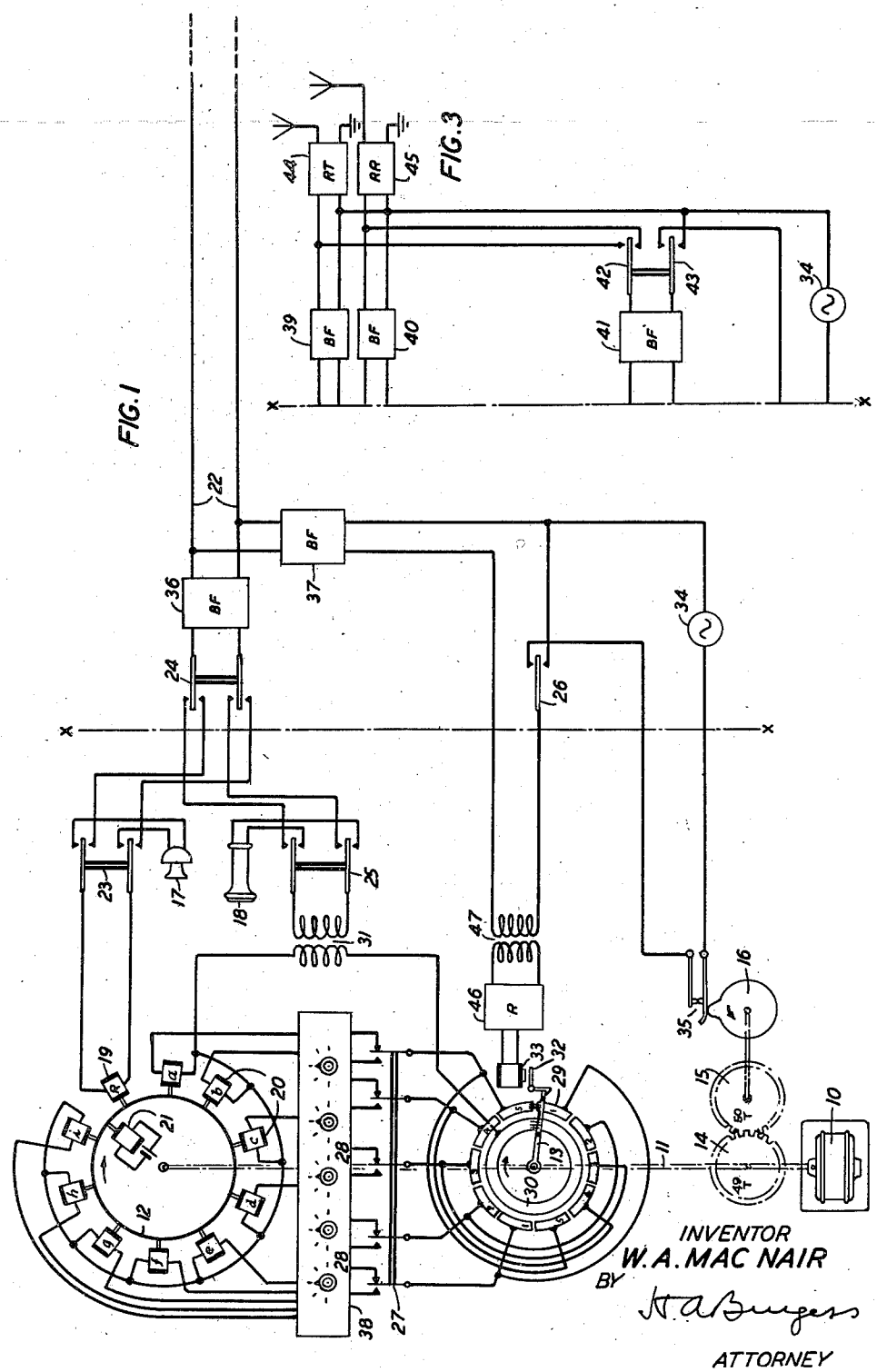
Aug. 27, 1946. W. A. MacNAIR 2,406,351

SPEECH PRIVACY SYSTEM

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SPEECH PRIVACY SYSTEM

Filed Oct. 8, 1941 2 Sheets-Sheet 2

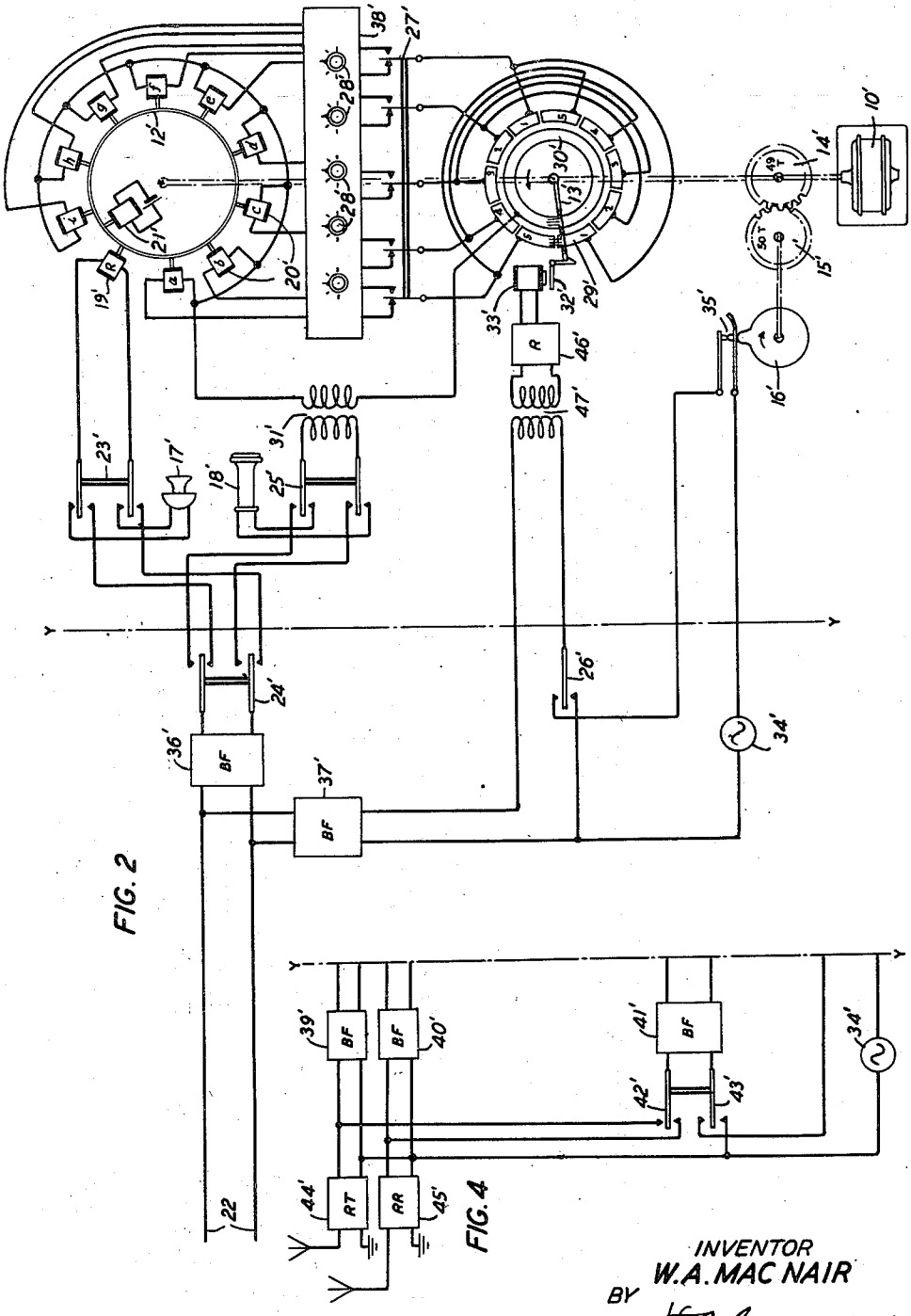


FIG. 2

FIG. 4

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SPEECH PRIVACY SYSTEM

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4 Claims. (Cl. 179—1.5)

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The present invention relates to coordinating the movements of mechanisms such as rotary distributors used in electrical communication.

