

Aug. 27, 1946.

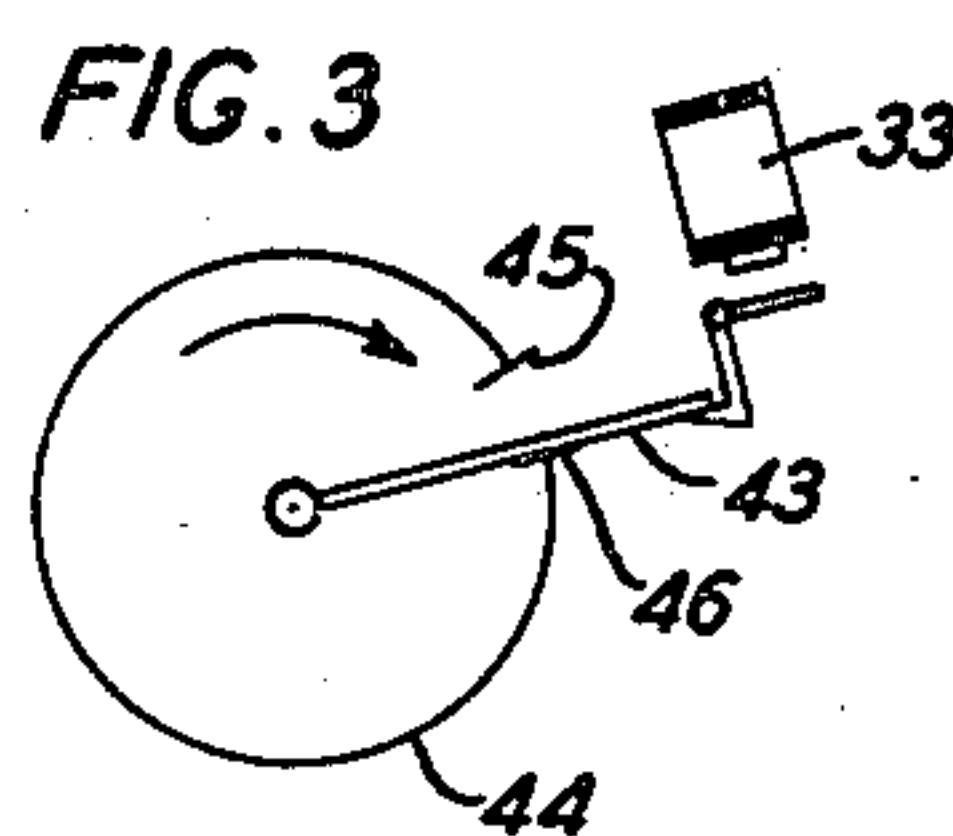
