

1947.

A Guide to the

Pamphonic

*Unit Construction System
for Sound Equipment*

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As the aim of this booklet is to cover the major problems associated with public address installations, a number of first principles have been stated which may be familiar to the reader.

This is unavoidable in presenting a complete picture and essential if the outstanding flexibility of Pamphonic equipment is to be fully appreciated.

SOUND *Pamphonic* EQUIPMENT

Sound equipment is a term used to cover all apparatus employed for the diffusion of sound over an area.

In general a sound equipment installation would be comprised of the following main items.

***1. Sound source** which can be one or more of the following:

- (a) Microphone
- (b) Gramophone pick-up
- (c) Radio receiver
- (d) Tone source for alarm or other signal.

***2. Amplifier**

***3. Wiring** between amplifier and loudspeakers, between microphone and amplifier and for mains supply

***4. Loudspeakers**

5. Switching, local and remote

6. Monitoring

The starred items are indispensable while the non-starred items may or may not be required on a particular installation.

Before going into details, a general outline of a typical installation may provide a helpful introduction to the subject.

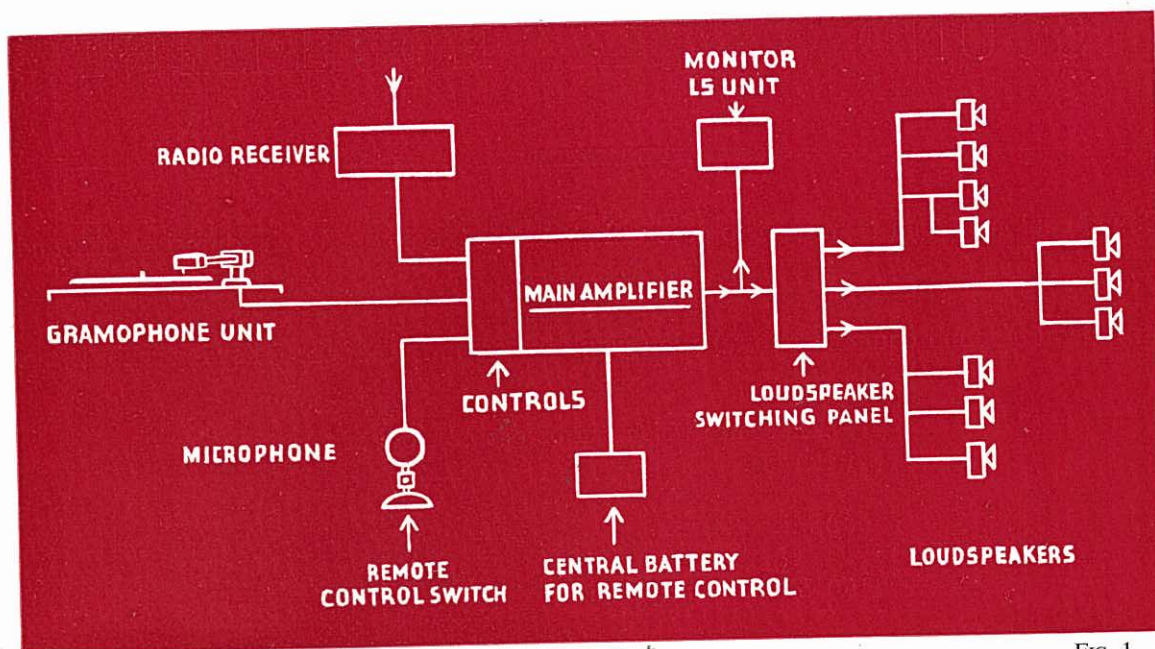


FIG. 1

Fig. 1 is a diagram showing how the more important of these items are interconnected in a particular sound system. Such a system would generally be accommodated as follows.

In a convenient location would be installed the amplifier, gramophone turntable and pick-up, and the radio receiver. These would be mounted on a vertical steel rack (as fig. 2.)

The microphone would probably be remote from this apparatus and in most cases a remote switching device would be required to allow the announcer to switch on at will.

Loudspeakers at chosen points in the area to be covered would be connected by wiring to the apparatus depicted in fig. 2, and the latter would require an electric supply.

This gives a very rough idea of a sound equipment set-up and it is the object of this booklet to give as much guidance as possible on the procedure to be adopted for assessing what is required where, and how the multitudinous requirements of different situations can be met from a relatively small number of basic units of apparatus.

