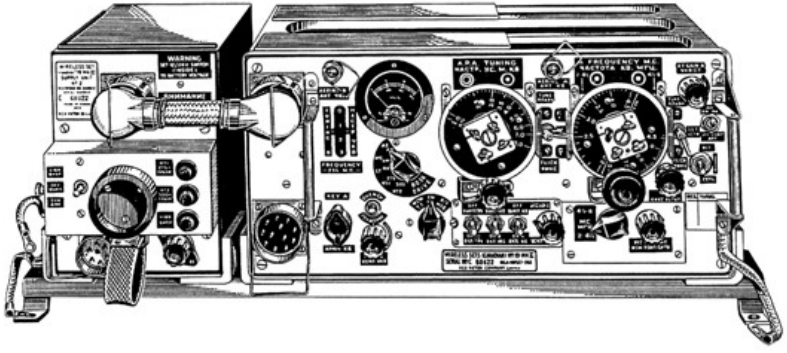

Wireless Set No 19 Mk.3 (Canadian)

MICROPHONE ELEMENTS

TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

GENERAL

1. Microphone elements may be divided into four groups, viz:-

Carbon types.
Moving-iron diaphragm types.
Moving-iron balanced armature types.
Moving-coil types.

The elements used in the Army are listed under their respective groups in Tables 1001 to 1004. The photographs illustrate typical elements in each group.

PRINCIPLES OF OPERATION

Carbon type microphone elements

2. The carbon microphone makes use of the fact that the resistance which a mass of carbon granules offers to an electrical current depends upon the pressure applied to the carbon. In the carbon microphone, a direct current is passed through the granules, which are mounted against a disphragm to form a 'button' (see Fig. 1). Sound waves striking the diaphragm cause it to vary the pressure exerted on the granules. This produces corresponding changes in resistance of the button and hence causes the current to vary with the pressure exerted against the diaphragm. The alternating component of this current is induced into a secondary circuit by means of a transformer.

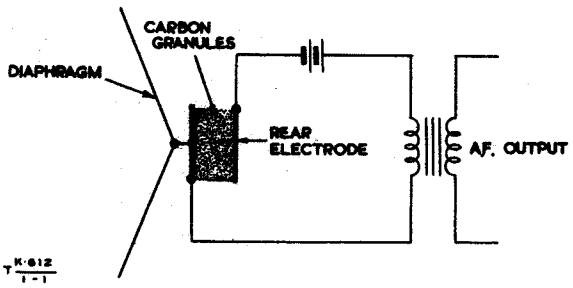

Fig. 1 - Carbon type microphone

3. Below the resonant frequency of the diaphragm, the output is substantially independent of frequency, but it falls off rapidly above resonance. The output at resonance depends on the damping system.

4. The main advantage of the carbon type of microphone is that its power output is greater than the audio power required to drive it and it thus acts as a form of amplifier. The main disadvantage is that there is always a background hiss caused by random variations in the granule resistance. The necessity for a polarizing voltage is also a disadvantage is some instances.

5. In most carbon microphones the current flows from an electrode mounted on the diaphragm, through the carbon granules to a rear fixed electrode. In the transverse current type of microphone, the current flows along the granule mass in a direction parallel with the diaphragm, from one fixed electrode to another. The diaphragm can, therefore, be made of a non-conducting light and pliable material thus giving the microphone a flatter frequency characteristic.

6. Differential microphones make use of a push-pull principle shown in Fig. 2. The polarizing current flows through the two halves of the mass of granules in opposite directions. When sound waves strike the diaphragm, it vibrates and thus causes the plate in the centre of the granules to vibrate. As the plate moves in one direction, it compresses one half of the granules while the pressure on the other half is decreased. As a result, the voltage at one end of the primary winding of the transformer rises while that at the other end falls. During the next half cycle of the movement of the diaphragm, the opposite occurs and thus an alternating voltage is applied to the transformer.

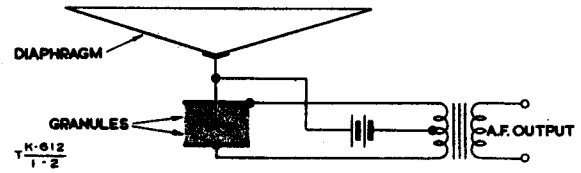

Fig. 2 - Differential type carbon microphone

Moving-iron diaphragm type microphone elements

7. In this type of microphone, a diaphragm of magnetic material is clamped rigidly at its edge, while its central portion bridges the pole-pieces of a permanent magnet as shown in Fig. 3. Round the tip of each pole is wound a coil having a large number of turns of fine wire. The diaphragm is made of a circular piece of very thin sheet iron. In its normal position it is as close to the pole-pieces as possible without actually touching them.

