March 28, 1944. F. A. HUBBARD ET AL 2,345,048

COMMUNICATION SYSTEM

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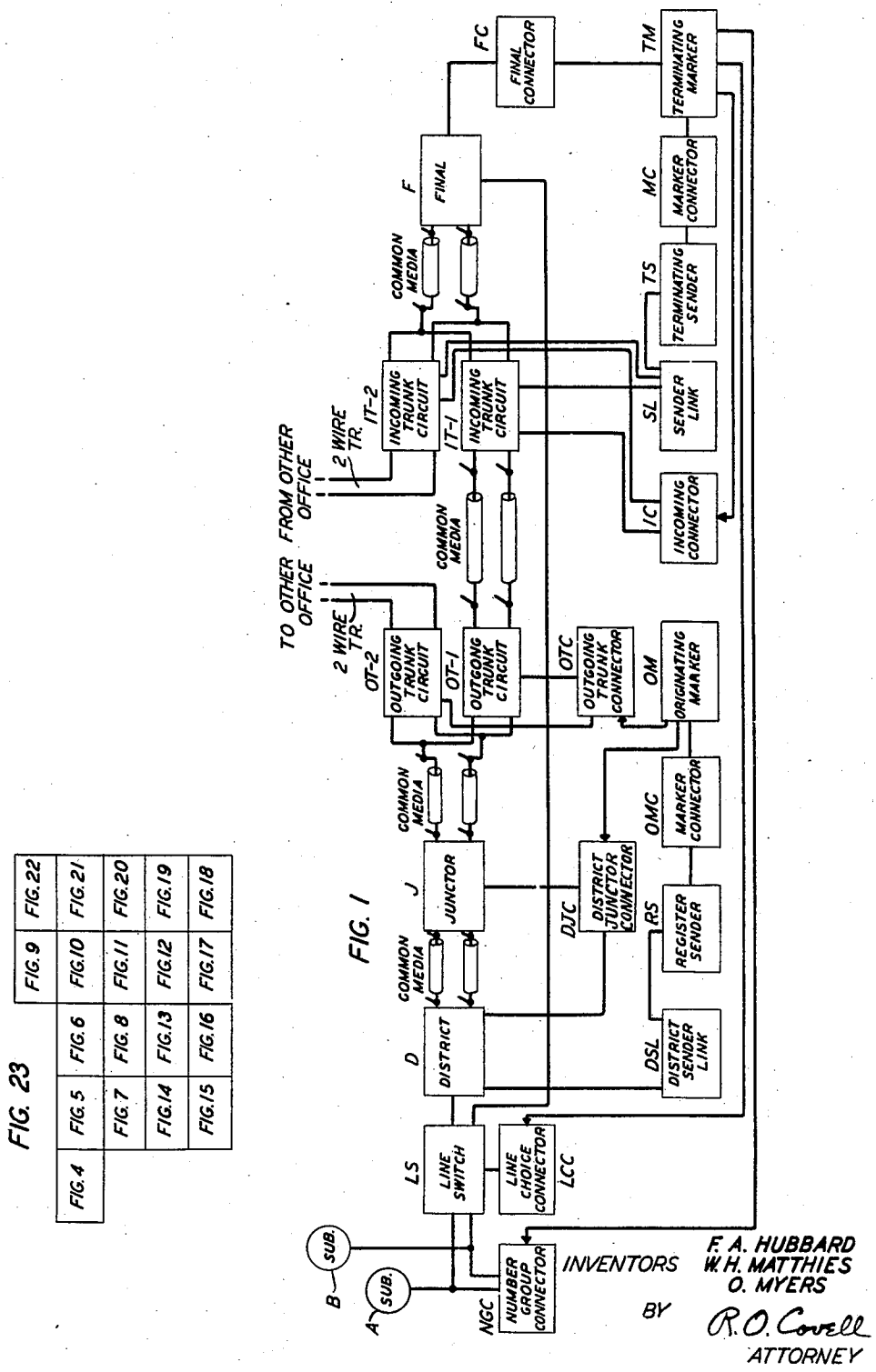


FIG. 1

FIG. 23

| | | | | | |
|---|---|---|---|---|---|
| FIG. 4 | FIG. 5 | FIG. 6 | FIG. 7 | FIG. 8 | FIG. 9 |
| | | | FIG. 14 | FIG. 13 | FIG. 10 |
| | | | | FIG. 15 | FIG. 16 |
| | | | | | FIG. 17 |
| | | | FIG. 20 | FIG. 11 | FIG. 21 |
| | | | | FIG. 19 | FIG. 12 |
| | | | | FIG. 18 | FIG. 22 |

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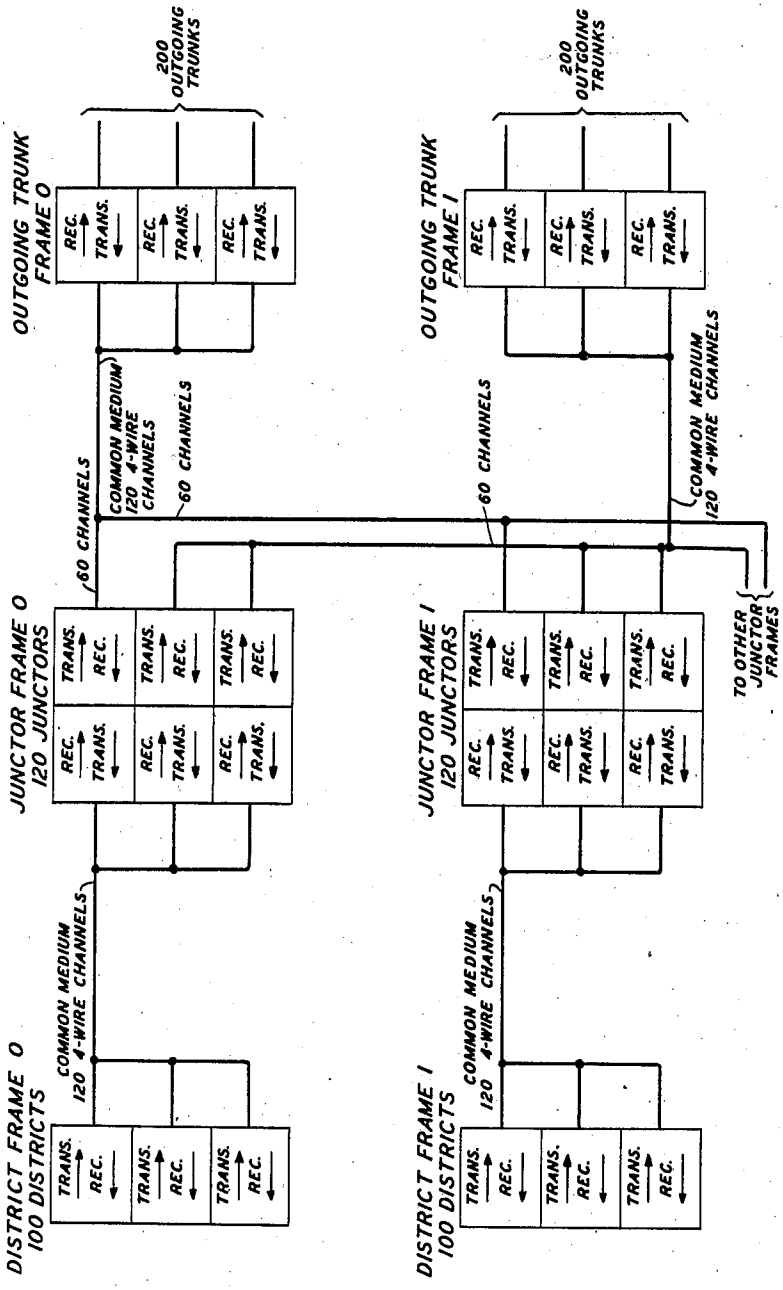