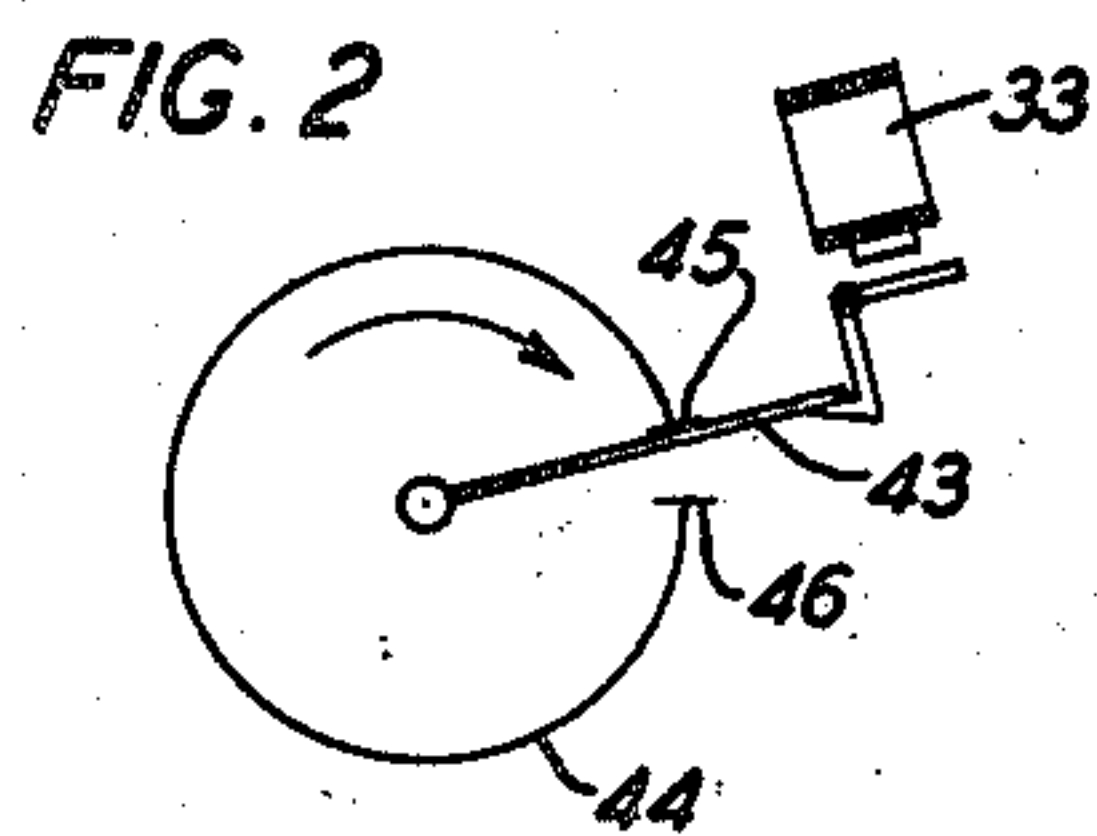
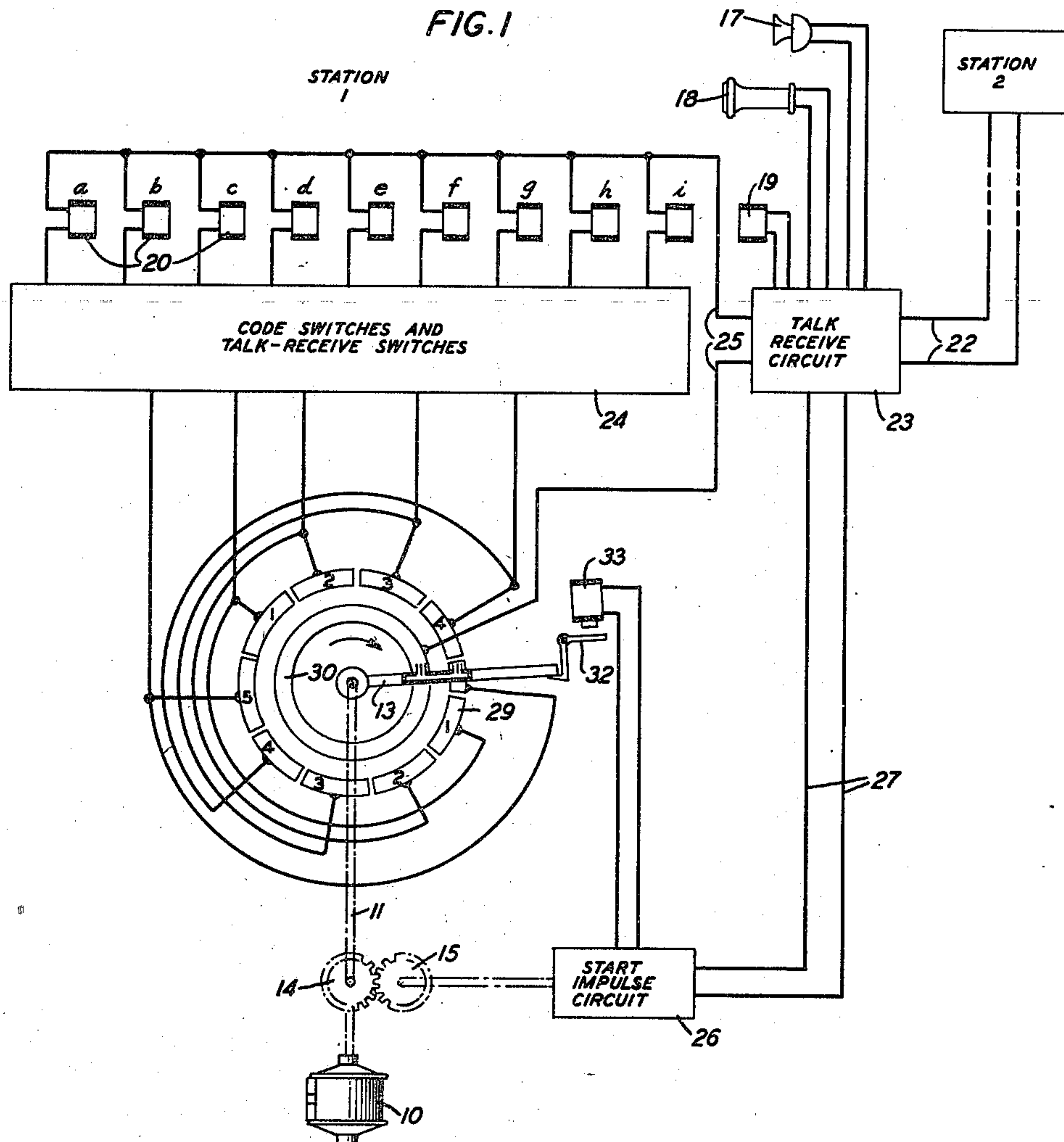
W. A. MUNSON