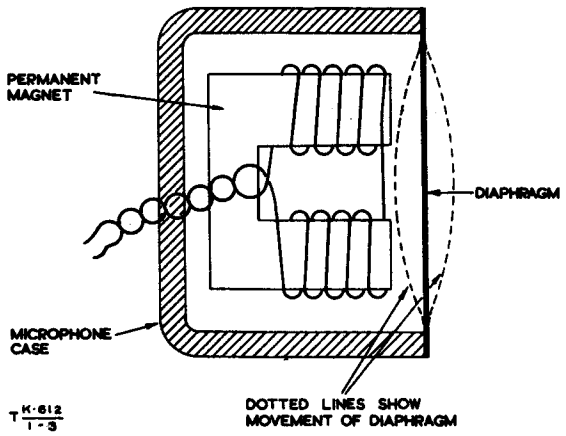

Fig. 3 - Moving-iron diaphragm microphone element

8. As sound waves strike the diaphragm, it is set in motion in the magnetic field, causing a change in the flux density between the diaphragm and the pole-pieces. This change in flux induces an e.m.f. in the coils wound round the pole-pieces. The vibrations of the diaphragm thus induce voltages in the coils corresponding to the nature of the sound waves impinging on the diaphragm.

9. One of the disadvantages of this type of microphone is the marked resonances in its frequency characteristic. This is avoided by designing the microphone such that these resonances occur either well above or well below the working frequency band. Another disadvantage of the moving-iron diaphragm type of microphone is that the diaphragm has to be made of magnetic material and also strong enough to withstand the steady pull of the magnet.

Moving-iron balanced-armature type microphone element

10. In the balanced-armature type of element, a magnetic armature is pivoted and lies in a magnetic field in such a way that the forces acting on each end are balanced and the armature is not subjected to any stress when in the quiescent condition (see Fig. 4A). One end of the armature is connected to the centre of the diaphragm and, when sound waves fall on the diaphragm, the armature moves away from the balance position in the magnetic field, thus varying the reluctance of the magnetic path and consequently the flux in the coil which surrounds it. This in turn sets up an alternating e.m.f. in the coil.

11. The armature is made of a sheet of magnetic material having two slits cut along the sides as shown in Fig. 4B. When the armature is clamped at the extremities of the side pieces, it will be effectively pivoted at some indeterminate point which is a short distance from the clamps.

Moving-coil microphone elements

12. In this type of microphone, a coil is attached to the diaphragm and is suspended in the radial field of a circular pot magnet (see Fig. 5). The outer end of the diaphragm is rigidly clamped. As sound waves strike the diaphragm, it is set into vibration and causes the coil to move in the magnetic field. An e.m.f. corresponding to the sound waves is then set up in the coil. The greater the intensity of the magnetic field, the greater is the output and a higher degree of electromagnetic damping will be produced. This damping is useful in that it flattens out resonances due to the diaphragm and other moving parts.

