

July 2, 1935.

C. N. HICKMAN

2,006,455

TELEPHONE MESSAGE RECORDING SYSTEM

Filed March 31, 1932

2 Sheets-Sheet 1

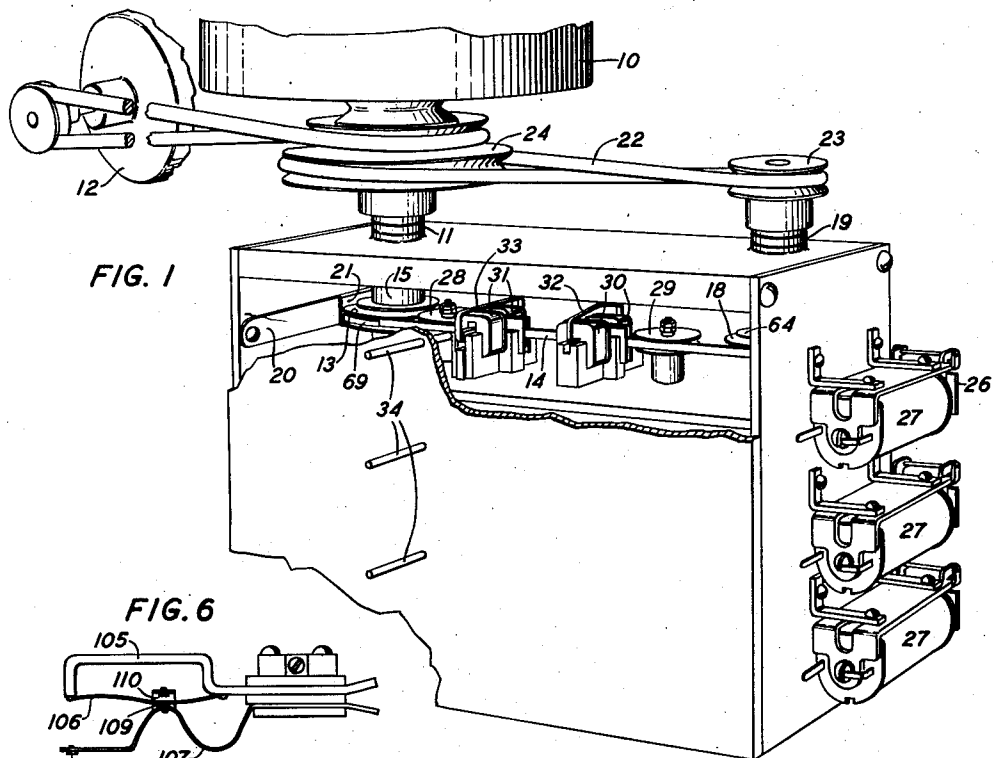
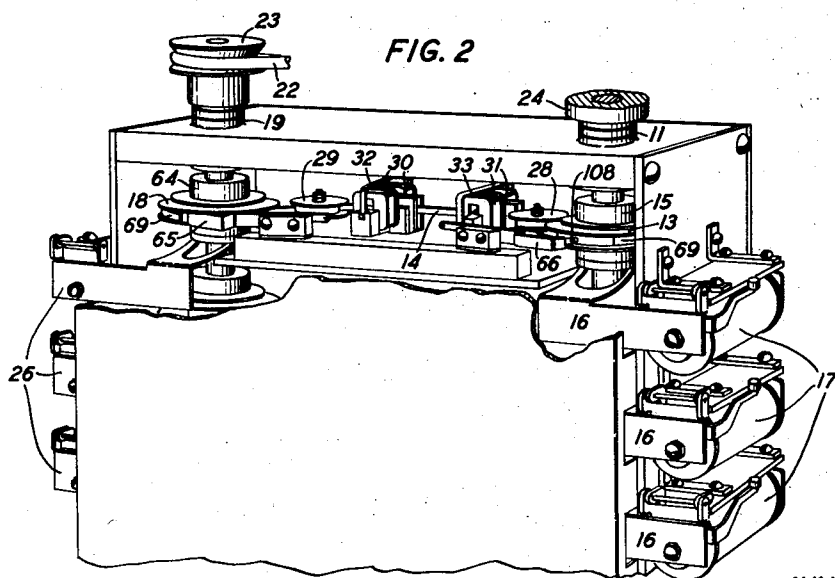


FIG. 1

FIG. 6

FIG. 2



INVENTOR
C. N. HICKMAN
BY
G. M. Campbell
ATTORNEY

July 2, 1935.

