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RADIO DEPARTMENT

TECHNICAL NOTE

No RAD. 250

SECRET

Technical Note No. Rad. 250

Technical Note No. Rad. 250
February 1945

ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH

German Radio-Frequency Cables

by

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Contents

Diagrams

Tables

Photographs

Plate I	Cables RFC/G/5-7 and 9-11
Plate II	Cables RFC/G/12-17
Plate III	Cables RFC/G/18-19 and 24-26
Plate IV	Cable RFC/G/16
Plate V	Cable RFC/G/20 and 23

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1. Summary

This note gives an account of a range of German Radio Frequency Cables received for test at the Cables Section, R.A.E. It contains a discussion of German Cables in general, and in section (4) special features of these Cables are dealt with in detail.

There are some technical matters on which further information from Germany might be of interest to British Cablemakers. Section 5 is concerned with these points.

Section 7 consists of a description of each cable giving dimensions and electrical characteristics. Table I records the more important characteristics of the cables. A series of photographs is included.

In some cases the manufacturers of the German Cables are known from the identification threads used. Information on this point is given in Section 8.

2. Introduction

The Cables discussed in this note are those which have been received by the Cables Section of the Radio Department at Ambarrow Court. The electrical measurements have been made by members of the section over a long period, and in certain cases have been published in Cables Section Test Reports, these reports are recorded in Section 9.

The series of Cables reported here is of course far from complete. It is estimated that the 26 which have been examined so far are about half the total number of German types.

In some cases the electrical data is incomplete because of the poor state of the sample received. For instance the only sample of RFC/G/13 available had spent a period in the sea, and only about 5 inches of RFC/G/12 was sent for test.

The information given in section 7 refers to individual samples and it is certain that the cables of different manufacturers will vary in some details for any given type.

The numbers allocated to the cables indicate the order in which the samples were received for examination.

It is proposed to issue further information as more samples are received.

3. Discussion of German Cables in General

The cables received for test are not altogether a fair sample of the complete German range of R.F. Cables as the airborne types are much more likely to reach the R.A.E. for test than those of the Navy or Army.

For this reason the samples discussed here are chiefly small, light, flexible cables, although a few large ground station concentrics have been examined.

Most of the small flexible cables are air-spaced using the articulated bead construction. There are no German cables with extruded polythene dielectrics such as are used in most British Cables. It is because supplies of polythene have not been available in Germany that the German Cablemakers have concentrated on the less satisfactory bead construction.

It is interesting to compare bead cables with those having a solid polythene dielectric.

The advantages of the bead cables are :-

(a) Lightness
(b) Flexibility
(c) Low effective dielectric constant

The disadvantages of the bead cables are :-

(a) Mechanical instability leading to electrical discontinuities
(b) Liability of damage by crushing
(c) Difficulty of manufacture in long lengths
(d) Difficulty of sealing air-spaced cables against moisture

Of the disadvantages (d) is probably the most serious so far as aircraft and tropical uses are concerned.

Advantage (c) of the bead construction makes possible the low capacity range of Cables RFC/G/2, 5, 9, 12 and 14. There are no cables equivalent to these in the British Preferred List. It is interesting to compare the capacitance of RFC/G/6, 17 pf/metre, with the 46 pf/metre capacitance of the British Uniradio 6.

The majority of German concentric cables have impedances in the range 65-75 ohm. With the polystyrene beads these impedances require rather large inner conductors, and for the 50 ohm concentric, ceramic beads, designed to leave but a small air-space, are used. For the cables of impedance 75 ohm where low capacity is not required, advantage (c) does not apply and the mechanical disadvantages make the bead constructed cables much inferior to the British cables of the same electrical characteristics.

Recently German cables have been introduced with solid dielectrics of plasticised polystyrene, but this material is soft and can only be considered a poor substitute for polythene.

The large ground station concentrics form an interesting class. They are comparable with the British Uniradio 7, 8, 9 and 23. These German cables are of more complicated construction than their Uniradio counterparts, but they show many features of great interest. The use of sheet outer conductors to reduce resistive losses is not found in the British Cables. The construction of this conductor in RFC/G/20 where the corrugations probably serve an electrical purpose, is well worth the attention of British designers.

There is no general sign of a rationalisation of German Cables although the construction of the beads of RFC/G/26 suggests that these are intended for use in other cables as well. The use of an identification thread under both P.V.R. sheaths in this same cable may be a sign that this double screen cable is made by putting an extra screen on a standard single screened cable of which we have not yet secured a sample.

4. Discussion of Special Features of the Cables

4.1 Inner Conductors

Most of the smaller cables have inner conductors of plain copper wire, the largest of these conductors being the 0.0975" wire of RFC/G/6. In some cases where the inner conductor is very small a copper coated steel wire similar to "Copper weld" wire is used. With the exception of RFC/G/11, which should really be considered as an LF rather than RF cable, there are no German cables with stranded conductors. Only one cable has tinned wire conductors. The twin cable RFC/G/8 is interesting because of the use of two phosphorbronze strips for its conductors.

The large concentric class show some interesting approaches to the problem of constructing a large diameter inner conductor. These are shown in figure 3 of R.A.E. Diagram 10824.

In RFC/G/16 the inner conductor is formed by wrapping a thin sheet of copper over a rubber core, folding the edges in a longitudinal seam and rolling spiral corrugations in the sheath in order to press the seam into the core, and to give strength and flexibility to the conductor.

In another form of sheet copper conductor the copper is wrapped over an aluminium core. This gives a considerable saving in copper with little reduction in strength. The conductor of RFC/G/20 made by A.E.G. Metallwerke, Berlin, is formed by rolling the copper sheet over the aluminium core and folding the edges to give a longitudinal seam. This seam is brought flush with the conductor surface by a subsequent drawing process. The samples of RFC/G/21, 22 and 23 made by Siemens-Schuckert have an alternative construction where the copper sheet is rolled onto the aluminium core with an edge-to-edge joint and is drawn into place. This latter form is the cheaper to produce and from the samples examined it appears to be quite satisfactory. The two constructions are shown in Diagram 10824 Fig.3.

The copper-on-rubber construction is lighter than the copper-on-aluminium, but it suffers from the disadvantage that the effective resistance of the conductor is increased by about 20% over that of a smooth cylinder because of the lengthening of the current path due to the corrugations. There are no British cables on the Preferred list having the copper sheet construction.

Most of the inner conductors are of the German Wire Gauge sizes, and in section 7 both the gauge size and measured diameter are quoted for these conductors. For reference the German Wire Gauge sizes are given in Table IV.

4.2 Dielectrics

4.2.1 Beads v. Diagrams 10825-26

4.2.1.1 Beads used with self supporting Outer Conductor

RFC/G/20 is the only cable with this class of bead. The beads of this cable are moulded discs of polystyrene well spaced out along the inner conductor. It is probable that these beads are moulded U shaped so that they can be slipped over, and not threaded onto, the inner conductor. It is thought that they are then fixed in place by warming the bead and bending the legs of the U to join and form a closed ring.

4.2.1.2 Beads used to support the outer conductor

These beads fit together to form an articulated tube over which the outer conductor is formed. They are divisible into two classes, those in which there is a minimum of dielectric material in order to obtain a low capacity, and those in which the interior of the cable is almost filled with the dielectric material in order to obtain a high capacity and low characteristic impedance. The former are made of polystyrene, the latter are generally made of a ceramic material. The first class of polystyrene beads is the more numerous.

Most of the polystyrene beads consist of a simple cup with a large clearance hole for the inner conductor at the domed end. There is no very marked sign of standardisation although RFC/G/6 and 19, and RFC/G/9 and 12 use the same beads. However, the bead used in RFC/G/26 appear to have been designed to fulfil several purposes. This bead is shown in Diagram 10826 fig.2. It has a central hole for use in concentric cables, and it has four outer holes, two of which are used in the present twin cable. The extra two holes suggest that the designer was thinking of providing a four conductor cable, but no such construction has been observed yet. Such a construction could give either a low impedance twin, or a low impedance concentric using all four wires as an inner conductor. It will be noted that the spacing of the beads of RFC/G/26 is rather less than the bead diameter. This is a factor which contributes to the marked flexibility of this cable.

It is probable that for a flexible cable of such a large diameter as RFC/G/16 the simple cup shaped beads would not be strong enough, and that this is the reason for the two-piece beads used in this cable. A bead from RFC/G/16 is shown in Diagram 10826 fig.1. In order to prevent burrs which might interfere with the articulation of the beads, the hole at the convex end is made oversize, and the bead is threaded concave end first. As a result the only burr which forms is at the concave end, and that is on the inside of the bead where it cannot interfere with the flexing of the cable. The oversize hole also permits the convex end to rock in the cup of the concave end.

The second class of bead includes the ceramic types of RFC/G/15 and RFC/G/25. By filling as much as possible of the volume between the conductors an effective permittivity of 2.4 is obtained in the case of the former cable. It is doubtful whether this type of bead should be used in twin cables. Beads from RFC/G/25 show much chipping of the ceramic at the ends of the holes which hold the inner conductors. This is because in flexing the stresses are concentrated at the ends of the holes.

4.2.2 Spiral Spacer Dielectrics

The three cables RFC/G/21, 22, 23 have a spiral spacer dielectric. This is much more elaborate than that of the British Uniradio 6 and is known by the trade name of "Styroflex".

In this type of construction a spiral spacer is formed by winding a thread of polystyrene on a slightly larger core of the same material. Two of these spacers are wound upon the inner conductor. Two layers of stiffish transparent tape cover these. Over this are wound two more spiral spacers and two more tapes. The outer-conductor fits directly over these tapes.

None of these three cables is flexible, and all have fairly rigid outer conductors which can give support and protection to the rather frail dielectric. For large low loss cables this construction is interesting, although of course careful waterproofing would be essential.

The advantage of this construction over the spacer construction of RFC/G/20 is that the polystyrene is evenly distributed and not concentrated in beads. At high frequencies the latter would be a source of non-uniformity in the cable.

4.2.3 Solid Dielectrics

Three concentric cables with solid dielectrics of a soft plasticised polystyrene have been examined. The construction used is very different to that of British polythene cables, this is probably due partly to the difference in the mechanical properties of the German and British dielectric materials, and partly to a shortage of extruding plant.

The dielectric is formed by extruding a layer of plasticised polystyrene on the inner conductor, wrapping this layer with a thin transparent tape, and then applying the rest of the dielectric in four layers, by rolling on pairs of tapes to give longitudinal covering.

The purpose of the transparent tape is probably to give protection to the first extrusion before the other layers are applied. The presence of this tape is a disadvantage of this construction as it would be difficult to avoid air films along the tape which would allow the spreading of damp throughout the cable.

So far no solid dielectric twin cables have been examined.

4.2.4 Polystyrene Tape Dielectrics

In RFC/G/17 the greater part of the dielectric is a series of thin polystyrene tapes. This twin cable is the only one so far examined which shows this construction.

The inner conductors of this cable are covered with a thin extrusion of plasticised polystyrene over which are wound 16 layers of thin polystyrene tape. The conductors are twisted and made up to circular form with two fillers of plasticised polystyrene (to form a pair). This pair is protected with more thin tapes and a sheath of plasticised polystyrene.

This construction gives a good filling of the inter-conductor space which is needed in order to obtain a Z_0 of 93 ohm. The coefficient of asymmetry is quite low, being 0.6%. However this type of construction gives a cable just as vulnerable to damp as those with a bead dielectric.

4.3 Outer Conductors

4.3.1 Wire Braids

Among the cables examined there have been samples of both tinned and plain copper wire braid. Some samples of RFC/G/17 have a plain and others a tinned wire braid.

The lay of wire in most German cables is in accordance with British practice. The average lay factor* observed being K_1 = 2.0.

* For definition see "The Characteristics of Braided Conductors in Flexible Concentric RF Cables" by F/L.R.C.Mildner. R.A.E.Tech.Note Rad.2

The braids are on the whole rather under-filled and the average filling factor* is only Kf = 0.58 which is considerably lower than the filling of current British Cables. Most braids are woven from 24 spindles, although one example of 36 and two of 40 spindles have been noted.

The two twin cables RFC/G/14 and 17 have exceptional braids. In these cables the inner conductors are twisted with a lay of about 3 inches. The braids are applied with the same lay as the inner conductors. This gives very low lay factors (K_1 = 1.26 and 1.20). This design feature is extremely interesting, because it was the subject of a proposed patent application submitted in February 1942 by F/Lt. R.C. Mildner, Radio/S.5560/RCM/-, the object of this invention was to improve the phase stability of flexible twin cables by removing the variable contact resistances between individual wires of the braid from the path of the screen currents. The application was not proceeded with because it was found that a helical lapping of overlapped metallised papers achieved the desired object in a more straightforward manner. It would be useful to make a direct comparative check of the technical achievements of the two designs. A very noticeable characteristic of these two cables is the marked over-filling of the braid - the filling factors are 1.14 and 1.13. This is all the more remarkable when it is remembered that the braids of other types of German cable are so much underfilled.

A peculiarity of some of the German braided outer conductors is the use of a different number of ends in right-hand and left-hand spindles. The reasons for this practice is not known. It is observed that this is a feature of some of the braids which perform the purely mechanical function of protecting copper tape outer conductors during later sheathing processes, and also of some protective braids of steel wire. The corresponding feature in tape braids has not been observed.

Table II gives collected data on the braids having this type of construction.

4.3.2 Copper Tape Braids

The copper tape braids are formed by weaving thin narrow tapes in the same way as the flat spindles of wires in the wire braid. Such braids are shown in the photographs of RFC/G/6, 13 and 25.