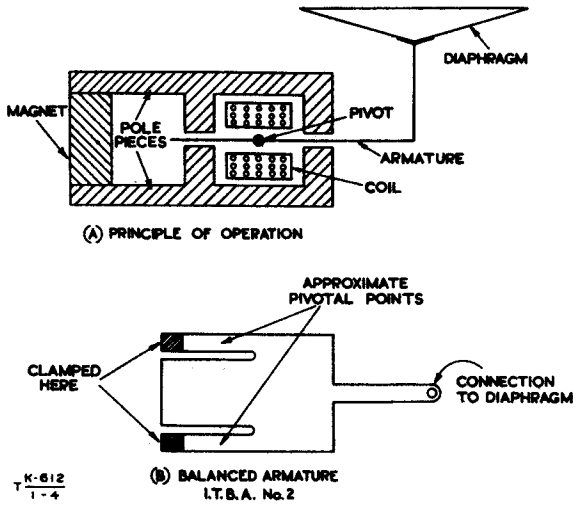

Fig. 4 - Moving-iron balanced-armature microphone element

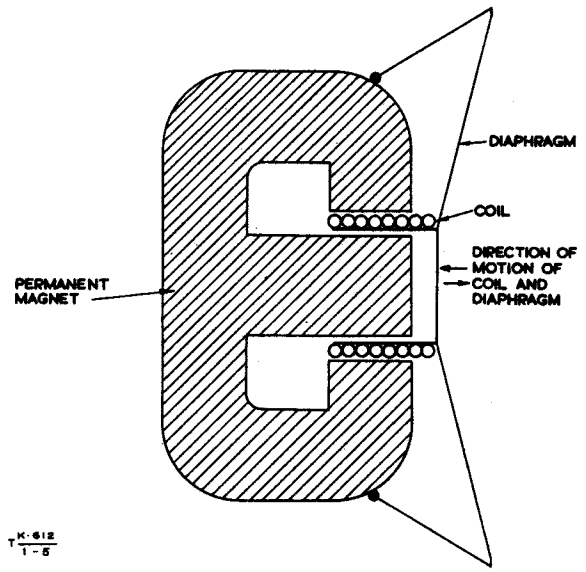

Fig. 5 - Moving-coil microphone element

Note: The next page is Page 1001.

Table 1001 - Carbon type microphone elements

Designation	Diameter in inches	Depth in inches	Weight in ounces	Current consumption	Where used	Remarks
Microphones, capsule, Mk. 4 (YA 1077)	2¼	1 1/10	2¼	40mA	Mic. hand, Nos. 3, 4, 4A, 6 & 8 also on Tels. hand, Nos. 1, 1A, 2A, 3, 5, 5A, 6, 6A and Transmitters, breast, No. 1.	Until recently, the most widely used capsule. Superseded by Microphone, capsule, No. 9. Diaphragm guard coloured blue.
Microphones, capsule, Mk. 5 (YA 2308)	2¼	1 1/10	2¼	40mA	Microphones, respirator, Nos. 1 and 2	Developed for use with respirators and is sealed to prevent gas from passing through. It has red bands painted on the granule chamber and diaphragm guard. Identical with Mk. 4 capsule in all other respects.
Microphone, capsule, No. 7 (YA 6519)	2¼	1 1/10	2¾	40mA	Mic. hand, No. 16	Developed for tropical use. Fitted with an internal mica diaphragm to prevent the metal diaphragm from being damaged by changing air pressures inside. Diaphragm guard coloured black.
Microphones, capsule, No. 8 (YA 7597)	2¼	1 1/10	2¼	70mA	Tels., hand, No. 9	Identical with the Mk. 4 capsule, but has lower resistance carbon granules. Diaphragm guard coloured black.

Table 1001 - (contd.)

Designation	Diameter in inches	Depth in inches	Weight in ounces	Current consumption	Where used	Remarks
Microphones, capsule, No. 9 (YA 7873)	2¼	1 1/10	2¼	40mA	Tele. hand, No. 10 of Ericsson manufacture	Immersion-proof version of Mk. 4 capsule. Granule chamber is hermetically sealed. Supersedes the Mk. 4 capsule. Diaphragm guard coloured black.
Microphone, capsule, No. 10 (YA 7982)	2¼	1 1/10	2¼	40mA	Tele. sets 'J'	Fully tropicalized, immersed electrode type inset. Similar to Mk. 4 capsule, but has drainage holes in the back of its case. Supersedes Mks. 4 and 5, Nos. 7 and 8 capsules. Diaphragm guard coloured yellow.
Insets, carbon, differential, No. 1 (YA 5054)	2¼	1 1/10	3	250mA	Mic.hand, Nos. 9 and 12	'Siemens' type 500 D/B low resistance.
Insets, carbon, differential, No. 2 (YA 8515)	2¼	1 1/10	3			Physically the same as No. 1 but has a higher resistance.
Insets,mic. hand, No.10 (ZB/M94 0002)	2⅛	¾		10-25mA	Mic.hand, No. 10	Transverse current type element. Not suitable for tropical use.

Table 1001 - (contd.)

