, dimmer settings, switch positions and motor speeds could be recorded on the card.

When the card was placed in the reading machine, the settings were restored to the control desk, at the touch of a button, but, of course, the lighting did not change until the move was started by the operator. This meant that, if necessary, last minute changes could be made to the settings if the unexpected happened on the stage.

This automatic recording of plots did not evoke the enthusiasm expected, chiefly due to the drawback of the system, which did not permit the producer to stop and go back frequently, as is so often required at rehearsals. Great interest has, however, been shown in the large Opera Houses, where the repertory system requires a recording device.

There was an interesting by-product of this experiment, which may well be considered in the future. The designer, considering the possibility of two hundred to three hundred circuits, was of the opinion that the desk would be too large for easy operation. Moreover, in order to fit in with the punch system, the standard lever was replaced by a series of internally illuminated push buttons, like an adding machine. He argued that, instead of the operator turning to reach the two hundred levers, it would be better if the levers turned to suit the operator. Accordingly the desk was constructed with ten sets of pushes, representing ten levers, and extra pushes engraved 1-10, 11-20, etc. The difference in size between a desk for one hundred and a desk for two hundred circuits would then be only the space necessary for ten pushes.

This novel idea may still prove to be the interesting result of this experiment and provide the solution to the space problem in large installations, which is already becoming difficult.

Finally, the experience gained in working with the S.C.R. and Punch card system, has resulted in the development of a transistorised preamplifier for the simple reactor incorporating a certain amount of feedback. This permits preset operation whilst providing a load ratio of at least 4 to 1. Moreover, as one amplifier can operate two reactors in parallel, it is possible to improve this by using a 500 watt reactor in parallel, thus giving a range of nearly 20 to 1, which is more than adequate for theatrical purposes.

In conclusion, the author would like to thank the Joint Managing Directors of The Strand Electric and Engineering Co. Ltd., for affording the opportunity for the reading of this paper. In addition, he would like to thank those Theatre Managements and Engineers who have given him the opportunity of examining and operating the majority of the systems described.

THE PRESIDENT: Thank you very much, Mr. Wood.

We have had the pleasure of listening to a very interesting paper and I am sure there are a number of delegates who would like to ask some questions.

I shall start off with one or two; I notice that in all the slides you have shown us, the use of footlights appears to have been abandoned. I would like to hear your remarks on this aspect. And also your reference to battens, in that they seem to be used specifically for lighting backdrops.

Have these two particular items of lighting on stage been completely replaced by the small spotlights?

Mr. J. T. WOOD (London): Mr. President, the question of footlights is a very thorny one which comes up on every occasion. The answer is that in most theatres (with the exception of perhaps the opera houses) they are not using them. Whether or not they are provided is rather a question of finance, and another thing to be borne in mind is that if you have a footlight you have three circuits, three dimmers, which can very often ill be spared.

I feel that they need not be provided any more, and if they are provided they should at least be made portable so that they could also be used as backlighting, alternatively with the front position. The reason also against their use is that they can provide very awkward shadows, all of which means that you have to increase the top lighting in order to remove the shadows from the footnights, and the problem then becomes complicated in that the power demand goes up.

Any theatre or large hall which is expecting to receive ballet companies, in particular, should be provided with a full set of battens, because they have to use very often classical scenery of borders and wings, and of course every time you have a border and a wing you have to have a batten behind it. You can see by looking at this stage here that you have a large number of curtains going backwards, and behind each curtain you must have a batten because of the shadows thrown by the borders.

Now it is very much open to criticism as to whether, if those two black borders have been omitted, that is to say the second and the third, and their associated battens, whether any effect would have been lost. The argument is, "Well of course, the people in the front row will then see the ceiling," but does that really matter when you consider the cost of providing the borders and the battens in order that they shan't see the ceiling. And that is why, in the smaller halls, fewer and fewer people are installing them.

The reason that you have four battens here is because of the stage layout demanding those drapes.

THE PRESIDENT: Thank you Mr. Wood. Any further questions?