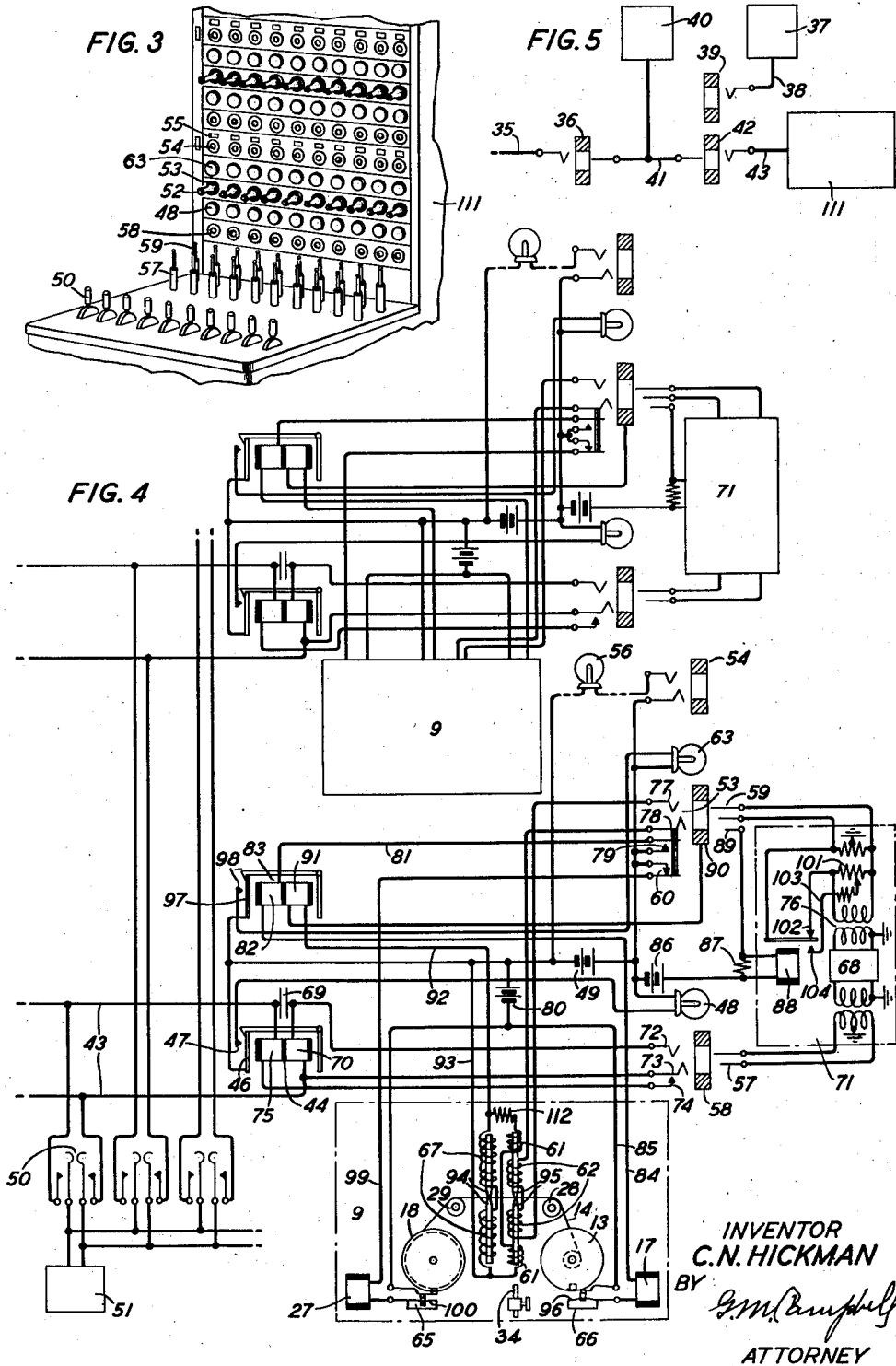
C. N. HICKMAN

2,006,455

TELEPHONE MESSAGE RECORDING SYSTEM

Filed March 31, 1932

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,006,455

TELEPHONE MESSAGE RECORDING
SYSTEM

Clarence N. Hickman, Jackson Heights, N. Y.,
assignor to Bell Telephone Laboratories, In-
corporated, New York, N. Y., a corporation of
New York

Application March 31, 1932, Serial No. 602,186

7 Claims. (Cl. 179—6)

This invention relates to sound recording and reproducing systems and apparatus and more particularly to a centrally operated system and apparatus adapted for recording and reproducing telephone messages.

