BEACON RADIO LTD.

P.O. BOX 2757
AUCKLAND

BEACON RADIO LTD.

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FACTORY & OFFICE
BROWN ST.
PONSONBY
AUCKLAND

1958 EDITION

Price 1/6

Beacon Radio Limited

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BEACON RADIO LIMITED

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1 Manufacture transformers, chokes, fluorescent lamp ballasts and discharge tube transformers on a large scale.

2 Attend to individual orders requiring special design work. (Transformers, Chokes, etc.)

3 Provide up-to-date technical service to back up their products and assist manufacturers, service-men and hobbyists.

4 Undertake rewinds and repairs involving the application of winding techniques.

IF THE ITEM YOU REQUIRE IS NOT LISTED IN THIS CATALOGUE PLEASE CONTACT US EITHER THROUGH OUR DISTRIBUTORS OR DIRECTLY.

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13-290

P.O. Box 2757,
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BEACON RADIO LIMITED

TRANSFORMER MANUFACTURERS

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PRICES

Price lists are issued to agents and dealers. These lists are brought up to date as the occasion demands. The right is reserved to change prices without notice. Special jobs and repairs are charged for on the cost of the individual job.

STOCKS

As far as practicable, stocks of standard lines are held at the factory. Our accredited distributors carry a range of BEACON transformers at all times.

REPAIR SERVICE

The factory maintains a testing and repair service. All types of radio transformers, mains transformers up to several kilowatts capacity, and many kinds of windings are catered for. It is requested that where possible full technical details, including circuit data, be supplied with unusual jobs. Many items forwarded for repair are so badly damaged, that it is impossible to ascertain winding details from them. Another difficulty often encountered when disassembling windings is that polymerising varnish may have been used in the original job thus making subsequent unwinding, turn by turn, almost an impossibility. Armature winding is not undertaken.

GUARANTEE

We give an unconditional 12 month guarantee with every transformer supplied, as from date of despatch from the factory, against defective materials and workmanship. Postage must be paid on any transformers returned to the factory.

TERMS OF BUSINESS

Monthly where satisfactory credit references have been established. In other cases cash with order or prior to delivery of goods.

DEVELOPMENT WORK

Manufacturers and others are invited to avail themselves of the facilities of our laboratory in having original designs engineered to suit their particular requirements.

DELIVERY

In Auckland within the inner city, a daily delivery is maintained. **Rail** deliveries are effected daily. **Shipping.** Goods are despatched at the first available opportunity.

CATALOGUE NUMBERS

In order to avoid mistakes in identifying any particular item it is desirable to make use of the Beacon catalogue number. If any major change in design of a standard line is made a new Beacon catalogue number is allocated. This ensures that no confusion exists between obsolete and up to date articles as any particular style and item is thus positively identified.

Beacon Catalogue numbers have now been changed — the first two figures have been dropped.

Beacon Catalogue numbers now consist of a letter indicating the group to which the item belongs, and two figures denoting a numerical sequence.

FILTER CHOKES FOR POWER SUPPLIES

Sometimes it is not realized that the inductance of a filter choke, or any other iron-cored choke, is influenced by the conditions of current, voltage, and frequency under which the choke works. Reputable manufacturers of filter chokes usually rate the choke inductance as that which will be presented under working conditions.

It is well known that the inductance of a filter choke can be greatly influenced by the passage of D.C. through it. An air gap is often provided for minimizing the saturation effect of the D.C. When a choke is designed with the aid of the appropriate Hanna's curves it is possible to predict the correct gap and number of turns for a given core size. The designer, however, must take into account other factors such as insulation requirements and the permissible winding resistance. Thus choke design becomes somewhat of an art.

The user of BEACON chokes may be sure that the rating quoted applies to normal working conditions. BEACON chokes are designed to give efficient service with an economical use of materials.

CHOKE INPUT FILTER SYSTEMS

To achieve long life and good regulation from power supplies using mercury vapour tubes, a choke input filter is indicated. The question then arises, "What should be the inductance of the choke?"

This question was answered in Q.S.T. some years ago by Delenbaugh and Quimby, and their results have been summarised in Terman's "Radio Engineers' Handbook."

For a full wave system on 50 cycle supply, the minimum value of the input choke, called the critical value, is approximately equal to the load resistance of the power supply, divided by a thousand.

To limit the peak plate current, this inductance should be at least one and a half times, and preferably double the calculated value. The following example will illustrate the point:—

A class B modulator draws 20 mills. standing current and 120 mills. full signal, with a plate supply of 750 volts. The bleeder resistance of 25000 ohms draw an additional 30 mills. The total drain, therefore, varies from 50 mills. to 150 mills. The equivalent load resistances, found by dividing the plate supply voltage by the load currents, are 15,000 ohms and 5000 ohms respectively.

Thus, the critical value of the choke at no signal is 15 henries, and at full signal 5 henries. The optimum values would be around 30 and 10 henries. A choke rated at 30 henries at 150 mills. would be quite satisfactory, as its inductance would not be below the optimum at any point. However, it would be considerably less expensive, and just as satisfactory, to use a choke that would swing from 30 to 10 henries with a load change of 50to 150 mills.

Where the load is fixed, a constant choke can be used. In the above example, for a steady drain of 150 mills., a 10 henry 150 mill. choke would meet the optimum requirements. It should be noted carefully that any value above the critical is satisfactory, but the use of the factor of two is very desirable to reduce peak plate currents.

HIGH Q AUDIO FREQUENCY CHOKES

A highly efficient type of core material is used for making audio frequency chokes with outstanding performance characteristics. When two of these chokes are employed in a filter such as used in the high frequency control section of Mr. H. H. Scotts DYNAMIC Noise Suppressor circuit it is possible to obtain, over a range of one octave, a 40 decibel reduction in signal due to the action of the filter alone.

The above performance is much better than that obtainable from chokes employing the more common types of core materials such as standard stampings of the nickel iron alloys. Experimenters and others will find an added advantage in the small physical size of the new chokes.

Should you require special filters for the higher audio frequencies or supersonic and carrier frequencies please let us have your inquiry.

EQUALIZERS AND FILTERS

Often special frequency characteristics are required of an amplifier. Equalizer circuits are employed extensively in radio and recording work in order to compensate for deficiencies in one or more links in the reproducing chain. Filter circuits for separating or suppressing certain frequencies or bands of frequencies are used in many different types of apparatus.

The designer of electrical or electronic circuits needs to know a good deal about the performance, required of a circuit in order to produce a suitable design. Not only must frequency response, input impedance, output impedance, and signal levels be considered, the materials available for construction of the necessary reactances also have a profound influence upon the behaviour of the finished equalizer or filter.

BEACON are prepared to wind inductances on ferrox cube cores suitable for audio and supersonic frequency application. If necessary BEACON will recommend suitable circuits to perform given functions.

CATHODE RAY OSCILLOSCOPE POWER SUPPLIES

Flux leakage, peak inverse voltage, rectifier tube ratings and condenser working voltages all demand attention when designing a cathode ray oscilloscope power supply. Bulky transformers with a more than usual number of windings on one core are expensive to make if one of the windings has a large number of turns of fine gauge wire and insulation requirements are severe. These conditions are found in the usual oscilloscope power supply transformer and often a rewind is required merely because the winding of fine wire has broken down. An electronic high tension supply for the cathode ray tube is one way of overcoming this difficulty. Another is to have a special transformer for the cathode ray tube high tension, with the cathode ray tube heater windindg, high tension rectifier filament windings, and high tension winding only on one core. The associated amplifier voltages are then obtained from a separate transformer of conventional type, or, if desired, from a transformer of special low flux density construction.

BEACON make Cathode Ray Oscilloscope Power Transformers to order. The variety of rectifier tubes, cathode ray tube, smoothing condensers and circuits available makes it rather difficult to arrive at a suitable range of standard design. When enquiring or ordering, please, if possible, give the contemplated circuit diagram, together with tube types and voltages required. This will help solve such problems as the insulation wanted and where to put the necessary electrostatic shields. Do not draw an elaborate circuit if it has already been printed in any of the better class radio magazines. It is usually sufficient to state the name and issue of the magazine and the number of the page showing the circuit diagrem.

THE DECIBEL

Because the human ear detects changes of power level in roughly the logarithmic ratio of the two powers and the acoustical output of a loudspeaker is proportional to electrical changes in the circuit that feeds it a logarithmic basis of comparing power changes is often used. The logarithm to the base 10 of the ratio of two powers is known as the bel. This unit is rather large for ordinary use and the decibel (one tenth of a bel) is commonly used. As power change in decibels is a ratio only it is necessary to specify a standard reference level. Zero db for 1 milliwatt into a stated resistance is common. This is the level used by BEACON when rating the maximum operating level of small audio transformers. A very good source of information on the decibel is found in the fourth edition of the "Radiotron Designers Handbook."

DRIVER TRANSFORMERS

A common method of energising the grids of a push pull class AB2 or class B audio audio amplifier is by means of a driven stage and driver transformer. The driver stage delivers some power into the grid circuit of the output valves. Although the average power might be very small the peak instantaneous power is often quite high.

Owing to the non-sinusoidal nature of the amplifier grid current the driver stage has to work into a highly variable load. In order to avoid undue distortion the driver transformer must be very carefully designed. The primary inductance must be high, leakage between primary and secondaries must be low and winding resistance should be small. The turns ratio must be such that the effect of a varying secondary load is minimised but there must be sufficient voltage output available to drive the amplifier valves to full output. The overall frequency response of the driver transformer must extend very considerably on either side of required band of signal frequencies.

The choice of valves for both driver and final amplifier can help considerably in keeping the cost of a driver transformer down.

It is desirable that where low distortion is required push pull valves are used, both for drive and amplifier. The choice of a sensitive type of power output valve with low peak grid current requirements is another step. The driver valves should have a low anode resistance in order that the primary inductance of the driver transformer may be kept as small as possible. This applies to triodes; should pentode or tetrode driver valves be used, a much higher percentage of distortion is to be expected although loading the secondary side of the driver transformer by means of resistance will assist in minimising the effect of variations in amplifier grid current. The equivalent grid current load resistance presented by the amplifier valves should not fall below about four times the anode load resistance of the driver valve.s This is taken care of by the correct choice of transformer turns ratio and driver valves.

INPUT AND LINE TRANSFORMER SPECIFICATIONS

The apparently wide range of impedance ratios required of transformers for use with sources of audio signals and lines is a vexing problem. Almost every person that orders an input transformer seems to have an individual preference and specifies his requirements accordingly. As manufacturers of audio input and line transformers we are inclined to agree with the Editorial Staff of "Audio Engineering" who in their June, 1949 issue deplored the present lack of standardisation.

Audio Engineering says that, as a starter the following range of impedances might be considered suitable for standardisation.

"(1) Primary to work from 30-50 ohm microphones unterminated."

"(2) Primary to work from 250 ohm source, unterminated; or across 500-600 ohm lines terminated with a resistor; or from a 250 ohm source with termination supplied on the secondary."

"(3) Primary to work from 600 ohm source with a termination supplied on the secondary; this winding centre-tapped to work from 150 ohm sources."

If the proposals outlined are examined closely it will be seen that three transformers can be made to cater for most ordinary low level audio transformer requirements.

MINIATURE WIDE RANGE PLUG-IN TRANSFORMERS

The transformers are astatically wound on mu-metal cores and are enclosed in a mu-metal shield. The whole is screened by a drawn can of magnetic alloy. A standard octal plug-in base is provided. The windings are made with tough, synthetic-enamel insulated wire. A pure, inert, micro-crystalline wax with high electrical and moisture proofing properties is used as the canfilling compound. Both primary and secondary windings are centre-tapped.

Special input or shunt fed, low-level, output transformers can be wound to order.

PLATE MODULATION

Taken all round the most common type of amplitude modulation system is a Class "B" audio amplifier modulating a Class "C" radio frequency stage. The audio amplifier is called upon to supply the side band power and must be capable of supplying power equal to half the unmodulated power produced in the tank circuit by the R.F. stage if 100% modulation is desired. Naturally in the interests of economy it is desirable that no excessive power losses should occur because of poor design, incorrect matching, or wrongly proportioned voltages. A well designed and properly adjusted low power transmitter, will usually give a much better signal than a transmitter having many times the power rating if the larger transmitter is not well modulated or is badly adjusted.

Hams are highly individualistic and very commendably, like trying out their own ideas. When it comes to modulation systems using plate transformers the BEACON multimatch lines are found very convenient. They are made in four sizes to handle 10, 30, 50, or 100 watts of audio power. The primary and secondary windings will both match loads from 2,000 ohms to 15,000 ohms. When correctly used the frequency response is flat from 150 c.p.s to 5,000 c.p.s.