2,406,352

TELEPHONE PRIVACY

Filed Feb. 11, 1942

2 Sheets-Sheet 1



INVENTOR
W. A. MUNSON
BY
H. A. Burgess
ATTORNEY

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FIG. 4

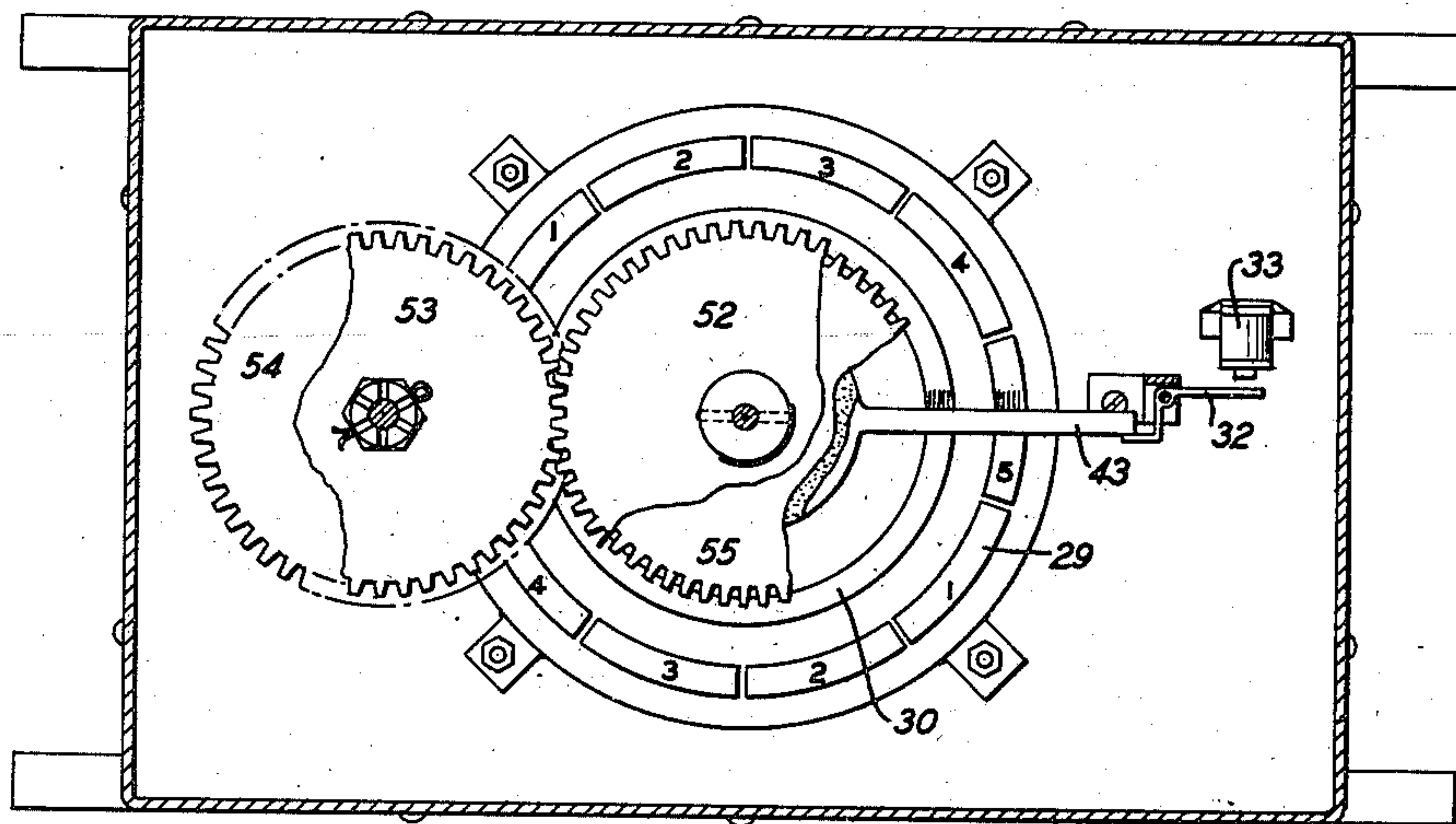
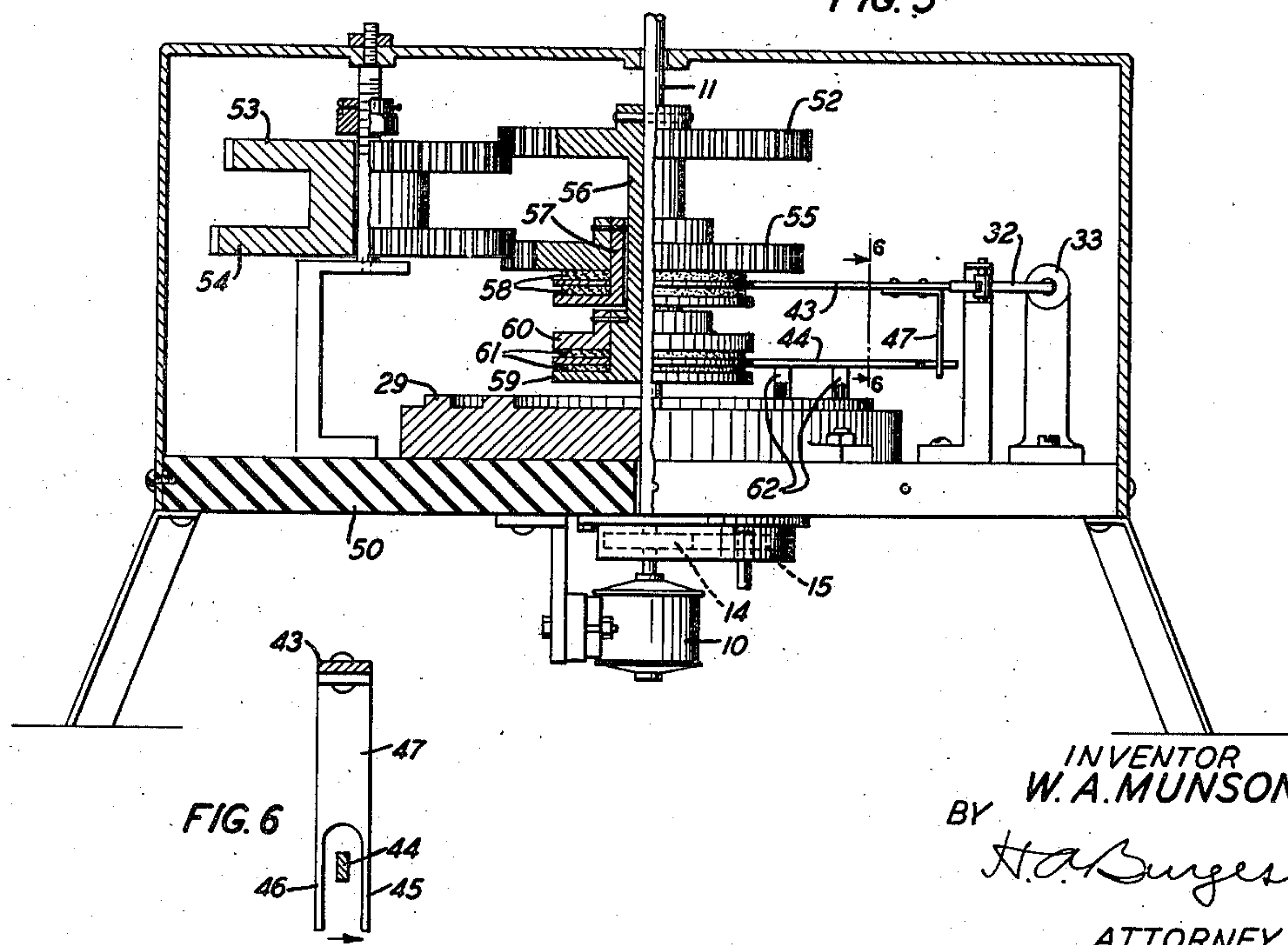