The object of the invention in general is to provide a compact, efficient and economical equipment under control of a centrally located switching system for the recording and reproduction of messages or for transcription or other purposes.

In general, this invention contemplates an organization of apparatus involving recording and reproducing units and switching apparatus by means of which a record of a message or other dictated matter from a calling subscriber may be made and stored against its time of delivery to the person for whom it is intended.

In its preferred form the apparatus consists of a plurality of electromagnetic tapes each associated with its recording and reproducing magnets and supported by reels operated from a common drive shaft through the agency of clutching mechanisms automatically operated in the process of connecting the apparatus for either recording or reproducing. A reversible connecting circuit with suitable amplifying and automatic volume control apparatus may be used for connecting the called party with the apparatus for recording and the apparatus with the called party for reproducing and transmitting the message.

Circuit breakers cooperating with each of the reels are adapted to be operated when the reel is full by the increase of diameter of the layers of material on the reel to automatically stop the rotation of the reel.

In the drawings,

Figs. 1 and 2 are views of the recording and reproducing units of the invention;

Fig. 3 is a typical message operator's switchboard position;

Fig. 4 is a wiring diagram for the switchboard of Fig. 3 showing two typical recording units;

Fig. 5 is a schematic diagram showing the manner of associating the message recording and reproducing system with the telephone system; and

Fig. 6 is a detail of the tape controlled circuit breakers on the recording units.

Figs. 1 and 2 show recording and reproducing apparatus comprising three separate units all driven from shaft 11 having a flywheel 10 by a suitable driving motor 12. The individual units

are quite small so that a large number of them may be operated from a single shaft.

Each unit 9 comprises a recording reel 13 upon which the tape 14 is wound during the recording process, the reel being automatically coupled to the shaft 11 by a disc clutch 15 operated by clutch arm 16 of the recording relay 17 as will be explained more fully below. The tape is supplied from a rewind reel 18 which during recording turns freely on the rewind shaft 19 due to the tension on the tape exerted by the reel 13. Each reel is provided with a friction brake to prevent the tape from unwinding faster than it is being wound up on the other reel. This brake, as shown in connection with reel 13, may take the form of a flat spring member 20 secured at one end to the frame of the unit and having at its other end a friction pad 21 which presses against the periphery of the reel. There is also a tape guard 69 on each reel to prevent the tape from slipping off the reel.

For very large installations several drive shafts may be used and these may be driven separately or from a single motor as desired. For speech recording the tape need not move more than six to eight inches per second so that an ordinary telephone conversation of three minutes can be recorded on a reel two inches in diameter or less. Since the spacing between the reels need not be more than one inch, it is practical to have as many as one hundred of them on a single shaft. The distance between the recording shaft and the rewind shaft need not be more than four or five inches and the lateral thickness of the apparatus need not exceed three inches so that the total space occupied by even five hundred to a thousand of these reels can be quite small.

It will be noted that the rewind shaft 19 is driven at constant speed by belt 22 or other suitable means, in the opposite direction to the rotation of shaft 11. Pulley 23 is made considerably smaller than pulley 24 so that the rewinding operation is carried out in a relatively short time. Each rewind reel 18 has a clutch 25 with which it is engaged at the proper time by clutch arm 26 of the relay 27. In passing from one reel to the other the tape engages idler pulleys 28, 29 which maintain it in proper alignment with respect to the polarizing magnets 30, 30 and the recording and reproducing or translating magnets 31, 31. The construction details of the recording units may be in accordance with principles well known in the art, but applicant finds that best results are obtained by using a very thin, narrow tape one or two mils in thickness and from $\frac{1}{32}$ inch to

$\frac{1}{8}$ inch wide. This tape is transversely magnetized to a very high degree by thin pole pieces having their tips in contact with the tape and disposed in accurate transverse alignment with respect to it. The translating magnets preferably consist of laminated pole pieces having very thin tips contacting the tape in the same manner as the polarizing pole pieces. The magnet coils each comprise a depolarizing winding and a recording and reproducing winding. The flux due to the depolarizing winding is preferably of such value that in the absence of current in the recording winding the tape is left in a perfectly neutral condition as it winds upon the reel 13. The pressure of the opposed pole piece on the tape is equalized by U-shaped springs 32, 33 contacting the free ends of the pole pieces as shown. These and other features of the preferred design are more fully explained in a copending application of C. N. Hickman and E. C. Wente, Serial No. 530,168, filed April 15, 1931.

