The Post Office Standard Motor Uniselector

C. A. MAY, M.A., A.M.I.E.E.†

U.D.C. 621.395.636:621.395.343

This article gives a detailed description of the construction and operation of the Post Office standard motor uniselector which is to be used as a group selector in the automatic trunk exchanges now being installed in this country.

Introduction

MOTOR uniselectors have been in use in this country in Messrs. Siemens Brothers original form since 1932 and in the British Post Office since 1935, when some 600 were installed as line finders in North exchange, London. Further use in the Post Office has been slight but a considerable number of uniselectors have been employed by British Railways and the London Transport Executive in their private telephone systems.

The facility available in the motor uniselector whereby rapid testing over a large number of contacts is possible renders it eminently suitable for use in automatic trunk exchanges, and the uniselector has therefore been adopted for this purpose. It will also be used in various circuits in connection with the Cordless Switchboard System. The item adopted has been coded as "Uniselector Motor Drive No. 2," and Fig. **1** shows its general assembly.

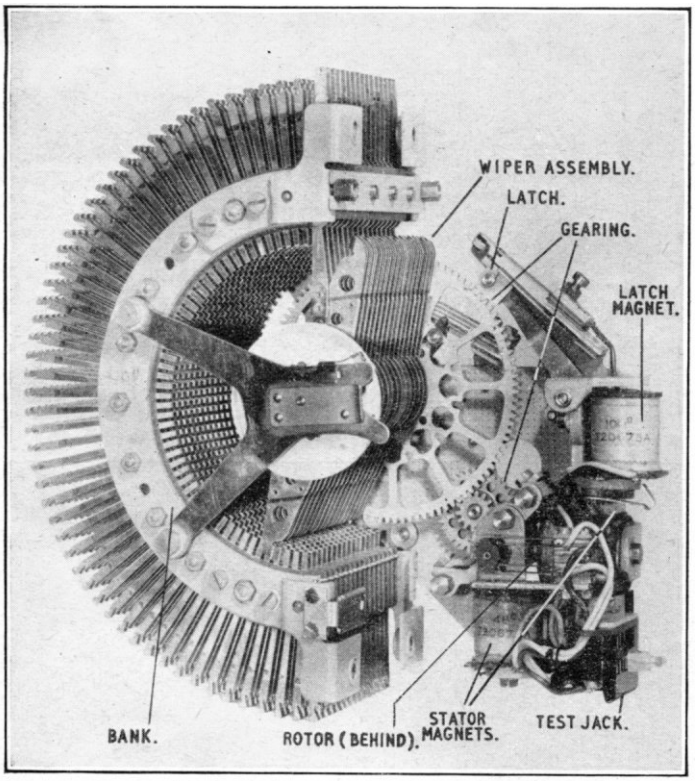

Fig. 1.—The Uniselector, Motor Drive, No. 2.

This article gives a number of details of the operation and construction of the switch.

Operation

The uniselector consists basically of a simple self-interrupting two-pole motor driving a wiper assembly through a train of gears. Stopping of the wiper assembly is achieved by the release of an electromagnetic latch. The release of this latch, which also breaks the motor circuit, may be carried out by two distinct methods: the first, which can stop the wipers only at certain pre-determined positions, consists of the operation of a spring-set, mounted on the mechanism frame, by cams fitted to the wiper assembly. The normal provision of such cams is one for switches having single-ended wipers and two for switches having double-ended wipers. This method of stopping is normally used to return the switch to its "home" position, or positions, after it has performed its circuit function.

The alternative method of releasing the latch is by the operation of a high-speed relay, controlled by the electrical conditions existing on the bank contacts over which the wipers are hunting. This is the normal method of positioning the wipers during operation. The uniselector will not respond directly to impulses.

The speed limits for all uniselectors are 170 to 230 contacts per second: switches having not more than eight wipers in the bank at one time can, however, be controlled to between 200 and 230 contacts per second. Switches having very light wiper loads have a copper slug fitted to each motor coil in order to restrict the speed to within these limits.

The speed may be varied by some 25 to 50 contacts per second by adjustment of the interrupter position.

Construction

Magnets, Armature and Interrupter Assembly.

Fig. **2** shows an exploded view of the motor mechanism and Fig. **3** indicates the circuit arrangements by which self-drive conditions are obtained.