Depending upon connections, which may be obtained from the charts supplied with transformers, the permissable currents are as follows:—

Catalogue Number .... Audio Power	M07 10 watts.	M01 30 watt.	M06 50 watt.	M03 100 watt.
Maximum modulator plate current per tube	150 MA or 50 MA.	100 mA. or 55 mA.	200 mA. or 100 mA.	360 mA. or 180 mA.
Total permissable Class "C" plate current.	100 MA. or 50 mA.	110 mA. or 55 mA.	200 mA. 100 mA.	360 mA. or 180 mA.

Note:—Sometimes trouble is experienced because modulation transformers and heavy duty chokes are mounted in such a way that fringing flux around the core gap passes through sheet metal chassis. The chassis then acts like a giant telephone receiver diaphram. The resultant noise is especially noticeable if because of plate current flowing thorugh the windings a strong D.C. field is present. The remedy is to mount the transformer in such a way that the fringing flux does not pass through the chassis. A gap of ¼in. is usually sufficient to dispel all objectional back ground noise.

POWER TRANSFORMER SPECIFICATIONS

It is not always realised that the performance of a transformer, power or audio, is often influenced by circuit conditions outside the transformer itself. To specify the windings required and other physical characteristics of the transformer will not always ensure that the expected operation will be satisfactorily obtained unless the associated circuit conditions have been examined and their effects allowed for. For instance, the voltage and maximum current of a power transformer working into a choke input filter will be quite different from that obtainable from the same transformer working into a condenser input filter.

For a condenser input filter the rectified voltage available will be much higher than that obtainable from the same high tension transformer used with a choke input filter. The wave shape of the current flowing through the windings is greatly different in the two cases. This effect means that the rectified output current available from a choke input filter is greater than that obtainable from a condenser input filter although the same rectifier tube and high tension transformer are used in each case. Approximately the same power output is obtainable from the two filter systems but the ratio of current to voltage is quite different in the two cases. A further point to bear in mind when contemplating ordering a power supply transformer is that the manufacturers of rectifiers usually specify the maximum operating conditions for which their goods are designed. The type of filter system sometimes makes quite a substantial difference to the allowable transformer secondary voltage applied to the rectifier plates.

In the case of a half wave rectifier the R.M.S. current in the secondary winding of the transformer attached to the rectifier plate is considerably greater than the value of the direct current output. This factor influences the physical size of the transformer making it somewhat larger than one would expect from a consideration of the rectified current and voltage alone.

BEACON designers are well qualified to cope with problems arising in the design of special transformers but are at times unable to guess just what a customer has in mind when insufficient details have been supplied with the order for a new transformer. It often saves time and trouble if when ordering a special transformer full details of the use to which the transformer is to to be put are supplied. A circuit diagram, a note as to the rectifier type and a brief explanation of your requirements can be most helpful to the designer working on special orders. Elimination of guess work leads to satisfaction on both sides. When ordering be sure to include such details as type of mounting, vertical or flat, and the type of winding termination desired as well as giving the more technical information about required electrical performance.

THE TESTING OF RADIO POWER TRANSFORMERS

A number of methods are available, no one of which gives the complete answer. The serviceman usually has limited means at his disposal but a wealth of valuable experience to fall back on. Actual measurements that may be made easily are:

(a) A measurement of primary and secondary voltages.

(b) A check on the primary input current when no load is connected to the secondary.

Unless something very serious is wrong neither of these checks will definitely indicate a defective transformer. A suitable wattmeter will usually show if excessive no load input current means shorted turns. Often a high no load input current means a 60-cycle transformer used on 50 cycles, or a core in which the air gaps between the laminations become significant as is generally the case for a very small transformer.

A good inductance bridge which will indicate a "Q" reading will help greatly in finally deciding if a transformer has shorted turns.

Insulation break-down between windings or from winding to core may not show up on a multimeter reading. Some device which will give a high voltage at a low current, such as a 500-volt megger, will readily detect bad insulation. More elaborate high voltage testers that detect excessive insulation corona are often used.

In all, the proper testing of transformers requires knowledge, experience, and equipment. There is one test from which Beacon transformers come out with flying colours and that is the test of time.

DISTRIBUTION OF LOSSES IN POWER TRANSFORMERS

The purpose of this topic is to show how the total power loss in a small power transformer is made up of three individual losses and the way these losses can be varied by the choice of material and operating conditions.

The total power loss, in small transformers, can be considered as the sum of core and copper losses. The core loss is subdivided into hysteresis and eddy components.

Dealing now with the control of these losses. It can be shown that the eddy current loss is proportional to the square of the flux density. For practical purposes the hysteresis loss is also considered proportional to the square of the flux density. This is not necessarily correct, but for the grade of silicon steel in common use the error is not very great.

The core losses also depend on the type of steel used. The hysteresis loss varies with the shape of the B-H loop while eddy current loss depends on the thickness, resistivity and insulating surface of the laminations. It follows then that we have more factors with which to control the eddy current loss than we have for controlling hysteresis loss. With the grade and thickness of silicon steel commercially available, the eddy current loss is usually about one third of the total core losses.

Considering now the copper loss. Since the windings are invariably of soft copper, the resistivity is fixed and the copper loss for a given winding can be considered proportional to the square of the current density.

It is often desirable to have the copper & core losses approximately equal, especially when considering a variable load. Maximum efficiency occurs when the two losses are equal and this can be arranged at the particular loading required.

BEACON power transformers have a total power loss determined either by the temperature rise or efficiency required. This loss is very often evenly divided between the copper and iron, depending on the transformer application. Of the total core losses, the hysteresis usually comprises two thirds, the remainder being due to eddy currents. The total copper loss is normally divided evenly between the primary and secondary windings thereby making efficient use of the winding space.

THE EFFICIENCY OF POWER TRANSFORMERS

Power transformers efficiencies range from 98.5% for a 100 k.v.a. unit down to 65% or lower for a 5 v.a. unit, these figures being representative of common practice. It is the purpose of this topic to indicate firstly how such high efficiencies can be obtained and secondly why it is usual for the smaller type transformers to have considerably lower efficiencies than the transformers with greater power ratings.

The reason for the high efficiencies compared with the efficiencies of other types of electrical machinery is that a transformer has no moving parts, the total losses are therefore almost completely confined to the copper and iron, the remaining small amount being due to the insulation. Considering a converter, for example, having the same K.V.A. rating as a large transformer the above losses are present with addition of friction, windage, and other limitations due to loading effects. It follows then, that due to these additional losses the converter or any similar machine can never be made as efficient as a transformer handling similar power.

Dealing now with the second point, namely low efficiency in the smaller transformer. Since there are no moving parts, the limit to the loading of a transformer is the maximum temperature at which it is safe to operate the insulation. The temperature rise must therefore be governed so that it does not impair the insulation under working conditions. In practice, especially when making small transformers, the usual aim is to construct units of the smallest possible physical size for a given output power, at the same time keeping the maximum temperature rise within a safe limit. This is in contrast to the aim of constructing a transformer giving the same continuous output but having maximum efficiency regardless of physical size. Unless the specific aim is for maximum efficiency, efficiency is a consideration secondary to the problem of temperature rise.

It can be shown that the heat dissipation area decreases as the square of the equivalent spherical radius, whereas volume, and therefore total loss, decreases as its cube. Smaller transformers can therefore radiate more heat per unit volume than larger ones. For the same temperature rise then, the smaller transformer can have a greater percentage loss of power. In other words if a small transformer is designed to have the same maximum temperature rise as a large one, the small transformer will automatically have a poorer efficiency.

In very small transformers such as one with a 5 v.a. rating, the magnetising current becomes a large factor governing the efficiency. The magnetising current is a flux producing, and therefore wattless, component of the total exciting current. Being 90 degrees out of phase with the primary voltage, the magnetising current does not involve any power loss directly. It is however added vectorially to the core loss component therefore having an influence on the total exciting current. In large transformers the copper loss in the primary winding due to exciting current is only about 0.25% of the primary copper loss at full load and is usually neglected. In very small transformers, however, the air gaps due to the butt joints of the laminations comprise a relatively large proportion of the total length of magnetic path. The resulting low permeability gives rise to a high magnetising current. This current flowing through the relatively high primary resistance results in a power loss which can no longer be neglected. A limit is therefore reached beyond which the efficiency of a very small transformer cannot be increased without a substantial increase in physical sizes.

Summing up then, and neglecting the latter effect which is serious only in very small transformers we draw the following conclusions:—

(a) In transformers, high efficiencies can usually be obtained owing to the absence of moving parts.

(b) Small transformers are usually designed to have the same temperature rise as their larger counterparts which automatically results in a lower efficiency.

(c) Small transformers can be designed to have efficiencies approaching that of larger ones but this means an increase in physical size and cost for a given load.

(d) For small transformers, unless a very high efficiency is required for some specific purpose, the increase which is made results in a lower temperature rise at the expense of not making the most economical use of the materials used in construction.

BEACON transformers are constructed to recognised standards for economy and efficiency.

TEMPERATURE RISE IN POWER TRANSFORMERS

The efficiency of typical radio power supply transformers varies from 80% to 95% approximately. In the case of a 60 watt transformer, about 8 to 10 watts loss might be expected when running at full load. These losses occur in the winding (copper loss), and the core (iron loss). These heat up the transformer the rise in temperature being dependant on the total power lost and the cooling area.

The limit to which the temperature can rise is fixed by the maximum working limit of the insulating materials employed. This is laid down in the relevant British Standard Specifications.

It is possible to achieve a very low rise by using a large stack of laminations and heavy copper conductors for the winding. This is not economical; although, when some manufacturers are not sure of their design, they will frequently use more material than is necessary for a satisfactory product. This results in a more expensive item and is wasteful of materials which are in short supply. The properly engineered transformer will sell for less, will perform equally satisfactorily for years and will be smaller and weigh less. But it will have a **known** safety margin which was predetermined in the original design calculations.

A rise of around 45 degrees centigrade is normal for transformers of this type, and in operation it may not be possible to hold the bare hand on the cover for very long with comfort. The practice of judging the merit of a transformer by touch is a thing of the past. More scientific methods are employed by BEACON to eliminate the guess work of a former era.

These include a precision thermometer and resistance bridge (General Radio) for temperature measurement and a sub-standard wattmeter (Weston) for loss measurement. Transformers are tested in accordance with B.S.S. and A.S.A. (American Standard Assoc.) where applicable, which includes making heat runs in a standard sized test enclosure. Temperature rise is calculated from the change of resistance of the windings during the test run. Hot spots on the core are checked on by measurements made with suitable thermometers.

VIBRATOR TRANSFORMERS

The frequency of the standard vibrator is about 115 cycles per second. If it is intended to use a vibrator having different fundamental frequency the transformer must be designed for the non-standard frequency.

Vibrator transformers are rated on D.C. voltage and rectified current. (e.g. a 6 volt input, 250 volt output vibrator transformer rated at 50 mA, will deliver 250 volts D.C. at 50 mA., with six volts applied to the primary. The turns ratio between primary and secondary windings of a vibrator transformer for given input and output voltages is not a simple ratio. Consequently it is not easy to determine the true voltage output without knowing a good deal about the transformer or making a measurement on a transformer actually in use.

The buffer condenser is very important. It is necessary to use the optimum size of buffer condenser if long and trouble free operation of the vibrator power pack is wanted. A very good method of selecting the correct buffer condenser under working conditions is to connect a cathode ray oscilloscope across the whole PRIMARY winding and observe results on the screen. By adjusting the value of the buffer condenser and watching the effect upon primary voltage wave shape the correct buffer condenser value may be selected. When buffer condensers are used in the secondary side of vibrator transformers the reflected capacity across the vibrator contacts is proportional to the square of the the transformer turns ratio.

HIGH VOLTAGE INPUT VIBRATOR POWER SUPPLIES

Vibrator power supplies operating with input voltages of 12 volts and upwards are liable to trouble known as contact flare. The flare is an ionization arc that occurs between the contacts, particularly during the starting period. A voltage between the contacts in excess of about 14 volts will maintain the arc. In order to extinguish the arc, it is necessary to reduce the current or lower the voltage.

High voltage, heavy duty vibrator power supplies are proneto contact flare owing to the voltages and currents involved. At the instant of starting a high "inrush" primary current is likely, and it is for this moment that some protection must be provided. Two methods are in general use. The first is to include a resistor in series with the input leads, the resistor being of such a value to limit the inrush current to a safe level. Once the vibartor is running, it is preferable to short out the limiting resistor. In this way a larger resistor can be used, ensuring more positive starting and yet not impairing the running efficiency.

The second method of inrush current limitation is by suitable transformer design. BEACON vibrator transformers for 6 and 12 volt operation are normally designed for use without a limiting resistor. For higher input voltages, it is preferable, though not essential, to use a limiting resistor. BEACON can, however, manufacture higher voltage transformers which will operate without a starting resistor, although the transformer must, of course, be made larger.