FIG. 5



INVENTOR
W. A. MUNSON
BY *H. A. Burgess*
ATTORNEY

UNITED STATES PATENT OFFICE

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TELEPHONE PRIVACY

Wilden A. Munson, Chatham, N. J., assignor to
Bell Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

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9 Claims. (Cl. 179—1.5)

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The present invention relates to the use of rotary distributors for subdividing message waves on a time basis for transmission or reception. More particularly the invention relates to the problem of coordinating the movements of a recording medium such as a magnetic tape and a rotary distributor located at one point to the movements of similar apparatus at a distant point.

The invention will be disclosed, for illustration, as embodied in a speech privacy system in which speech is recorded on a moving magnetic tape and is subdivided on a time basis by a rotary distributor so arranged as to send out the fragments of speech in abnormal sequence to make reception by unauthorized persons difficult. A similar magnetic tape recorder and rotary distributor at the receiving point subdivide the received privacy speech and rearrange its parts into understandable speech.

It has been proposed heretofore to use various types of start-stop distributors for securing synchronism between the switching operations performed at separated stations in reproducing the recorded speech fragments and transmitting them in altered sequence. Where the brushes are stopped in their motion relative to the distributor segments once in each revolution, they must be quickly accelerated again when started and this sudden transition in both stopping and starting not only places a strain on the mechanism but can give rise to errors due to the variable accelerate time under different conditions. This has been true in prior art systems where all machines, both those running in exact synchronism and those having an error, are subjected to this stopping and starting in each revolution.

The present invention involves a species of start-stop operation but the brushes themselves are never actually stopped so long as they are running in exact synchronism. In a system involving a number of machines, only those operating with a speed error are subjected to the stop-start action of the brushes so that the machines running normally are not penalized by the fact that other machines may need correcting.

It is common practice in printing telegraphy to use start-stop distributors and to run the receiving distributor normally slightly faster than the transmitting distributor so that normally it is stopped for a longer time, in each revolution, than the transmitting distributor. Errors in speed of the receiving distributor result in varying the duration of stoppage of the receiving distributor, and by running the receiving distributor

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normally too fast a greater margin is allowed in stoppage time to compensate for speed variations. If the receiving distributor varies in speed by becoming still faster the stoppage period is prolonged. If the variation is a slowing down, the stoppage time is reduced. It is customary in such systems to make the receiving distributor segments shorter than the transmitter segments so as to pick out the middle part of the transmitted pulse.

In a speech privacy system in which rotary distributors are used to subdivide the message waves as referred to above, the synchronizing presents a much more difficult problem since it is necessary to preserve as far as possible the entire wave, which means that ideally each transition of the two distributors from one segment to the next should be made at the same instant and with minimum transition time. Moreover, if the same apparatus is to be used alternatively to transmit and receive for purposes of two-way conversation, the distributors must be capable of serving for either transmitting or receiving and cannot be of different design.