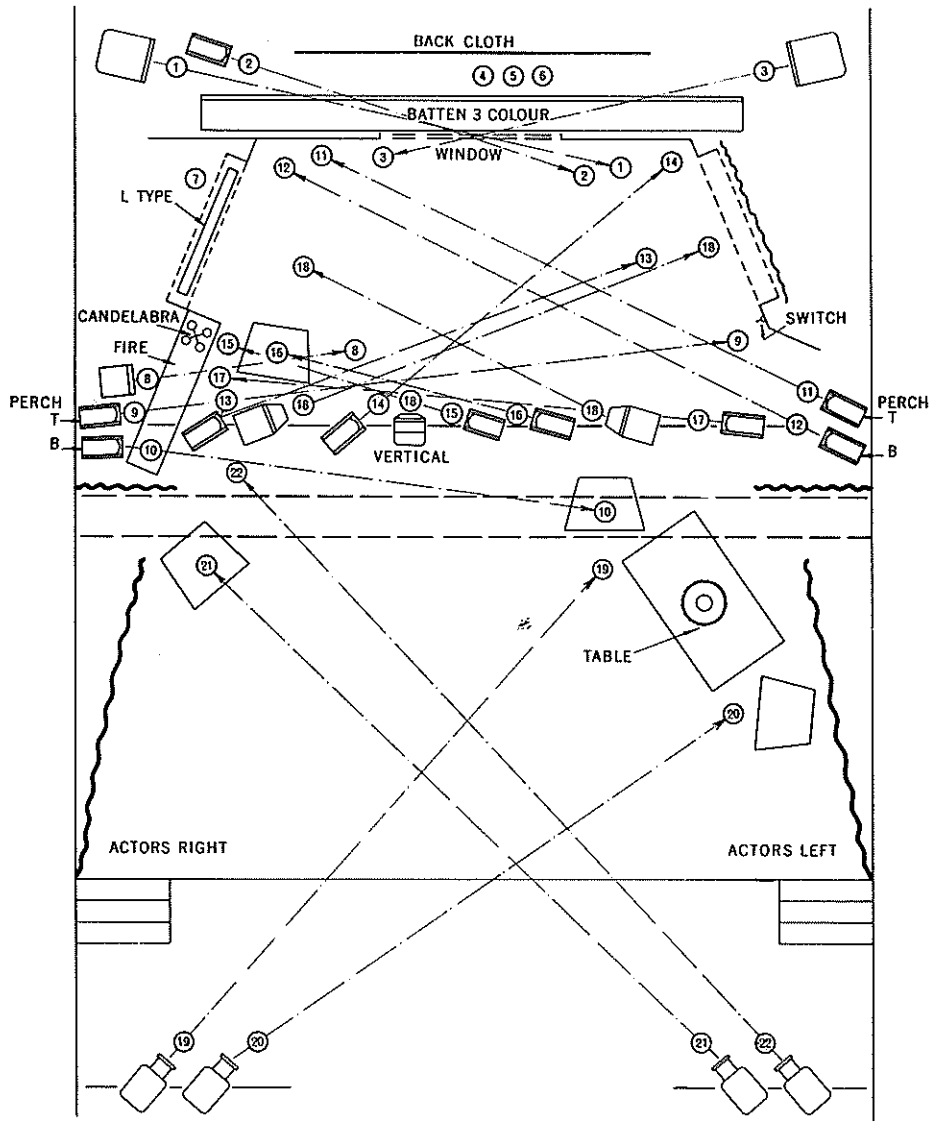
Mr. VAN DER WALT (Krugersdorp): Mr. President, to Mr. Wood, through you: I think most of us are confronted with the problem of having an old stage which must meet with modern requirements, and one big problem is the front of house spots.

You have given an idea, and shown the type of spot that can be mounted on a bracket on the side of the wall: could you indicate to us the maximum distance that you could put those spots from your stage?

Mr. WOOD: The first question which must come here is not that of maximum distance, but an angle to the stage, because taking this hall as an example, if you were to put your front of house spots either immediately under the first balcony or the second balcony (which would be a place for concealment), the angle would be such that they would be unusable because of the shadows that you would get.

You can see, sitting here as you are, that you are looking straight at the first circle, and so light coming from there will throw a large shadow on the back of the stage, and the angling of these spot lights is the first consideration, and the rough and ready guide is that the spot should form an angle of 300 with the stage; that is the angle between the horizontal and the stage should be thirty degrees.