HEAVY DUTY VIBRATOR POWER SUPPLIES

There is on the New Zealand market a range of heavy duty vibrators capable of handling power up to several hundred watts. The making of transformers to work in conjunction with these special vibartors entails satisfactorily solving several problems. BEACON have produced a variety of transformers that give excellent performance when used under the correct conditions. It is essential that any heavy duty vibrator power supply be properlyloaded. Should the load not be a pure resistance but have a reactive component then it is necessary to take this factor into account. BEACON are prepared to manfuacture transformers singly or in quantity for use with heavy duty vibrators.

CORROSION IN OUTPUT TRANSFORMERS

The problem of electrolytic corrosion in coils wound with fine gauge wires is an old one. It appears that electrolytic corrosion is caused by minute D.C. currents flowing thorugh an electrolyte formed in the insulation of the coil and ionizing the copper of the wire. The current may be caused by a potential difference due to a voltage applied to the coil or to a galvanic action at the junction of dissimilar metals.

Moisture condensing in the coil, chemical changes in the insulating material or the presence of fungus may cause an electrolyte to form. Transformers standing idle are more likely to absorb moisture than those in use.

It is possible to offer almost complete protection to a coil by using inert insulating materials and hermetically sealing the finished transformer in a suitable can. This is an expensive process and uneconomical for ordinary uses such as output transformers in mass produced radio sets. Protection is offered by the following processes; vacuum impregnation and dipping, vacuum impregnation, varnishing. The degree of protection falls off in the order shown.

The principle of isolating the core has proved very effective in practice for minimising breakdown in D.C. circuits. Careful selection of impregnation materials and proper impregnation techniques such as used by Beacon plays a big part in preventing premature transformer breakdown.

UNIVERSAL OUTPUT TRANSFORMERS

BEACON universal output transformers successfully contend with various limitations and give excellent service under conditions usually encountered in practice.

In order to appreciate what an output transformer has to do let us consider some things influencing its behaviour. (The performance of an output transformer is influenced by a number of factors external to the transformer.)

Firstly, there is the impedance of the signal source. Triode valves and pentode valves behave differently and the trans-
former must have a high primary inductance to allow for the use of either type of output valve. A pentode valve output stage
stage can have both high and low frequency response quite different from that of a triode output stage although the same output
transformer and recommended valve load may be used in each case.

Secondly, we have the load impedance to consider; this may be the same as the internal impedance of the valve or it may be
quite different, and it plays an important part in determining both the high and low frequency performance. The load impedance
may change with frequency, a loudspeaker providing a good example of this effect.

Thirdly, the frequency of the applied signal has a considerable bearing upon the performance of a transformer, if too low a
frequency is applied severe iron distortion may be apparent and if the frequency becomes too high resonance effects not only
drop the output voltage but cause distortion of the waveshape as well. A poorly designed transformer might exhibit both low
and high frequency distortion over part of the audio range normally used. Even a good transformer will show distortion effects
if it is improperly connected in a circuit or used to couple a load to an unsuitable source.

When using a universal output transformer it will be found in general that the higher the load impedance requirements of
the output stage the poorer will be the overall frequency response of the transformer. If the valve calls for a very low imped-
ance then the power handling capability of the transformer may be reduced because the primary winding current is greatly in-
creased. Similarly if a number of low impedance speakers are used in parallel the secondary winding current may become
excessive.

The remedy, of course, is to use a transformer with a higher power rating or rearrange the circuit to avoid overloading the
transformer. Between the extremes just outlined universal transformers can be relied upon to give very satisfactory service
indeed.

UNIVERSAL LINE MATCHING TRANSFORMERS

Often it is necessary to use a number of loudspeakers spread over an area and working from a single amplifier. The loud-
speakers may have different voice coil impedances and possibly different power requirements. A "universal" line to voice coil
transformers for each loudspeaker will allow almost any combination of loudspeakers to be matched into an audio frequecy trans-
mission line. Providing care is taken not to place too many transformer primary windings in parallel the frequency response of a
system using a number of universal transformers can be very good. BEACON make standard inexpensive universal line to voice
coil transformers and provide an impedance matching graph for facilitating the choice of secondary taps for any required primary
impedance. The transformers have a split primary winding so that nominal primary impedances of 150 ohms and 600 ohms may
be used with minimum insertion loss. Physical dimensions of the transformers are the same as those of the familiar BEACON
universal output transformers.

LOW POWER HIGH FIDELITY OUTPUT TRANSFORMERS

Some excellent circuits have been published recently for amplifiers having push pull output and overall feedback. In order
to cater for outputs of the order of a few watts BEACON now manufacture a moderately priced line of small output transformers
rated at 5 watts. Up to 16 decibels of feedback may be taken from the voice coil. When tested on the Radio and Electronics
push pull 6V6 triode 4 watt amplifier a frequency response flat from below 20 c/s to 20 kc/s was easily achieved.

Brief specifications of the transformers are:—

Primary inductance at 1000 c/s.	70 henries.
Primary resistance.	350 ohms.
Leakage inductance.	60 millihenries.
Frequency response without feedback.	+ 1 db 30 c/s to 15 kc/s.
Insertion loss.	approx. 1 db at 5 watts input.
Termination.	C.T. Primary, long leads, Split secondary, 4 lugs, (Sections may be series or parallel connected.)

Unbalance Current: No special provision need be made to balance anode current in each half of the primary when normal valves are used.

Impedance Ratio: Cat. No. S56 5000 ohms P to P to 3.7 ohms or 15 ohms. Cat. No. S57 5000 ohms P to P to 2 ohms or 8 ohms.

Physical Dimensions: 2¼ in. high, 2¼ in. wide, 3½ in. long including mounting lugs. Weight 1 lb. 10 ozs.

ULTRALINEAR OUTPUT TRANSFORMERS

Considerable interest has recently been taken in the American ultralinear version of the famous Williamson amplifier. A re-
duction in distortion and an increase in power output over that of the Williamson amplifier has been claimed by the originators of
the circuit. As in the Williamson amplifier a major part is played by the design and construction of the output transformer.

BEACON makes a transformer rated at 30 watts which will work well when used in an ultralinear circuit. Screen taps are
available so that push-pull KT66 valves, or similar types, may be used as pentodes with a sharing of load between screens and
plates. The frequency response over the audio frequency band is excellent. We recommend this transformer for use in amplifiers
where greater power ouput than that obtainable from the normal Williamson amplifier is required.

Cat. No. S66, 30 watt ultralinear output transformer 6600 ohms P to P to 1-4-9-16 ohms.

INPUT TRANSFORMERS

A01 Class A Input, 1:2 ratio. Secondary C.T.

A03 Microphone to Grid. Pri. 75 ohms. 90:1 ration. Drawn can $1\frac{3}{8}$" square, 2" high. Long leads.

A04 Voice coil to Grid for intercommunication sets 1/106 ratio.

INPUT TRANSFORMERS — Wide Range, Low Loss, Astatically Wound, Isolated Core Can, Turret Terminals

A05 Mic. to Grid. Pri. 30-50 ohms. Sec. unterminated.

A06 Mic. to Line. Pri. 30-50 ohms. Sec. 600 ohms nominal.

A07 Line to Grid. Pri. 250 ohms, unterminated or across 500-600 ohms terminated.

INPUT TRANSFORMERS — Speech Frequencies, Clamp Mounted

A08 Mic. to Grid. Speech frequencies, 30-50 ohms to unterminated grid, 1:10 ratio.

A09 Mic. to Line. Speech frequencies 30-50 ohms to 250 ohms or 500 ohms, 1:3.2 ratio.

A10 Line to Grid. Speech frequencies 250 ohms or 500 ohms to grid, 1:3 ratio.

INPUT TRANSFORMERS — Wide Range, Astatically Wound, Double Shielded, Octal Plug Base

A12 Mic. to Grid. Shielded (plug in).

A13 Mic. to Line. " " "

A14 Line to Grid. " " "

INPUT TRANSFORMERS — Wide Range, Miniature, Clamp Mounted

A15 Mic. to Line. (Miniature).

A16 Mic. to Grid. (Miniature).

A17 Line to Grid. (Miniature).

SMOOTHING CHOKES

C01	Vibrator "A" Choke.	0.6 ohms
C22	20-60 mA. 30 Hen. 855 ohms smoothing Choke for use with "Williamson" Amplifier.	
C02	50 mA. 4 Henry.	500 ohms.
C03	60 mA. 10 Henry.	400 ohms.
C04	80 mA. 12 Henry.	300 ohms.
C05	100 mA. 12 Henry.	350 ohms.
C06	125 mA. 15 Henry.	275 ohms.
C07	150 mA. 12 Henry.	210 ohms.
C08	200 mA. 11 Henry.	160 ohms.
C09	250 mA. 12 Henry.	70 ohms.
C32	500 mA. 5 mH.	0.5 ohms Miniature.
C21	Charger control choke for use with Cat. No. R40.	
C16	4 amp. Smoothing, 0.05 Henry, 0.3 ohms.	

HIGH VOLTAGE CHOKES

Insulated for use with the Power Transformers for Transmitting Requirements.

C26	150 mA. Smoothing	16 Henries 160 ohms. 1750 volts.
C30	250 mA. Smoothing	14 Henries 100 ohms. 1750 volts.
C27	350 mA. Smoothing	12 Henries 85 ohms. 1750 volts.

SWINGING CHOKES

Insulated for use with the Power Transformers for Transmititng Requirements.

C29	150 mA. Swinging 29/16	Henries 160 ohms. 1750 volts.
C11	200 mA. Swinging 26/8	Henries 160 ohms. 1200 volts.
C12	250 mA. Swinging 25/5	Henries 70 ohms. 1200 volts.
C31	250 mA. Swinging 26/10	Henries 100 ohms. 1750 volts.
C28	350 mA. Swinging 18/8	Henries 85 ohms. 1750 volts.

AUDIO CHOKES

C23	0.8 Henry, Ferrox cube core.
C24	2.4 Henry, Ferrox cube core.
C25	1000 Henry, C.T. Audio frequencies, Mumetal core.

DRIVER TRANSFORMERS

D01	Class B input (6N7 or 19).
D02	p.p. 6J5/p.p.807 Class AB_2.
D03	p.p. 2A3/p.p. ZB120 Class B.
D04	p.p. 2A3/p.p. TZ20 Class B.
D05	p.p. 2A3/p.p.809 Class B.
D06	6V6 triode/p.p.807 Class AB_2.
D08	p.p. 6V6/p.p.807 Class B Zero bias.
D15	EL41 triode/p.p.807 Class AB_1.

TRANSISTOR DRIVER TRANSFORMERS

D09	Transistor OC71/p.p. OC72 1.75/1 Turns Ratio. Standard size.
D11	Valve/Transistor 12K5/OC16.
D13	Transistor OC71/p.p. OC72. 1.75/1 Turns Ratio. Miniature.
D14	Transistor General Purpose. 1.75/1 Turns Ratio. Miniature.
D16	Transistor GT81/p.p. GT109. 6/1 Turns Ratio. Miniature.

FILAMENT TRANSFORMERS

F01	2.5/6.3v. ½ amp. Auto transformer.
F02	2.5/6.3v. 2 amp. ,, ,,
F03	230v/2.5v. C.T. 5 amp. Low voltage insulation.
F04	230v/6.3v. 2 amp. ,, ,, ,,
F05	230v/6.3v. 3 amp. ,, ,, ,,
F12	230v/6.3v. 5 amp. ,, ,, ,,
F 10	For Valve Testers, etc. 230v/1.4 — 2 — 2.5 — 4 — 5 — 6.3 — 7.5 — 12.5 — 25 — 30v.
F13	230v/0—4—6.3v @ 3 amps; 6.3v @ 3 amps; C.T.; 5v @ 3 amps; 2.5v @ 6 amps; 2.5v @ 6 amps.
F14	230v/0—4—6.3v @ 2 amps; 6.3v 2 amps. C.T.; 0—4—6.3v @ lamp; 5v @ 3 amps.

C.R.T. OSCILLOSCOPE TRANSFORMERS

F08	230v/6.3v. @ 0.6A; 6.3v @ 0.8A; 2.5v @ 7.15A (for E.H.T. supply).
F09	AUTO 6.3v/2.5v,, with separate 6.3v. @ 0.6A (for E.H.T. supply from standard power transformer).

RECTIFIER FILAMENT TRANSFORMERS

F11	230/2.5v C.T. 10 amps 750v D.C. working.
F06	230/2.5v C.T. 10 amps 2500v. D.C. working.
F07	230/2.5v C.T. 10 amps 4000v D.C. working.
F19	230/10v C.T. 5 amps 1500v D.C. working.

GARAGE LIGHTING TRANSFORMERS

F16	230/24v @ 15 V.A.
F20	230/12v or 24v @ 360 V.A.
F21	230/12v or 24v @ 240 V.A.
F22	230/12v or 24v @ 180 V.A.
F23	230/12v or 24v @ 120 V.A.
F24	230/12v or 24v @ 60 V.A.
F25	230/12v at @ 40 V.A.