In the copending application referred to it is explained that noise is reproduction due to residual magnetism in the pole pieces may be eliminated by circulating a small current in the depolarizing windings during the reproducing process. According to this invention the same result is obtained by mounting a small permanent magnet 34 opposite one of the pole pieces of each set of translating magnets 31. These magnets are secured in the unit casing by suitable clamping means so that their flux opposes that of the residual magnetism of the pole pieces and adjusted individually to give minimum noise in reproduction for each unit.

When the invention is applied to a message recording and reproducing system for hotels, for example, circuits of the general nature of those of Fig. 4 would be provided. In this figure only two recording units 9, 9 and the necessary circuits are shown but it will be understood that as many duplicates as are required for a given installation may be readily provided according to the invention. Such units are associated with the hotel telephone system in the manner indicated in Fig. 5. Trunk line 35 terminating in a jack 36 at the private branch exchange of the hotel is typical of the lines connecting that exchange with the central telephone office. The telephone subsets 37 in the various rooms are connected by lines 38 to jacks 39 on the hotel switchboard. The operator's telephone set 40 is in a cord circuit 41 by means of which connections are made between calling and called lines. In addition one or more message jacks 42 are provided for connecting calling and called parties to the message operating switchboard 111 of Fig. 3 over message trunks such as 43.

Referring now to Figs. 3, 4 and 5, the following procedure might be followed in case a telephone call comes into the hotel for a guest who cannot be located. The operator tells the calling party that the guest does not answer and asks if he desires to leave a message. On being informed by the calling party that he would like to leave a message, the operator connects him with the message operator who has control of the switchboard 111. When the operator calls the message operator, one of the white signal lights 48 is lighted. The message operator then closes her switch 50 corresponding to the trunk signal light 48; she tells the calling party that she is the message operator and asks the room number and name of the called party, also the name of the calling party. She then removes one of the plugs 52

from any message jack 53 and places it in the signal jack 54, having the number of the room which is being called on its designation plate 55. This lights a signal lamp 56 in the room of the party being called or sets a signal of some other type which informs the occupant of that room on his return that there is a message waiting for him at the telephone message department. The operator places the cord plug 57 in the trunk jack 58 corresponding to the white signal light 48, and the cord plug 59 in the message jack 53, from which she removed the plug 52. She then speaks into her transmitter, saying, for example "This is Mr. Smith calling Mr. Jones in Room 754. You may now proceed with your message, Mr. Smith." She then opens switch 50 to disconnect her telephone from the circuit unless she wishes to monitor the message.

The message is then recorded on one of the message reels of the recording machine in the following manner. When the cord plug 59 is placed in the message jack 53, the following events take place: Referring to Figs. 1 and 2, the recording clutch relay 17, by means of the clutch arm 16, pushes the recording reel 13 up against clutch 15, which is rigidly attached to the recording shaft. This causes the tape to be pulled from the rewind reel 18 over the idler 29 between the polarizing pole tips 94 of magnets 30 and the pole tips 95 of the depolarizing coils 61 and voice coils 62 of the magnets 31, over the other idler 28 to the recording reel 13. The magnetic condition of the tape during this process, as is well known in the art, is changed in such a manner that it contains a record of the message and may be reproduced at will.

When the calling party hangs up, the operator receives the disconnect signal, which in turn permits the message operator to disconnect her cord plugs 59 and 57. When the cord plug 59 is removed from the message jack 53, a red signal light 63 is lighted, which is an indication that there is a message on the reel corresponding to this particular message jack. The recording clutch relay 17 is also released, which permits the recording reel 13 to disengage from the recording clutch 15 and at the same time the rewind clutch relay 27 lifts the rewind reel 18 by means of its clutch arm 26, causing the reel to engage with the rewind clutch 64. The tape is then automatically rewound until the reel is full, at which time the circuit breaker 65 is operated by the tape to remove the current from the rewind clutch relay, thus permitting the rewind reel to drop away from its clutch.