FIG. 2

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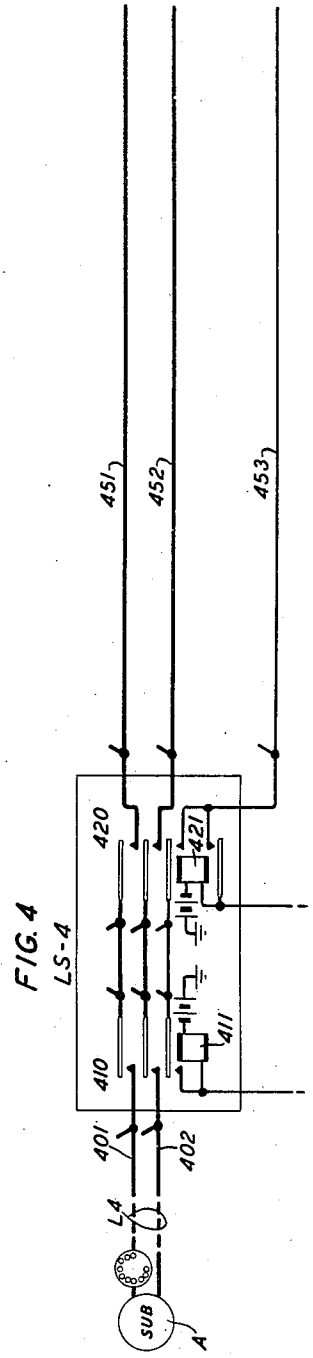


FIG. 4
LS-4

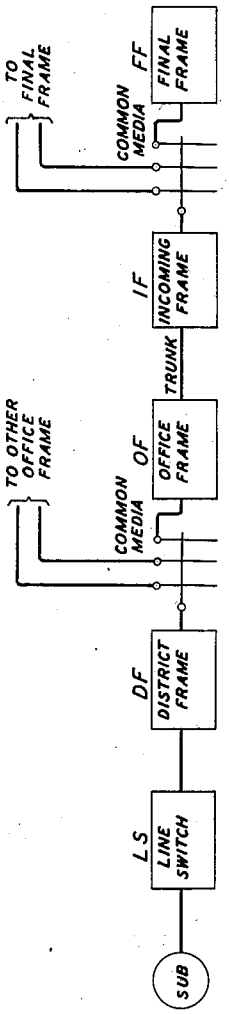


FIG. 3

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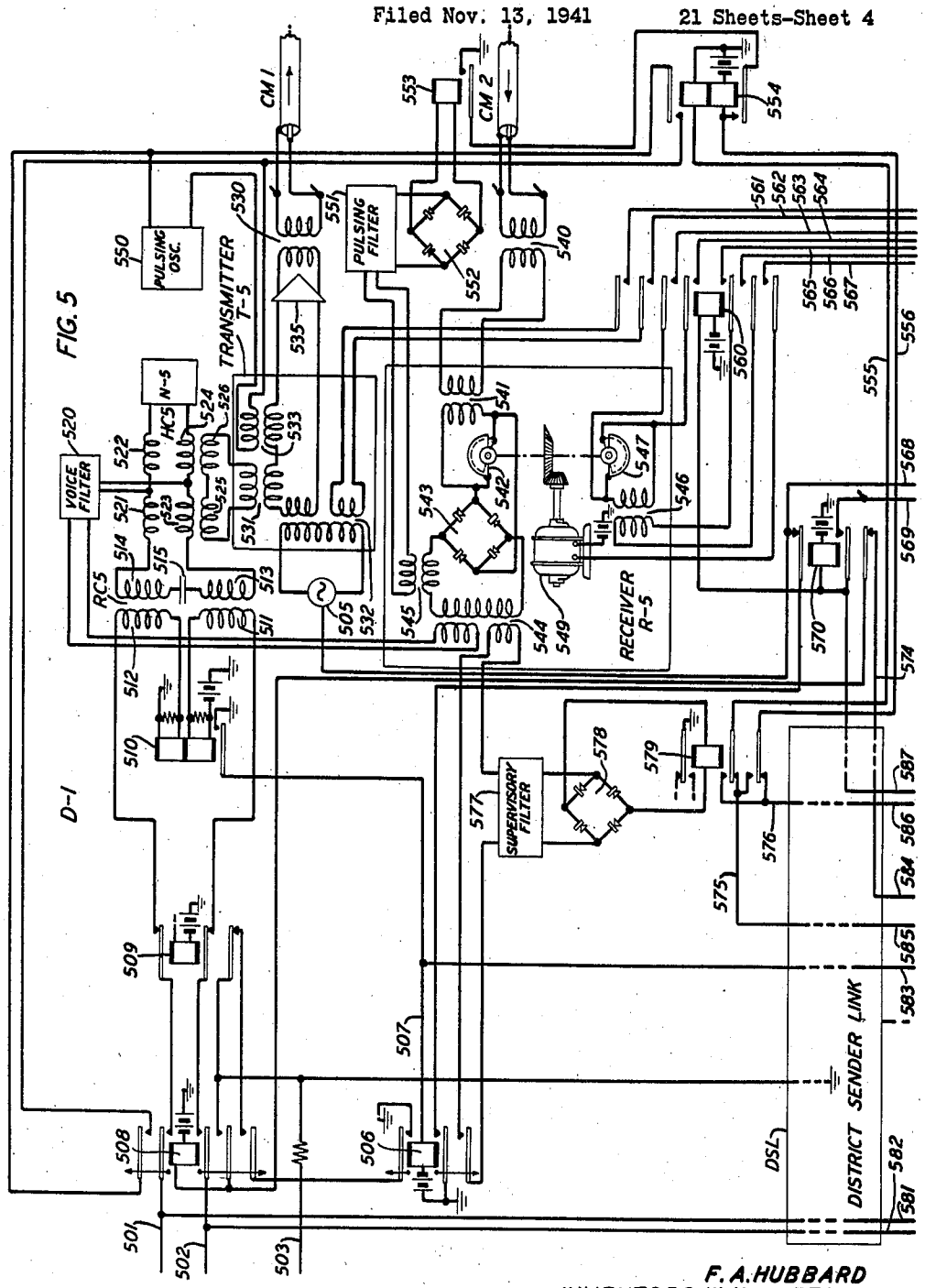