It is possible to secure some of the advantage of running the receiving distributor slightly fast, by actually running it at the same constant speed as the transmitting distributor but delaying slightly the sending out of the start impulse so that both distributors are normally stopped for an interval to allow a time margin in which to correct for errors in speed of the receiving distributor. This enables all distributors to be alike in construction, and when any distributor is converted from receiving to transmitting it is arranged automatically to send out the delayed starting pulses. All receiving distributors are then synchronized to the distributor that is at the time transmitting.

The invention possesses certain of the advantages obtained by use of the delayed starting pulse but avoids the attendant loss of a small percentage of the speech which has been experienced with certain types of apparatus using the delayed impulse method and avoids the stopping of the brush itself except when it is out of normal phase position.

In accordance with the embodiment of the invention to be specifically disclosed herein, the stop for the brushes is itself carried on a rotating arm so arranged that if the brushes are running at normal speed the stop is removed as the brush carrier comes up against it, and no stoppage of the brushes occurs. If the brushes are running in advance of normal they are stopped momen-

tarily. If the brushes are too slow the rotatable stop arm advances them toward normal.

The nature and objects of the invention will be more fully understood from the following detailed description taken in conjunction with the drawings, in which

Fig. 1 is a simplified over-all schematic diagram of a complete privacy system of a type to which the invention is particularly applicable.

Figs. 2 and 3 are explanatory diagrams;

Figs. 4 and 5 are respectively views in plan and elevation, partly in section, of rotary distributor mechanism constructed in accordance with the invention; and

Fig. 6 shows a detail of the movable stop in relation to the brush carrier.

The over-all system as diagrammed in Fig. 1 will first be described. This system as shown is assumed to be the same as that disclosed in application for United States Letters Patent Serial No. 401,908 of F. G. Buhrendorf filed July 11, 1941, and only a brief description of it will be given here sufficient to show how the improved distributor mechanism of the invention may be inserted into the system.

In Fig. 1 a motor 10, through a shaft 11, drives brush 13 of a rotary distributor and also drives a wheel (not shown) having a magnetic tape mounted on its rim so as to move past the pole pieces of a recording magnet 19 and a number of reproducing magnets 20 as more fully shown in the Buhrendorf disclosure.

When station 1 is used for transmitting, microphone 17 is spoken into and the contacts in the box 23, labelled talk receive circuit, are put in talking position so that the speech waves are sent to recording magnet 19. The tape bearing this recorded speech moves along past the reproducer magnets 20 in succession and is reproduced in each of them in successive phase. The code switches in box 24, and the talk receive switches therein, are set so as to connect certain specified ones of these reproducer magnets to the five pairs of segments of distributor ring 29 in accordance with the particular code being used. As the brush arm 13 (after being released) sweeps over these segments the brush bridges the segments in succession to the ring 29 so that the speech fragments are sent over leads 25 and through contacts in box 23 to outgoing line or channel 22 leading to station 2.

The shaft 11 also drives through gears 14 and 15, with slight speed reduction, a rotary contact maker in the start impulse circuit 26 which sends a start impulse to release magnet 33 once each revolution and also to outgoing line 22 through leads 27 and contacts in box 23 to start the distributor brushes of both stations at the same instant.

In the Buhrendorf disclosure the brush arm 13 is friction driven by shaft 11 so that it may be stopped while the shaft continues to rotate. The No. 5 segment on which the brush is shown resting in Fig. 1 is shorter than the other segments and the relation is such that the normal stoppage time on this short segment plus the travel time across this segment both before and after the stoppage is just equal to the normal time of travel of the brush across each of the other segments. This is coordinated with the delay in the sending of the start impulse (due to the gear reduction ratio of gear train 14, 15) so that when all machines are running normally the duration of the stoppage interval of the brushes is the same in all machines. If a receive-

ing machine is slightly slow, the stoppage interval is shortened; if slightly fast, the stoppage interval is prolonged, in each case by the amount necessary to insure starting of all brushes at the same time. Whatever error exists within the capability of the mechanism to correct it, is in this way wiped out at the conclusion of each rotation of the brush and is prevented from accumulating. The receiving machine or machines are governed from the sending machine by the sending out of the start impulse.