Having ascertained that you'll find that you're very limited as to where you can put



Ref.	POSITION	PATTERN	COLOUR
1	Up Stage Right Sun Act 2	143	Double 52
2	,, ,, Right Sunset	123	35
3	,, ,, Left Sun Act 1	143	53
3	,, ,, ,, Moon Act 2 Sc. 1	143	40
4	,, ,, Batten	"S" Type	17
5	,, ,, ,,	,,	18
6	,, ,, ,,	,,	32
7	Centre Right Archway Act 1	"L" Type	17 & 31
7	,, ,, ,, Act 2	,,	52 & 31
8	Fire Flood	237	34 & 31
9	Down Stage Right Perch Top	45	52 & 31
10	,, ,, Bottom (not used)	,,	52 & 31

Ref.	POSITION	PATTERN	COLOUR
11	Down Stage Left Perch Top	45	52 & 31
12	,, ,, ,, ,, Bottom	,,	40 & 31
13	No. 1 Bar Spot	45	52 & 31
14	,, ,, ,,	,,	52 & 31
15	,, ,, ,,	,,	52 & 31
16	,, ,, ,,	,,	52 & 31
17	,, ,, ,,	,,	52 & 31
18	,, ,, Floods	237	17 & 31
19	F.O.H. Spots	23	52 Diff. Glass
20	,, ,,	,,	52 Diff. Glass
21	,, ,,	,,	52 Diff. Glass
22	,, ,,	,,	52 Diff. Glass

them. Assuming that the distance then is of the order of 20 or 30 feet, the unit zone would be satisfactory. I did not however, have a slide available, and perhaps I should have mentioned it, that as with a camera you can fit telephoto lenses and wide angle lenses, so that particuar spot can be fitted with varying lenses, so that if it is to get the right angle you have to go further away, you come back with the same effect by using a narrow angle lens. Moreover the increase in distance is compensated for by the extra power obtained from the narrow angle lens, which happens to be a 6" diameter instead of a 3½" in this particular case and so increases the light output and gives you the same effect, so that we can say that . . . I have seen these 500 watt spots with the narrow angle used quite comfortably up to distances of 45 feet.

If it is necessary to go further, there is 1,000 watt which, though larger, comes back to the same effect.

Mr. PRESIDENT: Thank you, Mr. Wood. Are there any further questions?

Clr. D. DIVARIS (Salisbury): Mr. President, we from Salisbury are very interested in this particular talk which Mr. Woods has given us in view of the fact that we are now in the process of building an auditorium to seat approximately 800 people, and right at this moment we are discussing the sort of equipment which Mr. Wood has told us about.

I would like to ask three questions, if I may. The first one is: where should the equipment be sited? And by that I mean the control panels, or console, as you call it. The second one is, if it is far from the stage, does it cause any difficulty? And the third one is if you have an auditorium such as we are going to have, seating approximately 800, it would appear that we would have to get quite an elaborate type of console, and if we got this particular type of console, would we have to employ a skilled operator? Could he be trained, and would he of necessity be a full-time person, or could we just train our Mr. Mitchell here to do the job after hours? (Laughter).

MR. J. T. WOOD (London): In the first place I am afraid that Clr. Divaris is not aware of the fact that, during the last week, I have been discussing some of these problems with people in Salisbury which I visited on the way here for that specific purpose, but the answer to his question is of course of interest to everybody.

The question of the position of the control panel is one which I believe is exercising other gentlemen here as well as himself. It is a very difficult question indeed, and I can only give you my personal views on the subject, and in this case I would like you to remember that, as I told you, showing you the Stratford-on-Avon control desk, I was the designer and originator of that control desk and that position. In that particular house it is absolutely ideal, the reason being that in that theatre they have a repertory of plays which we could say they manufacture under their own roof, and which are designed about the facilities which they have.

Now, after Stratford, we installed four electronic controls, one in Manchester, one in Edinburgh, one in Glasgow and one in Blackpool. Those four theatres comprise what are known in England as No. 1 Touring Dates and the companies go from one to the other, arriving very often on a Monday morning, and at the earliest on a Sunday evening. They have from the time of arrival until 7.30 on the Monday night in which to prepare everything and open with the opening performance.

I have talked with a large number of people, to stage directors who are the people in charge in these places, and asked them what their comments were. Blackpool was the only theatre where the control board was put in the auditorium. It was actually put in what had been the old cinema operating box, and although the engineer in Blackpool had demanded this position because he wished his electrician to be unmolested and clear of the stage, the users of the equipment, in the form of a travelling company, said in every case where I made enquiries that they did not like this system, because when they arrived at the theatre with 12 hours to put on a performance, they like the electrician to be in contact, actual contact with the stage director.