The tape braids so far examined are much superior to the German wire braids, having an average lay factor of 1.43, and filling factor of 0.84. These virtues are not peculiar to tape braids, and many British wire braided cables have filling factors as high as 0.90 -0.95. The samples of tape braided cables so far examined have been too much damaged for any satisfactory comparison of the relative electrical merits of the German tape and the British wire braids to be determined. It is hoped that suitable samples will soon be available.

The three samples examined have plain copper tapes - no tinned tape braids are known.

4.3.3 Tape Conductors

Two German cables RFC/G/12 and 19 have a copper tape construction much as that of Uniradio 9. The tapes used in the German cables are corrugated so as to permit the bending of the cable. In RFC/G/12 the tapes are longitudinal, but in RFC/G/19 the tapes are applied with a LH lay. In both cables a thin short lay copper tape binder is used, and

*For definition see "The Characteristics of Braided Conductors in Flexible Concentric RF Cables" by F/Lt.R.C. Mildner. R.A.E. Tech. Note Rad. 205.

this is in turn supported by an open wire braid.

The construction in which the tapes are applied helically is to be preferred mechanically, but it is not likely that either construction would be really satisfactory for flexible cables as small as these.

4.3.4 Sheet Conductors

The sheet conductors have the advantages of low resistance and very good screening, but it is difficult to make a flexible conductor of this type.

The most simple form is that used in RFC/G/16 where a sheet of thin copper is wrapped over a sheath of plasticised polystyrene and corrugated by the tool which rolls it in place. The corrugations which form a three-start thread, allow a slight flexing of the cable. This sheet is kept in place by a very open copper wire braid. The corrugations probably have the effect of increasing the H.F. resistance of the copper sheet by about 20%.

The sheet conductor of RFC/G/20 is shown in the Diagram 10824 fig.1. An aluminium sheet is rolled into a tube and corrugations are rolled in to it at regular intervals. These give flexibility and hold the spacers in place, but it is likely that they also serve in some manner to counteract the discontinuity of the spacer.

The edge to edge joint in the sheet is preserved by small ears which prevent the lateral movement of the edges. Two layers of aluminium foil cover the sheet, probably merely to complete the screening.

The cables RFC/G/21, 22 and 23 show a third type of sheet construction in which the conductor is formed of two corrugated half cylinders which are held together by a binding of copper or aluminium tapes. This is illustrated in Diagram 10824 fig.2.

4.3.5 Extruded Conductors

None of the German cables so far examined has had a lead sheath used as outer conductor.

4.4 Screening

No measurements have been made to determine the quality of the screening of the German cables, and all the comments are based on visual examination.

The cables with sheet outer conductors are probably screened as well as they can be. The copper tapes with short lay binders should also give good screening. However, the wire braids on most of the cables would give poor screening because of their low filling factors.

RFC/G/26 is of interest because it is a double screen cable. Examination showed that in this case great care is taken in the assembly of terminations on the cable that the inner and outer screens should be soldered together at the terminations.

It is thought that the cellulose tapes of RFC/G/20 may be to insulate the lead sheath from the aluminium tapes in order to improve screening - however no sample of this cable with terminations fitted has been available for examination.

The steel wire braid of RFC/G/16 may be intended as an outer screen, but an examination of terminations captured with this cable did not settle conclusively whether the steel wire braid was intended to be connected or insulated from the inner sheath at the ends of the cable.

4.5 Protective Covering

4.5.1 P.V.R. Sheaths

The majority of flexible German cables are covered with a blue P.V.R. although brown, grey, black and bluish grey sheaths are occasionally used. The analysis of one sheath showed that the material used was a miniature of polyvinyl chloride and acetate; in another sheath of polyvinyl chloride, a phthalic acid ester was used as a plasticiser.

As materials used vary greatly from one cable to another the thickness of sheath varies with the qualities of the material. As a result of this there is no correlation between the core diameter and thickness of sheath used.

There is little information available about the range of working temperatures of the P.V.R. sheaths, but the sample of RFC/G/26 was labelled with a warning against using the cable below -5°C.

4.5.2 Steel Wire Braid

Some cables such as RFC/G/14 and 16 are covered with a braid of steel wire. This provides a protection where armouring would be too heavy and rigid. It is possible that use is made of the screening properties of this type of braid, although the evidence obtained from the examination of terminations is inconclusive.

It seems that in some cases the braid is protected by paint after installation.

4.5.3 Armouring

The armouring applied to German cables differs from British armouring in several respects.

In German cables the armouring is not invariably the outermost layer. In cables where the dielectric is rather delicate a first layer of armouring is applied inside the waterproofing sheaths as in RFC/G/14 and RFC/G/21.

In German cables both tape and wire armouring is used, in some cases tape and wire are used on the same cable. A further difference in practice is that German cables do not have a serving over the outer layer of wire armouring but use instead a narrow steel binder tape.

The narrow steel armouring tape with very short lay used in RFC/G/14 is very interesting because of its great flexibility. This has no British counterpart.

4.5.4 Miscellaneous Coverings

In some cables where a P.V.R. sheath is not used, waterproofing is achieved by a sheath formed of layers of plasticised polystyrene applied by longitudinal covering. Examples of this are RFC/G/16 and 21. In each of these cases the polystyrene sheath is of greater diameter than any P.V.R. sheaths observed.

In some cables it has been noticed that the varnished cambric used is bias cut, although straight cut tape is also used.

5. Points on which further information of German methods would be of interest to British Cablemakers

It is possible that for some applications where a cable has to withstand very high temperatures and yet be flexible, a ceramic bead dielectric might be useful. For this reason it would be interesting to know whether the German cable makers have adapted any of their designs such as RFC/G/15 for such work. As the threading of the beads on the inner conductor is the chief production drawback of this construction it is certain that many ingenious devices will have been devised for performing this operation. Information on these would be of interest.

In the German cables the longitudinal application of sheaths by rolling is carried out very neatly, and the seams are inconspicuous. Information about the methods used might be of value to manufacturers of sheathed wires where a softish sheathing material is used.

For the construction of low loss concentric cables where flexibility is unimportant the use of copper sheet conductors should be considered. For this reason the benefit of German experience in RFC/G/16, 20, 21, 22 and 23 would be of advantage.

At the present time while methods of improving the screening properties of braided cables are under discussion in this country it would be useful to have data on the German practice with regard to double screens which is now only imperfectly understood from the samples so far examined.

The use of different numbers of ends in right-hand and left-hand spindles in German braids is probably but a minor point - but it is done so often that there must be a reason for this practice - and it might be useful to know this reason.

It would be useful to have further information on the long lay braids used in RFC/G/14 and 17. The stability of the orthodox braided twin cable is rather low, and any methods of improving the stability of braids by special braid design are of interest. The special features of these braids are their long lay, which is equal to that of the inner conductors, and their overfilling (see 4.3.1).

6. The German Manufacturers of R.F. Cables

Many German R.F. cables have coloured marker threads from which their manufacturers can be identified. In general each type is made by only one manufacturer, and there does not seem to be any German counterpart to the Inter-Service specification EL800 which governs British RF cables. A study of wiring diagrams and installation instructions captured with German equipment shows that cables are called for by their manufacturer's type numbers, and not by any Government code corresponding to the British "Uniradio" and "DuRadio" code.

The manufacturers so far identified are :-

(1) Siemens-Schuckert Werke G.m.b.H; Siementsstadt, Berlin,
(2) Electrotechnische Fabrick A.G., Vacha a.d. Werra,
(3) A.E.G. Metallwerke, Berlin-Oberspree,

(4) Kabel und Metallwerke, Neumeyer A.G. Nurnberg,
(5) Südd. Telefon-Apperate, Draht und Kabelwerke, Nurnberg 2.

Advertisements for "Kapa-Hochfrequenzkabel" made by "Kabelwerke Vacha A.G." probably refer to cable maker (2). No cables of Norddeutsche Kabelwerke A.G. Berlin have been observed although this firm makes very prominent advertisement of it's "Thread Support" cables.

In Table III are shown the identification threads found in the samples so far examined.

7. Description and Details of Individual Cables

Code for recording details

Braids — Tinned copper wire. Lay 0.75". Spindles 24. Ends/Spindle 5. Diam. of ends 0.006"

Will be expressed:
24 x 5 x 0.006" t.c.w. lay 0.75"

If different numbers of ends were used in RH and LH spindles this would be written:-
(12 x 5 x 0.006" RH) t.c.w. lay 0.75"
(12 x 6 x 0.006" LH)

Tapes — Tape 1.00" wide, 0.001" thick. RH lay 1.4", Gap 0.15".

Will be expressed:-
1.00" x 0.001", Lay 1.4" RH, G 0.15"

An overlap will be written as Op.
An edge to edge lay will be written: E.t.E.

Other Abbreviations

t.c.w.	tinned copper wire
p.c.w.	plain copper wire
p.c.t.	plain copper tape.
V/c	Velocity ratio V = velocity of wave in cable c = velocity of light
RH	Right Hand
LH	Left Hand
P.V.R.	Polyvinyl Resin
G.W.G.	German Wire Gauge

7.01 RFC/G/1 Description of Cable

The dielectric of this cable is formed of ceramic beads wound with tapes of chlorinated rubber. Its outer conductor of tinned copper wire is sheathed with dark blue P.V.R.

Details of Construction

Inner Conductor	Plain Copper Wire	(GWG 15)	0.060" dia.
Beads	Ceramic, 0.260" long		0.245" dia.
Tapes	Plasticised chlorinated rubber tapes, 3/8" x 0.001". Slight overlap. Two outer tapes in opposite direction to the inner pair. Colour sequence (from inside) Clear/Red/Clear/Red.		0.255" dia.
Braid	24 x 5 x 0.006" t.c.w. lay 0.75"		0.279" dia.
Sheath	P.V.R. dark blue		0.349" dia.

Electrical Characteristics

Zo above 10 Mc/s.	58 ohm) (calc.)
V/c above 10 Mc/s	0.620)
Capacitance at 1 mc/s	92.8 pF/metre.
Inductance above 10 Mc/s	0.313 μH/metre (calc.)
Power Factor at 1 Mc/s	0.0010

7.02 RFC/G/2 Description of Cable

This is a small flexible concentric cable with polystyrene beads inside a rubber sheath. The outer conductor is a tinned copper wire braid which is covered by a cotton braid protected with black cellulose acetate lacquer.

Details of Construction

Inner Conductor	Copper coated steel wire (50 ton/sq. inch quality)	(GWG 23)	0.022" dia.
Beads	Polystyrene 0.285" long.		0.215" dia.
Sleeve	Extruded Rubber		0.325" dia.
Braid	24 x 5 x 0.006", t.c.w., lay 0.88"		0.349" dia.
Sheath	Fabric braid 16 x 3. Ends of 40/2 ply cotton, lay 0.81" Covered black cellulose acetate lacquer.		0.405" dia.

Electrical Characteristics

Zo above 10 Mc/s	140 ohms) (calc.)
V/c above 10 Mc/s	0.845)

Capacitance at 1 Mc/s	28.5 pF/metre
Inductance above 10 Mc/s	0.55 μH/metre (calc.)
Power Factor at 1 Mc/s	0.0070

7.03 RFC/G/3 This cable is similar to RFC/G/15.

7.04 RFC/G/4 This cable is similar to RFC/G/15.

7.05 RFC/G/5 Description of Cable

This is a flexible concentric cable of polystyrene bead construction. The beads are covered with a black rubber sheath which supports the tinned copper braid and the dark blue P.V.R. sheath.

Details of Construction

Inner Conductor	Copper coated steel	(GWG 23)	0.021" dia.
Polystyrene Beads	Length 0.277"		0.215" dia.
Rubber tube			0.364" dia.
Braid	40 x 4 x 0.0056", t.c.w., lay 1.1"		0.377" dia.
Sheath	Dark blue P.V.R.		0.440" dia.

Electrical Characteristics

Zo above 10 Mc/s	142 ohms	calc. values
V/c above 10 Mc/s	0.826	
Inductance above 10 Mc/s	0.575 μH/metre	
Capacitance at 1 Mc/s	28.3 pF/metre	
Power Factor 1 Mc/s	0.0043	

7.06 RFC/G/6 Description of Cable

This is a concentric cable with polystyrene beads forming the dielectric. The outer conductor of copper tape braid is applied directly over the beads, and the cable is waterproofed by a sheath of dark blue P.V.R.

Details of Construction

Inner Conductor	Copper wire	(GWG 11)	0.097_5" dia.
Polystyrene Beads	Length 0.400"		0.387" dia.
Braid	24 copper tapes 0.88" x 0.007" lay 3.8"		0.430" dia.
Sheath	Blue P.V.R.		0.585" dia.

Electrical Characteristics

Zo at 200 Mc/s	69.4 ohms
V/c at 200 Mc/s	0.865
Capacitance at 1 Mc/s	55.5 pF/metre
Inductance above 10 Mc/s	0.267 μH/metre (calc.value)
Attenuation at 200 Mc/s	1.47 db/100 ft.
Power factor at 1 Mc/s	0.0005_9

7.07 RFC/G/7 Description of cable

This is a small flexible twin cable. The two inner conductors are supported by polystyrene beads in a black rubber sheath. The braid is formed of tinned copper wire and this is protected by a P.V.R. Sheath.

Details of Construction

Inner Conductors	Copper coated steel	(GWG 23)	0.022" dia.
Polystyrene Beads	Length 0.282"		0.240" dia.
Rubber Tube			0.345" dia.
Braid	40 x 4 x 0.0056", t.c.w., lay 1.1"		0.360" dia.
Sheath	Blue P.V.R.		0.440" dia.