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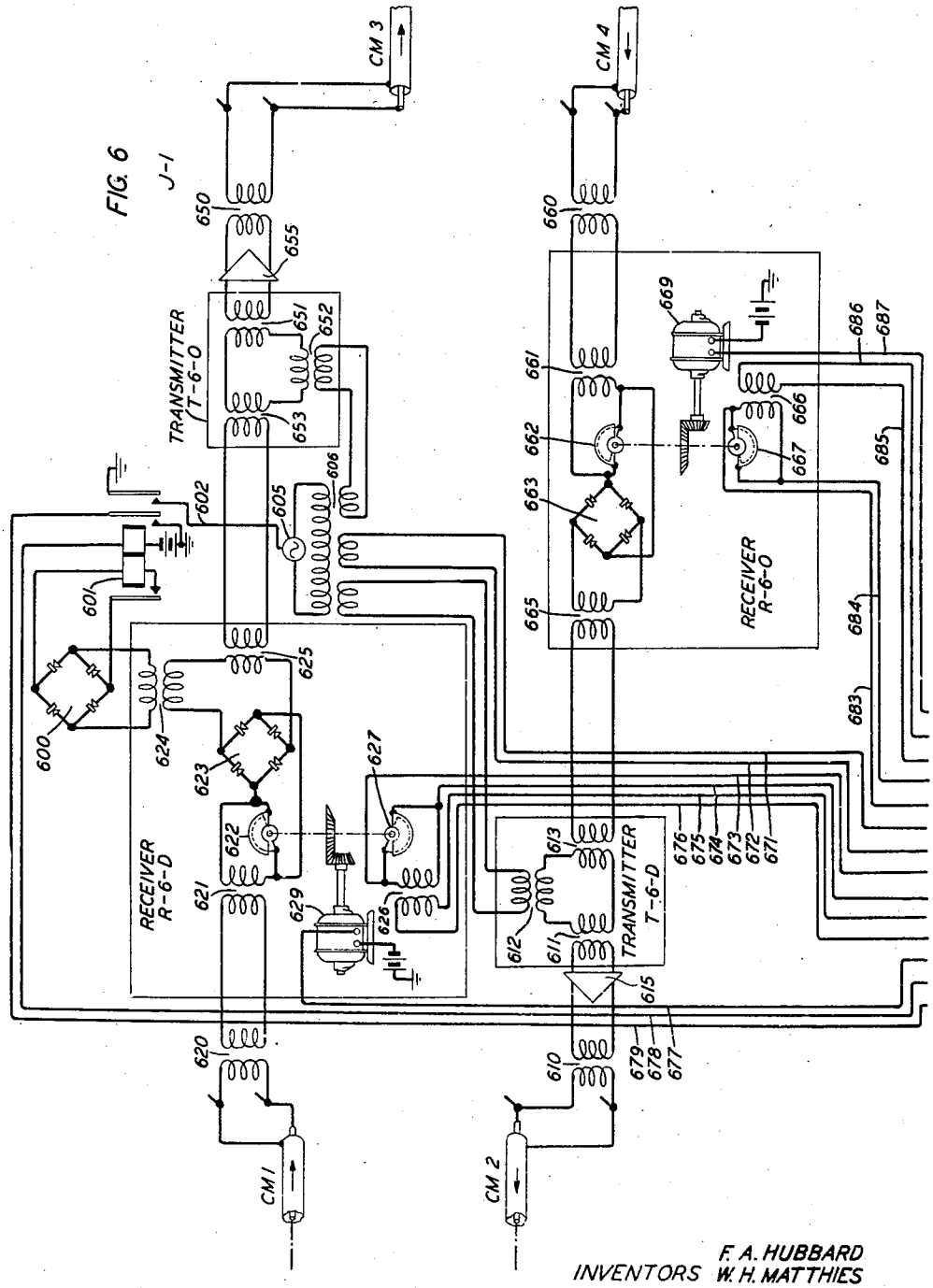


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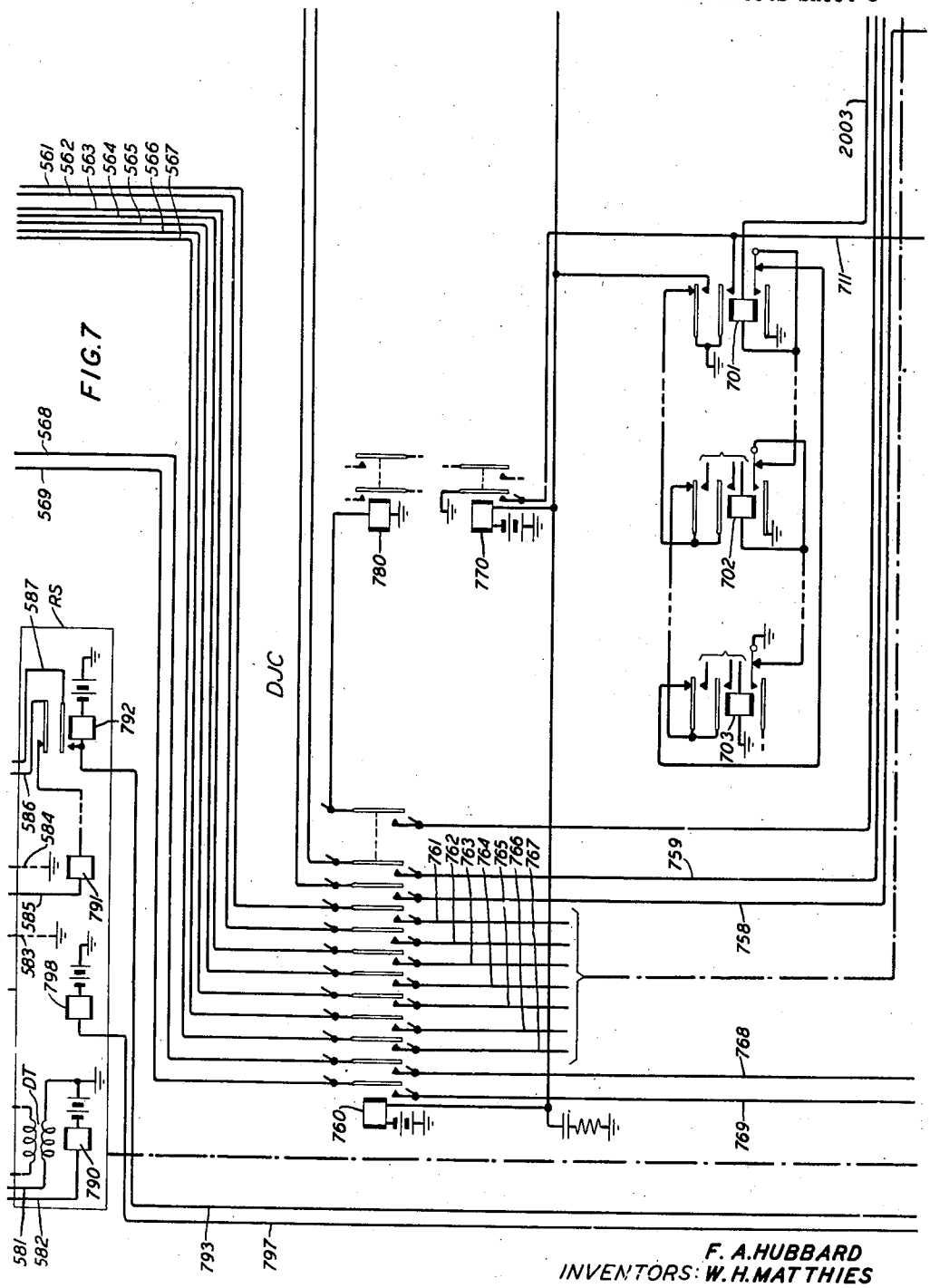