When the apparatus in Fig. 1 is used to receive from distant station 2, contacts are thrown in boxes 23, 24, and 26 at each station so that station 2 sends out the start impulse and the speech fragments in accordance with the code previously agreed upon. The speech fragments received over line 22 pass through contacts in box 23 to recording magnet 19 and the start impulses are sent through contacts in box 26 to the winding of release magnet 33. The reproducer magnets 22 pick off the recorded speech segments from the moving tape and these are sent through contacts of the code switches to the five pairs of distributor segments 29 in such manner that they are swept off by the brush in normal speech order and sent to receiver 18 over leads 25 and contacts in box 23 in receiving position. The brush arm 13 is stopped at the end of each rotation by latch 32 and is released in time correspondence with the distant transmitting distributor under control of the start impulses.

In the construction according to the present invention all of the commutator segments have equal length and there is no stoppage of the brushes on any commutator segment unless the brushes are running too fast and need to be stopped in order to be brought into proper starting phase. The principle of operation is illustrated in the diagrams of Figs. 2 and 3. There is a corrector arm 43 driven slightly faster than the brush carrier 44 represented as a ring (actually it may be an arm) having a small arc cut to present two limits 45 and 46 to the relative movement of arm 43 with respect to ring 44. In Fig. 2 the normal relation is shown at the instant of release of corrector arm 43 for the start of a rotation, the limit 45 just reaching the arm 43 as the latter is released, so that the movement of brush ring 44 is uninterrupted. In Fig. 3 the normal relation is shown at the instant of stopping of arm 43 at the end of a revolution. The normal stop interval is the time required for the ring to move from its Fig. 3 position to its Fig. 2 position.

If now the brush ring is too fast, the parts will reach the position shown in Fig. 2 in advance of the receipt of the start pulse from the distant station and the brush ring will be stopped until the start impulse releases the arm 43. If the brush ring is running slightly behind, the parts will be in the position shown in Fig. 3 at the instant of stoppage of the arm 43 because the arm 43 overtakes the limit 46 at some time during the rotation and advances the ring to the Fig. 3 position. The ring 44, if too slow, will not advance sufficiently far during the stoppage period of the arm 43 to reach the Fig. 2 position by the time arm 43 is released, but arm 43 will overtake the ring at some time during the revolution and for the remainder of the revolution the ring will travel with the arm and at the speed of the arm. The small error with which the brushes start out on a revolution will in this manner not be cumulative, but will again be the same at the com-

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pletion of the revolution. It will be observed that this is the opposite of the usual start-stop operation in which the brushes are started at the correct time, but, if slow, lag farther and farther behind during a rotation.

Referring to Figs. 4, 5 and 6, the motor 10 is mounted by suitable brackets on the bed plate 50 which forms part of a housing for the distributor mechanism, the rest of the housing being indicated at 51. Shaft 11 has keyed to it a pinion 52 which is formed integral with or has secured to it a sleeve 56 extending downwardly in Fig. 5 and terminating at its lower end in a flange 59. Mounted for rotation on this sleeve 56 is a larger sleeve 57 keyed to a pinion 55 for rotation therewith. Idler gears 53, 54 communicate motion from gear 52 to gear 55 with a slight speed increase (e. g. 2 per cent). Arm 43 is enlarged into a disc surrounding the sleeve 56 to provide relatively large surfaces for mounting between discs 58 of cork or other suitable friction material. The opposite end of the arm 43 extends toward the right in these figures and cooperates with latch 32 and release magnet 33 in the manner already described.

The brush carrier 44, indicated in diagram in Figs. 2 and 3 as a ring for convenience of description, is in the actual construction shown an arm similar in general to arm 43 in that it is enlarged into a disc at one end for mounting between friction discs 61 which are in turn held between flange 59 and washer 60. Arm 44 has brushes 62 supported on its under side.

Arm 43 has a depending member 47 (see Fig. 6) bifurcated at its lower end to provide two prongs 45 and 46 between which the end of the brush carrier 44 extends. These are the limits 45 and 46 referred to in the description of Figs. 2 and 3. Assuming movement toward the right in Fig. 6, arm 44 will under normal conditions just be coming into contact with prong 46 at the instant of reaching the stop 32 and will just be coming into contact with prong 45 at the instant of release of arm 43. If the brushes are behind, prong 46 will advance the arm 44 and if the brushes are ahead, prong 45 will stop the arm 44, as has been described above in connection with the diagrammatic Figs. 2 and 3. The friction discs 58 provide sufficiently greater friction than discs 61 so that arm 43 controls the motion of arm 44 in the manner described.