Electrical Characteristics

Zo above 10 Mc/s	192 ohms	)Calc.
V/c above 10 Mc/s	0.768	)values
Inductance above 10 Mc/s	0.832 μH/metre)	
Capacitance at 1 Mc/s	22.5 pF/metre	
Power Factor at 1 Mc/s	0.0032	

7.08 RFC/G/8 Details of Construction

Inner Conductors	2 phos. bronze strips 0.80" x 0.009" Spaced 0.12".	
Beads	Ceramic Slotted to take strips, slots 0.09" x 0.04"	0.241" dia.

Electrical Characteristics

Zo at 200 Mc/s	100 ohms
V/c at 200 Mc/s	0.55

7.09 RFC/G/9 Description of Cable

This cable has a very low capacity. The inner conductor is a fine wire supported in large polystyrene beads. The outer conductor is a tinned copper wire braid, and the outer sheath is of blue P.V.R.

Details of Construction

Inner Conductor	Plain Copper wire	0.012" dia.
Beads	Polystyrene, 0.470" long	0.455" dia.
Tape	Two tapes, 0.50" x 0.001", lay 0.40"	
Braid	(12 x 6 x 0.0076" RH) (12 x 8 x 0.0076" LH) t.c.w, lay 1.35"	0.502" dia.
Sheath	Blue P.V.R.	0.562" dia.

Electrical Characteristics

Zo at 1 Mc/s	213 ohms
Zo at 15.82 Mc/s	207 ohms
V/c at 15.82 Mc/s	0.950
Attenuation at 1 Mc/s	0.210 db/100 ft.
Series Resistance at 1 Mc/s	0.325 ohm/metre
Inductance at 1 Mc/s	0.773 µH/metre
Shunt Conductance at 1 Mc/s	0.060 µohm/metre
Capacitance at 1 Mc/s	16.96 pF/metre
Power Factor at 1 Mc/s	0.0005_6

7.10 RFC/G/10 Description of Cable

This cable is a small flexible twin. It has a dielectric of polystyrene beads supported in a rubber sleeve. The outer conductor is a tinned copper wire braid, and the outer sheath is of blue P.V.R.

Details of Construction

Inner Conductors	Plain Copper Wire (GWG 15)	0.059" dia.
Beads	Polystyrene 0.430" long	0.380" dia.
Sleeve	Sleeve of plasticised polystyrene longtudinally applied in two layers each 0.020" thick.	0.460" dia.
Braid	(12 x 8 x 0.0076" RH) (12 x 6 x 0.0076" LH) t.c.w., lay 1.33" NOTE 2 RH Spindles have 8 ends 1 LH Spindle has 6 ends	0.492" dia.
Sheath	Blue P.V.R.	0.561" dia.

Electrical Characteristics

Zo at 1 Mc/s	148.8 ohms
12 Mc/s	143.5 ohms
V/C at 12 Mc/s	0.828
Attenuation at 1 Mc/s	0.210 db/100 ft.
Coefficient of Asymmetry at 1 Mc/s	2.3%

Series Resistance at 1 Mc/s	0.255 ohm/metre
Inductance at 1 Mc/s	0.617 μH/metre
Shunt Conductance at 1 Mc/s	0.050 μmho/metre
Capacitance at 1 Mc/s	28.0 pF/metre
Power Factor at 1 Mc/s	0.00028

7.11 RFC/G/11 Description of Cable

This twin cable is a low frequency screened twin. The conductors are many stranded D.S.C. wire. Two filters of grey P.V.R. are bound with the conductors by a thin cotton tape which is covered by a grey P.V.R. sheath. The tinned copper braid is unprotected.

Details of Construction

Inner Conductors	D.S.C. stranded wire, with two transparent tapes below the silk. 43 wires 0.006" dia. One conductor has black silk outer layer Other " " red " " " Diameter over silk 0.057".	
Fillers	2 Grey plastic rods 0.043" dia.	
Tape	Thin cotton tape 0.5" wide; lay 0.4"	
Dielectric Sheath	Grey plastic	0.243" dia.
Braid	24 x 4 x 0.009", t.c.w., lay 1.4"	0.274" dia.

Electrical Characteristics

Zo at 1 Mc/s	71.1 ohm
Attenuation at 1 Mc/s	1.02 db/100 ft.
Coefficient of Assymetry	6.3%
Series Resistance at 1 Mc/s	0.317 ohm/metre
Inductance at 1 Mc/s	0.445 μH/metre
Shunt Conductance at 1 Mc/s	45.6 μmho/metre
Capacitance at 1 Mc/s	87.9 pF/metre
Power Factor at 1 Mc/s	0.0827

7.12 RFC/G/12 Description of Cable

This cable is a concentric of very low capacity. It has an inner conductor of very fine copper wire in large polystyrene spacers. The outer conductor is formed of copper tapes, and the outer sheath is of blue P.V.R.

Details of Construction

Inner Conductor	Plain copper wire	0.012" dia.
Beads	Polystyrene, 0.470" long	0.455" dia.
Tapes	Transparent tape	0.474" dia.

Outer Conductor	9 Longitudinal copper tapes 0.157" x 0.0056" Corrugations 7 to inch and 0.02" deep Copper Binder tape over longitudinal tapes, 0.39" x 0.002", lay 0.35" Copper mesh over binder tape 24 x 2 x 0.0075", p.c.w., lay 2.0" Weave, plain (over one, under one).	
Sheath	Blue P.V.R.	0.666" dia.

Electrical Characteristics

The sample examined was too short for any electrical tests. However the characteristics will probably be much as those of RFC/G/9.

7.13 RFC/G/13 Description of Cable

This is a flexible concentric cable of the solid dielectric type.

The inner conductor is a single thick copper wire. This is covered by a thin layer of plasticised polystyrene which is probably extruded upon the copper wire. This is covered by a wrapping of three thin transparent tapes of polystyrene. On this foundation the rest of the plasticised polystyrene is longitudinally applied in four layers.

The outer conductor consists of a braid of thin copper tapes. This is protected by a dark blue sheath of P.V.R.

Details of Construction

Inner Conductor	Plain Copper wire (GWG 14)	0.070" dia.
Dielectric	Composite	0.379" dia.

Dia. over first layer of plasticised polystyrene 0.098".
Thickness of polystyrene tapes 0.001".
Number of tapes 3. Dia. over tapes 0.104".
Plasticised polystyrene in four layers of approx. equal thickness.

Braid	p.c.t., 24 x 0.58" x 0.006", lay 1.4"	0.418" dia.
Sheath	Dark Blue P.V.R.	0.586" dia.

Electrical Characteristics

Zo at 200 Mc/s	67 ohms
V/c at 200 Mc/s	0.654
Capacitance at 1 Mc/s	72 pF/metre

7.14 RFC/G/14 Description of Cable

This twin cable is of a low capacity construction. Small single holed beads are threaded on each conductor. The conductors are twisted together and lapped with a transparent tape. Over this tape the outer conductor is braided with a lay equal to the lay of the inner conductors.

The outer conductor is protected by a narrow armouring tape. A cotton braid is used as bedding for a rubber waterproofing sheath. The cable is protected with an outer sheath of steel wire braid.

Details of Construction

Inner Conductors	2 tinned copper wires	0.023 dia.
Beads	Polystyrene. Length 0.222" Dia. 0.212" Spacing 0.172"	
Lay up	The copper wires with beads are twisted with a lay of 2.76" inches and a transparent tape 0.47" x 0.0015" is applied with a 1/16" overlap.	
Braid	24 x 10 x 0.012", t.c.w., lay 2.76" Covered with fabric tape, 1.54" x 0.009" Applied with lay 1.46", overlap 0.47"	0.495 dia.
Armour	Steel strip 0.087" x 0.036", Lay 0.13"	0.578" dia.
Braid	Cotton thread. 36 x 3, lay 1.26"	0.597" dia.
Sheath	Black rubber. Applied in two layers each 0.033" thick	0.752" dia.
Paper	Treated Red Lead. 0.005" thick, lay 1.97", overlap 0.39"	
Braid	Steel wire. 24 x 8 x 0.012", lay 1.67"	0.805" dia.

Electrical Characteristics

Zo at 1 Mc/s	249 ohms
Attentuation at 1 Mc/s	0.202 db/100 ft.
Coefficient of Assymetry	3.3%
Series Resistance at 1 Mc/s	0.380 ohm/metre
Inductance at 1 Mc/s	1.002 μH/metre
Capacitance at 1 Mc/s	16.9_8 pF/metre

7.15 RFC/G/15 Description of Cable

Ceramic beads form the dielectric of this cable which is a small low impedance concentric. Two transparent tapes are applied over the assemble beads before the braiding operation. The cable is sheathed in blue P.V.R.

Details of Construction

Inner Conductor	Plain Copper Wire (GWG 15)	0.060" dia.
Beads	Ceramic 0.25" long	0.237" dia.
Tapes	2 Transparent tapes 0.34" x 0.0017"	

Braid	p.c.w. 24 x 5 x 0.006", lay 0.75"	0.270" dia.
Sheath	Blue P.V.R.	0.347" dia.

Electrical Characteristics

Zo at 1 Mc/s	49.5 ohms
V/c above 10 Mc/s	0.645
Inductance at 1 Mc/s	0.234 µH/metre
Capacitance at 1 Mc/s	95.6 pF/metre
Power Factor at 1 Mc/s	0.001_1

7.16 RFC/G/16 Description of Cable

This is a large concentric cable built to have a very low loss, and good screening combined with a high order of electrical stability.

The inner conductor consists of a thin sheet of copper rolled with corrugations over a core of rubber. This core is formed in three layers upon a length of cord - v. Diagram 10824, Fig.3.

A series of long polystyrene beads, shown in Diagram 10826, Fig.1, are threaded onto the inner conductor. These are covered by a sleeve of plasticised polystyrene which is longitudinally applied in three layers.

Over this a thin sheet of copper is rolled to form the outer conductor. Helical corrugations are rolled in this to give flexibility. The copper sheet is held in place by loose braid of copper wire, over which two further layers of plasticised polystyrene are applied to form the outer sheath. This sheath is covered by a thin tape and a steel wire braid.

Details of Construction

Inner Conductor	Plain copper sheet 1.12" x 0.0069" Corrugations 1 start, 12.8 per inch, 0.019" in depth. Rubber core built in 3 layers on cord 0.078" dia. Dia. of layers 0.146", 0.200", 0.260"	0.290" dia.
Beads	Polystyrene - two piece - length 1.166"	0.660" dia.
Sleeve	Plasticised polystyrene - applied in 3 layers	0.902" dia.
Outer Conductor	Plain copper sheet, 3.2" x 0.0069" Corrugations 3 start, 0.042" deep and 7.8 per inch. Sheet rolled with 0.21" overlap	0.916" dia.
Braid	24 x 5 x 0.011_5", p.c.w., lay 4.2" Plain weave (over one, under one)	
Sheath	Plasticised polystyrene applied in two layers	1.13" dia.
Protective tape	Fabric 1.55" x 0.009", treated with Red Lead, lay 1.45"	1.15" dia.
Outer Braid	Steel wire (24 x 6 x 0.012" RH) (24 x 8 x 0.012" LH) lay 4.2"	1.25" dia.

Electrical Characteristics

Zo above 10 Mc/s	61.0 ohms (calc.)
V/C above 10 Mc/s	0.89
Attenuation at 200 Mc/s	0.69 db/100 ft. (calc.)
Series Resistance at 1 Mc/s	0.018 ohm/metre
Inductance at 1 Mc/s	0.254 μH/metre (calc.)
Shunt conductance at 1 Mc/s	0.060 μmho/metre
Capacitance at 1 Mc/s	65.9 pF/metre
Power Factor at 1 Mc/s	0.00014

7.17 RFC/G/17 Description of Cable

This is a twin cable with polystyrene tape dielectric. The inner conductors are covered with a thin extrusion of plasticised polystyrene and then wound with polystyrene tapes. After the conductors are twisted in pairs, they are lapped with polystyrene tape and covered with a sleeve of plasticised polystyrene. The outer screen is a plain copper wire braid of lay equal to that of the inner conductors. The cable is protected with a sheath of brown P.V.R.

Details of Construction

Inner Conductors	Plain copper wire (GWG 16) Plasticised polystyrene extrustion 0.100" dia. 16 transparent tapes 0.31" wide to bring dia. to 0.135"	0.055" dia.
Fillers	Two extrusions of plasticised polystyrene of triangular sections formed on a thin thread.	
Lay up	The two inner conductors and fillers are twisted with a lay of 3.1". They are then covered with a transparent tape. Overall diameter 0.260".	
Sleeve	Plasticised polystyrene applied in two layers	0.403 dia.
Braid	24 x 10 x 0.012", p.c.w., lay 3.1"	0.489" dia.
Sheath	Brown P.V.R.	0.652" dia.

Electrical Characteristics

Zo at 1 Mc/s	93.0 ohms
Capacitance at 1 Mc/s	43.2 pF/metre
Inductance at 1 Mc/s	0.376 μH/metre
Coefficient of Assymetry	0.7%

7.18 RFC/G/18 Description of Cable

This is a small flexible concentric cable of the solid dielectric type.

The inner conductor is a single strand of plain copper wire. This is covered by an extrusion of plasticised polystyrene and a thin transparent tape. Over this four layers of plasticised polystyrene are longitudinally applied to form the dielectric. An outer braid of plain copper wire covers the dielectric to act as outer conductor. The cable is sheathed with a thick extruded layer of a grey or brown P.V.R.