The circuit breakers 65 and 66 may be of any known type which can be arranged to open its contacts automatically when the reel is full of tape and close them automatically when the tape is removed from the reel. The preferred form shown in Fig. 6 is simple in construction and very dependable in its operation. The frame 105 which is of non-magnetic material serves as one terminal of the device and has secured to it a thin strip of contact metal 106 slightly longer than the spacing between the point of attachment so that the strip is slightly bowed. A flat spring member 107 forming the other terminal has a shoe 108 disposed to contact the tape when the reel is nearly full. The spring 107 has a contact point 109 and an insulating stop member 110 on the other side of the thin strip 106 as shown. As the tape builds up on the reel it pushes on the shoe 108 of the spring 107 which exerts pressure on the strip 106. As the pressure increases it finally

becomes great enough to cause the strip 106 to snap over breaking the contact with the point 109, opening the circuit and coming to rest against the stop 110. As the tape is removed from the reel the pressure on the shoe 108 decreases, the spring 107 moves towards the center of the reel and stop 110 causes the strip 106 to snap back into contact with the point 109 thereby restoring the circuit.

During the time the message was being recorded, if the calling party were to talk longer than the time required to use up all the tape on the rewind reel, the circuit breaker 66, would have likewise removed the current from the recording clutch relay and thus permitted the recording reel to drop away from the recording clutch. Also, simultaneously, the red signal light 63 corresponding to this reel would have come on, indicating to the operator that the party had used all of the tape available. She would, of course, then come in on the line and inform the party that he had used all of his time, but that if he wished to continue the message, she would assign him another message reel.

When the called party (in this case Mr. Jones) returns to his room and finds the signal indicating that there is a message for him at the telephone message department, he calls the operator and asks for the message operator. The operator connects him with the message operator, which again lights one of the white signal lights. The message operator closes the operator switch corresponding to this trunk signal and on being informed that Mr. Jones of Room 754 says he has a message, she looks at the signal jacks and finds that in the jack 54 having the room number referred to, there is a plug 52 having a No. 1 on it. This informs her that the message for Mr. Jones is on unit No. 1 which corresponds to the message jack 53. She then places the cord plug 59 in the trunk jack 58 corresponding to the signal light 48, and places the cord plug 57 in the message jack 53. When the cord plug is inserted in the message jack, the recording reel is again clutched and winds up the tape in the same manner as during the process of recording. This time, however, there are no polarizing currents in the coils 67 and no depolarizing currents on the coils 61, but the voice coils 62 are connected directly to the trunk line 43 through the amplifier 68 by means of the cord plugs 57 and 59. The message, together with the portion dictated by the operator, is reproduced. The operator listens in until after the portion which she dictated has been reproduced, thus insuring that the correct party is getting the message. She may then disconnect her telephone set 51 and proceed to take care of any other requests, it being understood, of course, that she will have charge of a number of recording units and cord circuits as shown by the switchboard of Fig. 3.

After the message has been delivered, the party will hang up, which gives the operator the disconnect signal and in turn permits the message operator to remove the cord plugs 57 and 59. The red signal light 63 was extinguished when the cord plug 57 was inserted in the message jack 53, so that the operator now knows that this message jack has delivered its message and she may return the corresponding plug 53 to it. This is an indication that this message jack is now available for another message. At the time she removes the cord plug 57 from the jack, the rewind reel proceeds to rewind the tape in ex-

actly the same manner as at the end of the recording of the message.

Having discussed the mechanical operations involved in operating the system, the electrical circuits used will now be described more in detail. It will be obvious to those skilled in the art that there are many circuits capable of accomplishing the desired results but that those shown on Figs. 4 and 5 represent a simple and convenient arrangement for illustrating the invention.

The hotel operator rings the message operator over the trunk line 43. The ringing current drops the armature 46 of relay 44 by the current through the condenser 69 and drop relay coil 70. The armature of this relay makes contact 47, which lights the white signal light 48 by means of the battery 49. The message operator then closes the operator's switch 50 which connects the subset 51 to the line 43. After obtaining the request to record a message she inserts the cord plug 57 in the trunk jack 58. In Fig. 4 this cord plug is connected to the cord circuit 71 which includes an amplifier 68. This amplifier is shown only diagrammatically since any amplifier suitable for a telephone repeater service may be used. The input circuit is thereby connected to the jack contacts 72 and 73 which in turn connect with the telephone line 43 through the condenser 69. When the plug is inserted the jack contact 73 is pushed against contact 74 which places the relay coil 75 of relay 44 across the line 43. This sets the relay again and thereby extinguishes the white light 48 which had been lighted by the relay at the time the call came in. The coil 75 across the line also serves to hold the call when the operator opens the switch 50.