The invention has particular reference to, and will be disclosed as embodied in, a speech privacy system in which rotary distributors are used to break the speech waves up into fragments and send them out in changed sequence, and conversely to receive the transmitted wave fragments and rearrange them into understandable speech.

The invention will be disclosed as embodied in a system using start-stop distributors in which the brushes are released once each revolution by a start impulse and progress through the revolution in unison but independently driven until, at the end of the revolution, they are stopped in readiness to be released again simultaneously by the start impulse.

It is common practice in printing telegraphy to employ start-stop commutators in which the receiving distributor is normally driven slightly faster than the transmitting distributor, which means that under normal conditions it reaches its stop sooner than the transmitting distributor and therefore remains stationary for a slightly longer period than the transmitting distributor. This is done in order to insure that under abnormal conditions that might tend to slow up the receiving distributor it will still be able to reach the stop member in time to be released by the start impulse. This practice is permissible in telegraphy where a small portion of a transmitted impulse is sufficient to operate the receiving relay and it does not matter if some of the impulse is lost. In fact, it is common practice to make the receiving commutator segments shorter than the transmitter segments with a view to picking out the middle portion of the impulse.

In speech transmission, however, in which the speech is recorded on a suitable medium such as a moving magnetic tape and subsequently distributed in segments it is essential for full intelligibility that the segments of the recorded message be preserved in their entirety or nearly so, and this imposes a much greater restriction on the synchronizing problem than in the case of telegraphy.

A further difficulty presents itself where two-way speech transmission is to be carried out with the same distributor serving alternatively as transmitting and as receiving distributor. In such case it would be impractical to drive the receiving distributor at a faster rate since the same distributor is, an instant later, to be changed over to transmitting.

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In accordance with the present invention the distributors are all driven as nearly as practicable at the same constant speed and are stopped at stated intervals, such as once each revolution, and started in synchronism and phase with one another by a start impulse sent out from the transmitting distributor. In order to allow for small errors in speed the impulse is delayed slightly to permit all receiving distributors that may be slow, to within an operative margin, to arrive at their stop positions before the start impulse is sent. This operation periodically corrects for small errors in speed, whether representing too fast or too slow speed, in the receiving distributors.

When a receiving distributor is switched over to become a transmitting distributor it automatically sends out the start impulses and all receiving distributors are thus synchronized to it.

It will be noted that this accomplishes something of the same result as in the case of telegraph systems with receiving distributors set to run slightly faster than the transmitting distributor but avoids the troublesome disturbance that would be produced by that type of operation in a speech transmission system. That is, if the receiving distributor were normally set to run slightly faster, it would gradually get more and more out of phase with the transmitting distributor during the complete revolution, which would mean that in each successive commutating interval a small piece of the speech fragment as transmitted would be lost while a small piece of the next successive speech fragment would be picked up out of its proper sequence. This would result in loss of intelligibility and increase of noise, and this would occur when the receiving distributors were running in their normal or intended manner. In the system according to the invention, however, there is no such loss of intelligibility or increase of noise so long as the distributors are functioning normally since they are started in unison and travel at the same speed throughout their entire revolution. All distributors are, under normal conditions, held stopped the same length of time. A fast receiving distributor is stopped for a slightly longer time and a slow receiving distributor is stopped for a shorter time than normal.