Details of Construction

Inner Conductor	Plain copper wire	0.061" dia.
Dielectric	Plasticised polystyrene The first layer of 0.099" dia. is extruded and covered by a transparent tape 0.002" thick. The rest of the dielectric is applied in four layers, the outside diameters of the first 3 layers being 0.115", 0.168" and 0.221".	0.269" dia.
Braid	24 x 4 x 0.007_2", p.c.w., lay 1.00"	0.286" dia.
Sheath	Grey P.V.R.	0.462" dia.

Electrical Characteristics

Zo at 1 Mc/s	62.1 ohms
Capacitance at 1 Mc/s	85.7 pF/metre
Inductance at 1 Mc/s	0.329 μH/metre

7.19 RFC/G/19 Description of Cable

This is a concentric cable with polystyrene bead dielectric, designed to have low copper loss and a good screening.

The inner conductor consists of a single plain copper wire. Threaded on this are polystyrene beads. These are lapped with a transparent tape.

The outer conductor is formed of 8 narrow copper tapes applied edge to edge with a left hand lay. These tapes are corrugated transversely in order to make them more flexible. A wide thin copper binder tape with a right hand lay covers the 8 narrow tapes. Over the tapes is an open braid of plain weave. This braid serves to hold the tapes in position during subsequent processes.

The outer sheath of the cable is of dark blue P.V.R.

Details of Construction

Inner Conductor	Plain copper wire (GWG 11)	0.099" dia.
Beads	Polystyrene. Length 0.407". Spacing 0.312"	0.390" dia.
Tapes	Transparent material - 0.380" x 0.001"	0.393" dia.
Outer Conductor	8 copper tapes 0.157" x 0.006" Corrugations 0.026" deep, 7 to the inch Applied with lay 3.05" (LH)	0.448" dia.
	Copper Binders 0.396"x 0.002_2" Lay 0.345"RH	0.466" dia.

	Braid (12 x 6 x 0.0076" RH) p.c.w., lay 1.75" (12 x 5 x 0.0076" LH)		0.501" dia.
Sheath	Dark Blue P.V.R.		0.621" dia.

Electrical Characteristics

Zo at 1 Mc/s	73.7 ohms
Capacitance at 1 Mc/s	54.0 pF/metre
Inductance at 1 Mc/s	0.293 μH/metre

7.20 RFC/G/20 Description of Cable

This cable is a heavy wire armoured, low loss, concentric cable. The AEG type number is ALTR 1A 5.5 x 20 mm.

The inner conductor is shown in Diag. 10824, Fig.3. It consists of a thin sheet of copper rolled on to an aluminium core. The copper is seamed by folding over the two edges and then drawing down.

The polystyrene spacers used are flat beads well spaced along the cable. They are a very tight fit on the inner conductor, and appear to be moulded U-shaped with a gap wide enough to allow the bead to slip over the inner conductor, and to be fixed in place by a heating and rolling of the arms of the U to close the gap and form a ring.

The outer conductor is formed from sheet aluminium rolled with a longitudinal seam. At intervals along the cable wrinkles are rolled in the outer conductor. These give flexibility to the cable, provide recesses into which the beads fit, and probably provide a discontinuity in the cable to compensate for the extra capacity introduced by the polystyrene bead. Details of this construction are given in Diag.15824, Fig.1.

Over the aluminium sheet are wound two aluminium foil tapes, and these are in turn covered with a winding of six layers of cellulose tape, and a lead sheath. The armouring consists of a steel tape wound over a compounded bedding of three paper and one cotton tape; this is covered with a cotton tape and steel wire armouring.

Details of Construction

Inner Conductor	Copper on Aluminium (GWG 1) Copper 0.012" thick rolled on and seamed	0.216" dia.
Spacers	Polystyrene Beads. Solid. Length 0.138". Spacing 2.42"	0.685" dia.
Outer Conductor	Aluminium Sheet. Thickness 0.024_3" formed as in Diag.10824 Fig.1	0.821" dia.
Aluminium Tapes	Two foil tapes. 1.17" x 0.002", lay 1.35", Op. 0.85"	0.830" dia.
Cellulose Tapes	6 tapes, tinted blue, 1.16" x 0.002_8" Applied 3 RH and 3 LH, lay 1.08", Op.0.18"	0.868" dia.
Sheath	Lead	1.026" dia.

Bedding	Compounded Paper and Tape 3 papers 0.0056" thick RH lay 1 cotton tape LH lay	1.144" dia.
Steel tape	0.794 x 0.024, lay 0.90" RH, G 0.12"	1.994" dia.
Fabric Tape	Compounded cotton, 1.28" x 0.009", lay RH, Op 0.32"	1.212" dia.
Outer armouring	Steel wires with iron binder tape Number of wires 46 Lay of wires 15" RH. Dia. of wires 0.077" (GWG 13) Iron tape 0.394" x 0.035", lay 3.5" LH.	1.43" dia.

Electrical Characteristics

Zo above 10 Mc/s	74 ohms	(calc.)
V/c above 10 Mc/s	0.972	

Capacitance at 1 Mc/s 52.3 pF/metre.

7.21 RFC/G/21 Description of Cable

This cable is a large airspaced concentric of the Siemens - Schuckert "STYROFLEX" series.

This, like cables RFC/G/22 and RFC/G/23, is constructed with a spiral thread support for the inner conductor.

The inner conductor consists of an aluminium wire over which is drawn a sheet of copper with a longitudinal edge to edge join. Polystyrene spacing spirals are formed by winding a thin rod of polystyrene around a core of the same material. The form of these is shown in the photograph.

Two of these spirals are wound on the inner conductor. Around these are wound two fairly stiff layers of polystyrene tape. Over this two more spiral spacers are wound, and these are also covered with two polystyrene tapes.

The outer conductor, shown in Diag.10824, Fig.2, is made of copper in two half cylinders which are applied longitudinally. Corrugations are rolled into the cylinders at equal intervals, and the corrugations in the two halves are staggered. The corrugations give flexibility to the cable and support the outer layer of polystyrene tape. A pair of thin copper tapes wound to break lay are applied to hold the two halves of the conductor together. These tapes are served with paper, wound with steel armour tape, served with more paper, with varnished cambric, and with cotton tape. Waterproofing is achieved by the longitudinal application of two layers of plasticised polystyrene to form a sleeve. Over this is wound a tape of rubber compound and a cotton tape. The cable is cased in a steel wire braid.

Details of Construction

Inner Conductor	Copper covered aluminium Copper layer 0.015" thick	(GWG 2)	0.198" dia.
Spiral Spacers	Polystyrene Thread 0.023" wound with RH lay of 0.10" on core of 0.041". Overall dia. 0.087"		

Transparent Tapes	Polystyrene. Width, Inner pair 0.83" Outer pair 0.91". Thickness 0.004_5"	
Lay up of Dielectric	(1) Two spiral spacers lay 1.30" RH. (2) Two transparent tapes of polystyrene breaking joint with LH lay. (3) Two spiral spacers lay 2.75" LH. (4) Two transparent tapes breaking joint with RH lay of 1.57".	
Outer Conductor	Copper v. Diag. 10824, Fig.2. Two half cylinders of copper 0.009" thick. Corrugations 0.12" wide, 0.063" deep and 0.43" apart. Copper tapes thickness 0.003_5". Width 0.63", applied breaking joint with lay 0.67" RH, giving gap of 0.15".	0.747" dia.
1st Paper Serving	0.95" x 0.004", lay 0.827"LH, Op 0.16".	0.759" dia.
Armouring	Steel tape, 0.59" x 0.019", lay 0.98" RH, G. 1/8".	0.804" dia.
2nd Paper Serving	1.18" x 0.0055", lay 1.34" LH, E.t.E.	
Varnished Cambric	1.22" x 0.008", lay 1.14" LH, Op 0.2"	0.831" dia.
Tape	Cotton, 1.34" x 0.0075", lay 1.22" RH, Op 0.23"	0.866" dia.
Sleeve	Plasticised polystyrene. Applied in two layers.	0.972" dia.
Tape	Rubber Compound, 2.52" x 0.015", lay 1.81" RH, Op 0.94"	1.016" dia.
Tape	Cotton, 2.05" x 0.003", lay 1.73", Op 0.35"	1.037" dia.
Braid	Steel Wire, 36 x 10 x 0.012", lay 4.73"	1.017" dia.

Electrical Characteristics

Zo at 1 Mc/s	70.0 ohms
Capacitance at 1 Mc/s	49.9 pF/metre
Inductance at 1 Mc/s	0.244 μH/metre

7.22 RFC/G/22 Description of Cable

This is a lead covered version of RFC/G/21. The samples of these two cables so far examined differ in minor respects. In the lead covered version the corrugations in the outer conductor are rather farther apart than in the flexible sample. Also in the lead covered cable the outer conductor is wound with aluminium tapes. The lead is extruded over the varnished cambric in place of the plasticised polystyrene sleeve.

Details of Construction

Inner Conductor	Copper on aluminium (GWG 2) Copper 0.015" thick.	0.198" dia.
Spacers	As in RFC/G/21.	
Outer Conductor	Copper. Two half cylinders 0.014" thick. Corrugations 0.12" wide, 0.050" deep, and 0.70" apart.	0.737" dia.
Aluminium tapes	Two tapes wound breaking joint by 50%. 0.62" x 0.004", lay 0.83" RH, G 0.15".	
Paper	0.94" x 0.005", lay 0.70" LH, Op 0.15".	
Armouring	Steel tape, 0.58" x 0.024", Lay 0.75" RH, G 0.15"	0.810" dia.
Paper	1.37" x 0.009", Lay 1.07" LH, Op 0.23".	0.820" dia.
Varnished Cambric	Two layers, bias cut. 1.37" x 0.009", Lay 1.25" RH, Op 0.15".	0.874" dia.
Sheath	Lead	1.008" dia.

Electrical Characteristics

Zo at 1 Mc/s	70.9 ohms
Capacitance at 1 Mc/s	52.2 pF/metre
Inductance at 1 Mc/s	0.262 μH/metre

7.23 RFC/G/23 Description of Cable

RFC/G/23 is a version of RFC/G/22 with a steel wire armouring applied outside the lead sheath. It's Siemens-Schuckert type number is XSty 56K RG 1A. 50 x 18 mm.

Details of Construction

For details of cable within the lead sheath see notes on RFC/G/22.

Lead Sheath		0.994" dia.
Bedding	Compounded, consisting of Brown Paper (2 layers) and jute yarn of lay 6¾"	1.15" dia.
Armouring	Steel wire and two binder tapes. No. of wires 38. Lay 16" RH. Dia. of wire 0.099" (GWG 11) Tapes 0.545" x 0.035", lay 4" LH.	1.42" dia.

Electrical Characteristics

These are the same as those of RFC/G/22.

7.24 RFC/G/24 Description of Cable

This is a small flexible concentric cable with a solid dielectric of plasticised polystyrene. The inner conductor of plain copper is covered by a thin extruded layer of the polystyrene. This is covered by a thin transparent tape, and over this further layers of the polystyrene are longitudinally applied.

The outer conductor is formed by a rather open braid of plain copper wire; protection is given to the cable by a sheath of black P.V.R.

Details of Construction

Inner Conductor	Plain copper wire	0.052" dia.
Dielectric	Plasticised polystyrene. 1st extruded layer 0.080" dia. Transparent tape 0.001" thick. 4 layers of plasticised polystyrene longitudinally applied.	0.249" dia.
Braid	24 x 4 x 0.007", p.c.w., lay 0.96"	0.262" dia.
Sheath	Black P.V.R.	0.457" dia.

Electrical Characteristics

Zo above 10 Mc/s	65 ohms (calc.)
V/c above 10 Mc/s	0.654
Capacitance at 1 Mc/s	76 pF/metre

7.25 RFC/G/25 Description of Cable

This cable is a flexible balanced twin with a dielectric of ceramic beads. The beads are shaped so as to occupy nearly all the space between the conductors and the screen. This results in a high capacity and low characteristic impedance.

The beads are covered with a thin transparent tape over which is woven a braid of copper tapes. A dark blue P.V.R. sheath covers this screen.

Details of Construction

Inner Conductors	Two plain copper wires	0.057" dia
Beads	Ceramic. Length 0.398" Spacing 0.285"	0.432" dia
Tape	Transparent material. Thickness 0.001"	
Braid	24 Copper Tapes, 0.092" x 0.005_6", lay 2.0"	0.485" dia
Sheath	Dark blue P.V.R.	0.643" dia

Electrical Characteristics

Zo at 1 Mc/s	78.5 ohms
Capacitance at 1 Mc/s	49.2 pF/metre
Inductance at 1 Mc/s	0.303 μH/metre
Coefficient of Asymmetry	0.3%

7.26 RFC/G/26 Description of Cable

This is a flexible twin cable of polystyrene bead construction. It is designed to have good screening.

The two inner conductors are of plain copper wire spaced by polystyrene beads having five holes in the end, of which two are used. The outer conductor consists of two copper tapes wound with opposite lays. These are covered by a tinned copper wire braid. A sheath of P.V.R. separates this braid from an outer braid of tinned copper wire. The whole cable is sheathed in a grey-green P.V.R.

The use of identification threads beneath each sheath suggests that the inner part is extruded for use without the second braid and sheath.