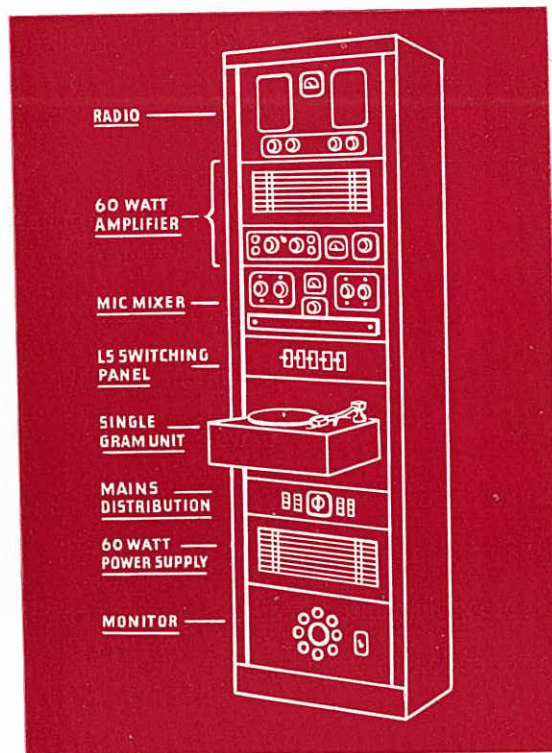


FIG. 2

EQUIPMENT FLEXIBILITY

The need for equipment flexibility is best illustrated by taking a few examples of the sound equipment needed for different applications.

Example 1

A Factory management decides to introduce 'Music while you Work'. The equipment is also required to provide a call system, and a future extension of the factory would have to be catered for at a later date.

Such requirements would be met by providing a central amplifier and record player mounted on a rack with space for an additional amplifier to cover the needs of the future factory extension. Loudspeakers at suitable locations throughout the factory would be wired back to the central amplifier. A microphone at the factory telephone board would also be wired back to the amplifier.

The telephone operator would be provided with an on/off microphone switch which would automatically, via a relay switching unit on the rack, give her priority over any musical programme being broadcast.

Example 2

A Stadium requires equipment to provide music from gramophone records, announcements via three microphones, remote switching from all microphone positions and radio for club-rooms.

Assuming the stadium has covered stands and holds between 6,000 and 10,000 people, a medium-power amplifier of about 120 watts would be needed.

Loudspeakers would be suspended under the stand roofs, fixed to the walls of restaurants and club-rooms and would be wired back to a loudspeaker selection panel on the main amplifier rack. The three microphones would probably be widely separated and arrangements would be needed to give them priority over any music being broadcast. In other words if a record is being played and an announcement is to be made, then a switch on a microphone must automatic-

ally switch off the music and give the announcer the right of way. Furthermore, it may be required to give one of the microphones priority over the other microphones as well as over the music.

Radio may be required in the club-rooms on some occasions, in which case it would be desirable to provide for the switching off of all the main stadium loudspeakers.

Example 3

A Theatre requires soloist and stage reinforcement microphones with loudspeakers in the auditorium and gramophone facilities for music and 'noises-off'. Here the sound sources are microphone and gramophone pick-up. The sound picked up by the former is to be diffused in the auditorium whilst the gramophone music may have to be reproduced either in the auditorium, orchestra pit or on the stage. This requirement demands output switching to selected loudspeaker banks. The footlight microphones for general stage reinforcement may require individual volume control as will certainly be the case for the soloist microphone. The main amplifier equipment for this application would normally be situated on the stage in one of the wings where the operator could observe the performance.

The types of loudspeakers employed would differ from those used in an open-air stadium, and again a different type would be needed in the orchestra pit from that used for general sound reinforcement in the auditorium.

These three examples illustrate the diverse requirements to be met. Individually engineered installations and apparatus involving fresh designs for each project is an expensive method of achieving the desired result, and does not lend itself to easy assessment or quick delivery.

UNIT CONSTRUCTION

The Pamphonic system overcomes these difficulties and makes selection of apparatus for a given job a relatively simple and straightforward task.