Designation	Diameter in inches	Depth in inches	Weight in ounces	Current consumption	Where used	Remarks
Insets, mic. hand, power, No. 1 (YA 2815)	3	1¼	6	5A	Mic.hand, power, No. 1	Contains eight differential units connected in parallel. Sufficient power to drive a loudspeaker.
Microphones, capsule, miniature, No. 1 (YA 8123)	1¼	1			W.S. No. 88 type B Tele., hand, No.11, Tele., hand, No.13A Micro-phone, hand No. 20 Micro-phone and receiver headgear assembly, No. 16A	Miniaturized carbon type microphone inset designed for tropical use and storage.

Table 1002 - Moving-iron diaphragm microphone elements

Designation	Diameter in inches	Depth in inches	Weight in ounces	Where used	Remarks
Insets, telephones, equalized, No.1 Mk. 1 (YA 6806)	1 1/10	¾	1½	Microphone, hand, I.T.E., Nos. 17 and 18	Equalized telephone inset for use as a receiver or microphone. Four terminal plates on the rear.
Insets, telephones, equalized, No.1 Mk. 2, (YA 7225)	1 1/10	¾	1½	As for No. 1, Mk. 1	Similar to I.T.E., No. 1 but with only three terminal plates on the rear.

Table 1003 - Moving-iron balanced-armature microphone elements

Designation	Diameter in inches	Depth in inches	Weight in ounces	Where used	Remarks
Insets, telephone, No. 1 (YA 3918)	2 1/10	1	4	Tele.,hand, H. Tele., hand, S.P. No. 1	Moving-iron type, metal diaphragm Resistance 70Ω. The diaphragm has no cover and should therefore be handled carefully.
Insets, telephone, No. 2 (YA 3919)	2 1/10	1	4	Transmitter, breast, S.P. No. 1	Moving-iron type, metal diaphragm. Resistance 40Ω.
Insets, standard, microphone, electro-magnetic, No. 1 (YA 8549)	1.828	0.77	1.4	Army field wireless sets and tele.sets (including sound powered)	Frequency range 200 to 3,400c/s. A microphone developed by Ministry of Supply which it is intended shall be the standard microphone used in future wireless and line equipment.
Insets, telephone, B.A., No. 2 (YA 4789)				Transmitters, breast, S.P. No. 2, Mk. 2, Receivers, watch, D.L.R. No. 2	
Insets, telephone, B.A., No. 4 (YA 4983)				Transmitters, breast, S.P. No. 2, Mk. 1	
Insets, telephone, B.A., No. 5 (YA 5275)	2 1/10	1	3¼	Transmitters, breast, No.2, Mk. 3. Receivers, watch, D.L.R., No. 5	Similar to I.T.B.A., No. 4 but has an improved output volume and frequency charateristic.

Table 1004 - Moving-coil microphone elements

Designation	Diameter in inches	Depth in inches	Weight in ounces	Impedance of speech coil at 1,000c/s	Where used	Remarks
Insets, microphone, moving-coil, No. 1 (ZA 11383)	$1\frac{3}{4}$	$1\frac{1}{8}$	$4\frac{1}{2}$	50Ω	Microphones, hand, No. 7	Not suitable for tropical use.
Insets, microphone, moving-coil, No. 2 (ZA 17602)	2	1	3	50Ω	Microphones, hand, No. 13	Not suitable for tropical use.
Insets, microphone, moving-coil, No. 3 (YA 8501)	2	$1\frac{1}{4}$		25Ω	Microphones, hand, moving-coil, No. 1	Frequency response of 350 to 600c/s. Has a duralumin diaphragm and a flux density of 9,100 lines per square cm.