Details of Construction

Inner Conductor	Two plain copper wires (GWG 23)	0.022" dia.
Spacers	Polystyrene beads. Length 0.477" Spacing 0.37"	0.465" dia.
Outer Conductor	Two plain copper tapes 0.40" x 0.003_3" Tapes wound with lay 0.30" Inner tape LH, outer RH.	0.480" dia.
1st Braid	(12 x 6 x 0.007_2" RH) (12 x 7 x 0.007_2" LH) t.c.w. lay 1.32"	0.513" dia.
Sheath	Blue-grey P.V.R.	0.584" dia.
Outer Braid	(18 x 4 x 0.007_2" RH) (18 x 5 x 0.007_2" LH) t.c.w. lay 1.24"	0.615" dia.
Sheath	Grey-green P.V.R.	0.759" dia.

Electrical Characteristics

Zo at 1 Mc/s	200 ohms
Capacitance at 1 Mc/s	14.3 pF/metre
Inductance at 1 Mc/s	0.576 μH/metre
Coefficient of Asymmetry	0.6%

8. Acknowledgements

Most of the electrical measurements quoted in this report have been made by members of the Cables Section over a period of the last two years. Miss D.M. Wood, and Messrs. K.W.L. Kemp and F.H. Mead have carried out most of the tests.

The measurements made on RFC/G/1 and 2 were made in the laboratories of Messrs. B.I. Cables and RFC/G/16 has been tested by Messrs. T.C.M. Ltd.

9. References

The following Cables Section Reports deal with individual German cables.

RFC/G/5	CS/F.303
RFC/G/6	CS/F.303 and 314
RFC/G/7	CS/F.303
RFC/G/9	CS/F.362
RFC/G/10	CS/F.363
RFC/G/11	CS/F.393
RFC/G/12	CS/F.394
RFC/G/13	CS/F.422
RFC/G/14	CS/F.483
RFC/G/15	CS/F.516
RFC/G/16	CS/F.567 and 580

RFC/G/1) The measurements on these cables are the subject
RFC/G/2) of a letter from Messrs. B.I. Cables, ref. BW/M
) of 3.10.41

RFC/G/16 has also been described in R.A.E. Tech. Note 246 and is the subject of a letter from Messrs. T.C.M., ref. EWS/ER 27/10/44.

Attached: Tables I - IV
Diagrams 10824, 10825, 10826
Neg. Nos. 57981, 57982, 57983, 57606, 57984

Circulation: R.A.E.
D.C.D.
T.R.E.
A.D.I.Sc.
A.I.2g.

Radio S.5132/RCM/29
21st December 1944.

TABLE I

Characteristics of German Radio Frequency Cables

Cable	Type	Zo in ohms	Cap.in pF/metre	Outside diam.	Wt/1000 yds.	Construction
RFC/G/1	Concentric	58 ohms	92.8 pF/metre	0.349"	285 lbs.	Porcelain Beads, PVR Sheath - Dark blue.
RFC/G/2	Concentric	140 ohms	28.5 pF/metre	0.405"	240 lbs.	Polystyrene Beads, Sheath-Fabric Braid, covered with Black Lacquer.
RFC/G/5	Concentric	142 ohms above 10 Mc/s	28.3 pF/metre	0.440"	250 lbs.	Polystyrene Beads, Sheath - PVR. Dark blue.
RFC/G/6	Concentric	69.4 ohms above 10 Mc/s	55.5 pF/metre	0.585"	520 lbs.	Polystyrene Beads, Sheath - Blue P.V.R.
RFC/G/7	Twin	192 ohms above 10 Mc/s	22.5 pF/metre	0.440"	340 lbs.	Polystyrene Beads, Sheath - Blue P.V.R.
RFC/G/8	Twin	100 ohms				Ceramic Beads, Phos-bronze strip conductors.
RFC/G/9	Concentric	207 ohms above 10 Mc/s	16.96pF/metre	0.562"	700 lbs.	Polystyrene Beads, Sheath - Blue P.V.R.
RFC/G/10	Twin	143.5 ohms above 10 Mc/s	28.0 pF/metre	0.561"	375 lbs.	Polystyrene Beads, Sheath - Blue P.V.R.
RFC/G/11	Twin	71.1 ohms at 1 Mc/s	87.9 pF/metre	0.274"	130 lbs.	Dielectric - Silk and Grey Plastic. Braid, Tinned Copper Wire.
RFC/G/12	Concentric	207 ohms above 10 Mc/s	16.96 pF/metre	0.562"	520 lbs.	Polystyrene Beads, Sheath Blue P.V.R.
RFC/G/13	Concentric	67 ohms at 1 Mc/s	72 pF/metre	0.586"	500 lbs.	Dielectric - solid Plasticised Polystyrene, Sheath - Dark Blue P.V.R.

TABLE I (contd)

Cable	Type	Zo in ohms	Cap. in pF/metre	Outside diam.	Wt/1000 yds.	Construction
RFC/G/14	Twin	249 ohms at 1 Mc/s	16.98 pF/metre	0.805"	1400 lbs.	Polystyrene Beads, Braid - steel wire.
RFC/G/15	Concentric	49.5 ohms at 1 Mc/s	95.6 pF/metre	0.347"	300 lbs.	Ceramic Beads, Blue P.V.R. Sheath
RFC/G/16	Concentric	62.0 ohms above 10 Mc/s	65.9 pF/metre	1.25"	2200 lbs.	Polystyrene Beads; Braid - steel wire.
RFC/G/17	Twin	93.0 ohm at 1 Mc/s	43.2 pF/metre	0.652"	830 lbs.	Solid dielectric Plasticised Polystyrene; Sheath - Brown P.V.R.
RFC/G/18	Concentric	56.8 ohm at 1 Mc/s	85.7 pF/metre	0.462"	390 lbs.	Dielectric - Plasticised Polystyrene; Sheath - Brown P.V.R.
RFC/G/19	Concentric	73.3 ohms at 1 Mc/s	54.0 pF/metre	0.621"	150 lbs.	Beads - Polystyrene, Sheath Dark Blue P.V.R.
RFC/G/20	Concentric	74 ohms at 1 Mc/s	52.3 pF/metre	1.43"		Polystyrene Beads, Steel wire armouring.
RFC/G/21	Concentric	70.0 ohm at 1 Mc/s	49.9 pF/metre	1.037"	2100 lbs.	Spiral Spacers Polystyrene, Steel wire braid.
RFC/G/22	Concentric	68.8 ohm at 1 Mc/s	52.2 pF/metre	1.008"	3000 lbs.	Spiral thread dielectric. Lead sheath
RFC/G/23	Concentric	68.8 ohm at 1 Mc/s	52.2 pF/metre	1.42"	8000 lbs.	Spiral thread Dielectric, Steel wire armouring.
RFC/G/24	Concentric	65 ohm at 1 Mc/s	76 pF/metre	0.457"	580 lbs.	Dielectric Plasticised Polystyrene, Sheath - Black P.V.R.
RFC/G/25	Twin	78.5 ohm at 1 Mc/s	49.2 pF/metre	0.643"	900 lbs.	Ceramic Beads, Sheath - Dark blue P.V.R.

TABLE II

Identification Threads Found in German R. F. Cables

Cable No.	Colour of Thread						
	Purple & White	Red, White & Green	Red, Yellow & Green	Bronze & White	Threads (3)&(4)	Threads (1)&(3)	No Thread
RFC/G/1						x	
RFC/G/2							x
RFC/G/5						x	
RFC/G/6						x	
RFC/G/7						x	
RFC/G/9			x			x	
RFC/G/10			x			x	
RFC/G/11					x		
RFC/G/12						x	
RFC/G/13			x				
RFC/G/14							x
RFC/G/15			x			x	
RFC/G/16	x						x
RFC/G/17	x					x	
RFC/G/18	x	x					
RFC/G/19			x			x	
RFC/G/20							x
RFC/G/21		x					
RFC/G/22		x					
RFC/G/23		x					
RFC/G/24				x			
RFC/G/25						x	
RFC/G/26	x						

(1) Purple-White — Electrotechnishe Fabrik. A.G., Vacha a.d. Werra.
(2) Red, White, Green, White — Siemens-Schuckert Werke G.m.b.H., Siemensstadt, Berlin.
(3) Red, Yellow, Green — Probably the V.D.E. thread for airborne cables.
(4) Red, Dark Blue, Green — Kabel und Metallwerke Neumeyer A.G., Nurnberg.
(5) Bronze, White. — Südd. Telefon-Apparate, Draht und Kabelwerke, Nurnberg 2.

(6) Both (1) and (3)

(1) (2) (5) are single threads with splashes of colour.
(3) (4) each consist of three coloured threads twisted.

RFC/G/20 was made by A.E.G. Metallwerke, Berlin-Oberspree but no identification thread was used.

TABLE III

Braids with Different Numbers of Ends in RH & LH Spindles

Cable	Lay	Spindles	Ends	Dia.of end	D	Function
RFC/G/9	1.35	24	6RH 8 LH	0.007_6	0.481	As outer conductor of cable
RFC/G/10	1.33	24	8 RH 6 LH	0.007_6	0.476	Ditto.
RFC/G/26	1.24	36	4 RH 5 LH	0.007_2	0.600	Ditto.
RFC/G/19	1.75	24	6 RH 5 LH	0.007_6	0.466	As support to copper tape
RFC/G/26	1.32	24	6 RH 5 LH	0.007_2	0.497	Ditto.
RFC/G/16	4.2 5.1 4.4	48 48 48	6 RH 8 LH 5 RH 7 LH 7 RH 5 LH	0.012) 0.013) 0.013)	1.20 1.20 1.20	Steel wire outer braid on three different samples of this cable.

D = mean diameter of braid.

TABLE IV

German Wire Gauge Sizes

Wire Size	Millimetres	Inches
1	5.50	0.216
2	5.00	0.197
3	4.50	0.177
4	4.25	0.167
5	4.00	0.158
6	3.75	0.148
7	3.50	0.138
8	3.25	0.128
9	3.00	0.118
10	2.75	0.108
11	2.50	0.0984
12	2.25	0.0886
13	2.00	0.0787
14	1.75	0.0689
15	1.50	0.0591
16	1.375	0.0542
17	1.250	0.0492
18	1.125	0.0443
19	1.000	0.0394
20	0.875	0.0344
21	0.750	0.0296
22	0.625	0.0246
23	0.562	0.0221
24	0.500	0.0197
25	0.438	0.0172

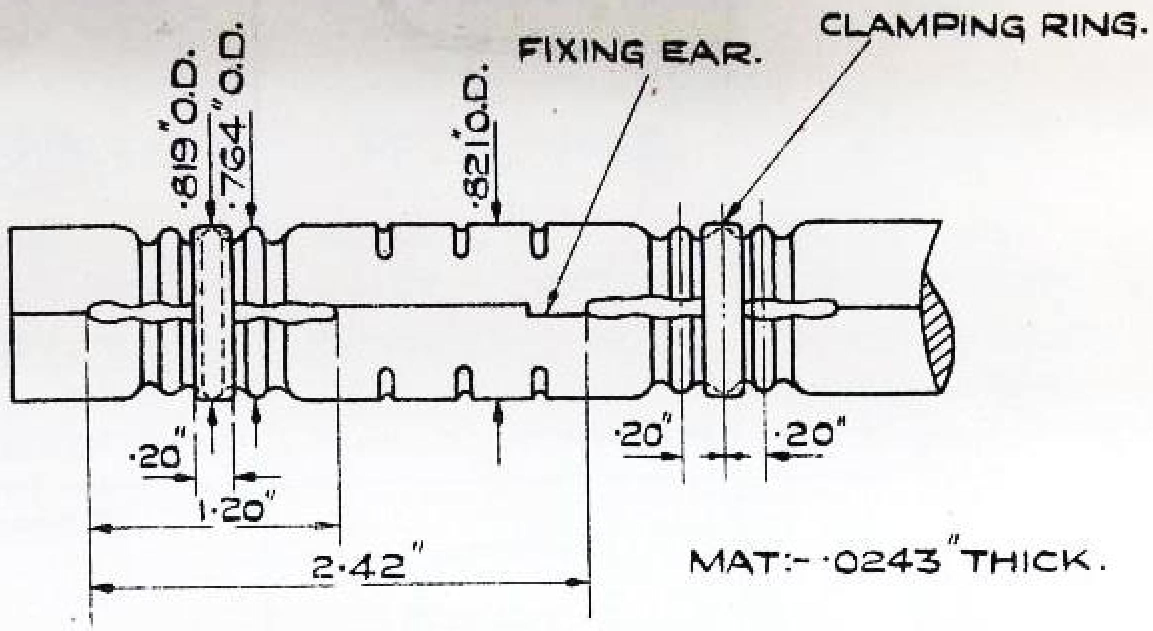


Fig.1. Outer Conductor. R.F.C./G/20.