FIG. 3

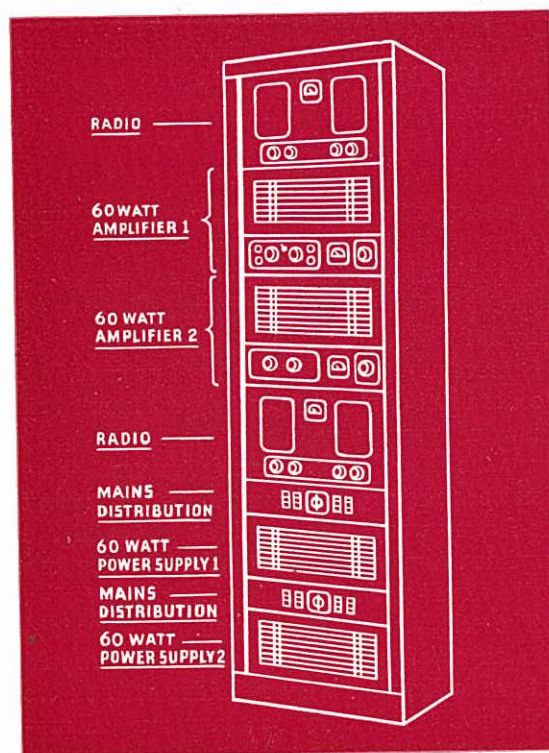


FIG. 4

The system is based on the building-brick concept. A number of different specialised bricks are available for assembly into a wide variety of structures. The possible structures, however, far outnumber the number of basic bricks. The basic bricks or units have been designed after sixteen years of sound-equipment experience, and are such as to give a range of combinations that will meet practically every sound system specification.

Referring back to the list of main items that go to make up a sound system, it will be seen that each numbered item represents a distinct class of equipment. Each class can be subdivided into a variety of types, and again each type may be further subdivided into sub-types and forms.

To illustrate this, reference should be made to the table inside the back cover. The table is

essentially a 'tree' proceeding from the general in the first column to the particular in the right-hand columns. It will be seen that the table is also a tabloid catalogue, which, together with the price list, gives practically all the information required for estimating purposes.

SELECTING UNITS FOR A PROPOSED INSTALLATION

Before attempting to select units from the table for a proposed sound system, it is necessary to know the function that the system is expected to perform, the approximate area to be covered by loudspeakers, how much of this area is in the open air, and how much is indoors. In addition some idea will be needed of the general noise level in the various loudspeaker locations. Assuming that one has acquired this general picture, a

detailed survey is carried out to decide on the optimum location of each loudspeaker, the appropriate type of loudspeaker and its power. The total number of loudspeakers is then ascertained and also the total number of watts required to feed them. The latter figure will permit the selection of an amplifier with an appropriate power-output to meet the immediate requirements. If extensions to the installation are envisaged at a later date this will have to be taken into consideration as well.

Next comes the selection of suitable input apparatus (sound sources) such as pick-ups, microphones, alarm signals and radio, &c. The particular selection will determine the precise amplifier form required. Each main amplifier is made in four forms. These differ only in the detailed arrangement of the first amplifying

stage and the form chosen must be appropriate to the particular selection of sound source or sources.

Finally, switching and monitoring apparatus must be selected, the former to provide the switching of microphones, loudspeakers, high tension supply, &c., and the latter to give an aural or visual check on the performance of the system.

Having decided upon all the units required, one is in a position to assess from column five of the table the number of rack frames to mount them. Two sizes of rack frame are available, having seventy-two and forty inches of panel space respectively. It is, therefore, a simple matter to judge the number and size of racks required. There will, however, be border-line cases where the total panel space required approaches