We know full well that talk back facilities can be easily provided but they are not very satisfactory in moments of stress, particularly where the stage is concerned, where a loud speaking telephone cannot be tolerated, from the noise angle, and there is no doubt that the stage management like to be able to talk to the operator and say, "In a few moments we're going to do this, or this will be the next cue," and get a personal contact.

On the other hand, as in the case of Stratford and the Old Vic, and as you saw, in Mannheim Theatre, Germany, the front of house position has been chosen and is working extremely satisfactorily.

I think, therefore, that you must discuss with the proposed users of your hall and get a certain concensus of opinion, but if it is to be travelling companies coming in at the last moment, my advice would be not to site the apparatus remote from the stage.

There are other devices. If the questioner would visit the Reps Theatre in Salisbury, they have put the control desk there on the stage. They have a little side room off the stage from which there is a door into the front of the stage, which could have been admirably used for the purpose and which would give the operator a better view than he would possess on the stage, but would allow that amount of contact. As I understand the use of your hall is for a multipurpose, the front of house position, I feel is perhaps not altogether wise.

As far as the distance is concerned, the amount of distance which can be tolerated nowadays is really unimportant. I have myself seen controls used 8 or 900 yards away from the lighting, so that that should present no problem whatever. The cables involved are not expensive, and that should not cause any embarrassment.

The third question, regarding the type of labour required, I think that any manufacturer of equipment would be unwilling to supply apparatus which was unsuitable for the location. My own employers would not consider supplying an apparatus which they did not think could be maintained and operated by the personnel on site.

The operation of I think 90 circuits, can be quite simply accomplished and I don't think you need have any fears about that.

THE PRESIDENT: Thank you Mr. Wood. Are there any other contributors?

Mr. J. W. KANE (Johannesburg): Mr. Wood, I am rather disappointed that you were not a little bit more forthright, and said that Jimmy Mitchell could never be taught to operate anything of this nature!

Mr. Wood, one rather peculiar question I think, I believe it is the common practice on the Continent, where you have multiplicity of circuits, as I should imagine you have, on these control panels, to use the frame as a neutral. It is I think common practice in America. Can you tell me whether that is the trend in Britain nowadays?

Mr. J. T. WOOD (London): I'm afraid we are not allowed to use the frame as neutral. In fact we ourselves always provide an insulated neutral. In some countries, I think it's Finland, we have to provide facilities for earthing the neutral at the frame, but I didn't know that it was permitted anywhere else. I'm rather surprised to hear you say that it is.

Mr. R. W. KANE (Johannesburg): I am only assuming it is rather common on the Continent. Our Planetarium in Johannesburg has arrived in South Africa without any neutrals at all except the frame.

Mr. J. T. WOOD (London): I have never heard of that. I know the Germans have just constructed a big control for Cologne and there we had to keep them isolated. I believe that something funny goes on in Sweden. I'm not too certain about Sweden.

Switzerland is definitely very, very fussy and in fact we got into trouble there the other day because we supplied a board which had yellow wire in it and one of these internal connections, and they made us paint it green because they said it wasn't neutral. But in most countries, we did an installation in Poland, and there very definitely they were isolated, and that is all I can tell you about it.

Mr. R. W. KANE (Johannesburg): Thank you. It rather looks as if what is good enough in a country is totally different from what it sells to anybody else!

THE PRESIDENT: Gentlemen, we had better curtail the general discussion as time is getting on; I would now like to call on Mr. J. C. Downey to propose a vote of thanks to Mr. Wood for his paper.

Mr. J. C. DOWNEY (Springs): Mr. President, Mr. Wood, gentlemen: I should like to thank Mr. Wood for his interesting paper on the control of stage lighting. Good stage lighting planning is a job for a specialist, and it is indeed a rare occasion to have a specialist such as Mr. Wood presenting a paper to the A.M.E.U. on stage lighting, but the paper as published is a little disappointing, and does not answer the general problems with which the average municipal electrical engineer is faced in South Africa, and for this I would like to level a little criticism at at persons responsible for advising the author on the details of his subject matter. Much valuable and useful information that could have been included in his presentation has therefore been omitted, which would have been most valuable to all of us.

It is a pity I did not meet Mr. Wood at the last C.I.E. Convention in Brussels, as I would have surely placed these points before him.