AIR CORED CHOKES FOR CROSS OVER NETWORKS — 15 OHM SPEAKERS

J 01	2.25 mH choke for 1500 c/s cross-over filter. Two chokes and two 5 mfd condensers are required.
J 04	4 mH choke for 8 33 c/s cross-over filter. Two choke and two 9 mfd condensers are required.

SEE PAGE 22 FOR CIRCUIT DIAGRAM

MODULATION TRANSFORMERS

M07	10 Watt Multi Match.
M01	30 Watt Multi Match.
M06	50 Watt Multi Match.
M03	100 Watt Multi Match.

SEE PAGE 24 FOR OPERATING DETAILS

M04	5 Watt 16,000 ohms P to P/5000 ohms Sec.
M05	5 Watt 16,000 ohms P to P/6000 ohms Sec.
M08	7000/9100 ohms AUTO 30 mA./40mA. D.C.

POWER TRANSFORMERS FOR TRANSMITTING REQUIREMENTS

Except for the lower voltage transformer Cat. No. P04 these transformers are tapped to deliver D.C. volages of 1250v, 1000v or 750v using 866 A rectifiers. Swinging chokes are available for use in the capacities listed below. All high-tension terminals are well insulated.

Cat. No.		
P01	150 m.a.	1460/1180/900v aside.
P02	250 m.a.	1460/1180/900v aside.
P03	350 m.a.	1460/1180/900v aside.
P04	250 a.m.	delivers 750v, 600v or 500v D.C. when used with 866A's.

POWER TRANSFORMERS

The transformers listed are available in various mountings depending upon the size of the laminations. Where a choice is available please indicate which mounting is required.

C = Clamp — long lead terminations.

V = Vertical — long lead terminations.

F = Flat — Wrap on terminal board.

Vertical mounting transformers will be supplied unless flat mounting is specifically asked for.

If essenital 2.5 volt or 12.6 volt filament windings of the same wattage rating as the 6.3 volt filament winding can be substituted at an additional cost of 10%.

R33	V	5mA 2000v Halfwave, 6.3v @ 0.6A; 2.5v @ 1.75A.

SEE PAGE 23 FOR COLOUR CODE

R34	C	30mA 110v Halfwave, 6.3v @ 1A.
R64	C	30mA 220v Halfwave, 6.3v @ 1.9A.
R57	V	35mA 190/190v, 6.3v @ 2.5A.
R01	C	30mA 150/150v, 6.3v @ 1.5A.
R89	C	40mA 175v Halfwave, 6.3v @ 1.6A.
R68	V	42mA 250/250v, 6.3v @ 2.3A.
R70	V	47mA 175/175v, 6.3v @ 1.85A.
R54	V	50mA 250/250v, 6.3v @ 3A.
R63	C	53mA 85v Halfwave.
R87	V or F	55mA 245/245v, 6.3v @ 2.4A.

R85	V or F	60mA 225/225v, 6.3v @ 2A; 6.3v @ 1A.
R84	V or F	60mA 260/260v, 6.3v @ 2A; 6.3v @ 0.6A.
R02	V or F	60mA 280/280v, 6.3v @ 3A.
R88	V or F	60mA 280/280v, 6.3v @ 3A. Low flux density for tape recorders.
R03	V or F	60mA 280/280v, 6.3v @ 2A; 5v @ 2A.
R04	V or F	60mA 350/350v, 6.3v @ 2A; 5v @ 2A.
R32	C	65mA 110v Halfwave.
R55	C	65mA 110v Halfwave.
R05	V or F	80mA 280/280v, 6.3v @ 3A; 5v @ 2A.
R71	V	80mA 280/280v, 6.3v @ 3.5A.
R06	V or F	80mA 330/330v, 6.3v @ 3A; 5v @ 2A.
R07	V or F	80mA 385/385v, 6.3v @ 3A; 5v @ 2A.
R08	V or F	100mA 310/310v, 6.3v @ 4A; 5v @ 2A.
R09	V or F	100mA 385/385v, 6.3v @ 4A; 5v @ 2A.
R38	V or F	125mA 310/310v, 6.3v @ 4A; 5v @ 2A.
R10	V or F	125mA 310/310v, 6.3v @ 2A; 6.3v @ 2.5A; 5v @ 3A.
R11	V or F	125mA 400/400v, 6.3v @ 4A; 5v @ 3A.
R39	V or F	150mA 310/310v, 6.3v @ 5A; 5v @ 3A.
R17	V or F	150mA 310/310v, 6.3v @ 3A; 6.3v @ 3A; 5v @ 3A.
R13	V or F	150mA 400/400v, 6.3v @ 5A; 5v @ 3A.
R14	V or F	150mA 400/400v, 6.3v C.T. @ 3A; 6.3v@ 3A; 5v @ 3A.
R52	V or F	150mA 425/425v, 6.3v C.T. @ 4A; 5v @ 3A.
R15	V or F	200mA 400/400v, 6.3v @ 4A; 6.3v @ 3A; 5v @ 3A.
R16	V or F	200mA 500/500v, 6.3v @ 4A; 6.3v @ 3A; 5v @ 3A.
R53	V or F	250mA 565/565v, 6.3v @ 2.5A; 5v @ 2A. Choke Input.

VIBRATOR TRANSFORMERS

R18	30 mA	6v — 115v.
R19	30 mA	6v — 135v.
R20	30 mA	6v — 150v.
R83	50 mA	6v or 12v — 230v.
R74	50 mA	6v — 235v D.C. using 6X4 Rectifier.
R75	50 mA	12v — 235v D.C. using 6X4 Rectifier.
R86	50 mA	6v or 12v — 250v.
R21	50 mA	6v — 250v.
R22	50 mA	12v — 250v.
R49	60 mA	6v — 200v.
R51	60 mA	12v — 200v.
R23	75 mA	6v — 275v.

R56	75 mA	12v — 275v.
R48	95 mA	6v — 270v.
R50	95 mA	12v — 270v.
R24	100 mA	6v — 300v.
R25	100 mA	12v — 300v.
R60	110 mA	12v — 90v — 135v Intermittent.
R61	110 mA	6v — 90v — 135v ,,
R26	150 mA	12v — 360v.

VIBRATOR — MAINS TRANSFORMERS

R72	50 mA	12v/230v; 250/250v; 12.6v @ 1 amp.
R73	50 mA	6v/230v; 250/250v; 6.3v @ 2 amp.

BATTERY CHARGER TRANSFORMERS

R26	½ amp. 6 volts D.C. output from full wave C.T. rectifier. Use with ballast.
R27	1 amp. 6 volts D.C. output from full wave C.T. rectifier. Use with ballast.
R82	1 amp. 6 or 12 volts D.C. full wave Bridge rectifier. Use with ballast.
R28	2 amp. 6 volts D.C. output from full wave C.T. rectifier. No ballast.
R35	2 amp. 6 volts D.C. output from full wave C.T. rectifier. Use with ballast.
R29	2 amp. 12 volts D.C. output from full wave C.T. rectifier. Use with ballast.
R77	2.5 amp. 6 or 12 volts D.C. full wave Bridge rectifier. Use with ballast.
R78	4 amp. 6 or 12 volts D.C. full wave Bridge rectifier. Use with ballast.
R62	5 amp. 12 volts D.C. output from full wave Bridge rectifier. Use with ballast.
R40	5 amp. 36 volts D.C. output from full wave Bridge rectifier.
R41	5 amp. 90 volts D.C. output from full wave Bridge rectifier. (Choke C21.)
R79	6 amp. 6 or 12 volts D.C. full wave Bridge rectifier. Use with ballast.
R80	6 amp. 6 to 36 volts D.C. full wave Bridge rectifier. Use with ballast.
R42	6 amp. 33-55 volts output from half wave Bulb rectifier (with rectifier filament and 6.8 volt extension lamp windings).
R31	30 amp. 6 or 12 volts D.C. output from full wave Bridge rectifier.

HIGH FIDELITY OUTPUT TRANSFORMERS

These are designed for use in equipment where wide frequency range and low distortion are essential. In general, the transformers with **RADIO METAL CO RES,** listed below, give a response within 1 D.B. from 20 c/s to 20 Kc/s. Those with SUPER SILCOR CORES are down approx. 2 D.B. @ 20 c/s. Those with SILICON STEEL CORES are down approx. 3 D.B. @ 20 c/s.

Trans. Rating Watts	Prim. Load Ohms.	Sec. Load Ohms.	For Use with Amp	Radio Metal	Super Silcor	Silicon Steel
5	5000	3.7-15	R. & E.	S 56	—	—
5	5000	2-8	AUG. 1950	S 57	—	—
10	3000	1-4-9-16	—	S 01	S 11	S 21
10	5000	1-4-9-16	—	S 02	S 12	S 22
10	10,000	1-4-9-16	—	S 83	S 88	S 89
10	6000/8000	3.7-15	PHILIPS	—	—	S 71
10	6000/8000	2-8	MULLARD	—	—	S 72
12	7000	3.7-15	OSRAM 912	—	—	S 81
15	3000	1-4-9-16	—	S 03	S 13	S 23
15	4000	1-4-9-16	—	S 04	S 14	S 24
15	5000	1-4-9-16	—	S 05	S 15	S 25
15	10,000	1-4-9-16	WILLIAMSON	S 06	S 16	S 26
15	10,000	31-500	—	S 10	S 20	S 30
20	4000	1-4-9-16	—	S 07	S 17	S 27
20	6600	1-4-9-16	—	S 53	S 58	—
20	8000	1-4-9-16	—	S 80	S 90	—
20	9000	1-4-9-16	—	S 08	S 18	S 28
20	10,000	1-4-9-16	—	S 09	S 19	S 29
30	6600	1-4-9-16	ULTRA LINEAR	—	S 66	—

See Page 21 for electrical data of above transformers.

OUTPUT TRANSFORMERS

3 WATTS

S33	5000/3 ohm		Core Size: Tongue 9/16" Stack 11/16"
S34	7000/3 ohm		
S35	10000/3 ohm	C.T. Prim.	
S36	14000/3 ohm	C.T. Prim.	
S37	18000/3 ohm	C.T. Prim.	

3 Watt Replacement Type

S73	5000/3.5 ohm	Core Size: Tongue 9/16" Stack 9/16"
S74	7000/3.5 ohm	
S75	10000/3.5 ohm	
S76	15000/3.5 ohm	

6 WATTS

S38	5000/3 ohm		Core size 3/4" x 3/4" x 1 1/8".	
S39	7000/3 ohm		" " " " "	
S40	10000/3 ohm	C.T. Prim.	" " " " "	
S41	14000/3 ohm	C.T. Prim.	" " " " "	
S42	18000/3 ohm	C.T. Prim.	" " " " "	
S67	5000/2 ohm		" " " " "	These transformers have a higher primary inductance, and therefore a better low frequency response, than the standard 6 watt output transformers.
S68	5000/3.7 ohm		" " " " "	
S69	5000/5 ohm		" " " " "	
S70	7000/3.5 ohm		" " " " "	

OUTPUT TRANSFORMER REPLACEMENT WINDINGS

Replacement windings for all the above transformers are available. The S33 - S37 group, S46 and S60, are available on layer wound wax impregnated formers only. The remainder are available on moulded bobbins. In addition to the above, the following replacement windings are also available.

S46	Replacement windings, 7000/3 ohm.	Core size 11/16" x 13/16" x 1" long.
S60	Replacement windings, 10,000/3 ohm.	Core size 11/16" x 13/16" x 1" long.
S91	" " 5000/3.5 ohm.	" " 1/2" x 1/2" x 3/4" long.
S92	" " 7000/3.5 ohm.	" " 1/2" x 1/2" x 3/4" long.
S93	" " 10,000/3.5 ohm.	" " 1/2" x 1/2" x 3/4" long.
S94	" " 15,000/3.5 ohm.	" " 1/2" x 1/2" x 3/4" long.

LINE MATCHING TRANSFORMERS

S50	3 watt Pri. 600 ohms, or 150 ohms nominal Line/V.C. multimatch.	See Page 20 for matching chart.
S51	6 watt Pri. " " " " " " " "	
S52	10 watt Pri. " " " " " " " "	
S55	3 watt 15 ohms — 3.7 ohm matching transformer, Speech frequencies.	
S31	0—2—4—8—15 ohm Auto transformer, for use with 1500 c/s crososver network.	

UNIVERSAL OUTPUT TRANSFORMERS

The 3 watt and 6 watt transformers are butt packed. The 10 watt transformers are interleaved and are most suitable for push-pull output stages.

The 20 watt transformers have output tappings suitable for line impedances as well as voice coil impedances. These transformers are average quality and particularly suitable for home experimenters.

The 35 watt and 60 watt transformers have interwound primary and secondary pies. These transformers give excellent performance over the audio band from approximately 40 c/s to 10,000 c/s.