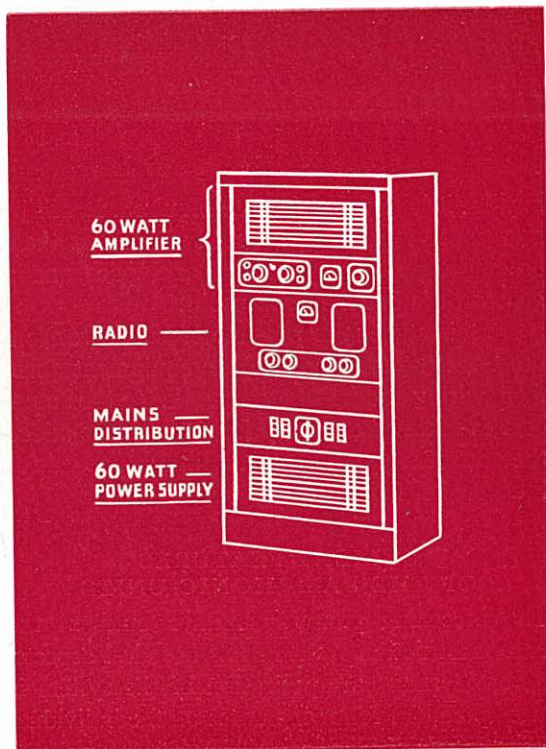


FIG. 5



FIG. 6

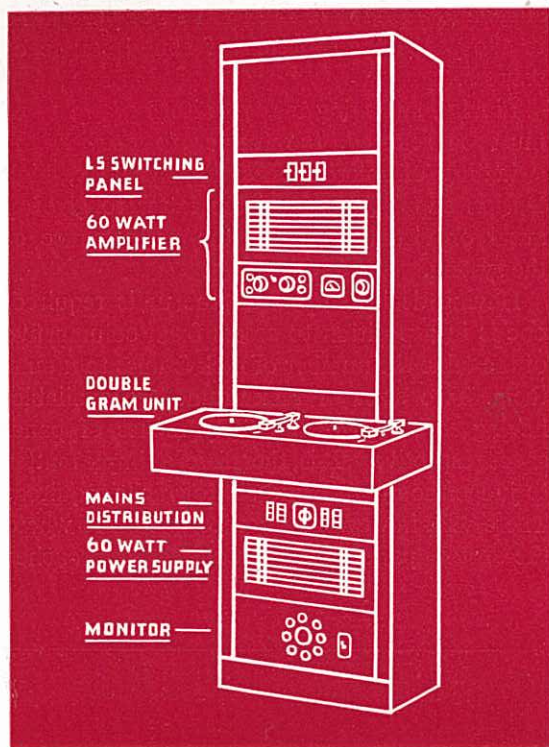


FIG. 7

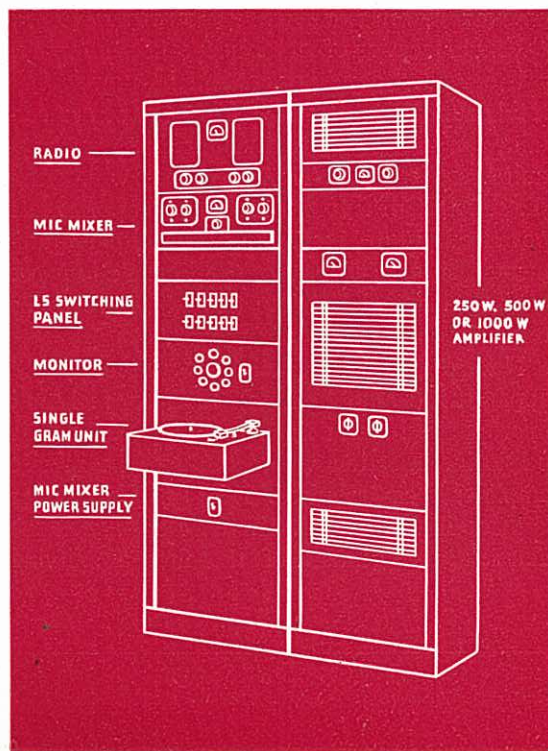


FIG. 8

either forty or seventy-two inches. If in such cases all the apparatus were to be mounted on one rack, some of the controls might be too low for convenient operation or in an inaccessible position under a gramophone turntable unit. When this is the case with a large rack, two racks should be used. In the case of the small rack, it can either be raised from the floor or again the apparatus can be spread over two racks. Figs. 3, 4, 5, 6, 7 and 8 show examples of typical rack layouts which have proved satisfactory and it is recommended that the principal features exhibited by these examples be adhered to as far as possible. This is of primary importance where the 250-, 500- and 1,000-watt amplifiers are concerned. In the greater number of cases calling for 250-, 500- or 1,000-watt amplifiers it is nearly always essential to provide a separate rack for

any additional units that are required. It will be seen that with these particular amplifiers there are only eight inches of spare panel space, and in general it is better not to use it.

At this stage it is possible to calculate from the table the total cost of the equipment apart from wiring and installation work. To the actual cost extracted from the price list must be added the cost of any non-standard fittings needed for loudspeaker fixing, &c.

SALIENT FEATURES OF THE PAMPHONIC UNITS

The preceding paragraphs have outlined the unit construction system in its broadest aspects. Before a practical application of the system is attempted, the following notes on the individual units should be consulted. Whilst the inform-

ation given on sound sources, loudspeakers and monitors is widely known and is not necessarily peculiar to Pamphonic equipment, that given on amplifiers and switching applies only to Pamphonic equipment. The great flexibility of the Pamphonic unit construction system is in large measure due to the special features included in the amplifiers and the exceptional scope offered by the local and remote switching arrangements.

SOUND SOURCES

Microphones. Two types of microphone head are available, viz.: high-fidelity and general-purpose. The former should be employed for relaying music and speech where the highest-quality reproduction is required. The general-purpose type is intended for speech only, although it can give pleasing results as a crooner's microphone. Its large diaphragm gives it a more directional sound pick-up than the high-fidelity type, and this feature is of considerable value where the microphone has to be used in close proximity to loudspeakers as the tendency to 'howl' is less pronounced.

Microphone stands of the desk type are in every case supplied with a switch. This renders the microphone inoperative in the 'off' position and is provided with an additional pair of contacts for the remote switching of amplifier circuits.