FIG. 7

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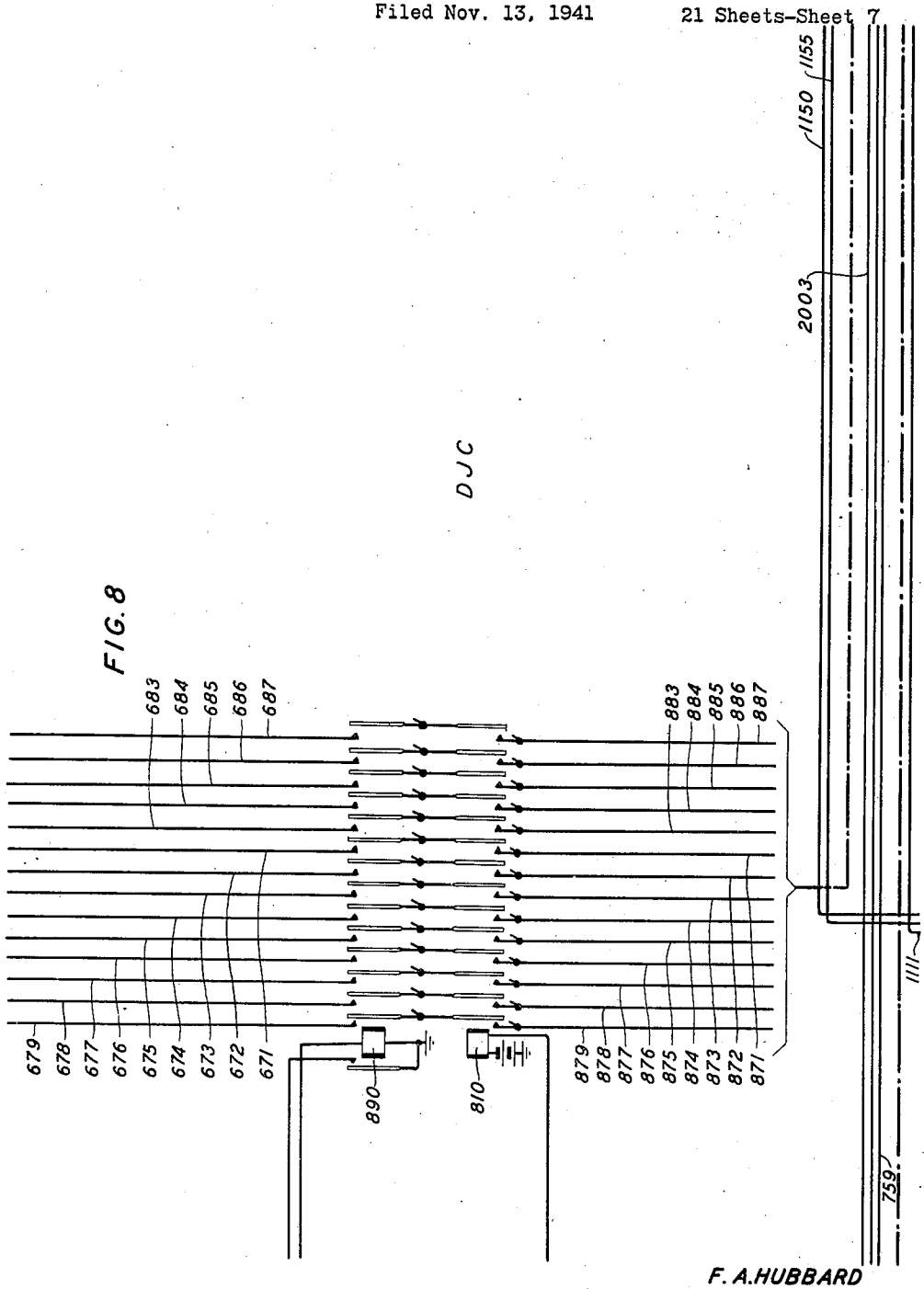


FIG. 8

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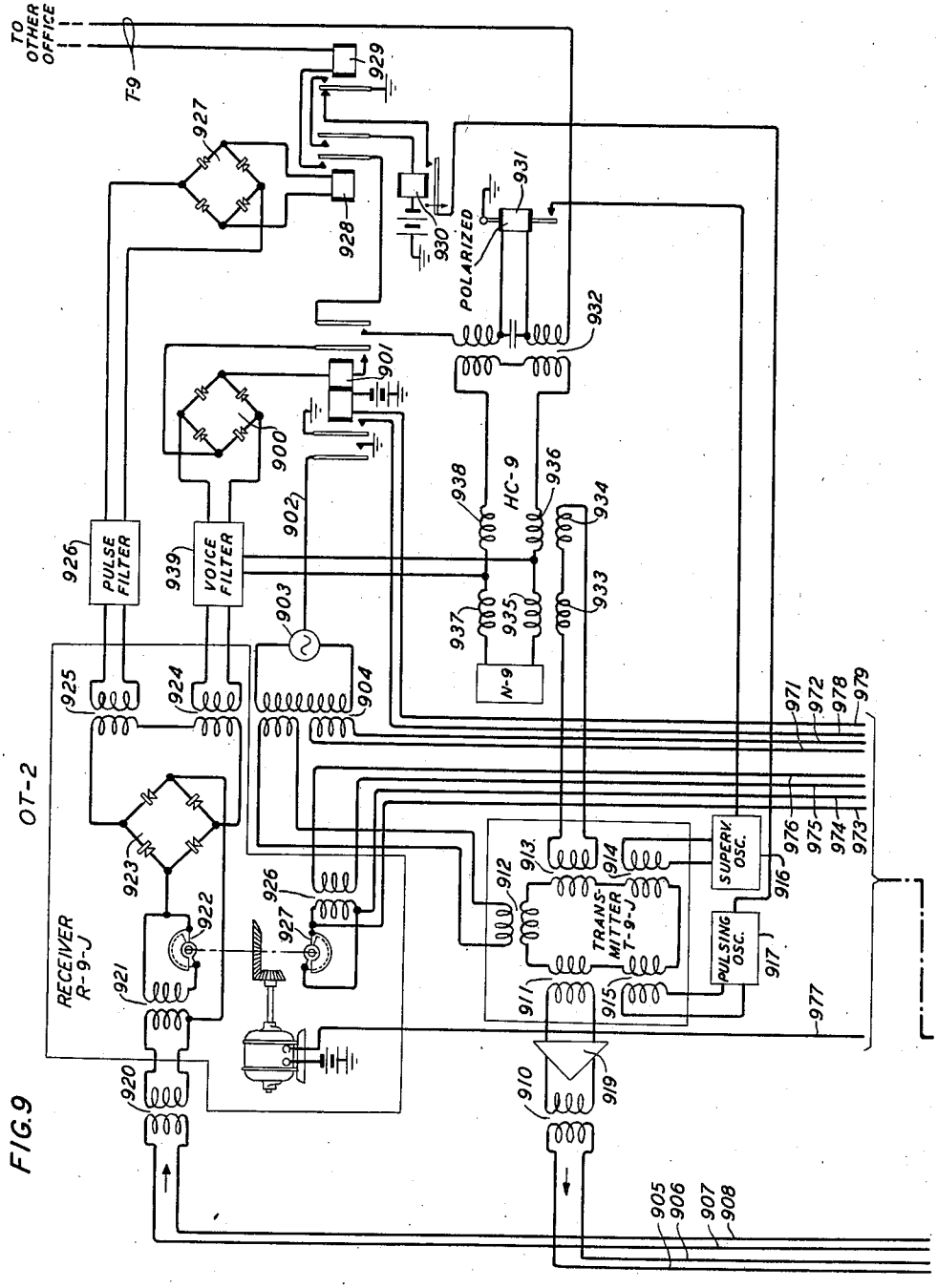