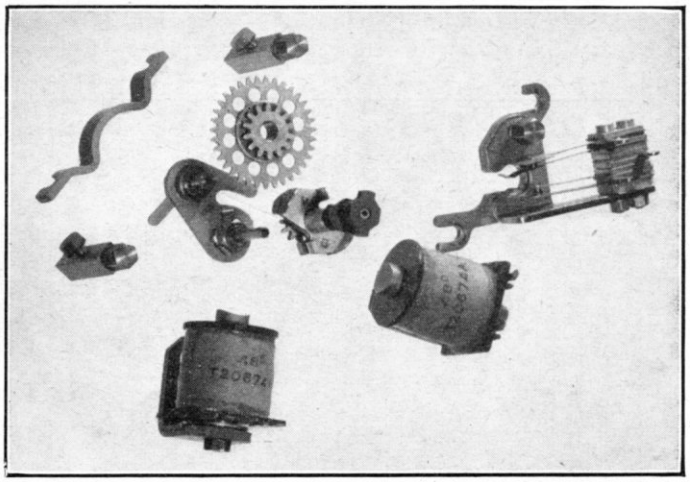

Fig. 2.—Exploded View of Motor Mechanism.

Each magnet coil consists of 2,200 turns of 0·0088-in. enamelled copper wire wound on a soft iron core, the coil cheeks being of synthetic resin-bonded paper (S.R.B.P.). The end of the core adjacent to the armature is concave so that the armature may rotate close to it with the minimum of air gap. The resistance of each coil is 48 ohms.

The soft iron armature, which is not wound, is keyed to a mild steel pinion which rotates freely on a spigot-type stainless steel bearing, through which passes a lubricating wick. The shape of the armature blades ensures an adequate starting torque and determines the direction of rotation.

† Executive Engineer, Telephone Development and Maintenance Branch, Engineer-in-Chief's Office.

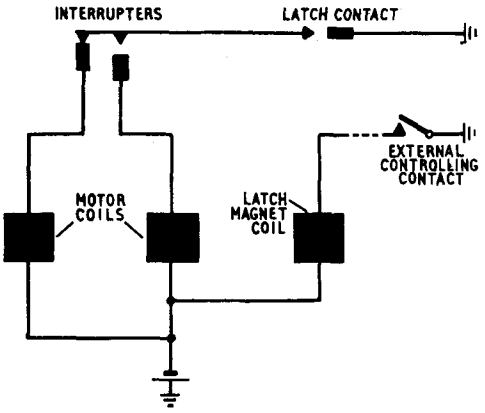

FIG. 3.—SIMPLIFIED CIRCUIT OF MOTOR UNISELECTOR.

Fixed to the end of the armature assembly is a cam of loaded ebonite which operates the interrupter springs. The symmetrical construction of the springsets and the fact that the fixed spring of each action is tensioned lightly against the circular portion of the cam ensure that wear in the bearing or irregularities in the straightness of the spindle do not interfere with the adjustment of the contact openings.

A spark quench consisting of a 1μF capacitor in series with a 10-ohm resistor is connected across each pair of contacts.

Banks.

These consist of 8 or 16 arcs of 51 contacts, each arc occupying 173°5′. The contacts are of nickel silver and are clamped between S.R.B.P. insulators, the arcs being separated by aluminium spacers. To minimise crosstalk the spacers are connected to earth by means of a serpentine nickel-silver wire making contact with each spacer and with the bank frame. Fig. **4** shows a typical 16-level bank with one brush feed assembly removed.

Because of the absence of any percussive forces, such as are found in ratchet switches, motor uniselectors are comparatively free from vibration. It is not, therefore, necessary to mount the uniselectors on rubber blocks or insulated metal springs as is customary with other selectors and the banks are rigidly bolted to the rack framework. The mechanism frame is thus always earthed when in the bank and, to assist in maintenance, an insulated outrigger is available. Fig. **5** shows a mechanism fitted in an outrigger.