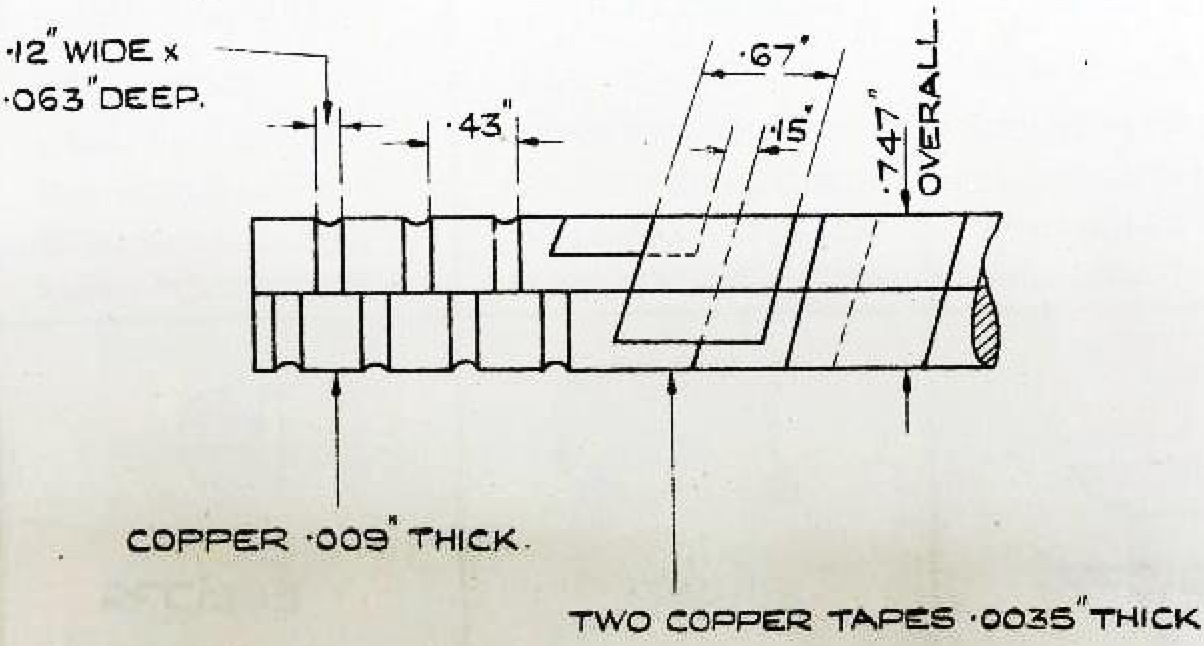


Fig.2. Outer Conductor. R.F.C./G/21, 22 & 23.

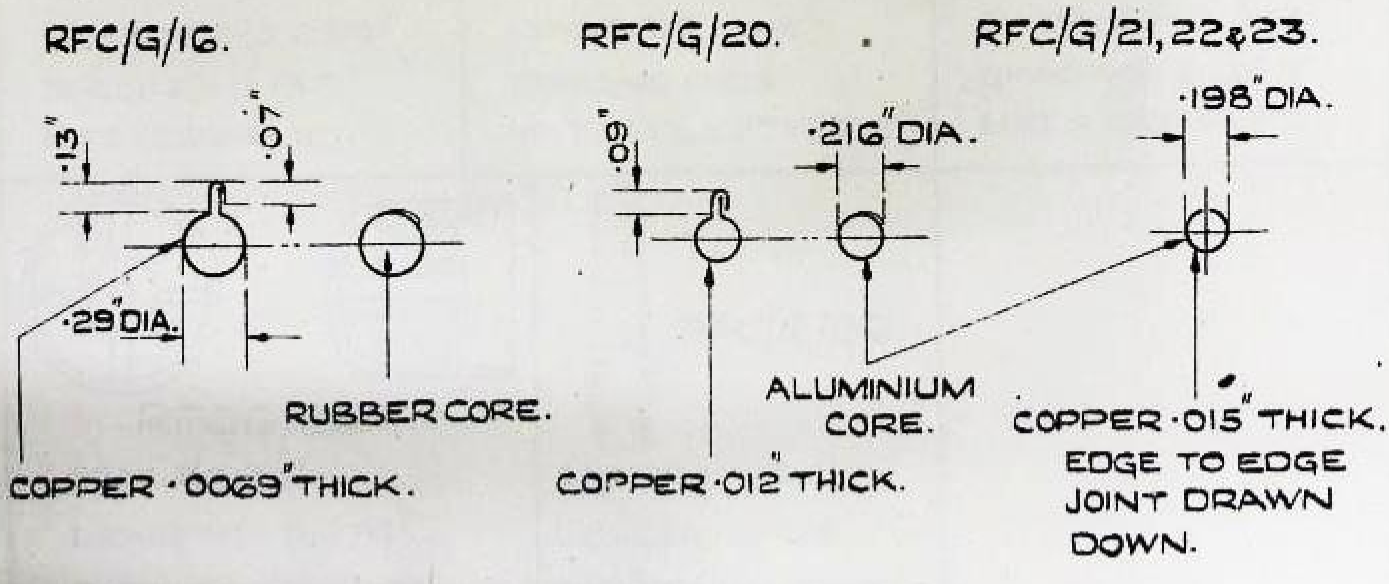
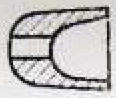


Fig.3. Inner Conductors.

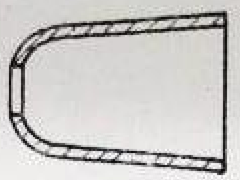
Issue:-1 23·10·44.

Diag. No. 10824.



RFC/G/5.

SCALE = x2
LENGTH = 0·269"
DIAMETER = 0·210"
SPACING = 0·217"
MAT. = POLYSTYRENE.

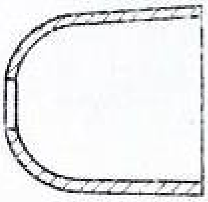


RFC/G/19 & G6.

SCALE = x2
LENGTH = 0·407"
DIAMETER = 0·390"
SPACING = 0·312"
MAT. = POLYSTYRENE.

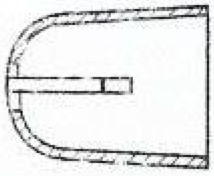
RFC/G/7.

SCALE = x2
LENGTH = 0·270"
DIAMETER = 0·227"
SPACING = 0·20"
MAT. = POLYSTYRENE.



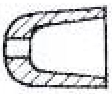
RFC/G/9 & 12.

SCALE = x2
LENGTH = 0·500"
DIAMETER = 0·457"
SPACING = 0·350"
MAT. = POLYSTYRENE.



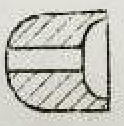
RFC/G/10.

SCALE = x2
LENGTH = 0·450"
DIAMETER = 0·383"
SPACING = 0·340"
MAT. = POLYSTYRENE.



RFC/G/14.

SCALE = x2
LENGTH = 0·214"
DIAMETER = 0·265"
SPACING = 0·178"
MAT. = POLYSTYRENE.

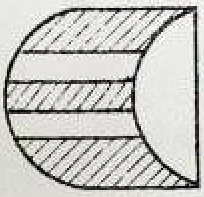


RFC/G/15

SCALE = x2
LENGTH = 0·230"
DIAMETER = 0·234"
SPACING = 0·197"
MAT. = CERAMIC.

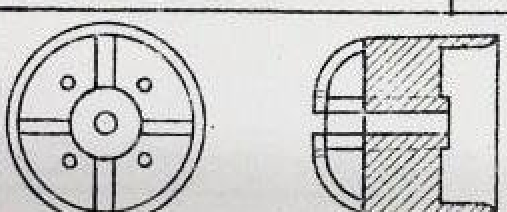
RFC/G/16.

SCALE = x1
LENGTH = 1·20"
DIAMETER = 0·67"
SPACING = 1·08"
MAT. = POLYSTYRENE.



RFC/G/25.

SCALE x2
LENGTH = 0·398"
DIAMETER = 0·432"
SPACING = 0·285"
MAT. = CERAMIC.

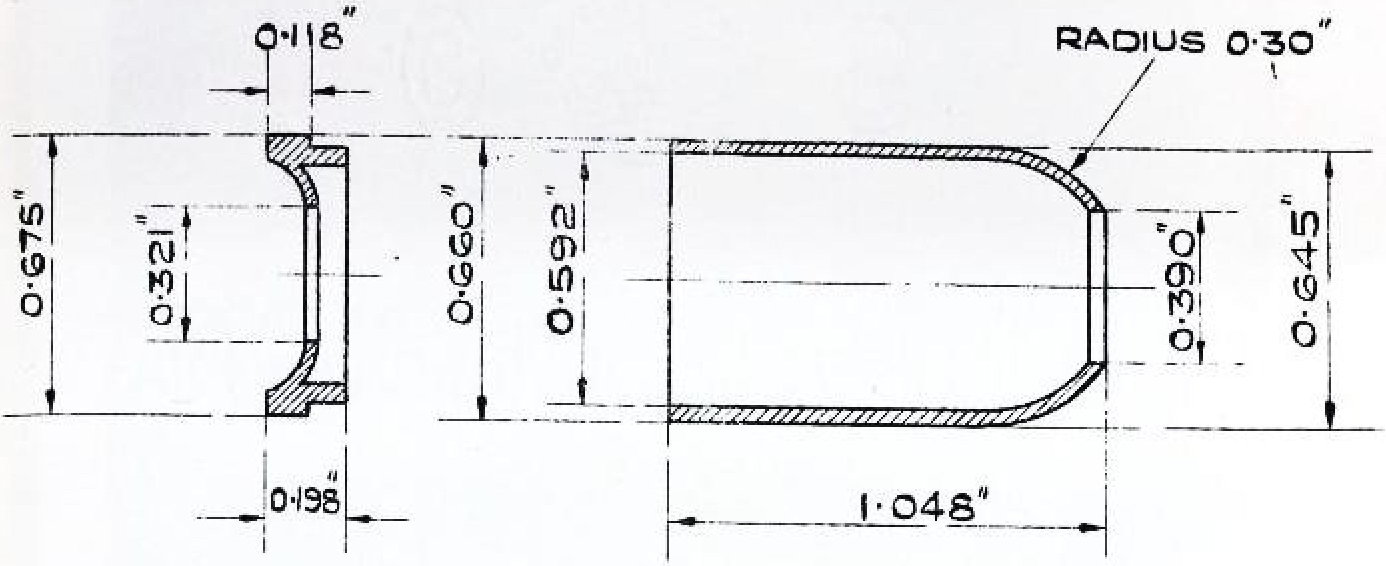


RFC/G/26.

SCALE = x2.
LENGTH = 0·474"
DIAMETER = 0·467"
SPACING = 0·374"
MAT. = POLYSTYRENE.

RFC/G/20.

SCALE = x2
LENGTH = 0·138"
DIAMETER = ·685"
SPACING = 2·42"
MAT. = POLYSTYRENE



THE TWO PARTS ARE CEMENTED TOGETHER
WITH STYRENE CEMENT.

FIG. 1. POLYSTYRENE SPACING BEAD FROM R.F.C/G/16.