The nature of the invention and its various objects and features will appear more fully from the following detailed description in connection with the accompanying drawings in which:

Figs. 1 and 2 when placed side by side with Fig. 1 at the left show in schematic circuit diagram the two terminals of a two-way privacy telephone

system incorporating the invention, while Fig. 3 is a partial diagram of a radio terminal which may be substituted for the portion of Fig. 1 to the right of the line X—X, and Fig. 4 is a similar partial diagram to be substituted for the portion of Fig. 2 to the left of the broken line Y—Y.

Referring to Fig. 1, a constant speed motor 10 of suitable type drives a shaft 11 which is shown as driving magnetic tape 12 mounted on the rim of a suitable disc, brush arm 13 rotatable over the segments of commutator 29, and a gear train 14, 15 driving a contact making arm 16. The system is arranged to transmit with privacy when speech is spoken into the transmitter 17, under certain circuit conditions to be described, and to receive with privacy in receiver 18. The transmission and reception of the privacy waves takes place over the line 22 shown interconnecting the terminals in Figs. 1 and 2.

A number of two-position switches are illustrated at 23, 24, 25, 26 and 27. These switches may, if preferred, be ganged together or they may be in the form of relays operated by a single push button. These switches are all assumed to be operated to their upper positions in the figure (and switch 27 to the right) when speech is to be transmitted and to be operated to their lower or opposite position when speech is to be received. Such switches are commonly referred to as push-to-talk switches and may conveniently be retracted to their receiving positions by springs (not shown), the receiving position in such case being considered normal. The circuit of Fig. 1 will first be described for the transmitting conditions so that switches 23 to 27 are considered thrown to their upper or talking positions.

The tape 12 is assumed to be rotating in a clockwise direction at constant speed. Located around the periphery of the tape are an erasing magnet 21 supplied continuously with current from the battery shown, a recording magnet 19 and nine reproducer magnets 20 located at equal intervals around the tape. When speech is spoken into transmitter 17, therefore, the speech is recorded on the tape at 19 and the recorded portions in passing the magnets 20 generate corresponding electromotive forces in their windings. The terminals of these windings are connected through code switches 38, five in number, and thence through contacts of switch 27 to the segments of commutator ring 29, which are numbered in order 1, 2, 3, 4, 5 over one half of the circumference, with these numbers repeated in the second half of the circumference, diametrically opposite segments being directly connected together. The code switches are so arranged that one winding terminal of reproducers 20 may be connected in a number of different sequences to the commutator segments of ring 29. Brush arm 13 carries brushes bridging across from segmented ring 29 to solid ring 30, the latter being connected to one terminal of winding of speech coil 31, the opposite terminal being common to one terminal of each of the reproducer magnets 20.

It will be seen, therefore, that as the brush arm 13 rotates and sweeps the brush over the segments of the commutator, different reproducers 20 are connected to the speech coil 31 in sequence, the particular sequence is at any given time determined by the setting of the code switches 38. For example, designating the reproducers 20 beginning next to the recording magnet 19 and continuing around the periphery

of the tape as reproducers *a, b, c, . . . i*, reproducer *a* may with one code setting be connected to commutator segment 1, reproducer *c* may be connected to segment 2, reproducer *e* may be connected to segment 3, etc. With a different setting of the code switches 38 reproducer *d* might be connected to segment 1 and other reproducers to the other segments. In this way it is arranged that the currents transmitted through coil 31 represent fragments of the recorded speech picked up in a sequence different from the sequence in which they were recorded. Moreover, this sequence is varied from time to time by changing the settings of the code switches 38. This general method of transmitting fragments of speech out of their normal sequence and of changing the code is more fully disclosed in a copending application of J. C. Steinberg, Serial No. 401,897, filed July 11, 1941, which may be consulted for further details including the construction of the code switch mechanism 38.

The speech waves occurring out of their normal order in coil 31 are transmitted through switches 25 and 24 and band-pass filter 36 to the outgoing line 22.