S43	3 watt Universal Output.	See Page 18 for matching chart.
S44	6 watt " "	
S45	10 watt " "	
S32	20 watt " "	See Page 19 for matching chart.
S54	35 watt " "	
S65	60 watt " "	

TRANSISTOR OUTPUT TRANSFORMERS

S86	150 Milli Watt	900 Ohms — P.P.	GT109/3 Ohms	Wide Range. Miniature.
S87	150 Milli Watt	900 Ohms — P.P.	GT109/3 Ohms	Speech Freq. Std.
S77	200 Milli Watt	400 Ohms — P.P.	OC72/3 or 5 Ohms	High Efficiency & Quality.
S79	200 Milli Watt	320 Ohms — P.P.	OC72/3 Ohms	Speech Freq. Std.
S82	1.5 Watts	24 Ohms	OC16/3.5 Ohms	Wide Range.

DOOR CHIME TRANSFORMER

U02 230v/15v. @ 0.5A.

PHOTOFLASH IGNITION TRANSFORMER

U04 Photoflash Ignition transformer. For use in condenser-discharge-through-primary circuit.

ELECTRIC FENCE TRANSFORMERS

U03 for building into electric fence units, with separately energised contactor, 6 volt input.

U05 as above but for long-dwell contactors.

BELL TRANSFORMER

U06 230v/3-5-8v @ 1 Amp.

MAINS ISOLATING TRANSFORMERS

V25	15 V.A.	230/230V.	
V26	25 V.A.	" " "	Standard finish is vertical mounting, pressed steel end shrouds, 3 core prim. flex, 2 core sec. flex. If required in can, add letter "C" to Cat. No.
V27	50 V.A.	" " "	
V28	100 V.A.	" " "	
V29	150 V.A.	" " "	
V30	250 V.A.	" " "	Standard finish is compound filled can with carrying handle. 3 core flex prim. Flush mounted 3 pin socket sec. If required for wall mounting add "W" to Cat. No. For floor fixing add "B" to Cat. No.
V31	500 V.A.	" " "	
V32	750 V.A.	" " "	
V33	1000 V.A.	" " "	
V34	1250 V.A.	" " "	
V35	1500 V.A.	" " "	
V36	2000 V.A.	" " "	
V37	2500 V.A.	" " "	
V38	3000 V.A.	" " "	As above but with Reyrolle sec. socket.
V39	4000 V.A.	" " "	Mounted as required.
V40	5000 V.A.	" " "	

STEP DOWN TRANSFORMERS

V41	15 V.A.	230/115V.	Standard finish, 3 core flex on prim., 2 core flex on sec.
V42	25 V.A.	" " "	
V43	50 V.A.	" " "	Standard finish, 3 core flex on prim., T pin socket on sec.
V44	100 V.A.	" " "	
V45	150 V.A.	" " "	
V46	250 V.A.	" " "	Standard finish is compound filled can with carrying handle. 3 core flex on prim., flush mounted T pin socket on sec.
V47	500 V.A.	" " "	
V48	750 V.A.	" " "	
V49	1000 V.A.	" " "	
V50	1250 V.A.	" " "	Can as above but with crabtree 3 round pins socket.
V51	1500 V.A.	" " "	
V52	2000 V.A.	" " "	
V53	2500 V.A.	" " "	Can as above but with Reyrolle socket.
V54	3000 V.A.	" " "	
V55	4000 V.A.	" " "	Mounted as required.
V56	5000 V.A.	" " "	

AUTO TRANSFORMERS

V57	100 V.A.	230/115V.
V58	350 V.A.	" " "
V59	600 V.A.	" " "
V60	1000 V.A.	" " "

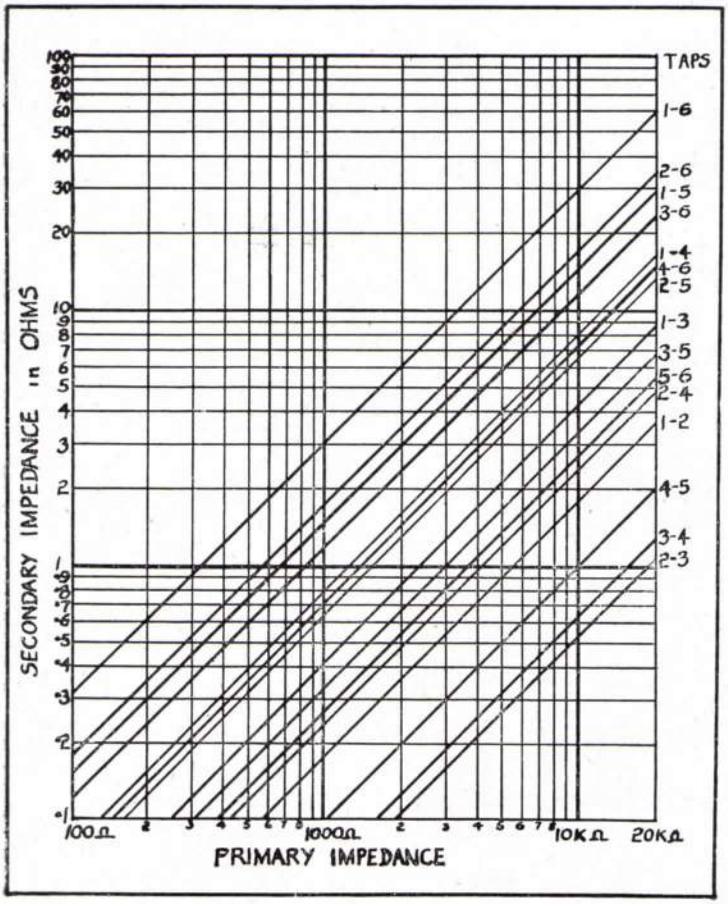
HEDGE CLIPPER TRANSFORMERS

V23	230 V.A.	230/230V.	Mounted in galvanised steel can with carrying handle and ground spikes. Reyrolle socket on sec.
V24	230 V.A.	230/115V.	

BEACON universal output transformers are designed to give correct impedance matching between a wide variety of output valves, operated either singly or in push pull, and most loud-speaker voice coils. For single ended operations, the red primary centre tap is ignored and one blue lead connected to the valve anode, the other being connected to the high tension supply. For push-pull operation the blue leads are connected to the valve anodes and the red becomes the high tension connection. The 3 watt and 6 watt sizes are suitable for both single and push pull operation, the 10 watt size is normally manufactured to give best results where there is very little unbalanced direct current in the primary winding, as is generally the case in push pull operation.

To use the GRAPH follow these simple directions, and no difficulty should be experienced in selecting the correct secondary taps for use with any given primary impedance and voice coil impedance.

IMPEDANCE MATCHING GRAPH for BEACON 3 watt 6 watt and 10 watt UNIVERSAL TRANSFORMERS



(1) Ascertain from published valve data the correct anode load plate to plate load in the case of push pull valves.

(2) Locate the impedance along the bottom edge of the graph and draw a **vertical** line form this point.

() Similarly locate the correct voice coil impedance with the aid of the figures on the lefthand side of the graph. Draw a **horizontal** line from this point.

(4) The **diagonal** line nearest the point where the two lines cross, will indicate which secondary taps to use.

As an example take the case of 6V6GT with recommended anode load of 5,000 ohms, being required to work with a 3.7 ohm voice coil. Using the procedure outlined above, the correct secondary taps are found to be 4 and 6.

If neither voice coil impedance nor anode load impedance are known, the correct secondary connections may readily be determined by trial, but when they are known the graph should save valuable time by assisting in the selection of the taps.

UNIVERSAL OUTPUT TRANSFORMERS

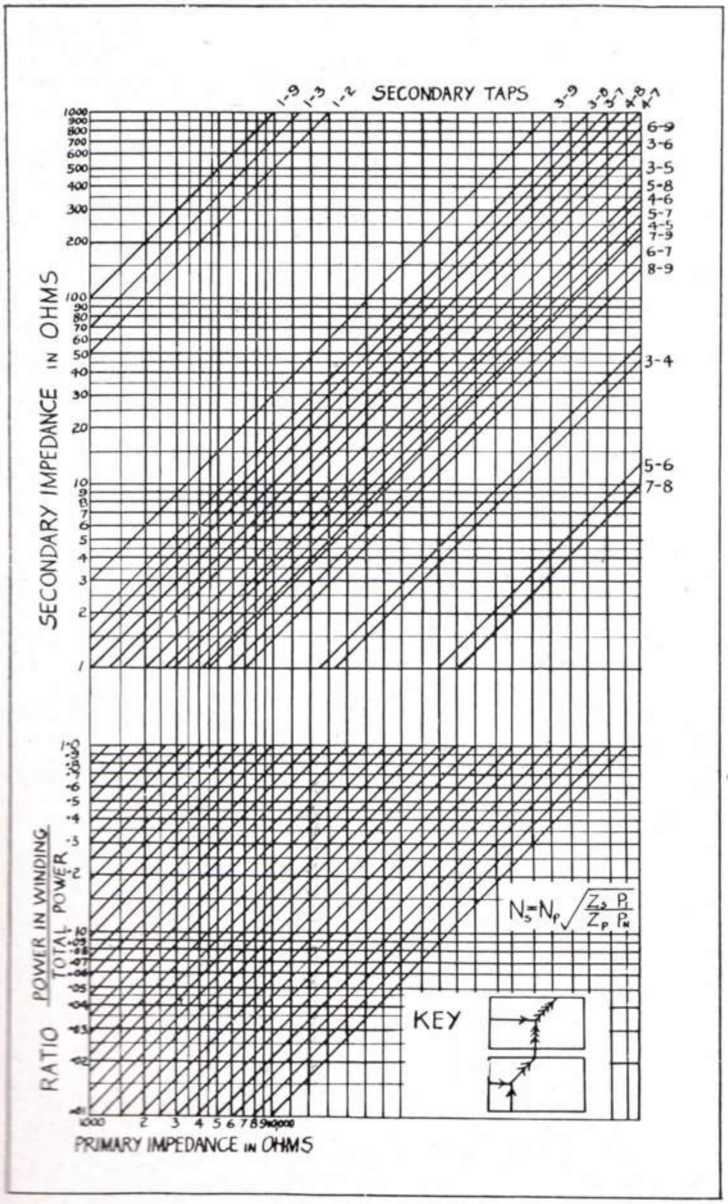
INSTRUCTIONS 20 watt, 35 watt and 60 watt

These BEACON Universal Transformers are designed to give correct impedance matching between push-pull output valves and a line or loudspeaker voice coils over frequencies from 40 c/s to 10 kc/s. Provision is made on the graph for choosing secondary taps to match several speakers to the one set of output valves even though each speaker voice coil may have different power requirements.

After a little practice, no difficulty should be experienced in using the graph.. To use the graph the following simple directions should be followed. The Key shown on the graph will assist in carrying out the correct sequence of operation.

(1) Ascertain from published valve data the correct plate to plate load.

(2) Locate this impedance along the bottom edge of the graph marked **Primary Impedance** in **ohms** and draw a **vertical** line from this point.



(3) On the left hand side of the lower portion of the graph locate the decimal quantity that expresses the proportion of power required to be delivered to the loud speaker or line under question. Draw a **horizontal** line through this point. As an example two speakers may be used with one quarter of the total power to be delivered to one and the remaining three-quarters of the total power to the other. The power ratios as decimal quantities would of course be 0.25 and 0.75.

(4) Using the **diagonal** lines as a guide proceed from the intersection of the ratio and impedance lines to the unity ratio line.

(5) From this point go **vertically** again until opposite the required voice coil impedance.

(6) The nearest **diagonal** line through this point of intersection will give the correct secondary taps to use for that speaker.

(7) Repeat the sequence for the other speakers in turn.

EXAMPLE:—A pair of 6v6 valves working into a plate to plate load of 8000 ohms are required to deliver 12 watts of audio signal to a 15 ohm speaker and 2 watts to a 3 ohm speaker. (The proportion of power is 12/4 or 0.86 and 2/14 or 0.14). From the graph it may be seen that the taps to use for the 15 ohm speaker are 3 and 7. The 3 ohm speaker should be connected to taps 3 and 4.

If the full 14 watts is required to be delivered to the 1-5 ohm speaker it will be seen from the graph that taps 3 and 8 should be used. In this case the lower section of the graph is ignored and a vertical line drawn from the required primary impedance until opposite the correct voice coil impedance.

UNIVERSAL LINE MATCHING TRANSFORMERS

3 watt, 6 watt and 10 watt :: INSTRUCTONS

BEACON universal line matching transformers are designed to give correct impedance matching between a wide variety of line impedances and speaker voice coil impendances. The primary is wound in two sections so that either series or parallel connections may be used depending upon the line impedance. For series primary operation the two red leads are joined together and the two blue leads connected to the line. For parallel primary operation join the red lead of one winding to the blue lead of the other winding, and vice versa.