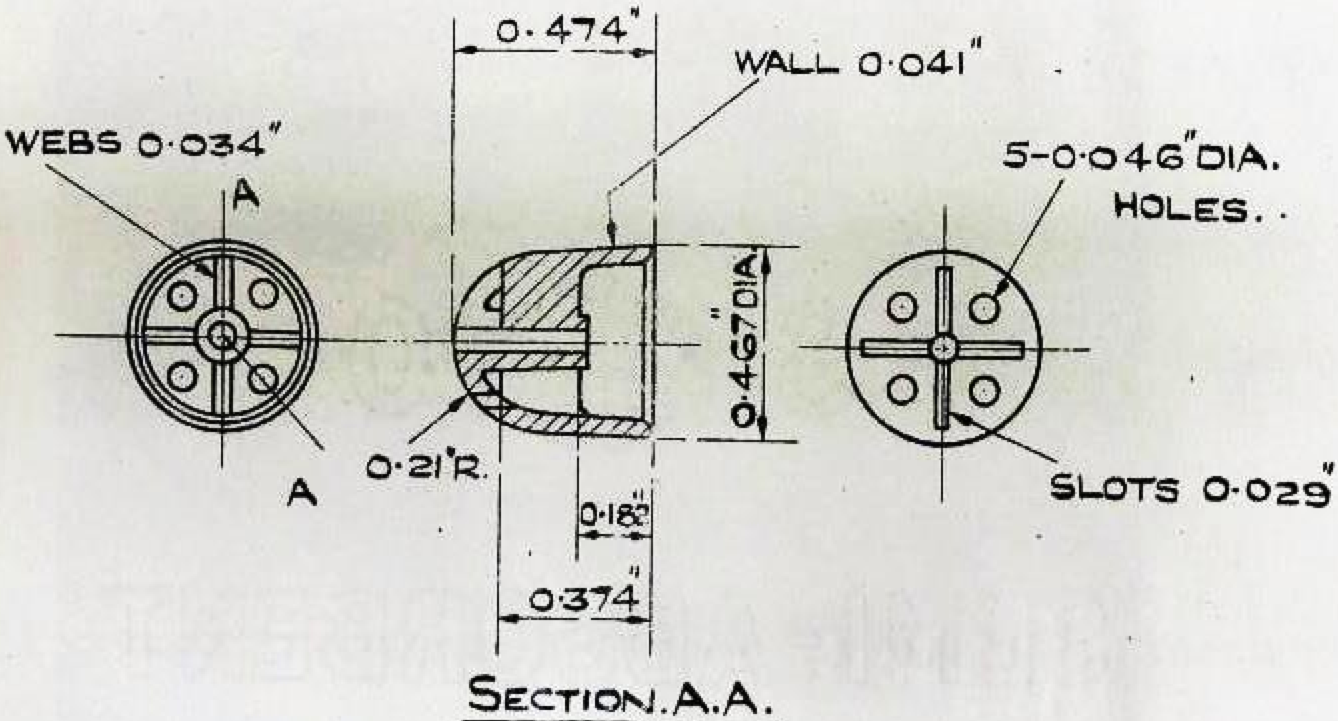


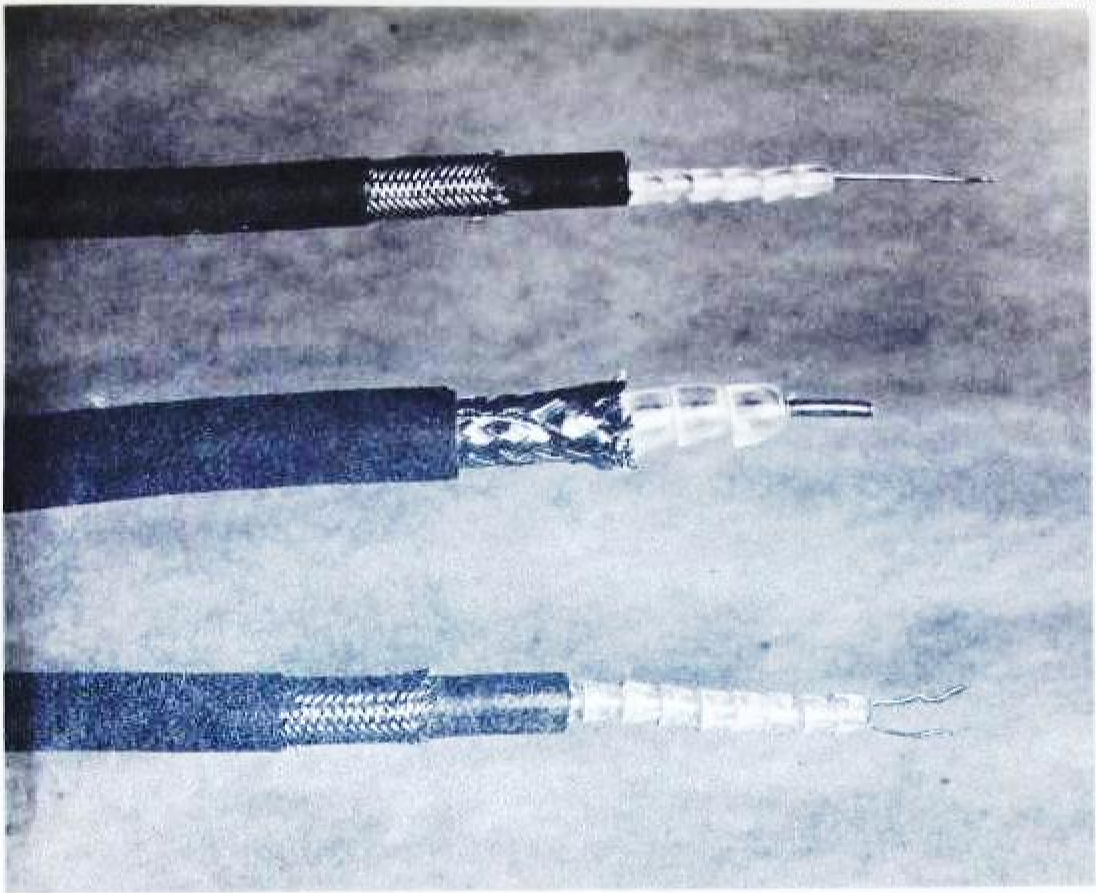
FIG. 2. POLYSTYRENE SPACING BEAD FROM RFC/G/26.

DETAILS OF BEADS FROM RFC/G/16 & RFC/G/26.

ISSUE:- 1. 23·10·44. DIAG. No. 10826.

SECRET

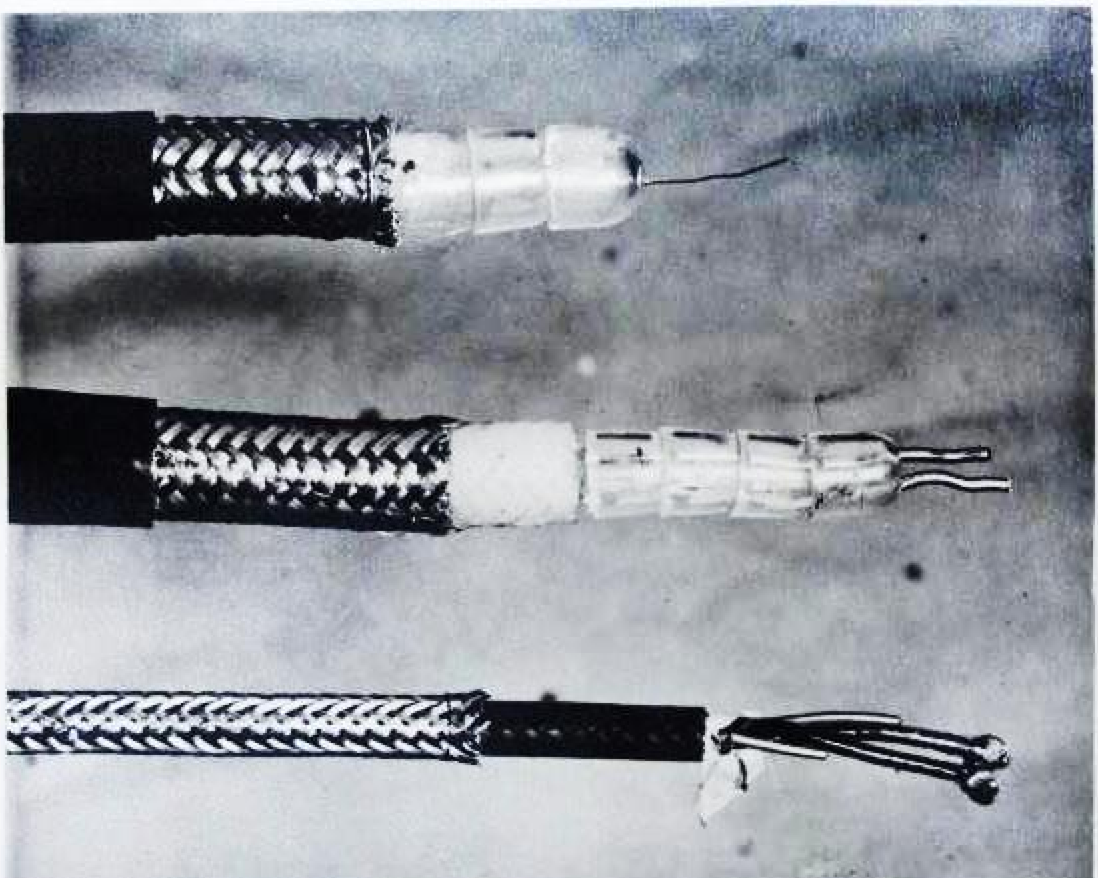
PLATE 1.



RFC/G/5

RFC/G/6

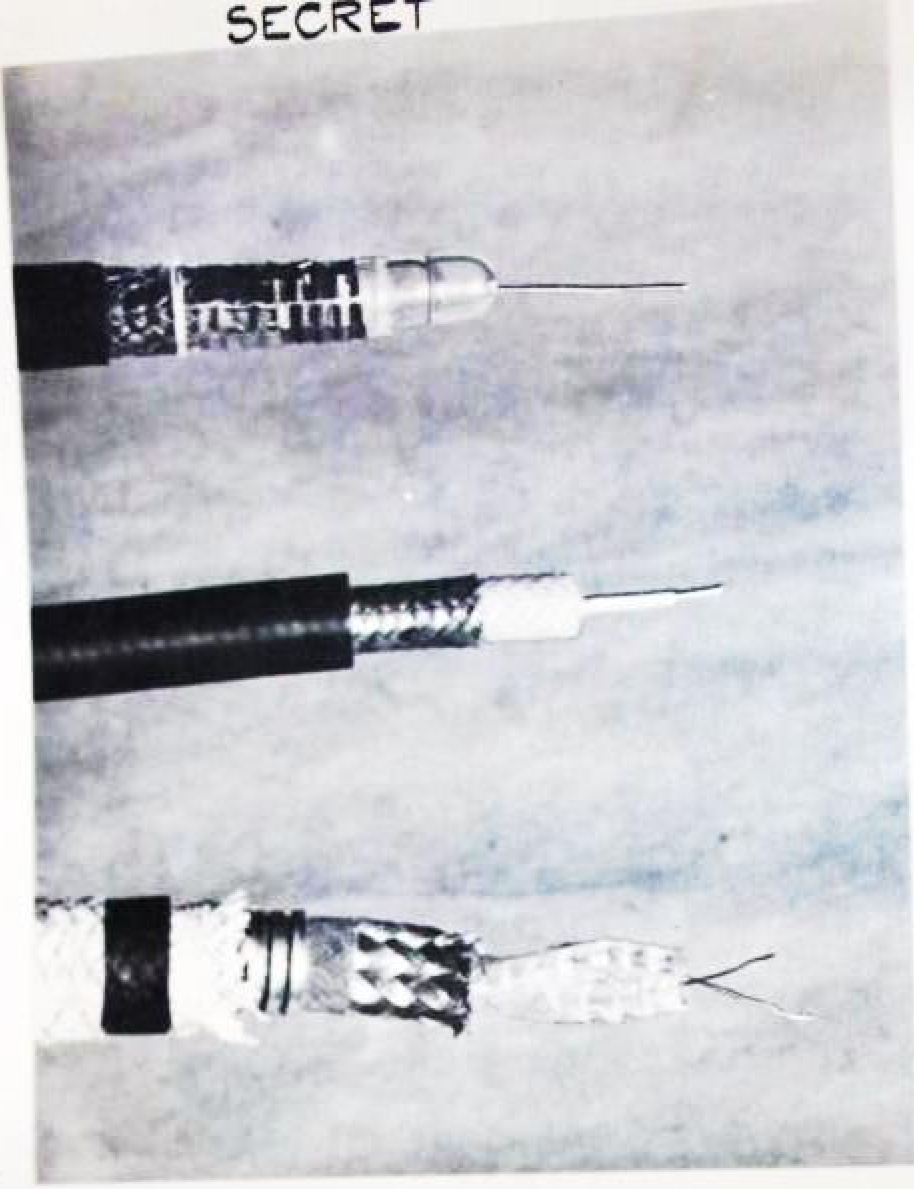
RFC/G/7



RFC/G/9

RFC/G/10

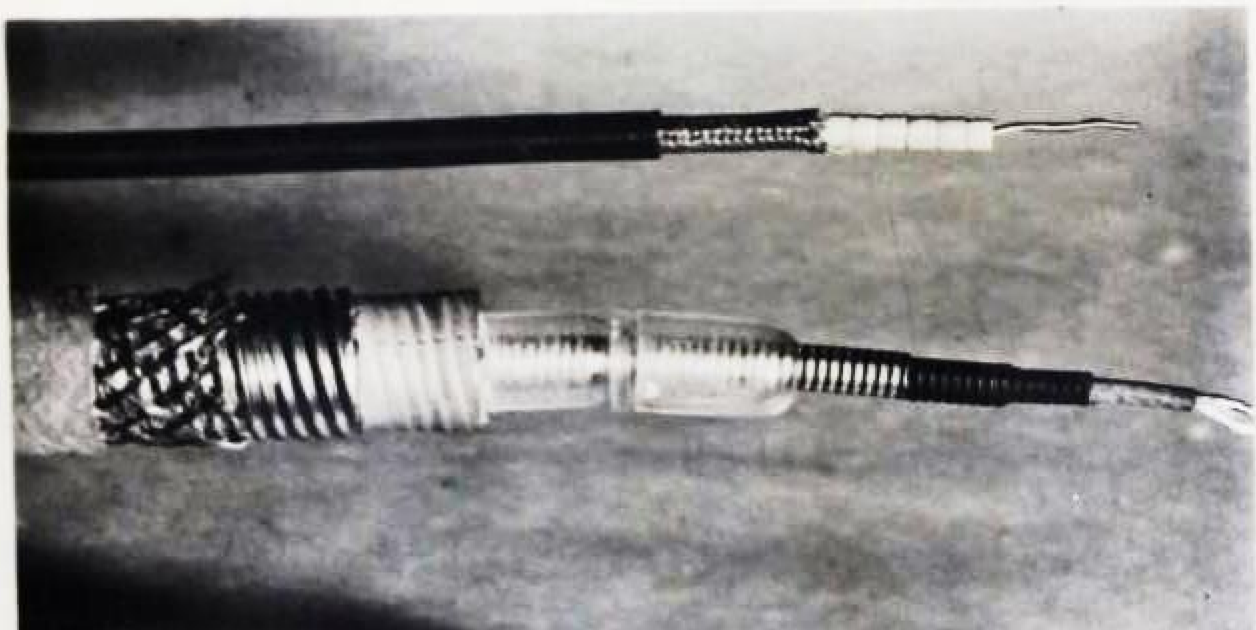
RFC/G/11.