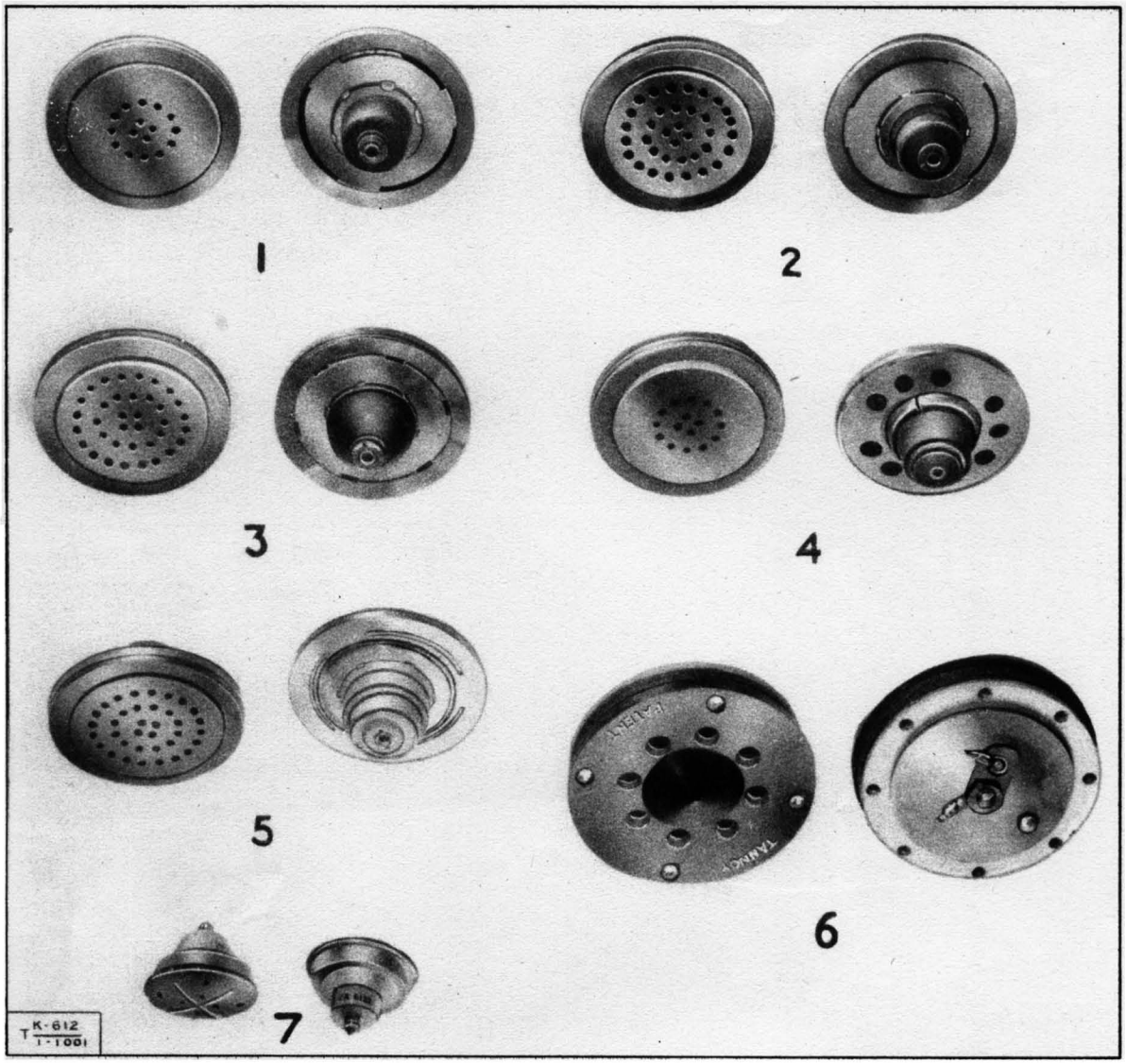

Fig. 1001 - Carbon type microphone elements

1. Microphones, capsule, Mk. 4
2. Microphones, capsule, Mk. 5
3. Microphones, capsule, No. 8
4. Microphones, capsule, No. 10
5. Insets, carbon, differential, No. 1
6. Insets, microphone, hand, power, No. 1
7. Microphones, capsule, miniature, No. 1