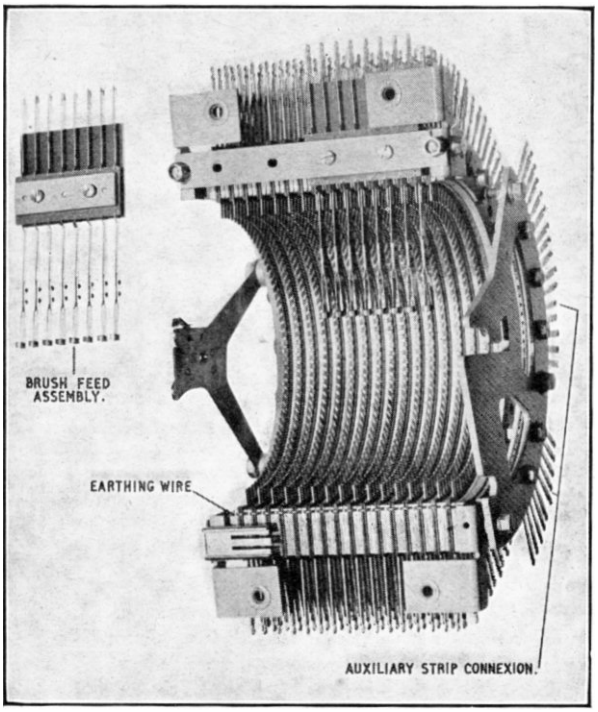

FIG. 4.—A 16-LEVEL BANK WITH ONE BRUSH FEED ASSEMBLY REMOVED.

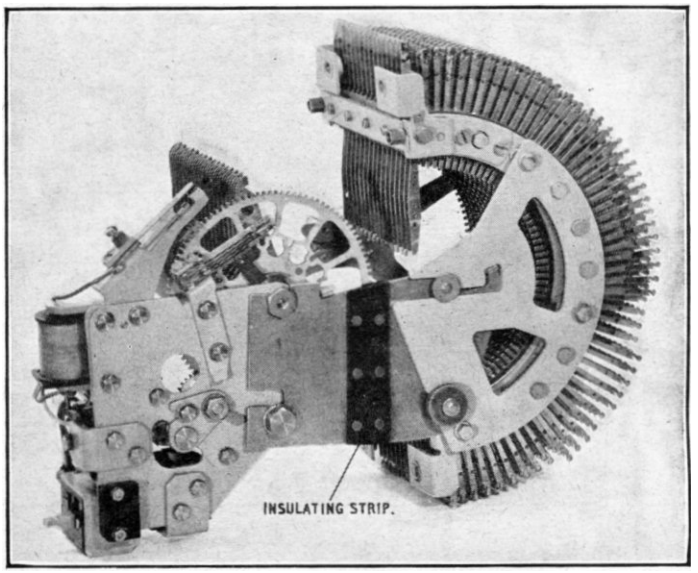

FIG. 5.—MECHANISM FITTED IN OUTRIGGER.

For convenience in placing marking conditions on groups of wires, or for other cross-connection purposes, a connection strip can be fitted alongside the bank and fixed to it. It consists of 26 flat tags in two groups, one of 16 tags and one of 10.

Ribbon Cable.

For commoning the bank contacts to form a multiple a special cable form has been introduced. Fig. **6**(*a*) shows a portion of a typical form: the normal length consists of 10 "appearances" of the bared conductors.

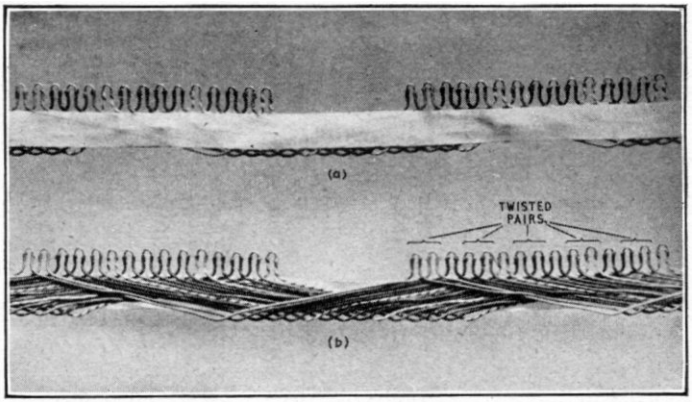

FIG. 6.—RIBBON CABLE USED FOR BANK MULTIPLE.

The form consists of double-cotton-covered wires held in position by two tapes of woven cellulose acetate secured to the wires by adhesive. The shape to which the wires are formed can be seen in Fig. **6**(*b*) which shows a length of the cable with one tape removed.

Any number of wires from 1 to 16 can be made up into a form and any required adjacent pairs of wires can be twisted together, two half-twists occurring between each successive appearance. The colours of the insulation conform to the normal Post Office colour code.