Attention will now be given to the start-stop mechanism to which the invention particularly relates. The brush arm 13 frictionally engages the shaft 11 by suitable friction clutch mechanism so that when the brush is released by latch 32 it rotates with the shaft 11 but can be held stationary by latch 32 while shaft 11 continues to rotate. Latch 32 is released by tripping magnet 33 when energized from source 34 under control of contacts 35 when the station is transmitting or under the control of similar impulses received over the line from a distant station when the station shown is receiving.

The gear train 14, 15 drives the arm 16 at a slightly slower rotational speed than shaft 11. For example, the differences in speed may be 2 per cent. In this case gear 14 has forty-nine teeth while gear 15 has fifty teeth.

Assuming that arm 13 is stopped against latch 32 and that cam 16 is about to pass under and lift the lower spring of contact 35, this contact will, then, close and permit the flow of current from generator 34 through contact 35, switch 26, transformer 47, through the filter 37 to the opposite terminal of source 34. The impulse transmitted through transformer 47 is rectified at 46 and operates tripping magnet 33 to release brush arm 13. The tripping magnet 33 is energized releasing brush 13 and simultaneously the start impulse is sent out through filter 37 to line 22 to the distant station to release the brush arm thereat. The generator 34 may generate a frequency of 2000 cycles per second by way of example. In this case filter 37 is a narrow band-pass filter passing 2000 cycles while filter 36 is a band suppression filter offering high attenuation to 2000 cycles but freely passing frequencies in the speech band both lower and higher than 2000 cycles.

Referring now to Fig. 2, it will be noted that this figure is a duplicate of Fig. 1 with corresponding parts indicated by the same reference numerals primed. Continuing the description of the operation of transmitting from the station of Fig. 1, it is assumed that all of the switches 23′ to 27′ are in their lower or receiving positions.

When the synchronizing impulse was sent out as described from the station of Fig. 1 it was received over line 22 at the station shown in Fig. 2 and selectively transmitted through filter 37′,

lower contact of switch 26', transformer 47', rectifier 46' and winding of tripping magnet 33', thus releasing brush arm 13' simultaneously with the release of brush arm 13. As long as the station of Fig. 1 continues to transmit, switch 35 sends out a synchronizing impulse once each revolution of the cam 16 which as stated rotates at a slightly lower speed than shaft 11. This causes the brush arm 13 to be stopped momentarily once each revolution. As stated, brush 13', if running in exact synchronism, is stopped once each revolution for the same length of time or if not in exact synchronism it is stopped for a shorter or longer length of time depending upon whether the brush is running slow or fast by a slight amount.

The jumbled speech waves received through filter 36' and switches 24' and 23' energize the winding of recording magnet 19' to make a record of the received waves on the tape 12'. As this tape rotates past the various reproducer magnets 20', these latter pick up the recorded waves and transmit them through code switch 38' and switch 27' to the segments of commutator 29' and the wiring and settings of the code switches are such that as the brush 13' passes over the commutator segments in succession the speech fragments are rearranged in their normal order in the coil 31', from which they are transmitted through switch 25' to receiver 18'. When the code switches 38' and the wiring are made in accordance with the disclosure of the Steinberg application above referred to, a given setting of the knobs 28' will result in transmitting in accordance with a particular code and also in receiving in accordance with the same code. The knobs 28 and 28' in Figs. 1 and 2 are, therefore, given the same setting.

When the station in Fig. 2 desires to change from receiving to talking, the switches 23' to 26' are shifted to their talking position, while the corresponding switches of Fig. 1 are shifted to their receiving contacts. The station of Fig. 2 then becomes the transmitting station and it will be noted that switch 26' now controls the sending out of the synchronizing pulses from switch springs 35' under control of cam 16'. These synchronizing pulses when received at the opposite station, Fig. 1, pass through filter 37 and switch 26 in its lower position, coil 47 and rectifier 46 to the tripping magnet 33, the switch 35 being under these conditions ineffective on account of the break in the circuit at switch 26.