When the cord plug 59 is placed in the message jack 53, the following events take place: the output of the amplifier 68 is connected to the jack contacts 77 and 78, which in turn are connected with the recording and reproducing voice coils 62. At the same time, contact 79 is closed which causes current from batteries 80 and 49 to flow from contact 79, conductor 81, winding 82 of relay 83, conductor 84, clutch relay 17, circuit breaker 66, conductor 85, back to battery 80. At the same time, current from batteries 49 and 86 passes through the resistance 87 and amplifier relay 88, the purpose of which is explained below, through the sleeve 89 of the cord plug 59 to the framework 90 of the message jack 53 and thence through the winding 91 of relay 83, conductor 92, where the current divides and part of it flows through the polarizing coils 67 back to the battery 49 over conductor 93 and the other portion of the current flows through the depolarizing resistance 112, the depolarizing coils 61 and thence back to the battery 49. No action takes place at the drop relay 83 because both sets of coils are energized. The current through the recording clutch relay, by mechanical means already explained, causes the recording reel to start revolving to move tape 14 from the rewind reel 18 over the idlers 29, 28 between the polarizing pole pieces 94 and the pole pieces 95 of the depolarizing and voice coils respectively. A potentiometer 101 is connected across the output terminals of transformer 76 of the amplifier 68.

When relay 88 is unoperated the output circuit is completed through back contact 102 of the relay so that the full gain of the amplifier is used. Upon the operation of the relay, as just explained, the output circuit is completed through conductor 103 and front contact 104

and the output level is reduced by an amount corresponding to the setting of the potentiometer. This relay arrangement is for the dual purpose of preventing overloading during recording 5 which would result in a distorted record and for insuring sufficient gain during reproduction so that the message may be easily heard. The specific circuit shown for illustration represents a very simple arrangement for the purpose, but 10 obviously it may be replaced by any known form of automatic volume control or volume compression and expansion circuit to avoid possible difficulties due to weak or excessively strong signals.

If the output jack of the amplifier remains 15 connected to the message jack 53 until the recording reel is full of tape, the recording circuit breaker 66 opens contact 96 as already explained thereby releasing recording clutch relay 17 and disengaging the recording reel 13 from the recording shaft. The circuit breaker also deenergizes winding 82 of relay 83 and allows the armature 97 to close contact 98 and light the red light 63 by means of battery 49.

On the other hand, if the output plug 59 of the 25 amplifier is removed from the message jack before the recording circuit breaker 66 has operated, the current will be removed from the recording clutch relay and the winding 82 of the drop relay 83 by the opening of contact 79 of 30 the jack, and the red light will come on as before. The circuit of the polarizing and depolarizing coils 61 and 67 is broken by sleeve 89 and contact 60 closes causing current from batteries 80 and 49 to energize the rewind clutch relay 27 35 over a circuit extending from battery 80, the rewind circuit breaker 65, the relay winding, conductor 99, contact 60 to battery 49. In the drawings the circuit breaker is shown open because the rewind reel is full of tape. At this time, 40 however, the tape is on reel 13 so that the circuit breaker has already closed to prepare a circuit for the rewind relay.

When the call comes in from telephone set 37 asking for the delivery of the message, the white 45 light signal 48 comes on, due to the ringing current from line 43, as explained before. The message operator answers the call but this time she puts the output plug 59 of the amplifier 68 into the trunk jack 58. As was the case with the 50 other plug, this extinguishes the white light 48. The input plug 57 of the amplifier is then connected to the message jack 53. The reproducing operation is similar to the recording operation already described except that there is no current 55 placed on the framework 90 of the message jack, and consequently no current flows through the winding 91 of the drop relay 83, nor through the polarizing coils 67 or depolarizing coils 61. The red light 63 is extinguished, due to the opening of contact 98 by current in winding 82, of 60 the relay flowing over a circuit already traced. The recording reel 13 draws the tape between the pole pieces as before but this time there is no current in coils 61 and 67. As the tape passes 65 between pole tips 95 the magnetic variations representing the message recorded in the tape induce in the coils 62 corresponding currents which are conveyed to the input of the amplifier 68 by the 70 plug 67. From the output of the amplifier the message is transmitted at a suitable level to the calling party by means of plug 59 in jack 58 of the line 43 as already described. It will be noted that no connection is made to the framework of 75 jack 58 so that relay 88 in the amplifier is not

operated and the full gain of the amplifier is used for reproducing purposes.