RFC/G/12

RFC/G/13

RFC/G/14



RFC/G/15

RFC/G/16

RFC/G/17

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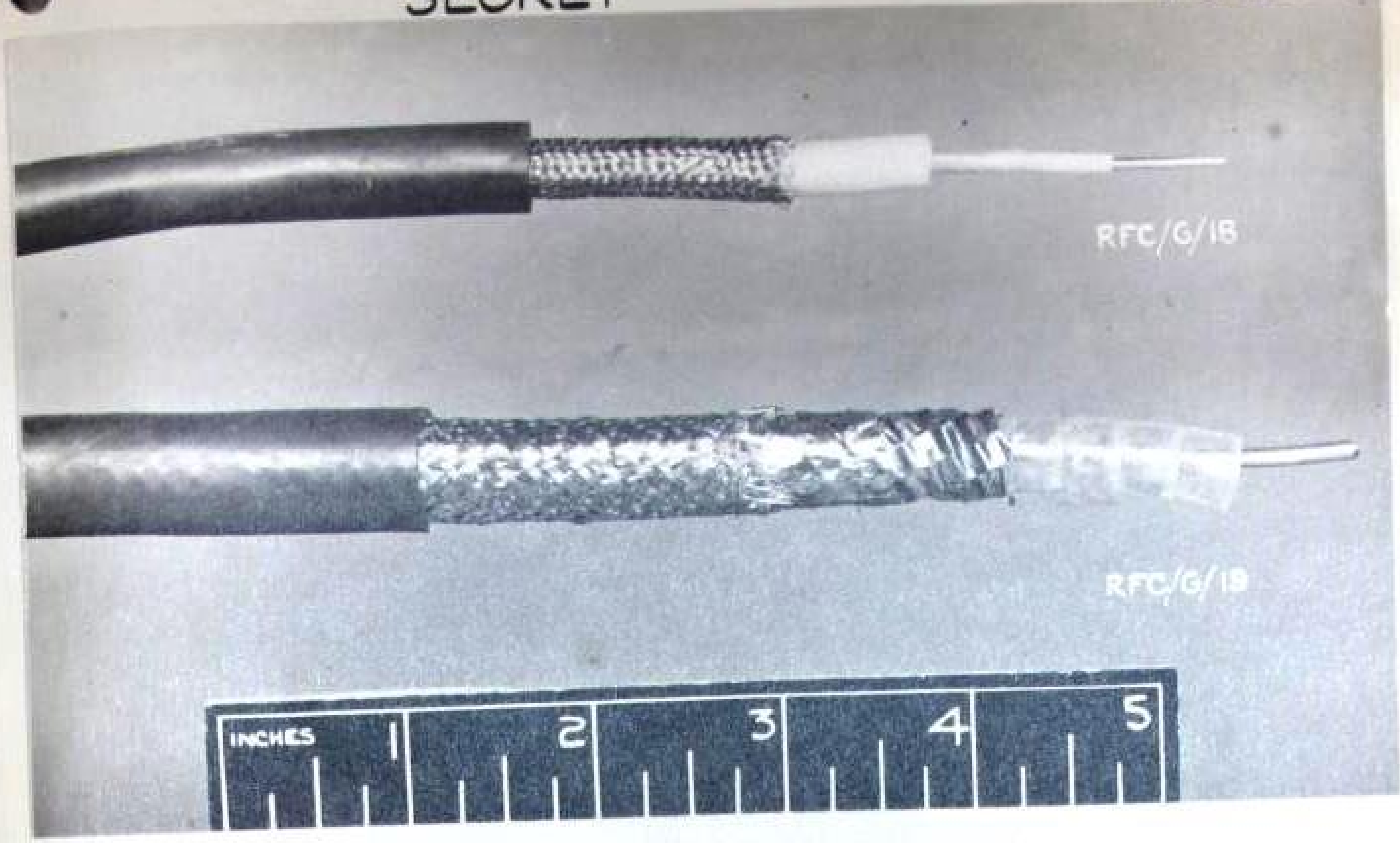
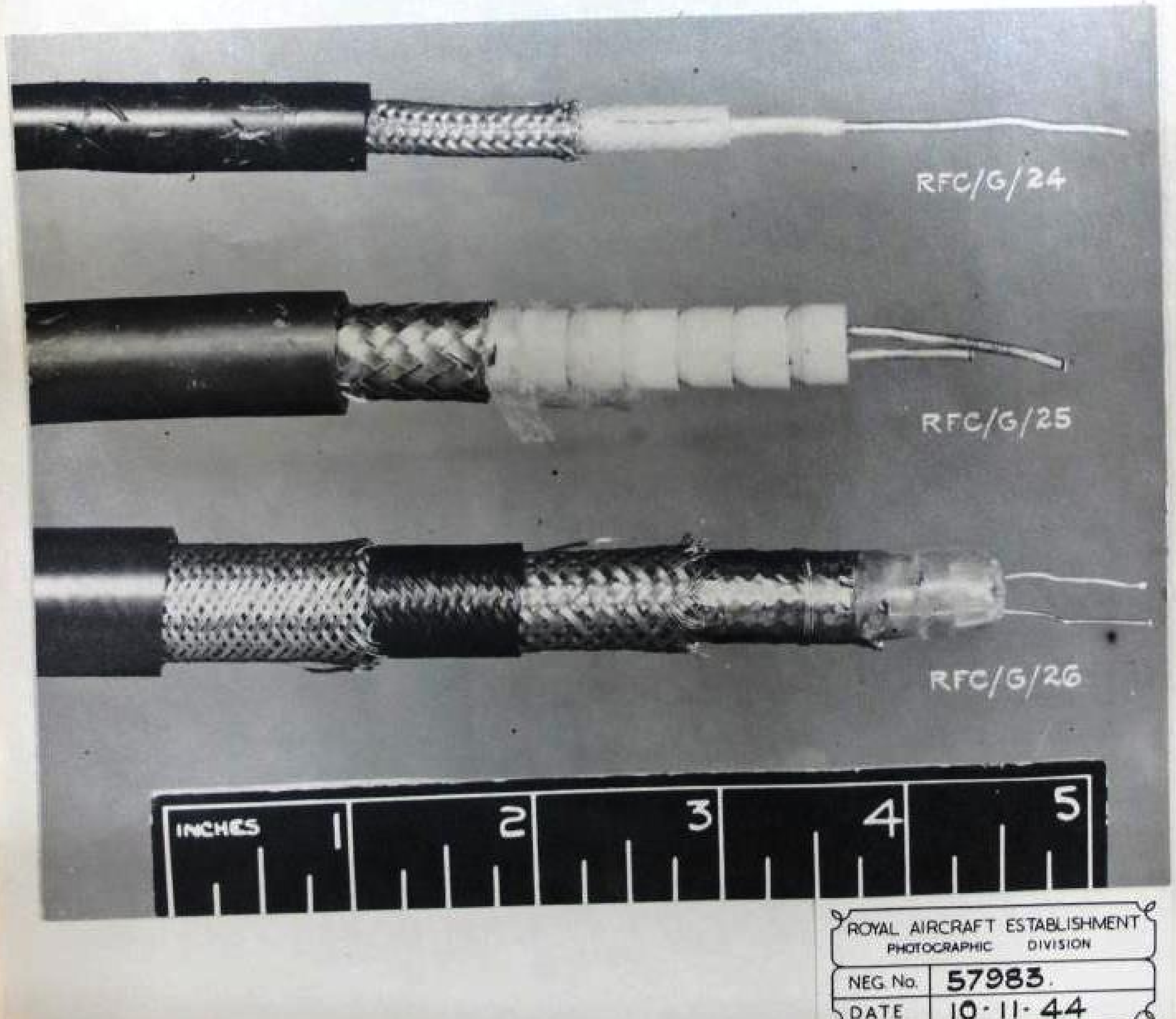

RFC/G/18
RFC/G/19
INCHES 1 2 3 4 5


RFC/G/24
RFC/G/25
RFC/G/26
INCHES 1 2 3 4 5
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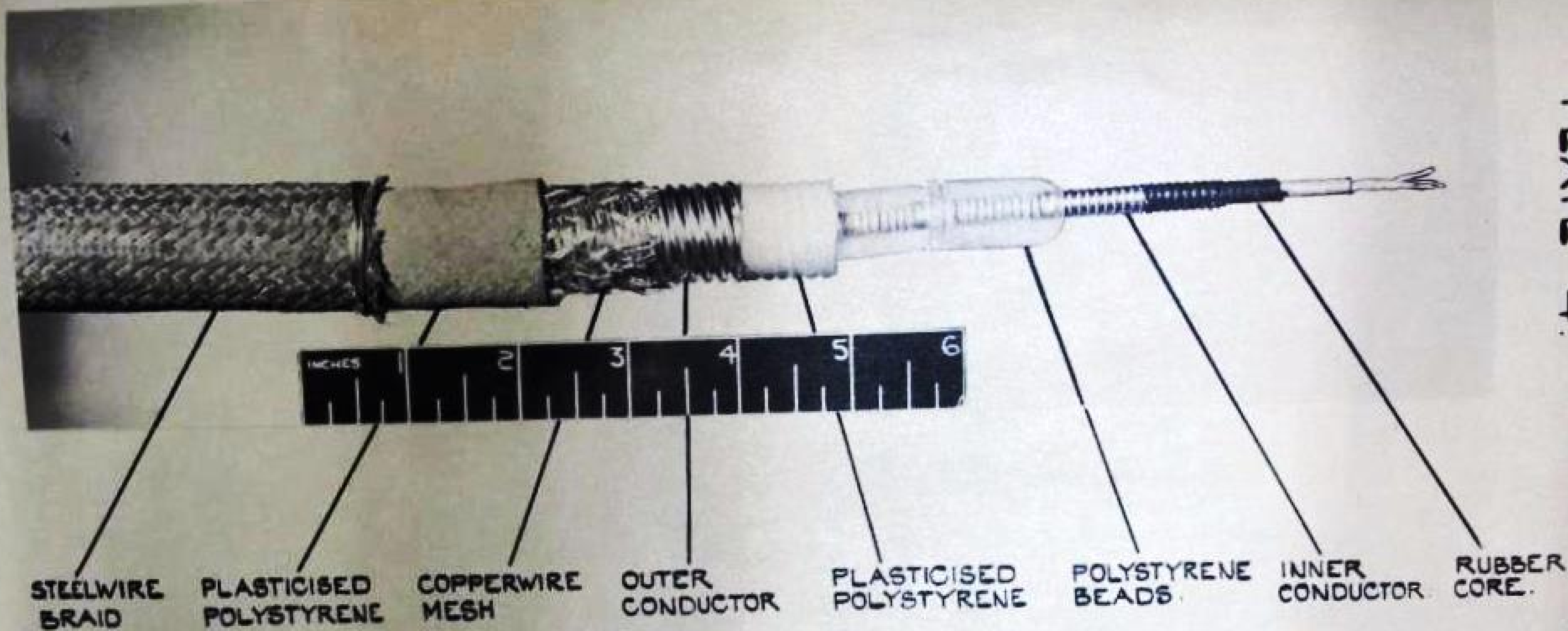
PHOTOGRAPHIC DIVISION
NEG. No. 57983.
DATE 10·11·44

PLATE 4.

SECRET



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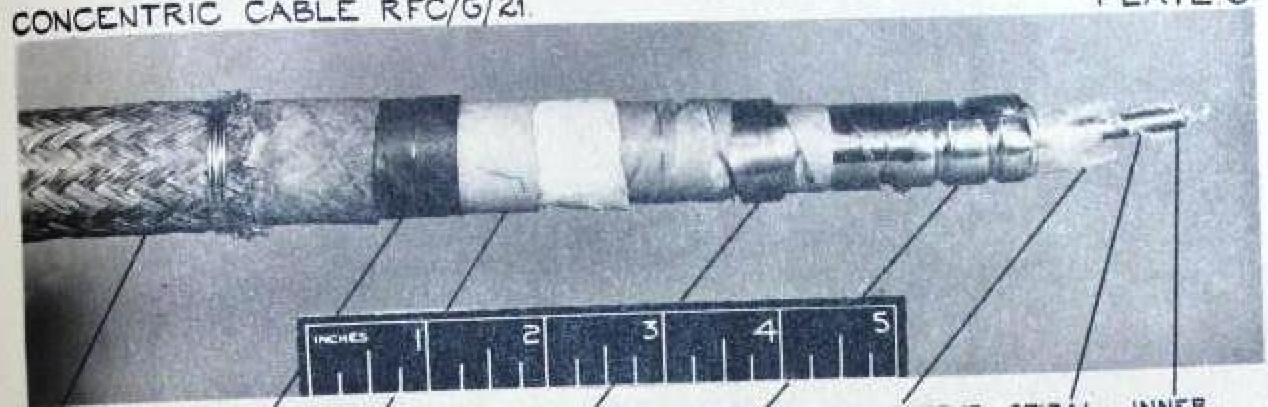
NEG. No. 57606
DATE 26 · 10 · 44.

CONCENTRIC CABLE RFC/G/16

CONCENTRIC CABLE RFC/G/20 PLATE 5.

STEEL WIRE ARMMOURING
STEEL TAPE
LEAD SHEATH
CELLULOSE TAPES
ALUMINIUM FOIL TAPES
OUTER CONDUCTOR
SPACING BEAD
INNER CONDUCTOR

CONCENTRIC CABLE RFC/G/21. PLATE 6



STEEL WIRE BRAID.
RUBBER TAPE
PLASTICISED POLYSTYRENE
STEEL TAPE
OUTER CONDUCTOR
POLYSTYRENE TAPE
SPIRAL SPACERS
INNER CONDUCTOR.

CONCENTRIC CABLE RFC/G/22. PLATE 7

LEAD SHEATH
VARNISHED CAMBRIC.
BROWN PAPER
STEEL TAPE
ALUMINIUM TAPE
OUTER CONDUCTOR.
POLYSTYRENE SPIRAL SPACERS.
INNER CONDUCTOR.

CONCENTRIC CABLE RFC/G/23. PLATE 8

STEEL WIRE ARMMOURING
JUTE BEDDING.
LEAD SHEATH
VARNISHED CAMBRIC
BROWN PAPER
STEEL TAPE
ALUMINIUM TAPE
OUTER CONDUCTOR.
INNER CONDUCTOR.

ROYAL AIRCRAFT ESTABLISHMENT
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NEG No. 57984
DATE 10-11-44