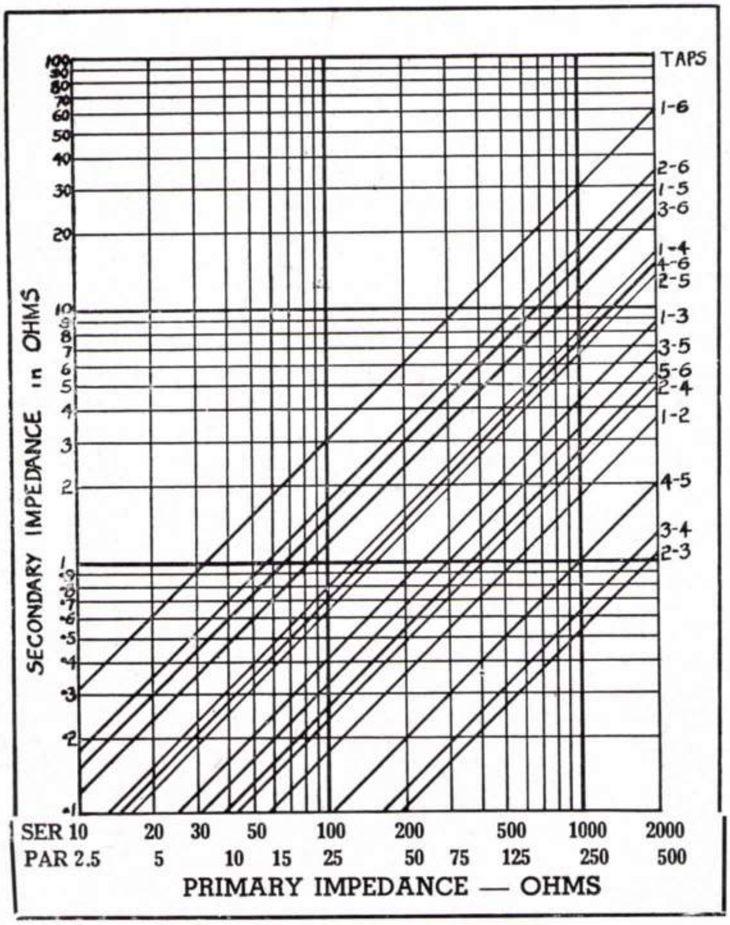
It will be noted that some impendance ratios can be satisfied with either series or parallel primary connections. For example, 500/2 ohms. With the series connection, secondary taps 1 - 3 would be used. With the parallel connection, seocndary taps 4 - 5 would be used. Both connections will give satisfactory operation, the difference being that the series connection will give a better low frequency response whereas the parallel connection gives the minimum overall power loss.

To use the graph, follow these simple directions:

IMPEDANCE MATCHING GRAPH

for 3 watt, 6 watt and 10 watt

UNIVERSAL LINE MATCHING TRANSFORMERS



(1) Having decided upon the method of connection, locate the line impedance along the respective base line. Draw a **vertical** line from this point.

(2) Locate the voice coil impedance along the left hand side of the graph. Draw a **horizontal** line from this point.

(3) The diagonal line nearest the point where the two lines cross will indicate which secondary taps to use.

As an example, assume that it is desired to match a 3 ohm speaker to a 500 ohm line, maintaining a good low frequency response. The series connection should be used and the secondary taps are found to be 2 - 5.

A further example — match a 15 ohm speaker to a 250 ohm line. The parallel connection must be used and the secondary taps are found to be 2 - 6.

BEACON HIGH FIDELITY TRANSFORMERS

ELECTRICAL DATA (approximate values)

Cat. No.	Rating	Impedance	Initial Primary Inductance at 5 volts. 20 c/s.	Leakage Inductance	Primary Resistance
S 01 S 11 S 21	10 watts	3000 ohms C.T. to 1-4-9-16 ohms	65 Henries 33 " 14 "	10 mh	145 ohms
S 02 S 12 S 22	10 wats	5000 ohms C.T. to 1-4-9-16 ohms	110 Henries 55 " 23 "	10 mh	230 ohms
S 03 S 13 S 23	15 watts	3000 ohms C.T. to 1-4-9-16 ohms	55 Henries 28 " 14 "	10 mh	80 ohms
S 04 S 14 S 24	15 watts	4000 ohms C.T. to 1-4-9-16 ohms	70 Henries 35 " 18 "	10 mh	110 ohms
S 05 S 15 S 25	15 watts	5000 ohms C.T. to 1-4-9-16 ohms	100 Henries 50 " 25 "	10 mh	160 ohms
S 06 S 16 S 26	15 watts	10,000 ohms C.T. to 1-4-9-16 ohms	180 Henries 85 " 50 "	15 mh	250 ohms
S 07 S 17 S 27	20 watts	4000 ohms C.T. to 1-4-9-16 ohms	65 Henries 45 " 20 "	16 mh	115 ohms
S 08 S 18 S 28	20 watts	9000 ohms C.T. to 1-4-9-16 ohms	160 Henries 100 " 45 "	16 mh	240 ohms
S 09 S 19 S 29	20 watts	10,000 ohms C.T. to 1-4-9-16 ohms	190 Henries 90 " 50 "	16 mh	270 ohms
S 10 S 20 S 30	15 watts	10,000 ohms C.T. to 31 or 500 ohms	180 Henries 85 " 50 "	15 mh	250 ohms
S 53 S 58	20 watts	6600 ohms C.T. to 1-4-9-16 ohms	130 Henries 65 "	15 mh	175 ohms
S 56	5 watts	5000 ohms C.T. to 3.7 or 15 ohms	135 Henries	60 mh	350 ohms
S 57	5 watts	5000 ohms C.T. to 2 or 8 ohms	135 Henries	60 mh	350 ohms
S 66	30 watts Ultra Linear	6600 ohms C.T. to 1-4-9-16 ohms	90 Henries	15 mh	87 ohms
S 71	10 watts	6000/8000 ohms C.T. to 3.7 or 15 ohms	50 Henries	24 mh	415 ohms
S 72	10 watts	6000/8000 ohms C.T. to 2 or 8 ohms	50 Henries	24 mh	415 ohms
S 80 S 90	20 watts	8000 ohms C.T. to 1-4-9-16 ohms	150 Henries 85 "	16 mh	195 ohms
S 81	12 watts Ultra Linear	7000 ohms C.T. to 3.7 or 15 ohms	55 Henries	17 mh	257 ohms
S 83 S 88 S 89	10 watts	10,000 ohms C.T. to 1-4-9-16 ohms	220 Henries 110 " 46 "	12 mh	405 ohms

BEACON TRANSFORMERS FOR THE WILLIAMSON AMPLIFIER

POWER TRANSFORMERS

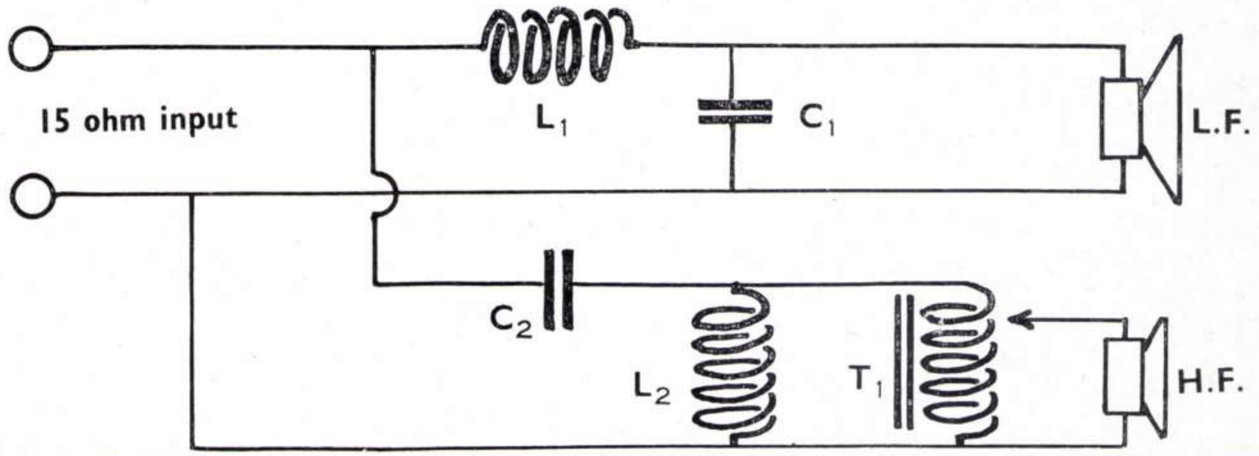
Cat. No.	R 52	150 m.a.	425 volt aside, 5 volt at 3 amp, 6.3 volt at 4 amp C.T.
Cat. No.	R 53	250 m.a.	choke input, 565 volt aside, 5 volt at 2 amp, 6.3 volt at 2.5 amp.

FILTER CHOKES

Cat. No.	C 22	20 m.a.	30 henry	855 ohms
Cat. No.	C 07	150 m.a.	12 henry	210 ohms
Cat. No.	C 09	250 m.a.	12 henry	70 ohms

CROSS-OVER NETWORK (for 15 ohm low frequency speaker)

Cat. No.	J 01	2.25 mH choke for 1500 c/s cross-over filter. Two chokes and two 5 mfd condensers are required.
Cat. No.	J 04	4 mH choke for 833 c/s cross-over filter. Two chokes and two 9 mfd condensers are required.
Cat. No.	S 31	0 - 2 - 4 - 8 - 15 ohm auto transformer for tweeter unit where the tweeter voice coil is less than 15 ohms, Radiometal core.



OUTPUT TRANSFORMER

A range of output transformers is carried in stock. Transformers in this range are made with three grades of core material. The low frequency response differs with each grade of material, but the high frequency response remains unchanged.

The frequency response of the transformers having a nickel iron alloy core is rated at ± 1 db from 20 c/s to 20 kc/s. The next two grades of core material, namely supersilcor and silicon steel, restrict the low frequency response by approximately 1 octave and 2 octaves respectively above 20 c/s. At full output the frequency response of the transformers is virtually the same for all three grades.

The better grade transformers can be wired directly into the Williamson circuit. With the other two grades of transformer some reduction of feedback voltage may be necessary to avoid instability of the amplifier.

This range of transformers performs excellently in circuits employing push-pull pentode output stages working class A or class AB. Some modification of the overall frequency response is to be expected when pentodes are used in the place of triodes. A rising characteristic at 20 kc/s and above is found in the output voltage response curve. The low frequency response is not quite as good as when the same transformer is used with triodes.

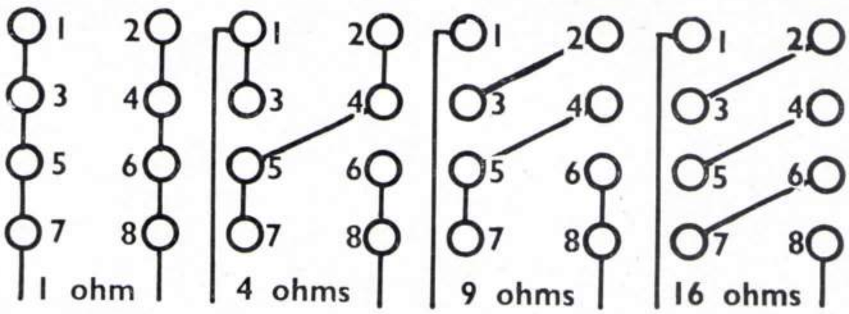
Output transformers for special purposes such as the Acros ultra linear version of the Williamson amplifier, can be wound to order.

PHYSICAL DIMENSIONS OF BEACON HIGH FIDELITY OUTPUT TRANSFORMERS

Power	Width	Length	Height	Mtg. Centres	Weight
5 watt	2.1/4"	3.1/2"	2.1/4"	3.1/8"	1.3/4 lb
10 watt	2.1/2"	3.7/8"	3.1/4"	2.1/8" x 2.1/4"	3.1/2 lb
15 watt	3.1/4"	4.1/2"	3.7/8"	2.5/8" x 2.1/2"	6.1/2 lb
20 watt	3.1/4"	4.3/4"	3.7/8"	2.5/8" x 2.3/4"	7 lb
30 watt	3.3/4"	7"	4.5/8"	6.3/8" x 3"	12 lb

HIGH FIDELITY OUTPUT TRANSFORMERS

These are designed for use in equipment where wide frequency range and low distortion are essential. In properly designed inverse feedback circuits such as the Radiotronics A 515 and the Williamson Amplifier, the very low leakage inductance of these transformers avoids instability when employing large amounts of feedback.



For finest results the Radiometal type is recommended, although results much better than with normal multi-match transformers can be obtained from the other types.

Connections to match various secondary loads are shown above. All primaries are split to enable currents to be balanced.