FIG. 9

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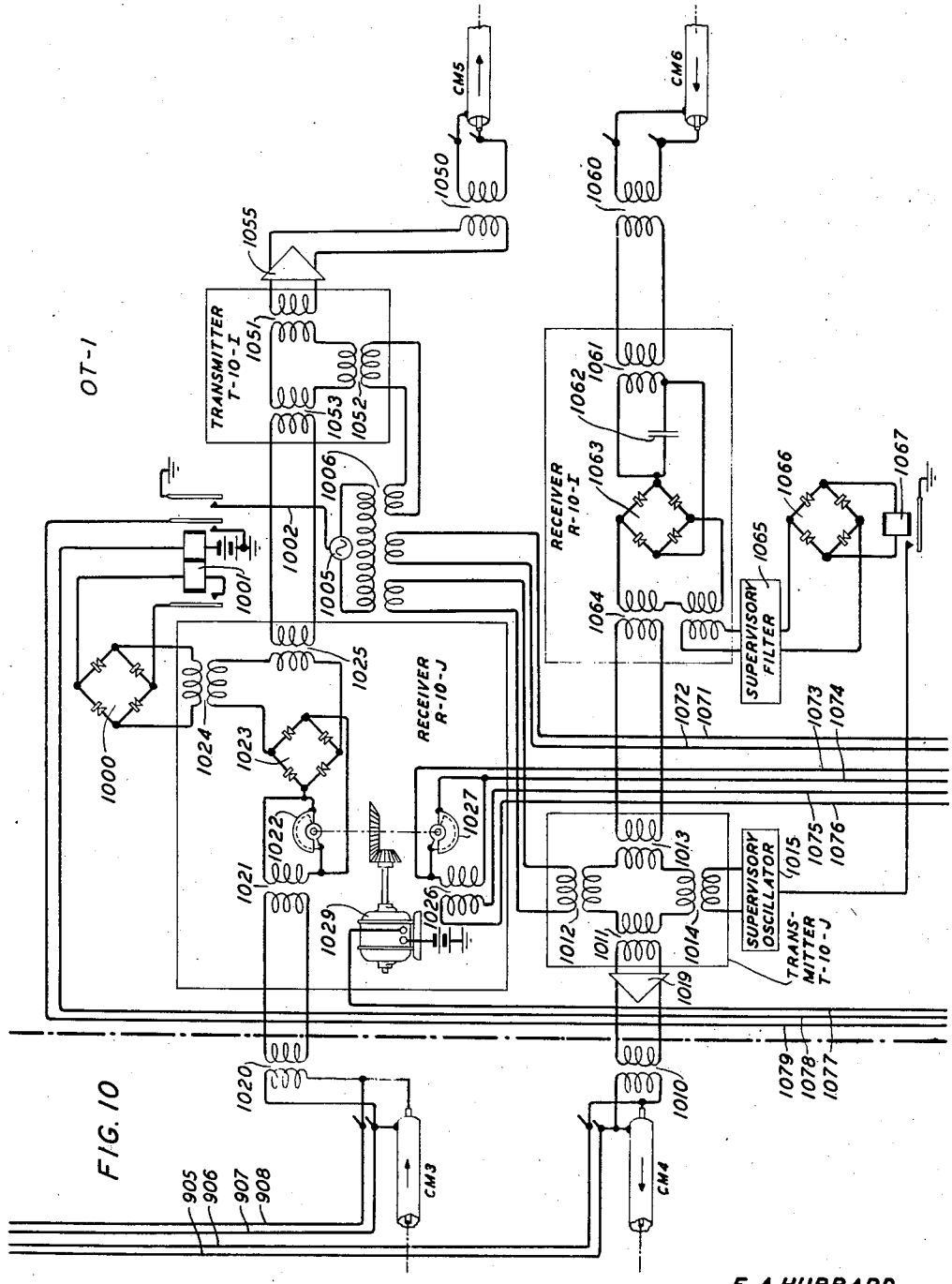