Gramophone Units. These are supplied in three forms: single-turntable, twin-turntable and auto-changer. They bolt on to the front of the rack at any desired height from the ground and occupy twelve inches of panel space. The pick-ups available are of the permanent stylus, high-fidelity type, or of the standard needle variety. The twin-turntable unit has individual volume controls for each pick-up, thus providing for the mixing of the two pick-up outputs if required. The single-turntable and auto-changer units rely on the 'Gram' volume control on the main amplifier.

Radio. This unit is a superheterodyne receiver covering the usual short, medium and long wavebands. It has built-in its own monitor loud-speaker and tuning meter and there is a switch which permits the tuning-in operation to be performed prior to switching the programme through to the main amplifier. The receiver unit occupies twelve inches of panel space.

Tone Signal. A tone signal is frequently required for fire-alarm purposes or as a time signal. The standard tone signal unit is available in two forms: (a) continuous note; (b) interrupted note. They each occupy four inches of panel space.

AMPLIFIERS

Pre-amplifiers. This term applies to all amplifiers which are intended to feed into other amplifiers, as opposed to amplifiers intended to feed directly into loudspeakers. There are two main divisions of pre-amplifier in the Pamphonic range, i.e. microphone mixing pre-amplifiers and repeater amplifiers.

Microphone Mixer. When mixing facilities are required for two or more microphones the microphone mixer unit will generally be required. (Two microphones can be mixed in the main amplifier, but so doing precludes the use of a gramophone unit.) This is a composite unit consisting of a mixer valve chassis and a number of plug-in pre-amplifier units, one for each microphone. It has an entirely separate power-pack which is usually mounted away from the mixer unit on the lower part of the rack. Fig. 9 shows the mixer unit with two of the pre-amplifier units plugged in. Each plug-in unit has its own volume, bass and treble controls. A meter and selector switch on the main mixer valve chassis enables the currents in the plug-in units and mixer valve to be read. The microphone lines to the plug-in units terminate on screw terminals at the rear of each. The pre-amplifier and mixer unit occupy eight inches of panel space and the power-pack four inches.

One power-pack will supply two microphone mixer units complete with their full complement of plug-in units.

Accommodation is provided on the mixer chassis for up to four microphone priority relays.

Repeater. The need for a repeater panel is rarely met on the general run of sound systems. Its use is generally confined to the more complex installations which incorporate a large amount of remote and automatic switching equipment. Its function is to provide pre-amplification or re-amplification and the Pamphonic unit has the additional feature that it provides up to six independent outputs from a common input. It is designed on the same lines as the microphone mixer unit in that the independent outputs are derived from plug-in units. It makes use of the same power-pack as the microphone mixer unit and one power pack will supply two complete repeater units. The repeater unit occupies eight inches of panel space, exclusive of power-pack.

In all instances where repeater units appear

to be necessary it is strongly advised that reference be made to Pamphonic Reproducers Ltd. before any final specification for a sound system is drawn up.

Main Amplifiers. Main amplifiers are available in five different power outputs as follows:

60 watts
120 "
250 "
500 "
1,000 "

Each of these is made in four forms, the choice of which to select for a given job being determined by the particular combination of sound sources called for. The catalogue number of each main amplifier is suffixed A, B, C or D according to its form. The sound source combinations represented by these letters are as follows:

- A. An amplifier that will accept: microphone mixer unit and a gramophone unit.
- B. An amplifier that will accept: one microphone and a gramophone unit.