The form fits between the rows of bank tags and is

separated from them by folded strips of non-inflammable cellulose acetate. The conductors are soldered to the inner notches of the tags by a mass soldering method.[1]

Feeder Brushes and Collector Rings.

The feeder brushes are fitted at the top of the bank in the form of a separate assembly (see Fig. **4**) consisting of 8 brushes. One of these assemblies is fitted to an 8-level bank and two to a 16-level bank. Each feeder consists of a single blade, to the end of which is riveted two splayed brushes, the tips being flared to permit the entry of the disc-shaped collector when the mechanism is offered to the bank (See Fig. **7**).

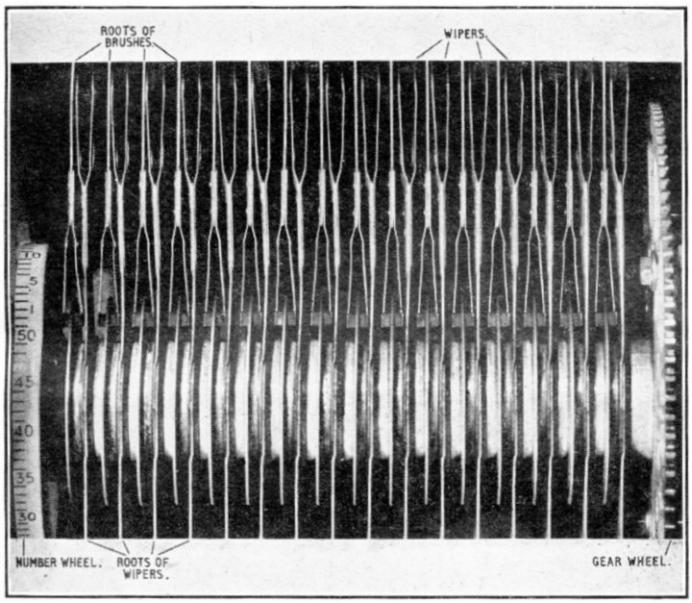

FIG. 7.—FEEDER BRUSHES AND COLLECTOR RINGS.

Wiper Assembly.

The wiper assembly and its axle are secured to the mechanism side plate (see Fig. **8**). The complete mechanism assembly locates in the bank side plate so that the wiper

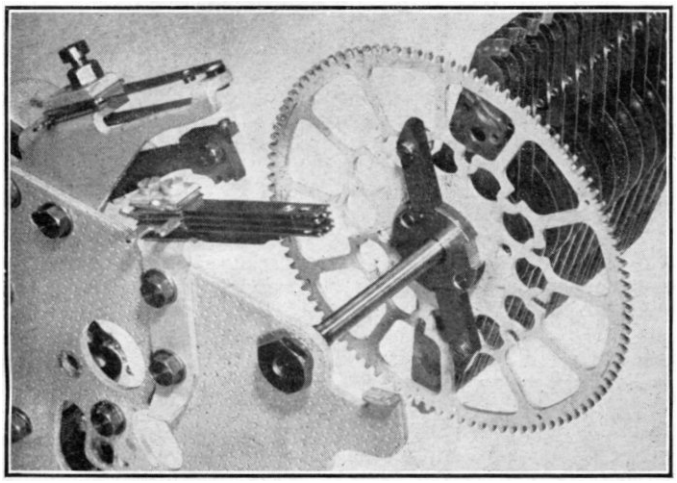

FIG. **8**.—WIPER ASSEMBLY SHOWING FIXING OF AXLE TO SIDE PLATE.

axle is concentric with the bank contacts. The end of the axle remote from the mechanism is steadied by fitting into a hole in a V-shaped bracket attached to the bank. This bracket also carries a pointer alongside which the number wheel rotates. The wipers, collector discs, insulators, spacers and the collar to which the number wheel is screwed are assembled on a hub of high tensile steel, from which they are separated by an ebonite insulating bush. The whole is clamped together under pressure by manganese bronze nuts screwed to each end of the hub. These nuts also serve as bearings for the rotation of the assembly on its axle, which is of stainless steel. One of the bearings has two projecting stainless steel pins which locate the gear wheel, and also four slots, machined to a considerable degree of precision, into which the cams are fitted. From Fig. **7** it will be seen that the feeders are offset slightly in the direction of their respective wipers; this ensures that any false contacts which might occur between wipers and feeders due to vibration of the wiper tips are only between pairs which are already electrically connected.