The author has made a passing remark on the use of gas for stage lighting, and some information from one which actually worked at the Drury Lane Theatre, when gas was the only means of providing the lighting of the stage. I was informed that the heat caused by the multitude of gas jets was teriffic, especially up in the flies; and apart from the fire hazard, the incidents behind the stage were many. In one case an apparent explosion by a faulty gas line caused the persons working in the flies to vacate the theatre at the double, but on reaching the street they found that nobody had followed, then they returned to find that the act was proceeding quite normally.

Many amusing and embarrassing situations do arise backstage in amateur theatre, and the one operating the lighting effects is called upon to do all sorts of jobs as well. In dealing with a bomb scene, a blank cartridge from a gun was fired into an empty barrel to give the effects of a muffled explosion. The barrel provided by the local merchants was originally one which had contained oxide of lead. The operator emerged from the sound effects looking like a Red Indian as he was covered in red oxide.

In a town hall built a few years ago the control board was placed in such a position that it required three persons to operate the lighting, one which took the actors' cues, another to transfer the cues, and another for operating the board. No blackout switch had been provided, and when this was required the over enthusiasm of the operator pushed the levers over at such a rate that arms jumped the stops and caused a flashover, tripping the main circuit breaker supplying the town hall. Fortunately a flash of lightning outside from the storm at the time gave the audience the impression that the lightning had caused a blackout and had delayed the proceedings.

You will be interested to know that two of the operators are two of the municipal electrical engineers in this hall at the present moment, and should therefore be regarded as dangerous operators!

This shows what happens when the basic design and planning are not carried out by persons with the required experience in stage lighting. The bulkiness of control equipment has been a real problem in the past, and has always presented the problem in selecting the correct position so that the operator can see what is happening on the stage.

The new control methods described by the author are not only interesting, but fascinating, as the bulk of the control box is not only reduced but can be operated simply by one person.

In the new Civic Theatre recently completed in Springs the control box which is no larger than a small accordion is placed in the projection room, which enables the operator to have a full view of the stage, and in addition he is in full knowledge of what is happening from the stage by means of a small loudspeaker.

I understand that a new idea is to place the lighting effects operator in front of the stage, with a remote control box in the position where the conductor of the orchestra stands. This, I understand, would enable him to watch and see the full effects of his work, and to hear at the same time.

The author's views on this would be most welcome.

Theatre lighting is receiving more attention everyday, now that Civic Theatres are being erected in many centres. The smaller towns, must of necessity, use their town halls, not only for public functions such as bazaars, dances, bioscope shows, but also for school concerts and theatrical shows as well. It is the lighting of these stages that present a real problem to the local engineers, as money is usually extremely limited. It would, I am sure, be a great assistance if the author could explain the basic principles of stage lighting in a written reply.

We are indebted to the author for his enlightenment on the developments of stage lighting control equipment, which is obviously a job for a specialist in large theatres.

Mr. President and gentlemen, I have much pleasure in proposing a hearty vote of thanks to the author for his most interesting and informative paper. (Applause)

THE PRESIDENT: Thank you Mr. Downey.

I now ask Councillor Main of Johannesburg to second the vote of thanks.

Clr. R. H. MAIN (Johannesburg): Mr. President, gentlemen: I too would like to add a word of congratulation to Mr. Wood for the extremely interesting paper that he has presented here this afternoon; I think it was extremely well illustrated, and it certainly contains a tremendous amount of information on the question of how to handle and control the "lumin" required on a proscenium in modern days.

I have only one grouse at the type of questions being asked. We are all inclined to think of our little tupenny-hapenny stages that are being erected all over the Union of South Africa, and I think it is right and appropriate to acknowledge the fact here in our country of South Africa at this stage, that I think Mr. Wood's paper has been very timeous indeed.

I may be a little prejudiced in this matter, but right now Johannesburg is concerning itself, I may say, not at the request of the public, but in fact following on the demand of the public, particularly theatrical societies, who, in fact, have almost given an ultimatum to the City Council of Johannesburg, to provide them with an adequate theatre.

Mr. Wood, I can assure you that this presented us with very many problems, and I am sure that our technical staff too, were very pleased to know that the City Council of Johannesburg went to the trouble of in fact sending our consulting architect overseas to study these things, the design of prosendiums, the design of cycloramas, the study of illumination—although of course, I have my doubts as an engineer about the efficiency of an architect when it comes to matters of illumination. But that is by the way, Mr. President!