BEACON RADIO LTD. — COLOUR CODE

INPUT TRANSFORMERS

Inside Primary	Red
Outside "	Blue
Inside Secondary	Green
C.T. "	Black
Outside "	Green

SINGLE ENDED OUTPUT TRANSFORMERS

Inside Primary	Red
Outside "	Blue

OUTPUT TRANSFORMERS

Inside Primary	Blue
C.T. "	Red
Outside "	Blue

12 VOLT VIBRATOR TRANSFORMERS

Inside Primary	Black
C.T. "	Yellow
Outside "	Black
Inside Secondary	Red
C.T. "	Yellow
Outside "	Red

POWER TRANSFORMERS

Inside Primary	Black or Blue
Outside "	Black or Blue
Inside H.T.	Red
C. T. H.T.	Yellow
Outside H.T.	Red
5v	Red
6.3v	Yellow
6.3v	Green
2.5v	Black

6 VOLT VIBRATOR TRANSFORMERS

Inside Primary	Green
C.T. "	Yellow
Outside "	Green
Inside Secondary	Red
C.T. "	Yellow
Outside "	Red

C.R.T. OSCILLOSCOPE TRANSFORMER—Cat. No. R 33.

Lead Colour Code	Winding
Blue	230 volt primary
Orange	Electrostatic shield
Green	6.3 volt @ 0.6 amp.
Black	2,000 volt @ 5 m.a.
Red	2.5 volt @ 1.75 amp. tied to other end of 2,000 volt winding.

All secondary windings have the same insulation between them and to earth. The windings are in the order shown with the 2.5 volt winding on the outside.

MULTI-MATCH MODULATION TRANSFORMER CONNECTIONS

CODE	PRIMARY			SECONDARY		CONNECTIONS				
	P.	H.T.	P			Join the terminals shown.				
A	8	9-10	11	1	6	9 & 10	3 & 4			
B	7	9.10	12	1	6	9 & 10	3 & 4			
C	8	9-10	11	2	6	9 & 10	3 & 4			
D	1	3.4	6	7	12	9 & 10	3 & 4			
E	1	3-4	6	8	12	9 & 10	3 & 4			
F	7	9-10	12	2	6	9 & 10	3 & 4			
G	1	3-4	6	8	11	9 & 10	3 & 4			
H	8	9-10	11	1	3	9 & 10	1 & 4	3 & 6		
J	1	3-4	6	7	12	8 & 10	3 & 4			
K	7	9-10	12	1	3	9 & 10	1 & 4	3 & 6		
L	1	3-4	6	7	9	9 & 12	3 & 4	7 & 10		
M	1	3-4	6	8	9	9 & 11	3 & 4	8 & 10		
N	1	2-5	3	7	12	1 & 4	2 & 5	3 & 6	9 & 10	
P	1	2-5	3	8	12	1 & 4	2 & 5	3 & 6	9 & 10	
Q	1	2-5	3	8	11	1 & 4	2 & 5	3 & 6	9 & 10	
R	1	2-5	3	7	12	1 & 4	2 & 5	3 & 6	8 & 10	
S	1	2-5	3	7	9	1 & 4	2 & 5	3 & 6	7 & 10	9 & 12
T	1	2-5	3	8	9	1 & 4	2 & 5	3 & 6	8 & 10	9 & 11

MULTI-MATCH MODULATION TRANSFORMER — CHOICE OF CONNECTION

MODULATOR LOAD

in Kilo Ohms. Class C Load in Kilo Ohms.

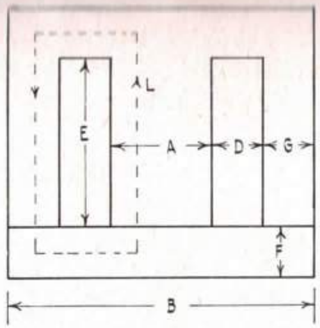
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	S	R	Q	P	P	N	N							
3	T	S	R	R	Q	Q	P	P	N	N	N			
4	T	S	S	R	R	Q	Q	Q	P	P	P	N	N	N
5		T	S	S	R	R	R	Q	Q	Q	Q	P	P	P
6		T	T	S	S	R	R	R	R	Q	Q	Q	Q	Q
7	K	H	F	E	D	C	B	B	B	A	A	A	A	A
8	K	J	G	F	E	D	C	B	B	B	A	A	A	A
9	L	J	H	G	E	E	D	C	B	B	B	B	A	A
10	L	K	H	G	F	E	D	D	C	B	B	B	B	B
11	L	K	J	H	G	F	E	D	D	C	B	B	B	B
12	M	L	J	H	G	F	E	E	D	D	C	C	B	B
13	M	L	J	J	H	G	F	E	E	D	D	C	C	B
14	M	L	K	J	H	G	F	F	E	E	D	D	C	C
15	M	L	K	J	H	H	G	F	E	E	D	D	D	C

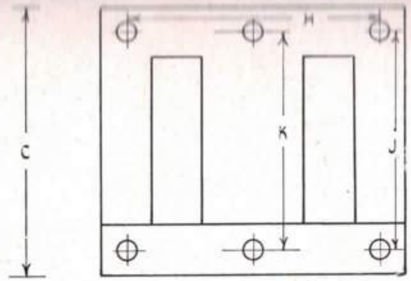
Locate code letter at the intersection of the linescorresponding to the modulator plate load and class C load and then refer to transformer connections.

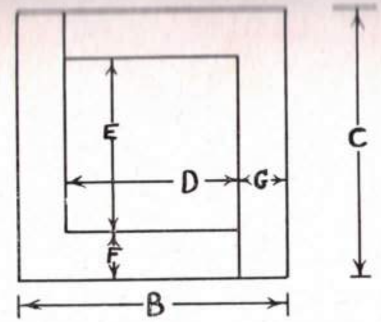
Depending upon connections, which may be obtained from the charts supplied with transformers, the permissable currents are as follows:—

Catalogue Number / Audio Power	M07 10 watts.	M01 30 watt.	M06 50 watt.	M03 100 watt.
Maximum modulator plate current per tube	150 MA or 50 MA.	100 mA. or 55 mA.	200 mA. or 100 mA.	360 mA. or 180 mA.
Total permissable Class "C" plate current.	100 MA. or 50 mA.	110 mA. or 55 mA.	200 mA. 100 mA.	360 mA. or 180 mA.

51635
= 280/7v = [illegible] 4000
4000 Mod
4000 P.







LAMINATIONS used by BEACON RADIO LIMITED

LAMINATION NUMBERS					TONGUE	OVERALL		WINDOW		LIMBS		MOUNTING CENTRES			MAG. PATH	TYPE
Beacon	M.E.A.	Rola	Sankey	Scott	A	B	C	D	E	F	G	H	J	K	L	
—	187	—	—	—	¼ in.	1 in.	¾ in.	¼ in.	½ in.	⅛ in.	⅛ in.	—	—	—	2 in.	E, E
—	67	—	—	—	—	1⅜ in.	1⅜ in.	⅝ in.	⅝ in.	⅜ in.	⅜ in.	—	—	—	4 in.	L, L
—	36	—	—	—	7/16 in.	1 27/32 in.	1½ in.	29/64 in.	1 in.	¼ in.	¼ in.	—	—	—	3.87 in.	E, I
—	—	*	—	—	½ in	1½ in.	1¼ in.	¼ in.	¾ in.	¼ in.	¼ in.	—	—	—	3¼ in.	,, ,,
00	18	1	219	212	9/16 in.	1 11/16 in.	1 13/32 in.	9/32 in.	27/32 in.	9/32 in.	9/32 in.	—	—	—	3.38 in.	,, ,,
0	145	—	222	145	⅝ in.	1⅞ in.	1 9/16 in.	5/16 in.	15/16 in.	5/16 in.	5/16 in.	—	—	—	3.75 in.	,, ,,
0B	—	—	—	—	⅝ in.	1⅞ in.	3 3/16 in.	5/16 in.	2 9/16 in.	—	5/16 in.	—	—	—	—	E, E
—	74	2	74	130	11/16 in.	2 1/16 in.	1 23/32 in.	11/32 in.	1 1/32 in	11/32 in.	11/32 in.	—	—	—	4.47 in.	E, I
1	35	—	70	120	¾ in.	2¼ in.	1⅞ in.	⅜ in.	1⅛ in.	⅜ in.	⅜ in.	—	—	—	4.5 in.	,, ,,
—	—	G12	8	—	13/16 in	2 9/16 in.	2 in.	7/16 in.	1⅛ in.	7/16 in.	7/16 in.	—	—	—	4.625 in.	,, ,,
2	147	—	223	279A	⅞ in	2⅝ in.	2 3/16 in.	7/16 in.	1 5/16 in.	7/16 in.	7/16 in.	2 3/16 in.	1¾in.	—	5.26 in.	,, ,,
3	29A	—	111A	43A	1 in	3 in.	2½ in.	½ in.	1½ in.	½ in.	½ in.	2½ in.	2 in.	—	6 in.	,, ,,
4	—	—	—	277A	1 in	3¼ in.	2⅞ in.	⅝ in.	1⅝ in.	⅝ in.	½ in.	2⅝ in.	2¼ in.	—	6.75 in.	,, ,,
5	78N	—	133	174N	1¼ in.	3¾ in.	3⅛ in.	⅝ in.	1⅞ in.	⅝ in.	⅝ in.	—	—	2⅞ in.	7.5 in.	,, ,,
6	146A	—	—	282A	1¼ in.	4 in.	3½ in.	¾ in.	2 in.	¾ in.	⅝ in.	3¼ in.	2¾ in.	2¾ in.	8.25 in.	,, ,,
7	—	—	—	—	1.5 in.	4.8 in.	4.2 in.	0.9 in.	2.4 in.	0.9 in.	0.75 in.	4 1/16 in.	3 5/16 in.	—	9.9 in.	,, ,,
—	120	—	241	173N	1½ in.	4½ in.	3¾ in.	¾ in.	2¼ in.	¾ in.	¾ in.	—	—	3⅜ in.	9 in.	,, ,,
Large F	—	—	—	—	1½ in.	5 in.	3⅝ in.	1 in.	2⅛ in.	¾ in.	¾ in.	4¼ in.	2⅞ in	2⅞ in.	9.25 in.	F, F
8	2	—	—	—	1¾ in.	6 in.	5¼ in.	1¼ in.	3 in.	1⅛ in.	⅞ in.	—	—	—	12.5 in.	E, I
10	87	—	—	276	2 in.	7 in.	6½ in.	1½ in.	4½ in.	1 in.	1 in.	—	—	—	16 in.	,, ,,
11	41A	—	41A	213A	2½ in.	8½ in.	7¼ in.	1¾ in.	4¾ in.	1¼ in.	1¼ in.	7¼ in.	6 in.	—	18 in.	T, U
12	161	—	—	—	75 mm.	220 mm.	170 mm.	35 mm.	95 mm.	37.5 mm.	37.5 mm.	—	—	—	41 cm.	E, I
—	171	—	—	—	3 in.	9½ in.	9½ in.	1¾ in.	6½ in.	1½ in.	1½ in.	8 in.	8 in.	—	23 in.	E, I