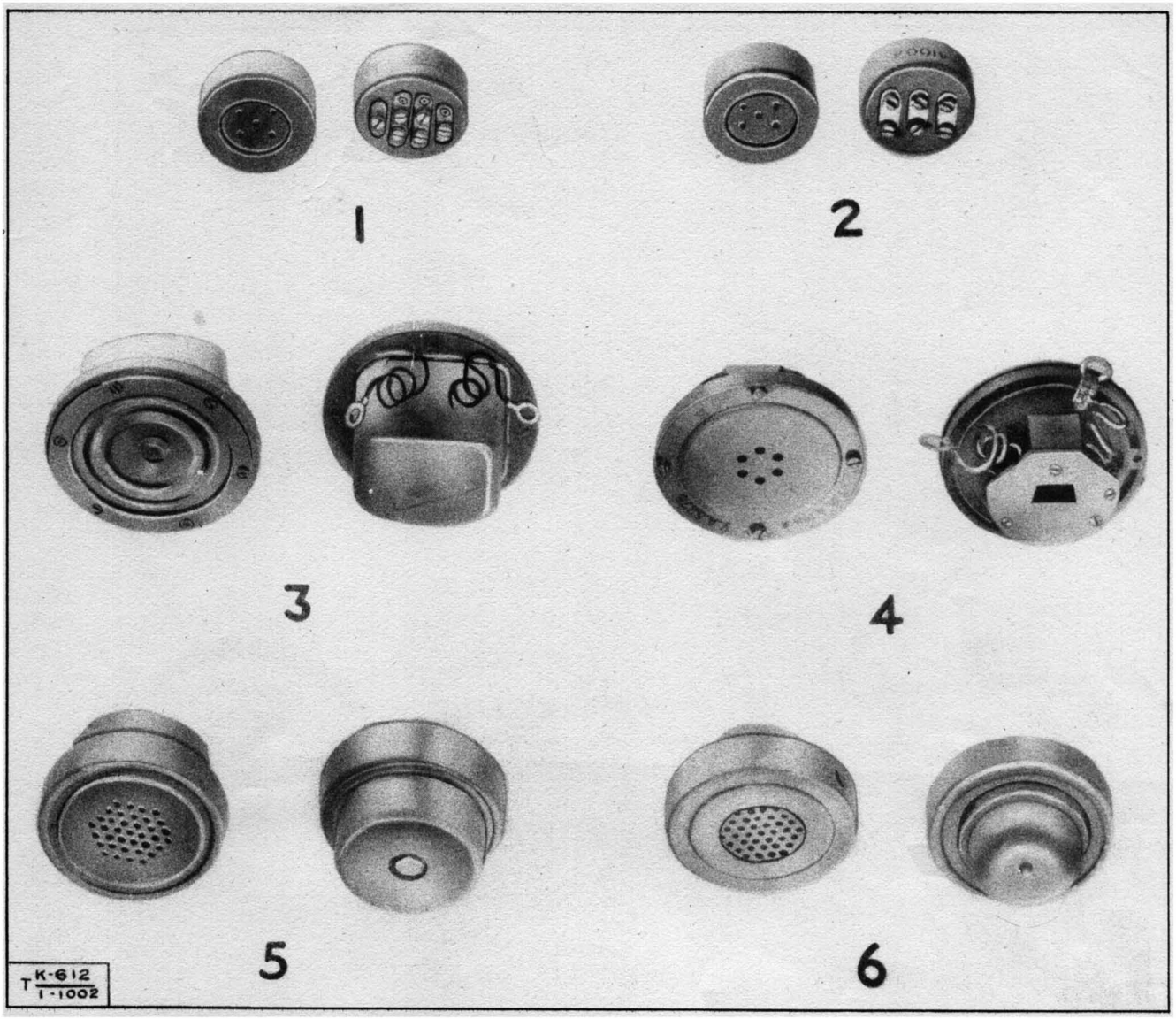

Fig. 1002 - Moving-iron diaphragm, balanced-armature and moving-coil microphone elements

1. Insets, telephone, equalized, No. 1, Mk. 1
2. Insets, telephone, equalized, No. 1, Mk. 2
3. Insets, telephone, No. 1
4. Insets, telephone, B.A., No. 2
5. Insets, microphone, moving-coil, No. 1
6. Insets, microphone, moving-coil, No. 2

57/Maint./3683

END

ELECTRICAL AND MECHANICAL
ENGINEERING REGULATIONS
(By Command of the Army Council)

TELECOMMUNICATIONS
J 359 Misc Inst No. 1

MICROPHONE ELEMENTS

TECHNICAL HANDBOOK - MISCELLANEOUS INSTRUCTION

Redesignation of EMERs

Information

1. To maintain the proper sequence of EMER numbers, it is intended that:-

   (a) all future issues of EMERs on this equipment will be published in the series Tels J 350 - J 359 and

   (b) the current EMERs will be redesignated.

Action

2. The following EMERs will be redesignated as shewn.

	Present designation				New designation
	EMER designation (a)	Pages (b)	Issue No. (c)	Date (d)	(e)
1	Tels K 612	1 - 4 1001 - 1007	1 1	22 Sep 52 22 Sep 52	Tels J 352

57/Maint/6670

END