When all of the message has been delivered and the plugs removed, the tape is rewound as explained in the case of recording, the message 5 jack plug is then removed from the signal jack and returned to the message jack. The signal light in the called room is thus extinguished and the unit which has just delivered the message may be used again by any calling party. 10

While the invention has been described with reference to a message recording system for hotels, it is equally applicable to other uses such as giving secretarial service to telephone subscribers. In this case the recording units might 15 be located at the telephone central office and the recorded matter could be typed at the convenience of the typist who might be at any desired location within the field reached by the telephone system. For telephone dictation recording within a single 20 organization, the recording units would be directly associated with a local telephone system as illustrated in the drawings. For such applications it might be desirable to employ larger reels so that more matter could be recorded by a single 25 unit but obviously these units could be made up with any desired capacity.

Other modifications will occur to those skilled in the art and the invention is intended to be limited only by the following claims. 30

What is claimed is:

1. In a system for recording and transmitting telephone messages, a plurality of recording tapes, recorders and reproducers associated with each tape, a supply and a take-up reel for each tape, 35 a common driving means for said tapes normally disassociated therefrom, telephone lines for transmitting and receiving messages, a trunk circuit and means operative when the trunk circuit is connected to one of the recorders or reproducers 40 for connecting the corresponding tape with the driving mechanism for recording or reproducing a message.

2. In a system for recording and transmitting telephone messages, a plurality of recording units 45 each comprising a record tape, recording and reproducing means and supply and take-up reels for the tape, a common driving means for the units normally disconnected therefrom, telephone lines for transmitting and receiving messages, a 50 trunk circuit for selectively interconnecting the lines and the units, means operated when the trunk is connected to a recorder unit for connecting the driving means to that unit, and means associated with each reel and operated by the 55 tape on the reel for disconnecting the reel from the driving means.

3. In a telephone exchange system in combination, telephone lines, a switching station for connecting the lines for conversation, a plurality 60 of recording and transmitting units at the station exclusively controlled therefrom, means for selectively connecting any unit with any one of the lines, signal means associated with a called line and controlled from the station, and means 65 at the station for identifying the selected unit with the called line.

4. In a telephone exchange system in combination, telephone lines, a switching station for connecting the lines for conversation, message 70 recording and transmitting means located at the switching station, a trunking circuit at the switching station including an amplifier for connecting a calling party with the recording apparatus to receive a message and subsequently 75

connecting the recording apparatus with a called party to reproduce and transmit a recorded message, and relay means operated upon the connection of the trunk circuit with a calling party for reducing the effective gain of the amplifier.

5 In a telephone exchange system in combination, telephone lines, a switching station for connecting the lines for conversation, message recording and transmitting apparatus at the
10 switching station comprising a plurality of recording tapes each associated with recording and reproducing apparatus, means associated with each tape for conditioning it for recording, a trunk circuit at the switching station, and means associated with the trunk circuit operative only
15 when it is connected with a calling party for operating the tape conditioning means.

6. Apparatus for recording and reproducing telephone messages comprising a recording shaft,
20 a rewind shaft, and a plurality of magnetic telegraphophone units associated with the shaft in close-

ly spaced relation to form a compact unitary mechanism, each unit comprising a recording reel and a rewind reel on the respective shafts, a tape extending between the reels, means for conditioning the tape for recording, recording and reproducing magnets, a clutch for associating each reel with its shaft and a relay for operating the clutch.

7. In a telephone exchange system in combination, telephone lines, a switching station for connecting the lines for conversation, message recording and reproducing means, a circuit for connecting a line with the message recording and reproducing means, means operated upon the connection of one end of the circuit to the message means for conditioning said means for recording and means operated upon the connection of the other end of the circuit to said message means for conditioning said means for reproducing.

CLARENCE N. HICKMAN.