In the alternative terminal shown in Fig. 3, the transmission is on a four-wire basis and the transmitting and receiving channels are radio channels although they could as well be line wire channels operating at carrier or voice frequency. Switch 24 (Fig. 1) is not needed but when the switches 23, 25 and 26 are thrown to talking position, the output of coil 31 is impressed on band suppression filter 39 (similar to 36) leading to radio transmitter 44 of known and suitable type for transmitting speech modulated waves. In this case the waves are modulated by the jumbled speech. The synchronizing impulses are transmitted as before from source 34, but in this case through switch spring 43, band-pass filter 41 (similar to 37), switch spring 42 and across the input terminals of transmitter 44.

When the switches are in receiving position, the received modulated waves from the distant station are demodulated to the speech frequency level in radio receiver 45 and are sent through band suppression filter 40 (similar to 36) whence they pass into coil 31 for decoding as previously described. The received synchronizing impulses from receiver 45 pass through switch springs 42 and 43, filter 41, and to the tripping magnet as previously described. The construction and operation of Fig. 4 is apparent from the foregoing description, similar reference characters being used in Fig. 4 with primes.

Amplification will ordinarily be introduced at various points in both the transmitting and receiving circuits for both the message waves and synchronizing waves, but amplifiers have been omitted from the drawings in the interest of simplicity.

The invention is not to be construed as limited to the detailed disclosure but may be varied to suit conditions within the scope of the claims, which follow.

What is claimed is:

1. A two-way signal terminal comprising means to record signals for transmission and means to record received signals, distributor means for breaking up the recorded signal before transmission to render transmission private, said distributor means operating to restore received broken up signals to normal for intelligible reception, start-stop mechanism for said distributor including a latch tripping magnet, means coordinated with said distributor for energizing said tripping magnet and simultaneously sending out a start impulse once each revolution of said distributor means, and means to delay the energizing of said tripping magnet and the sending of said start impulse relative to the movement of said recording means.

2. In a signalling system, means to record signals for transmission, transmitting distributor means for breaking up the recorded signals before transmission, distantly located means for recording the transmitted signals and receiving distributor means for restoring the signals to a form suitable for reception, start-stop mechanisms for both of said distributor means, means operatively associated with the transmitting distributor means for periodically starting the same and for simultaneously sending out a start impulse to cause starting of the receiving distributor means, and means to delay the starting of said transmitting distributor means and the simultaneous sending out of said start impulse until after the transmitting distributor means has been stopped.

3. A two-way station for a privacy system for signals such as speech, including a continuously operating recorder for recording normal signals to be transmitted and secret signals to be received, a rotary distributor for breaking up the recorded signals and rearranging them in abnormal order for sending and normal order for receiving, start-stop mechanism for said distributor, switches for connecting the recorder and distributor to a transmission path in either transmitting or receiving condition with respect thereto, a continuously driven contact closer and means controlled thereby for operating said start-stop mechanism to release the distributor for rotation and simultaneously to transmit a start impulse to said transmission path when said station is in transmitting condition, and means to drive said contact closer at a slightly reduced speed relative to said recorder to provide a small normal stop interval for said distributor.

4. In a privacy system for signals such as speech, continuously running recorders at each station for the signals, means for driving said re-

corders at the same nominal speed, start-stop distributors for breaking the recorded signals into fragments on a time basis and effecting different relative delays in the sending and receiving of the various fragments, switches for conditioning each station to either transmit or receive, means in each station operative when the station is in transmitting condition for starting its own distributor and for sending a start impulse

to the other stations once each revolution of its distributor, and means to delay by a slight amount the sending of said start impulse relative to the movement of the recorder of the station transmitting to provide a short interval in which each distributor at the station or stations receiving may arrive in proper starting phase before receipt of the start impulse.

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