FIG. 10

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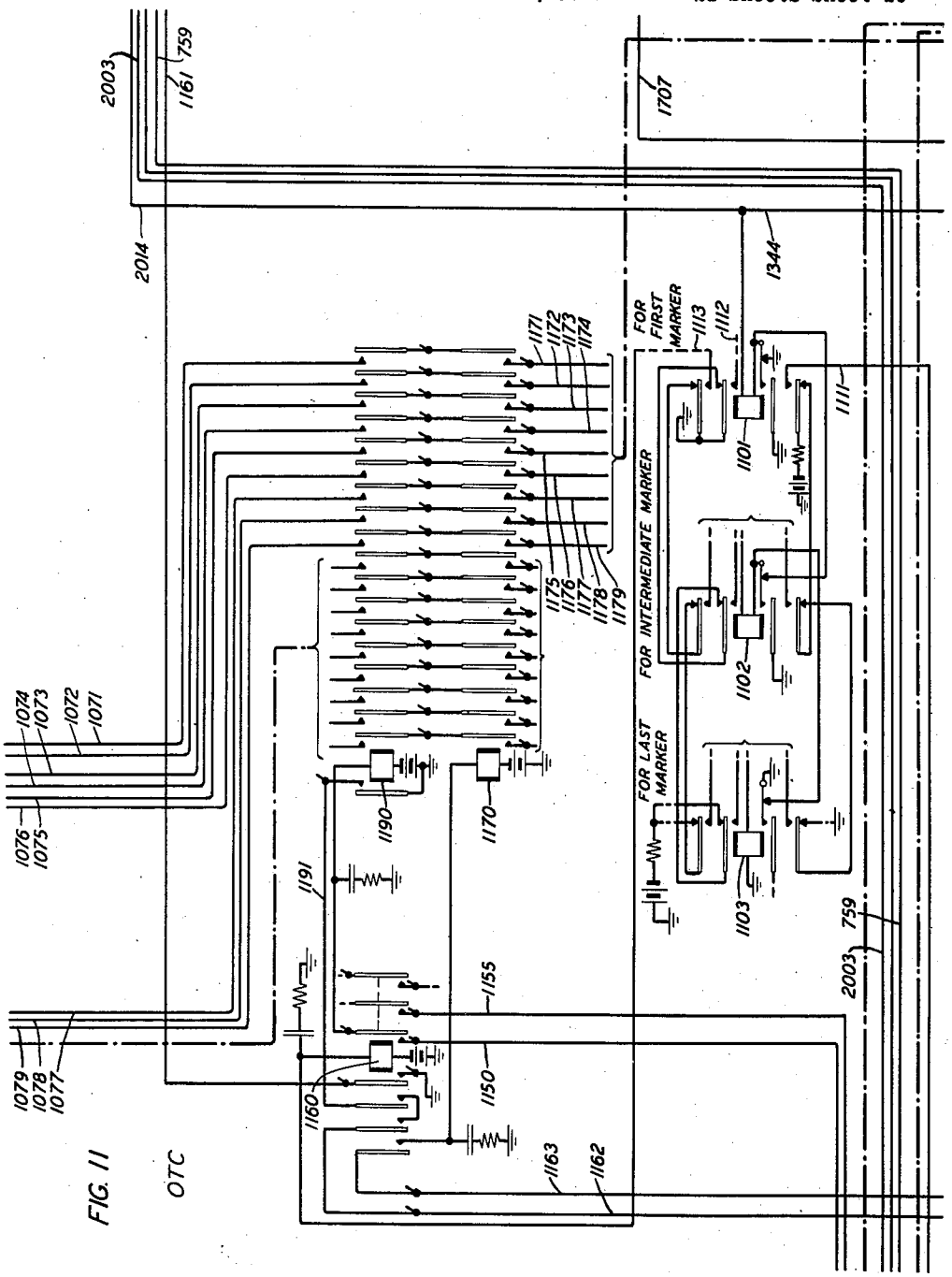


FIG. 11

OTC

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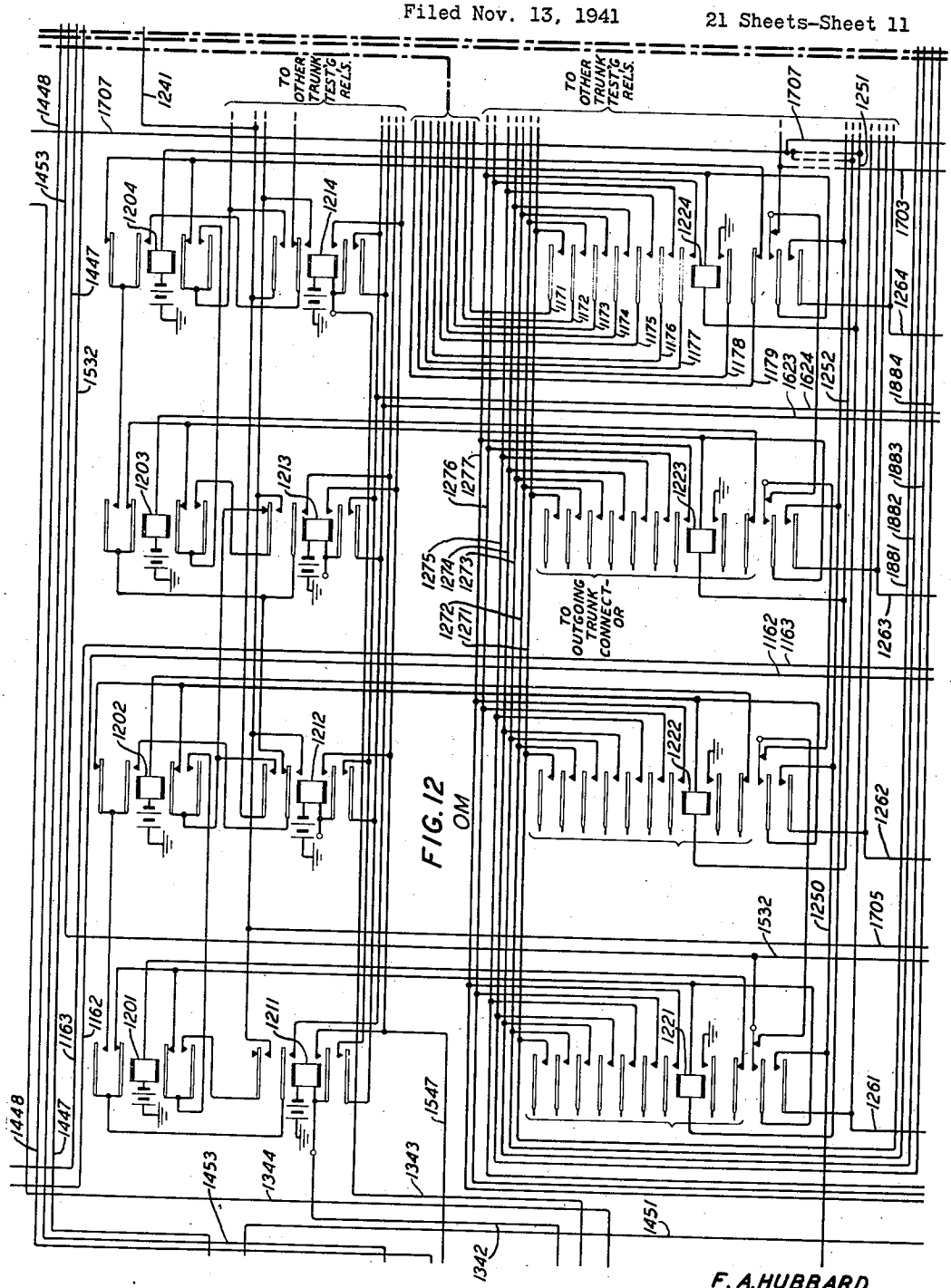