ALPHABETICAL INDEX

INDEX BY CATALOGUE NUMBER

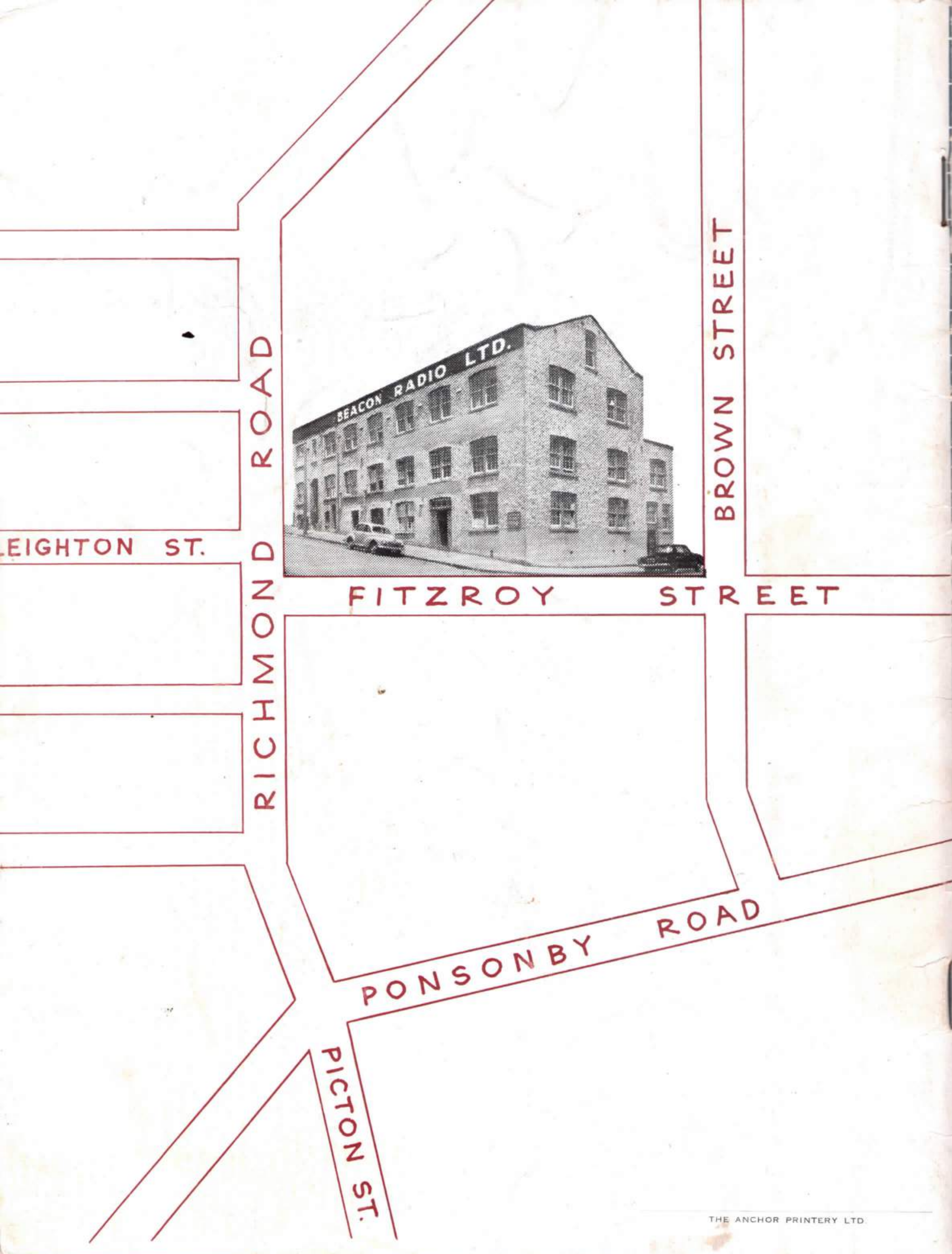
Cat. No.	Page	Lamination	Stack	Mounting
A01	8	1	¾"	Clamp.
A03	8	00	11/16"	Clamp.
A04	8	00	11/16"	"
A05	8	MEA67	⅜"	Isolated Core Can
A06	8	MEA67	⅜"	" " "
A07	8	MEA67	⅜"	" " "
A08	8	00	11/16"	Clamp.
A09	8	00	11/16"	"
A10	8	00	11/16"	"
A12	8	L1600	⅜"	Octal Base, Plug-in
A13	8	L1600	⅜"	" " "
A14	8	L1600	⅜"	" "
A15	8	MEA187	¼"	Clamp.
A16	8	"	¼"	"
A17	8	"	¼"	"
C01	8	1	¾"	"
C02	8	00	11/16"	"
C03	8	1	¾"	Clamp.
C04	8	2	⅞"	"
C05	8	2	1¼"	"
C06	8	4	1"	V.M.
C07	8	4	1¼"	"
C08	8	5	1¼"	"
C09	8	6	2"	"
C11	9	5	1¼"	"
C12	9	6	2"	"
C16	8	6	2"	V.M.
C21	8	6	1½"	"
C22	8	2	1¼"	Clamp.
C23	9	D36/22	12.3mm.	Pot.
C24	9	"	12.3mm.	Pot.
C25	9	00	11/16"	Clamp.
C26	9	7	1¼"	V.M.
C27	9	7	3"	"
C28	9	7	3"	"
C29	9	7	1¼"	"
C30	9	7	2¼"	"
C31	9	7	2¼"	"
C32	8	MEA187	¼"	Clamp.
D01	9	1	¾"	"
D02	9	2	1½"	"
D03	9	6	1¾"	V.M.
D04	9	5	2"	"
D05	9	6	1¾"	"
D06	9	2	⅞"	Clamp.
D08	9	3	1½"	V.M.
D09	9	00	11/16"	Clamp.
D11	9	00	9/16"	"
D13	9	MEA187	¼"	"
D14	9	MEA187	¼"	"
D15	9	1	¾"	"
D16	9	MEA187	¼"	"
F01	10	00	11/16"	Clamp.
F02	10	1	¾"	"
F03	10	2	⅞"	"
F04	10	1	¾"	"
F05	10	2	⅞"	"
F06	10	6	1¼"	V.M.
F07	10	6	1½"	Can.
F08	10	3	1¼"	V.M.
F09	10	2	⅞"	Clamp.
F10	10	4	1"	V.M. T.B.
F11	10	4	1"	V.M.

Cat. No.	Page	Lamination	Stack	Mounting
F12	10	4	1"	V.M.
F13	10	6	1½"	"
F14	10	4	1½"	"
F16	10	2	1¼"	Clamp.
F19	10	6	1¼"	V.M.
F20	10	8	2¼"	End Bells or Can
F21	10	7	2¾"	V.M.
F22	10	7	2¼"	V.M.
F23	10	6	2"	"
F24	10	5	1¼"	"
F25	10	4	1½"	"
J01	10	AIR	3½"	dia. overall.
J04	10	AIR	3½"	dia. overall.
M01	11	6	1¾"	V.M.
M03	11	8	2"	End Bells.
M04	11	2	1¼"	Clamp.
M05	11	2	1¼"	"
M06	11	7	2"	V.M.
M07	11	3	1½"	"
M08	11	1	¾"	Clamp.
P01	11	7	3"	V.M.
P02	11	8	2¾"	Cast End Bells.
P03	11	10	2"	" " "
P04	11	7	3"	" " "
R01	11	2	1¼"	Clamp.
R02	12	4	1¼"	V. or F.
R03	12	4	1¼"	" "
R04	12	5	1"	" "
R05	12	5	1¼"	" "
R06	12	5	1½"	" "
R07	12	5	1½"	" "
R08	12	6	1½"	" "
R09	12	6	1½"	" "
R10	12	6	1¾"	" "
R11	12	6	1¾"	" "
R13	12	7	1¾"	" "
R14	12	7	2"	" "
R15	12	7	2¾"	" "
R16	12	7	3"	" "
R17	12	7	1¾"	" "
R18	12	1	¾"	Clamp.
R19	12	1	¾"	"
R20	12	1	¾"	"
R21	12	2	⅞"	"
R22	12	2	⅞"	"
R23	12	3	1"	V.M.
R24	12	4	1"	"
R25	12	4	1"	"
R26	12	5	1¼"	"
R27	13	2	1¼"	"
R28	13	2	1½"	Clamp.
R29	13	5	1½"	V.M.
R31	13	10	2"	End Bells.
R32	12	2	⅞"	Clamp.
R33	11	6	1½"	V.M.
R34	11	2	⅞"	Clamp.
R35	13	3	1½"	V.M.
R36	13	1	1"	Clamp.
R38	12	6	1½"	V. or F.
R39	12	7	1½"	" "
R40	13	8	2½"	End Bells.
R41	13	11	2½"	" "

Cat. No.	Page	Lamination	Stack	Mounting
R42	13	8	3"	End Bells.
R48	13	3	1½"	V.M.
R49	12	2	⅞"	Clamp.
R50	13	3	1½"	V.M.
R51	12	2	⅞"	Clamp.
R52	12	7	2"	V.M.
R53	12	7	2½"	"
R54	11	4	1"	"
R55	12	1	1"	Clamp.
R56	13	3	1"	V.M.
R57	11	3	⅞"	Clamp.
R60	13	3	1"	V.M.
R61	13	3	1"	V.M.
R62	13	7	1½"	"
R63	11	1	¾"	V. Clamp.
R64	11	2	⅞"	Clamp.
R68	11	3	1"	V.M.
R70	11	3	1"	V.M.
R71	12	5	1¼"	"
R72	13	4	1"	Clamp or V.M.
R73	13	4	1"	Clamp or V.M.
R74	12	2	⅞"	Clamp.
R75	12	2	⅞"	Clamp.
R77	13	4	1¼"	V. or F.
R78	13	6	1¾"	" "
R79	13	7	1¾"	" "
R80	13	8	2½"	End Bells.
R82	13	2	1½"	Clamp.
R83	12	2	⅞"	"
R84	12	4	1¼"	V. or F.
R85	12	4	1"	" "
R86	12	2	⅞"	Clamp.
R87	11	3	1¼"	V. or F.
R88	12	4	1¾"	" "
R89	11	2	⅞"	Clamp.
S01	14	3	1¾"	V.M.
S02	14	3	1¾"	"
S03	14	5	2"	"
S04	14	5	2"	"
S05	14	5	2"	"
S06	14	5	2"	"
S07	14	5	2¼"	"
S08	14	5	2¼"	"
S09	14	5	2¼"	"
S10	14	5	2"	"
S11	14	3	1¾"	"
S12	14	3	1¾"	"
S13	14	5	2"	"
S14	14	5	2"	"
S15	14	5	2"	"
S16	14	5	2"	"
S17	14	5	2¼"	"
S18	14	5	2¼"	"
S19	14	5	2¼"	"
S20	14	5	2"	"
S21	14	3	1¾"	"
S22	14	3	1¾"	"
S23	14	5	2"	"
S24	14	5	2"	"
S25	14	5	2"	"

Cat. No.	Page	Lamination	Stack	Mounting
S26	14	5	2"	V.M.
S27	14	5	2¼"	"
S28	14	5	2¼"	"
S29	14	5	2¼"	"
S30	14	5	2"	"
S31	15	1	¾"	Clamp.
S32	16	4	1¼"	V.M.
S33	15	00	11/16"	Clamp.
S34	15	00	11/16"	"
S35	15	00	11/16"	"
S36	15	00	11/16"	"
S37	15	00	11/16"	"
S38	15	1	¾"	"
S39	15	1	¾"	"
S40	15	1	¾"	"
S41	15	1	¾"	"
S42	15	1	¾"	"
S43	16	00	11/16"	"
S44	16	1	¾"	"
S45	16	2	⅞"	"
S46	15	Wdg. only		
S50	15	00	11/16"	"
S51	15	1	¾"	"
S52	15	2	⅞"	"
S53	14	5	2¼"	"
S54	16	6	1½"	"
S55	15	00	11/16"	"
S56	14	2	⅞"	"
S57	14	2	⅞"	"
S58	14	5	2¼"	V.M.
S60	15	00	Wdg. only	
S65	16	7	2"	V.M.
S66	14	MEA120	3"	V.M.
S67	15	1	¾"	Clamp.
S68	15	1	¾"	"
S69	15	1	¾"	"
S70	15	1	¾"	"
S71	14	4	1¼"	V.M.
S72	14	4	1¼"	"
S73	15	00	9/16"	Clamp.
S74	15	00	9/16"	"
S75	15	00	9/16"	"
S76	15	00	9/16"	"
S77	16	1	1"	"
S79	16	00	9/16"	"
S80	14	5	2¼"	V.M.
S81	14	5	2"	"
S82	16	0	¾"	Clamp.
S83	14	3	1¼"	V.M.
S86	16	MEA187	¼"	Clamp.
S87	16	00	9/16"	"
S88	14	3	1¼"	V.M.
S89	14	3	1¼"	"
S90	14	5	2¼"	"
S91	15	Wdg. only		
S92	15	" "		
S93	15	" "		
S94	15	" "		
U02	16	2	⅞"	Clamp.
U03	16	4	¾"	V.M.
U04	16	1" dia.	2"	long approx.
U05	16	4	¾"	V.M.
U06	16	2	⅞"	Clamp.

Cat. No.	Page	Lamination	Stack	Mounting	Cat. No.	Page	Lamination	Stack	Mounting
V23	17	7	2½"	Can.					
V24	17	7	2½"	,,					
V25	17	2	⅞"	Clamp.					
V26	17	3	1¼"	V.M.					
V27	17	4	1½"	,,					
V28	17	6	1½"	,,					
V29	17	7	1¾"	,,					
V30	17	7	2¾"	Can.					
V31	17	8	2¾"	,,					
V32	17	10	2½"	,,					
V33	17	10	3"	,,					
V34	17	11	2¼"	,,					
V35	17	11	4¼"	,,					
V36	17	MEA171	3½"	,,					
V37	17	MEA171	4½"	,,					
V38	17	MEA171	6"	,,					
V39	17	—	—	—					
V40	17	—	—	—					
V41	17	2	⅞"	Clamp.					
V42	17	3	1¼"	V.M.					
V43	17	4	1½"	,,					
V44	17	6	1½"	,,					
V45	17	7	1¾"	,,					
V46	17	7	2¾"	Can.					
V47	17	8	2¾"	,,					
V48	17	10	2½"	,,					
V49	17	10	3"	,,					
V50	17	11	2¼"	,,					
V51	17	11	4¼"	,,					
V52	17	MEA171	3½"	,,					
V53	17	MEA171	4½"	,,					
V54	17	MEA171	6"	,,					
V55	17	—	—	—					
V56	17	—	—	—					
V57	17	4	1½"	V.M.					
V58	17	7	1¾"	,,					
V59	17	7	3"	,,					
V60	17	8	2¾"	End Bells.					



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