To simplify manufacture and to avoid the introduction of an excessive number of different uniselector codes, it was decided during development that switches would only be made in sizes of eight and sixteen levels.

For ease of assembly double-ended wipers are made up of two single-ended wipers, suitably set so that the tips are in line; this set can be seen in Fig. **7**.

Transmission.

The drive from the armature to the wiper assembly is transmitted via an idler gear. This consists of two concentric mild steel gears running on a nickel silver spindle through which passes a lubricating wick. The overall gear ratio is 26 : 1 and, as the wiper assembly gear wheel has 104 teeth, $\frac{1}{4}$ of a revolution of the armature steps the wipers from one contact to the next. Adjustments are provided to vary the depths of engagement of the idler gear with both the armature and the wiper gears: by this means backlash can be controlled and smooth and silent running ensured.

Latch.

The latch assembly consists of an electromagnet which, on energisation, attracts a pivoted armature to which is attached the latch detail consisting of three teeth shaped to mesh with the gear wheel on the wiper assembly. When the uniselector is at rest the coil is not energised and the latch engages the wiper gear wheel. On operation of the magnet the armature is attracted to the core and the latch is lifted, thus freeing the wiper assembly. Towards the end of the armature stroke the tungsten contact on the back of the latch detail makes with the "fixed" contact and the motor circuit is completed. The "fixed" contact in this instance, is secured to a thick spring, which flexes slightly, allowing the contacts to rub against each other. This rubbing action is necessary to break down the high-resistance oxide film which forms on tungsten when exposed to the atmosphere.

To assist in a fast release of the armature on disconnection of the latch magnet circuit a 0·008 in. phosphor bronze residual stud is fitted.

The armature restoring spring consists of two adjacent flat springs in order to reduce the internal stresses caused by the relatively large deflection. During the first portion of the movement on release the restoring spring is assisted by the "fixed" contact spring. A screw adjustment is fitted for varying the tension in the restoring spring, which is kept as high as possible compatible with full operation of the armature under all conditions.

In order to minimise the effects of shock on engagement of the latch, the latch detail is fixed to the armature by two bowed springs. The spokes of the wiper gear wheel also possess resilience to assist in absorbing the kinetic energy of the moving parts.

The latch magnet coil, which has a resistance of 100 ohms, consists of 3,400 turns of 0·0076 in. enamelled copper wire.

[1] Grinsted, W. H. "The Motor Uniselector and the Technique of its Application in Telecommunications." *Proc.I.E.E.*, Part III, No. 43, page 406.

Cam Springset.

The cam springset which can be seen in Fig. **8** consists of four springs, forming one make and one break action. Springs 1 and 2, which are broken when the wipers are standing on the "home" contacts, control the latch magnet. (Spring 1 is nearest to the wiper spindle.) The other contact action can be used in external circuits.

Fig. **9** shows the stages of operation of the springset.

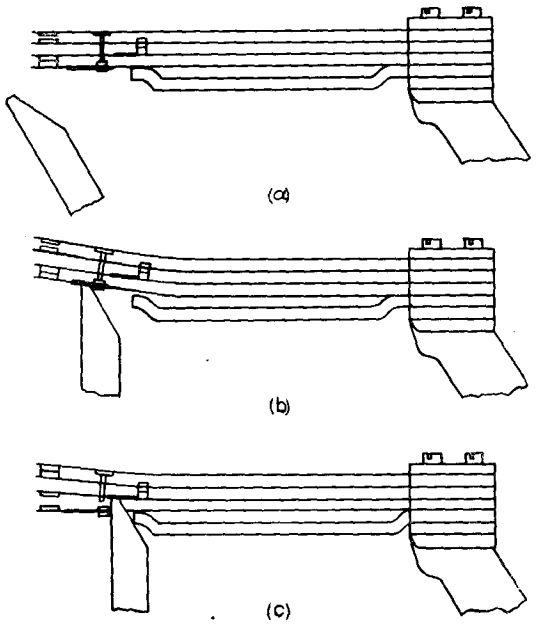

FIG. 9.—STAGES IN OPERATION OF CAM SPRINGSET.