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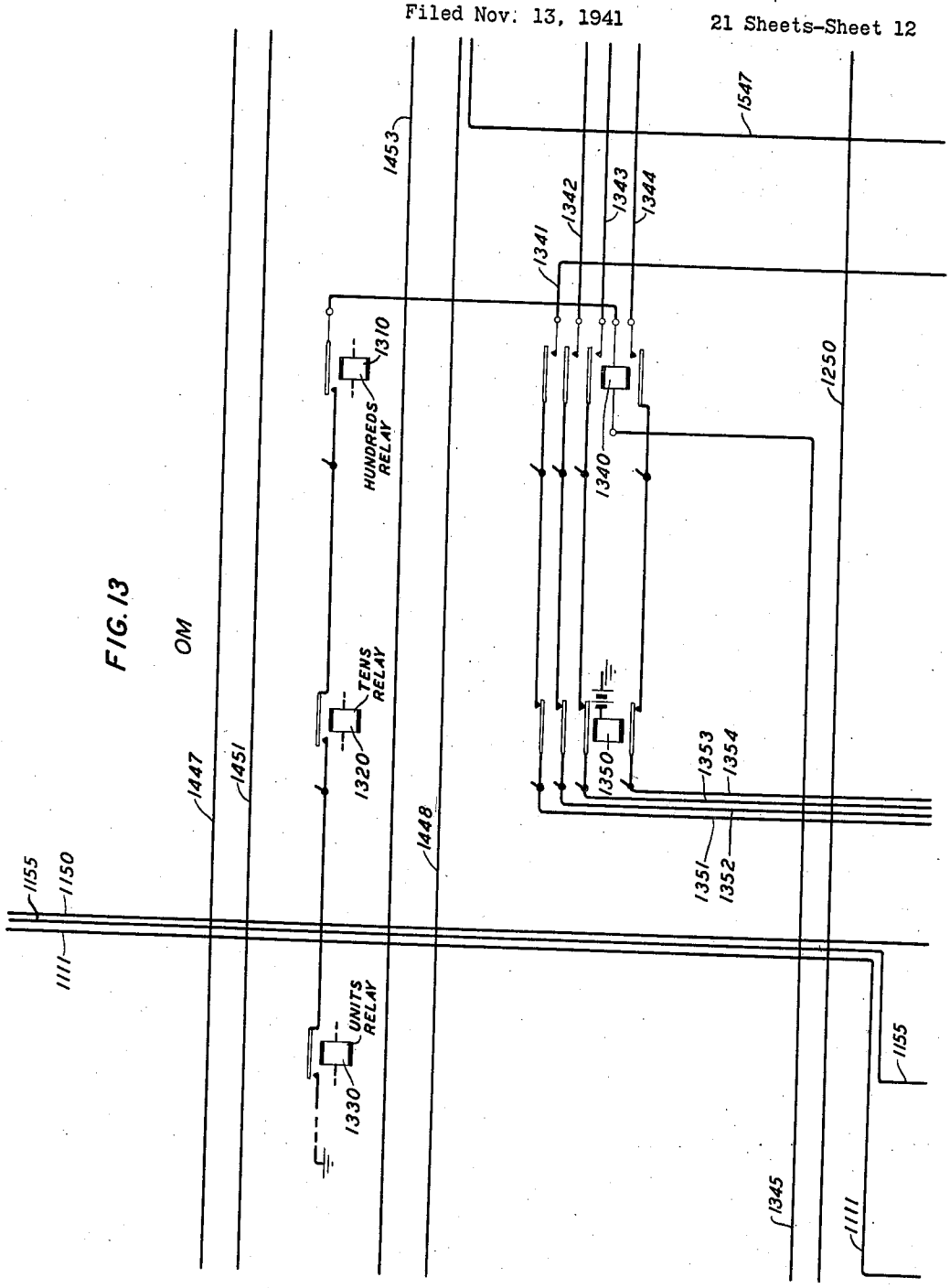


FIG. 13

OM

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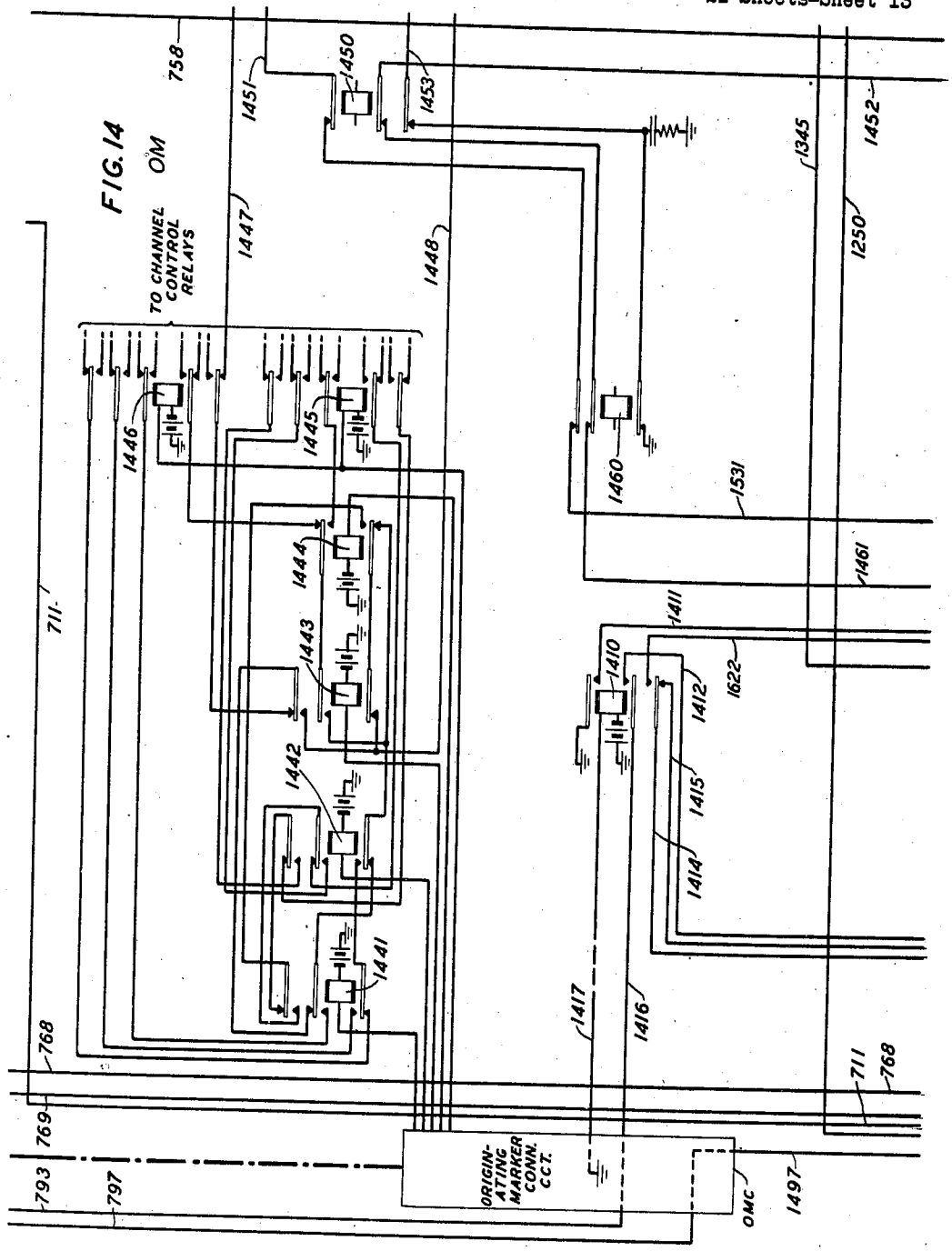