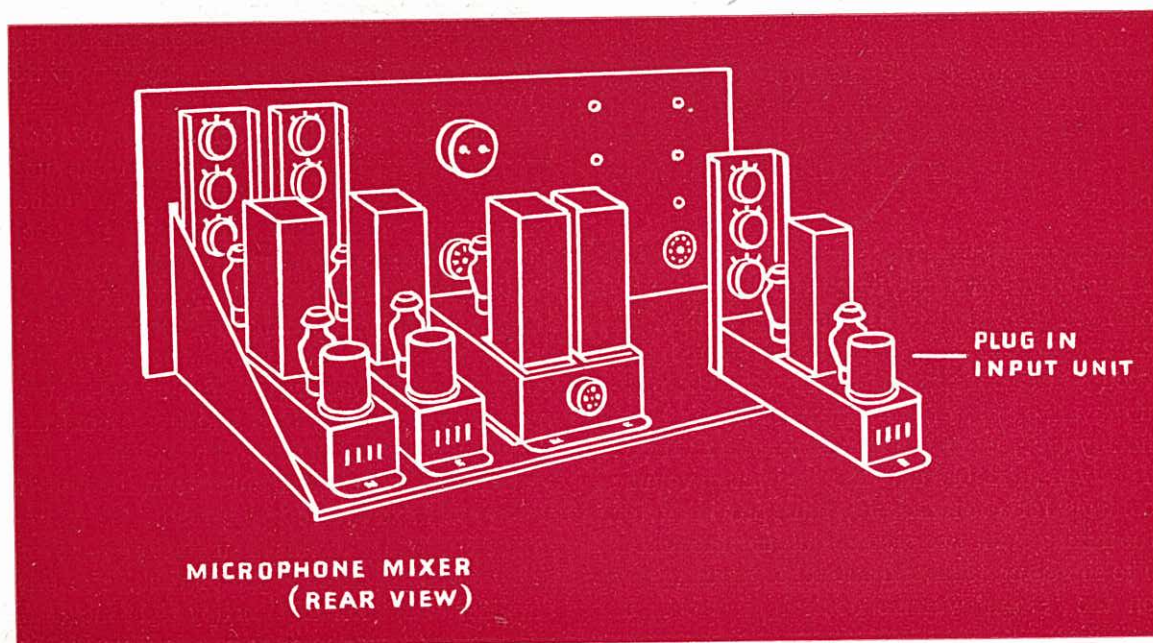


FIG. 9

- C. An amplifier that will accept two microphones.
- D. An amplifier that will accept one 600-ohm line input; generally used in conjunction with a repeater unit.

Provision for radio input is made on each of the above.

CONTROLS

The controls provided on the four amplifier forms are as under:

- A. Master volume control for microphone mixer input.

'Gram' unit volume control for single turntable or master Gram volume control when twin turntables are fitted.

Bass control for gramophone unit.

Treble control for gramophone unit.

Gram/Radio change-over switch.

Selector switch for current-check meter.

- B. Microphone volume control.

Microphone bass control.

Microphone treble control.

Gram or master Gram volume control according to whether single or twin turntables are fitted.

Gramophone bass control.

Gramophone treble control.

Gram/Radio change-over switch.

Selector switch for current-check meter.

- C. Volume control for each microphone.

Bass control for each microphone.

Treble control for each microphone.

Mic 1/Radio change-over switch.

Selector switch for current-check meter.

- D. Volume control.

Selector switch for current-check meter.

In all cases the two volume controls permit mixing.

ARRANGEMENT OF MAIN AMPLIFIER PANELS

The main amplifiers in each case occupy a number of panels. Flexibility of panel arrangement is, however, confined to the 60-watt and

120-watt units. The 250-, 500- and 1,000-watt amplifiers are always built with the same panel layout. The 60-watt and 120-watt amplifiers are each divided into: (a) amplifier and control panel, and (b) power-pack. In the panel space column of the table the first figure gives the amplifier plus control panel space and the second figure the power-pack space. It is usual to keep the amplifier plus control panels on the top half of a rack. The associated power-packs should be separated by twenty-four inches of panel space from their respective amplifiers.

LOUDSPEAKERS

The loudspeaker classification in the table is largely self-evident and since the majority of people are familiar with the loudspeaker as such, only those aspects will be considered here which are either peculiar to the products of Pamphonic or of special importance where sound systems are concerned.

Method of Feeding Loudspeakers

The method adopted by Pamphonic for feeding a number of loudspeakers from a central amplifier is known as the common-voltage system. In this system the amplifier supplies 100 volts to the loudspeakers when it is delivering its full rated output. This is the case in all Pamphonic rack-mounted amplifiers. All Pamphonic loudspeakers are accordingly designed to operate on 100 volts. Just as electric light bulbs are available in different wattages, so are Pamphonic loudspeakers available in different wattages. In this way a loudspeaker unit can be chosen to give more or less sound power according to the wattage rating of the unit. Standard loudspeaker ratings are: $\frac{1}{2}$ to 10 watts for cabinet types and 3 to 25 watts for horn types.

Since the wattage rating of a loudspeaker is the measure of the amount of power absorbed from the amplifier, the total wattage of all the loudspeakers connected to the amplifier must not exceed the rated output of the latter.

Loudspeaker Coverage

The question as to how many loudspeakers, what type of loudspeakers and what wattage rating they are to have to cover a given area, can only be answered correctly when all the factors which militate against audibility are taken into account. Although after a little practice and experience the art of assessing loudspeaker requirements is rapidly acquired, new situations continually arise calling for unusual care. Insufficient consideration in these cases may lead to extremely bad results. First-class

Horn loudspeakers are from three to five times more efficient than cabinet-type loudspeakers. This means that a 3-watt horn unit will give as much volume as a 10-watt cabinet unit for the same input. Cabinet loudspeakers, however, reproduce music very much better than the horn-type, so the latter should, in general, only be employed where their predominant role is for speech reproduction.