I think that this afternoon we have been treated to a very fine paper indeed, on the very many things that deserve the attention of design engineers when it comes to stage illumination, and I can assure you that in the Union of South Africa there is a definite upward trend in the demand for theatres, not only for opera, but the ordinary live theatre. We saw a performance last night, Mr. President. I had nothing to complain about the illumination—I thought it was very well done! But one has to bear in mind that, when you are dealing with human beings, whether in live theatre or anywhere else, you have the people who forget when they have really had their time, and in fact live in the theatrical world on borrowed time.

I mention this because one often has the occasion where you have the grand old lady with her knobbly knees, who still insists on appearing on the stage, and still thinks that she is the great lady of the day, and if anybody happens to comment about those knobbly knees she immediately turns round and blames the illumination engineer for having focussed attention on them!

Now that is just a little example of the tremendous importance that can in fact be attached to this question of illumination.

As an engineer, too, I was particularly interested in this silicone control rectifier, and the dimming arrangement, particularly as I think, in due course (I think Mr. Wood indicated it would be 1962), we would have a price. I do think that it will enable very many of the smaller local authorities, particularly in this country, to in fact invest in not only decently designed prosceniums but also adequate and proper illumination.

Mr. President, I do not wish to protract the seconding of my vote of thanks. I am sure that many others would still like to put a few questions to Mr. Wood, and it indeed gives me very much pleasure in seconding the vote of thanks to Mr. Wood for the very excellent paper he has delivered here this afternoon.

THE PRESIDENT: Thank you Clr. Main, for your very interesting and pleasant seconding of the vote of thanks.

I will ask Mr. Wood if there are any particular comments he would like to make in reply before we thank him formally.

Mr. J. T. WOOD (London): I must thank you very much for having allowed me this opportunity to appear today. I will try and deal with the proposer's request for some information on the general use of stage lighting. As far as the silicone control rectifier is concerned, I said we would get a price in 1962, but I'm afraid I musn't give Johannesburg too much encouragement in that respect. We shall just have to wait and see. Thank you very much.

THE PRESIDENT: Thank you, Mr. Wood, before asking the Convention to accord you the usual vote of thanks, I must endeavour to press you to change the form of your written paper to us today, in order to bring it more in line with what you have told us about. The paper that you actually gave us followed by the discussion which has taken place, should prove to be a very valuable paper, and of great assistance to many engineers in South Africa.

With those few words, I will thank you once again for a very interesting paper, and also thank you very much indeed for travelling such a long distance to read it to us.

Will you please accord Mr. Wood a vote of thanks in the usual manner. (Applause).

CONVENTION ADJOURNED AT 4.30 p.m.

ON RESUMING AT 8.15 p.m.

MEMBER'S FORUM

THE PRESIDENT: Good evening, ladies and gentlemen. Thank you very much for turning out this evening to this Forum. I'm sure you won't regret it. If Jimmy Mitchell is up to his usual form, I'm sure he'll keep this session running very nicely with little difficulty, and I don't think anybody will go to sleep either!

I think we will proceed with the Engineer's Forum. We have a very heavy programme to get through. I don't know how far we will take it tonight, but I'm sure he will do his best to get it through, and I'm not going to waste any time by talking, but will hand you over to our Quizmaster, Jimmy Mitchell, and wish you the best of luck. (Applause).

Mr. J. MITCHELL (Salisbury): Mr. President, ladies and gentlemen: Good evening, I hope you will forgive the opulence, but my friend Alec bought me this cigar just to give tone to the proceedings!

We have a big programme tonight, and you must not expect too much. If I may I'll sit down for this.

As I say you musn't expect too much because, like the story I heard about the Yorkshireman. Like all politicians, he promised them the earth, then off he went to Westminster and they didn't see him for about 18 months. Anyhow, he decided to come back and talk to them and tell them all what had happened, and then he said "Any questions?" and one Yorkshire farmer got up and said, "Ay! When we put 'ee in for Member of Parliament, tha told tha's goin' to do all sorts of things for us and nowt's happened yet." So the member thought he'd keep to agricultural language and he said, "Well, you farmers know you can't have things quickly. For instance, you buy a new bull and put it in with the cows, you don't expect to see