The invention is not to be construed as limited to the precise details or magnitudes that have been given herein but the scope of the invention is defined in the claims, which follow.

What is claimed is:

1. In a rotary distributor, a brush arm rotatable with respect to distributor segments, a stop therefor, timing means defining the starting time for each rotation of said brush arm, means to interpose said stop in the path of said brush arm a given interval in advance of the normal starting time representing a small fraction of a rotational period, and means controlled by said timing means to remove said stop at the end of said small interval whereby said brush arm is stopped only if it is in abnormally advanced phase at the instant of interposing said stop.

2. In a rotary distributor, a brush arm rotatable with respect to distributor segments, a stop arm also rotatable, engageable means between said arms for permitting said stop arm when stopped to stop said brush arm, timing means for defining the starting time for said stop arm in

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each rotation, means for rotating said stop arm in advanced phase with respect to said brush arm, means governed by said timing means to stop said stop arm in each rotation to permit said brush arm to approach said stop arm when the latter is stationary, said engageable means stopping said brush arm only when the latter is in abnormally advanced phase with respect to said stop arm at the instant of stoppage of the latter.

3. In a rotary distributor, a brush arm rotatable over distributor segments, a stop arm rotatable ahead of said brush arm and at a slightly greater rate, stop means for said stop arm, timing means to remove said stop means to permit said stop arm to begin a new rotation, and engageable means between said stop arm and brush arm for stopping the latter only when said brush arm overtakes said stop arm before the latter is released.

4. In a rotary distributor, a brush arm rotatable over distributor segments, a corrector arm rotatable with said brush arm and linked thereto by means permitting a limited small relative movement between said arms, means for driving said corrector arm at a slightly faster rate than said brush arm, stop means for said corrector arm and timing means for removing said stop means periodically to permit rotation of said arms.

5. A combination according to claim 4 including means for driving said corrector arm at such a rate in excess of the rate of motion of said brush arm that the corrector arm gains a distance equal to the extent of said limited relative movement during the normal time between the removal of said stop means and the next stoppage of said corrector arm.

6. In a rotary distributor, a brush arm rotatable with respect to distributor segments, and means for keeping said brush arm within certain limits of error in phase comprising a corrector arm rotatable with said brush arm and link means engaging said arms with a certain amount of leeway such that said corrector arm advances the brush arm when the latter is behind normal position and retards said brush arm when the latter is ahead of normal position.

7. In a distributor mechanism, a segmented ring, a brush carrier rotatable relative thereto, a pair of stops on said brush carrier spaced apart by a small angular distance, a rotatable arm mounted to rotate with said brush carrier and to have its movement with respect to said brush carrier limited by said two stops, means to drive said arm slightly faster than said brush carrier, and means to stop said arm in each rotation for an interval equal to the normal time of travel of said brush carrier through said angular distance.

8. In a start-stop distributor, a brush arm, a segmented ring, means to rotate the brush arm relative to said ring, a stop for said brush arm, constructed to stop the rotation of said arm in each revolution in which said brush arm is in advance of normal position, and means to remove said stop to permit said brush arm to continue its rotation without interruption in each revolution in which the brush arm arrives at said stop in normal phase.

9. In a speech privacy system in which the speech waves are first recorded and then are reproduced for transmission in abnormal order, distributor means for breaking the reproduced speech into fragments for rearrangement into

abnormal order comprising distributor segments and a brush arm rotatable thereover, a rotatable stop arm separate from the brush arm but mechanically linked thereto with provision for limited relative motion between said arms, a stop for said stop arm, whereby said stop arm may be stopped in advanced phase with respect to

said brush arm, and timing means for releasing said stop arm before the brush arm reaches the limit of said relative motion in each revolution in which the brush arm is not ahead of normal phase position.

WILDEN A. MUNSON.