The special forms of loudspeaker shown in the table have a much extended frequency range and they should be employed in all cases where

Location	Size	Noise Level	Watts Needed
Office	20' x 20'	Quiet	2
Assembly Shop	100' x 40'	Medium	25
Machine Shop	100' x 40'	Very Noisy	60-150
Theatre (Music)	800 People		60
Theatre (Sound Effects)	800 People		60-250
Church	100 People	Quiet to Medium	60
Railway Terminal	10 Platforms	Noisy	500-1000

FIG. 10

equipment often gets blamed by the public whose distress is caused solely by loudspeakers of unsuitable type unsuitably placed.

There is no golden rule for assessing loudspeaker requirements but the table in fig. 10 has been drawn up to give a rough frame of reference.

The figures given are only representative and cannot be applied without reference to many other factors such as the shape of the area to be covered, the amount of sound-absorbing material therein, &c., &c.

the very best sound quality is required. These cases include: theatre orchestra pits, dance halls, hotel lounges where music is required, and in all cases where the environment calls for everything to be first rate.

SWITCHING

Under this heading comes a large variety of local and remote control arrangements, a few of the more important forms being listed in the table.

Whether local or remote, the switching schemes can be divided into three broad categories, viz.:

- (a) Sound source switching.
- (b) Loudspeaker switching.
- (c) Amplifier On/Off switching.

In some cases only one of the above is required, in others all are required together.

Local Switching

By this term is meant any switching operation performed at the central amplifier, but since there is a certain amount of switching included as standard on any rack, only those forms which are extras are included under this heading on the table.

Groups of loudspeakers are frequently required to be under separate control. To meet this requirement each group must be separately fed from the amplifier and a switch placed in the feed to each group. Up to ten switches can be accommodated on the standard four-inch loudspeaker distribution panel, and the price is reckoned on the cost of panel plus additional cost per switch required. Switches are available in two ratings according to the loudspeaker load per switch.

Loudspeaker switching is the facility most often required, but there is a variety of other operations such as spare amplifier switching which are too many and complex to be listed in a simple manner. In the event of switching operations being required which are not listed, full details of the requirement should be submitted to Pamphonic Reproducers Ltd.

Remote Switching

This term covers all switching operations performed at a distance from the main amplifier. The majority of the remote switching schemes shown give one or more microphones control over the entire system. The need for a microphone operator to interrupt a musical programme has already been mentioned. This facility is listed in the table as 'Microphone to Gramophone/Radio'.

Inter-microphone priority gives any one microphone priority over all the others or provides a descending order of priority amongst any number of microphones up to four. Loudspeaker switching from a microphone is often needed when a loudspeaker is in close proximity to the microphone. If the nearby loudspeaker were not switched off when the microphone is switched on, the two might very easily react to produce a howl. To combat this an arrangement is available whereby the switching on of a microphone automatically switches off the loudspeaker in the immediate vicinity of the microphone. As will be seen from the table, this feature can be provided on up to four microphones. This is achieved by placing a relay at each loudspeaker to be controlled.

The relay is actuated over a third wire from another relay on the amplifier rack which is in turn actuated by the switch on the microphone.

A tone signal is very frequently used as an alarm, in which case it may require a number of remote control points. The types shown in the table are for the central control apparatus only, but all that is needed at remote points is a push-button or switch.

A central battery is required in all remote switching arrangements. The standard battery referred to at the foot of the table is large enough to supply the needs of any or all of the schemes listed.

'Amplifier, Standby to On' remote switching can be provided and allows the amplifier to remain with only valve filaments alight until a remote microphone is switched on. High tension is then applied to the valves until the microphone is switched off. This is done in the interests of economy in cases where the amplifier would otherwise have to be switched fully on for long periods of idleness.

MONITORING

Monitoring equipment is employed where it is desirable to keep a check on the aural quality

or intensity level of the programme going over the loudspeakers. The aural quality is checked by means of a local loudspeaker on the amplifier rack and the intensity level by a meter on the rack which indicates the average loudness relative to the maximum that the amplifier will handle without distortion. The monitor loudspeaker panel is provided with volume control and switch.

The visual level meter panel has a meter and switch. The monitor loudspeaker is almost indispensable on any amplifier rack and its inclusion is recommended in all cases. The visual level meter is of considerable assistance to the operator but cannot be classed as an essential unless the programme source is such as to make continuous monitoring advisable.