As the wipers approach the "home" contact, the cam on the gear wheel engages the lug on spring 1, thus tensioning all the springs without altering the relative positions of the contacts (Fig. **9**(*b*)). As soon as the wipers leave the contact preceding the "home" contact the cam moves away from the lug on spring 1 and supports the lug on spring 2, allowing springs 1 and 4 to restore, thus breaking the latch magnet circuit and completing the external circuit (Fig. **9**(*c*)).

The "two-stage" operation of the springset results in a clean action, the actual timing being substantially independent of contact openings and spring tensions.

The contacts on all the springs are of platinum: a spark quench consisting of a 0·5 μF capacitor in series with a 200-ohm resistor is fitted across springs 1 and 2.

ADJUSTMENTS

It is not proposed to discuss adjustments of the uniselector in detail; the following points may, however, be of interest.

Most of the adjustments can be carried out with the mechanism fitted in an outrigger, as shown in Fig. **5**. The outrigger is made in three sections, the centre section being of insulating material. The mechanism is not, therefore, connected to earth when in the outrigger and the wipers may be moved away from the "home" position without completing the "homing" circuit.

To facilitate the adjustment of the cam springset four small holes are drilled near the periphery of the main gear wheel: these identify the "home" positions when the mechanism is out of the bank and serve to locate the adjusting tool.

Adjustment of the position of the motor magnets, and the pillars which support the yoke and the interrupter assembly is carried out by means of a cylindrical gauge which mounts on the spindle in place of the rotor.

To enable the uniselector to be run without completing the external controlling circuit a hand-operated test spring is provided which earths the latch magnet.

ACKNOWLEDGMENTS

The author wishes to record appreciation of the assistance given by Messrs. Siemens Brothers & Co., Ltd. in the preparation of illustrations and to acknowledge help and criticism given by colleagues in the Engineer-in-Chief's Office.

Book Review

"Radio," Vol. 1. J. D. Tucker and D. F. Wilkinson. The City and Guilds Series, published by the English Universities Press, Ltd. 177 pp. 152 ill. 7s. 6d.

This book is the first of three volumes that are intended to cover the requirements of the Radio syllabus of the examinations of the City and Guilds of London Institute; Vol. 1 covers the syllabus of the Grade I Radio Examination and also part of that for the Radio Amateurs Examination.

The scope of Vol. 1 is indicated by the chapter headings, which are as follows: Electricity and Magnetism, Radio Communication (principles), Aerials and Tuning, Components and Valves, Audio Frequency Amplifiers, Radio Frequency Amplifiers, Power Supplies, Oscillators, Modulation and Detection, Receivers and Measurements in Radio Work.

In view of the relatively wide field covered, and the purpose of the book, the treatment is necessarily brief and at an elementary level. The authors have, it is considered, made an attempt to meet the needs of students who are new to the subject of radio. They have not neglected the practical aspects of the subject and they have endeavoured to present their material in a clear and interesting manner.

Unfortunately, Vol. 1 contains a number of inaccuracies that would certainly lose marks if reproduced by students in their answers to examination questions. For example, on p. 43 the equivalent circuit of a vertical wire is shown as a parallel-tuned circuit; in fact such an aerial behaves as a series-tuned circuit, since at low frequencies it approximates to a capacitor and not to an inductor. The diagram, Fig. III 7, on p. 39, gives an incorrect impressions of the effect of Q on the selectivity of a tuned circuit. The response of the low-Q circuit off frequency is shown as being greater than that of the high-Q circuit, whereas the reverse is the case; furthermore, such response curves should approach the frequency axis asymptotically and not abruptly as in the figure. Fig IX 13, on p. 143, which purports to show anode-bend detection, is misleading; such a detector uses the nearly square-law portion of anode-current/grid-voltage valve characteristic, whereas the diagram shows an abrupt change of anode current with grid voltage at the operating point. Fig. IX 12, on the same page, shows a bias battery in series with the tuned circuit, which would have a disastrous effect on the Q of the circuit. The oscillator circuits given in Figs. VIII 6 to 9 unaccountably include battery bias as well as self-bias RC grid circuits. A more serious error occurs on p. 153 where it is said that the combination of two waves of 90 and 100 kc/s is "exactly like that which we should produce if we modulated a carrier with a 10 kc/s note"; this is not so, the linear addition of two waves does not amount to modulation.

Before this book can be recommended for general use by students it is highly desirable that the inaccuracies mentioned above, and others that are present, be corrected.

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