CLASS	TYPE	SUB-TYPES	FORM	PANEL HEIGHT	TYPE NO.
SOUND SOURCES	MICROPHONE	HEADS	High Fidelity Moving Coil General Purpose		760 761
		STANDS	Floor Banqueting Desk Hand Suspension		795 796 797 798 799
		SINGLE TURNTABLE	Standard Pick-up Lightweight Pick-up	12" 12"	740 741
	GRAMOPHONE	TWIN TURNTABLE	Standard Pick-up Lightweight Pick-up	12" 12"	743 744
		AUTO-CHANGER	Lightweight Pick-up	16"	742
	RADIO		3 Waveband Superhet	12"	730
	TONE SIGNAL	CONTINUOUS		4"	711/A
		INTERMITTENT		4"	711/B
	PRE-AMPLIFIERS	MICROPHONE MIXER	Mixer + 1 Plug-in Unit " + 2 " Units " + 3 " " " + 4 " " Plug-in Unit only Power Pack for Microphone Mixer (<i>See Note 1</i>)		720/A 720/B 720/C 720/D 720/U 750
		REPEATER	Repeater + 1 Plug-in Unit " + 2 " Units " + 3 " " " + 4 " " " + 5 " " " + 6 " " Plug-in Unit only Power Pack for Repeater (<i>See Note 1</i>)		721/A 721/B 721/C 721/D 721/E 721/F 721/U 750
AMPLIFIERS	MAIN AMPLIFIERS	60 WATT	1 High-level input for Mic-Mixer + 1 Gramophone input 1 Single Microphone input + 1 Gramophone input 2 Microphone inputs and no Gramophone 1 High-level 600 input	12" + 12" 12" + 12" 12" + 12" 12" + 12"	704/A 704/B 704/C 704/D
		120 WATT	Ditto	24" + 20" 24" + 20" 24" + 20" 24" + 20"	703/A 703/B 703/C 703/D
		250 WATT	Ditto	72"	702/A 702/B 702/C 702/D
		500 WATT	Ditto	72"	701/A 701/B 701/C 701/D
		1,000 WATT	Ditto	72"	700/A 700/B 700/C 700/D
		L.S. AND VOLUME CONTROL		8"	710/A
MONITORS	VISUAL	LEVEL METER		4"	710/B
	HORN TYPE	UNITS	15 watt + 100v. matching tfr. tapped for 12, 8.5, 6, 4.5 & 3w. 25 " + " " "		770/A 770/B
		HORNS	Circular Exponential, 42 inches " " 72 inches Monoplanar, 46 inches Re-entrant Multicellular, 200 cps. cut off. No. of cells to order " 500 cps. " "		771/A 771/B 772/A 773/A 774/A 774/B
	CABINET TYPE	METAL	Wall. 2w. + 100v. matching tfr. tapped for 1 & ½w. Vol. Control extra Wall. 10w. + 100v. matching tfr. tapped for 5w. Vol. Control extra Suspension. 2w. + 100v. matching tfr. tapped for 1 & ½w. Suspension. 10w. + 100v. matching tfr. tapped for 5w.		775/A 775/B 776/A 776/B
		WOOD	Wall. 2w. + 100v. matching tfr. tapped for 1 & ½w. with Vol. Control Wall. 10w. + 100v. matching tfr. tapped for 5w. Vol. Control extra Diffuser. 10w. + 100v. matching tfr. tapped for 5w. Vol. Control extra		777/A 777/B 777/C
LOUDSPEAKERS	LOCAL	AT AMPLIFIER LOCATION	Special 5w. Labyrinth + 100v. matching tfr. Vol. Control extra " 10w. " " " " " " L/s groups up to 200w. per group, up to 10 switches Each group between 200 and 1,000 w. up to 6 switches	4" 4"	778/A 778/B 780/A 780/B
	REMOTE	FROM MICROPHONE LOCATION	Microphone to Gramophone/Radio Inter-Microphone Priority Microphone A over Microphones B, C, or D (<i>See Note 2</i>) Microphone A over B, B over C or D " " Microphone A over B, B over C, C over D " "		785/A 786/A 786/B 786/C
			Loudspeaker switching per Microphone Point 1 Loudspeaker (<i>See Note 2</i>) 2 Loudspeakers " " 3 " " " 4 " " "		787/A 787/B 787/C 787/D
	FROM ANY LOCATION	FROM ANY LOCATION	Stand-by to On. (<i>See Note 2</i>) Tone signal with priority over all sources. (<i>See Note 2</i>)		788
RACKS	STANDARD		With back cover. 78 inches high, 21¼ inches wide, 15½ inches deep		790
	SHORT		With back cover. 46 inches high, 21¼ inches wide, 15½ inches deep		790/S

NOTE: (1) One Power Pack will feed two complete Microphone Mixers or two complete Repeaters.
(2) A Battery must be included to provide power. A single Battery will cover the needs of all remote control arrangements.

NOTES