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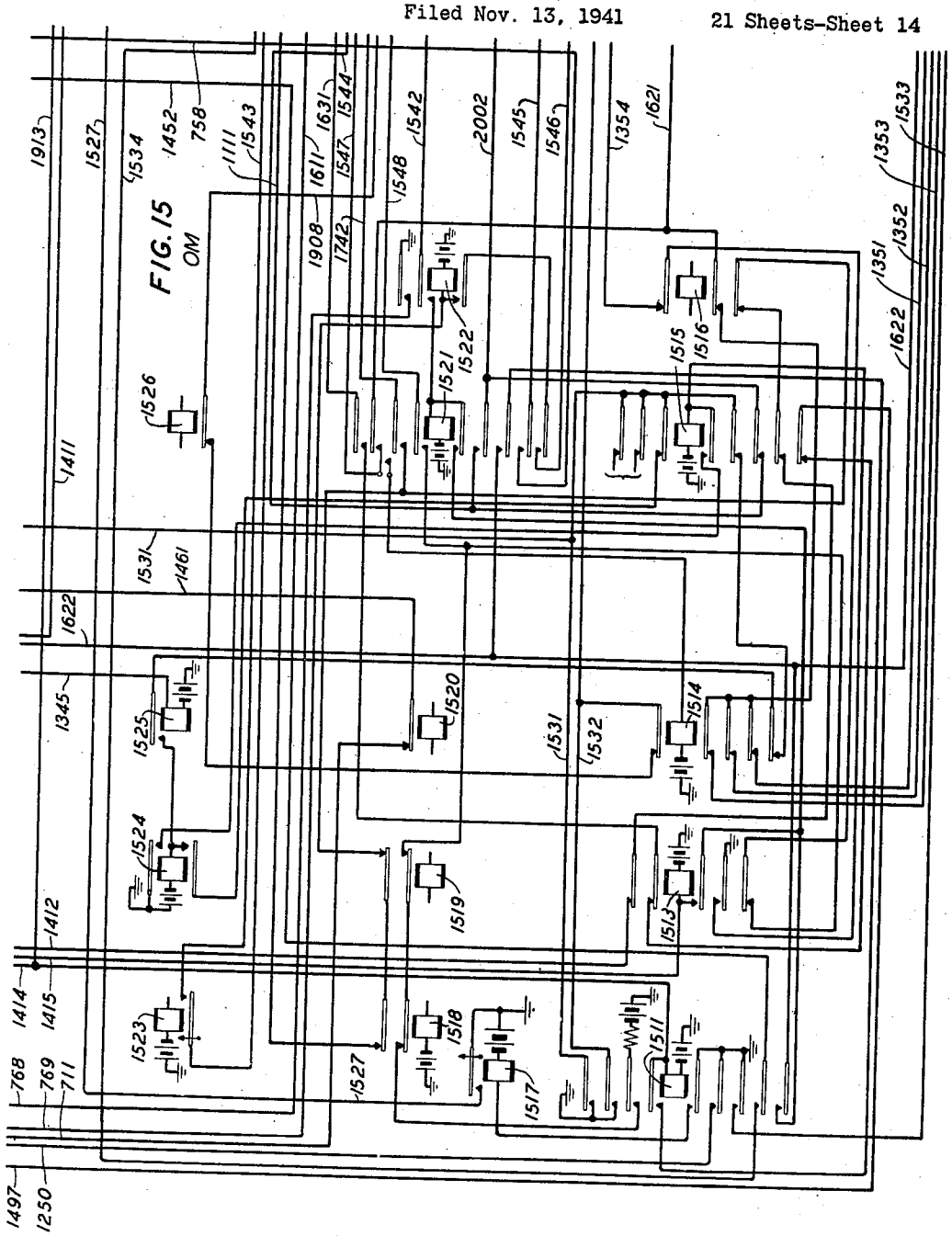


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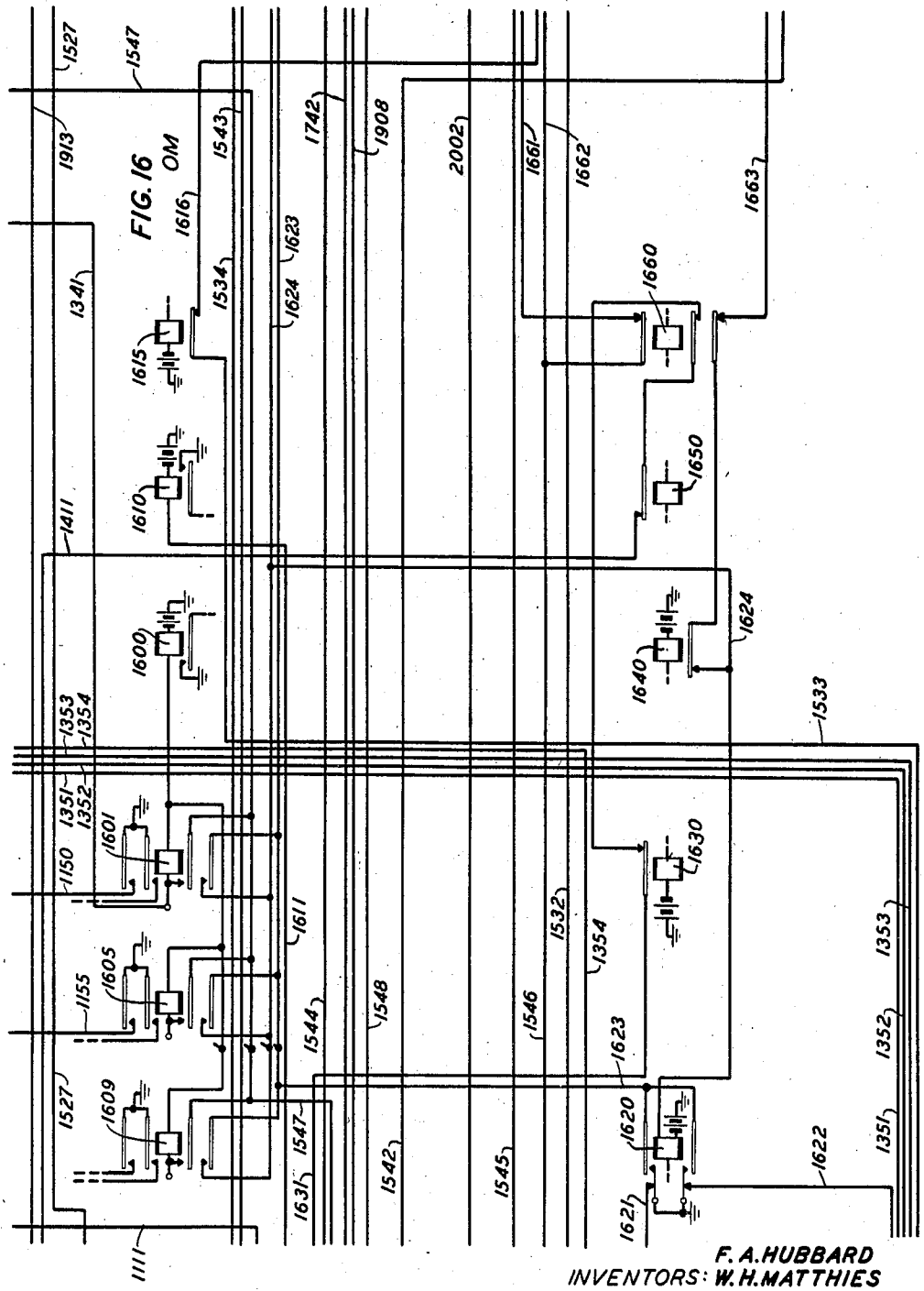


FIG. 16

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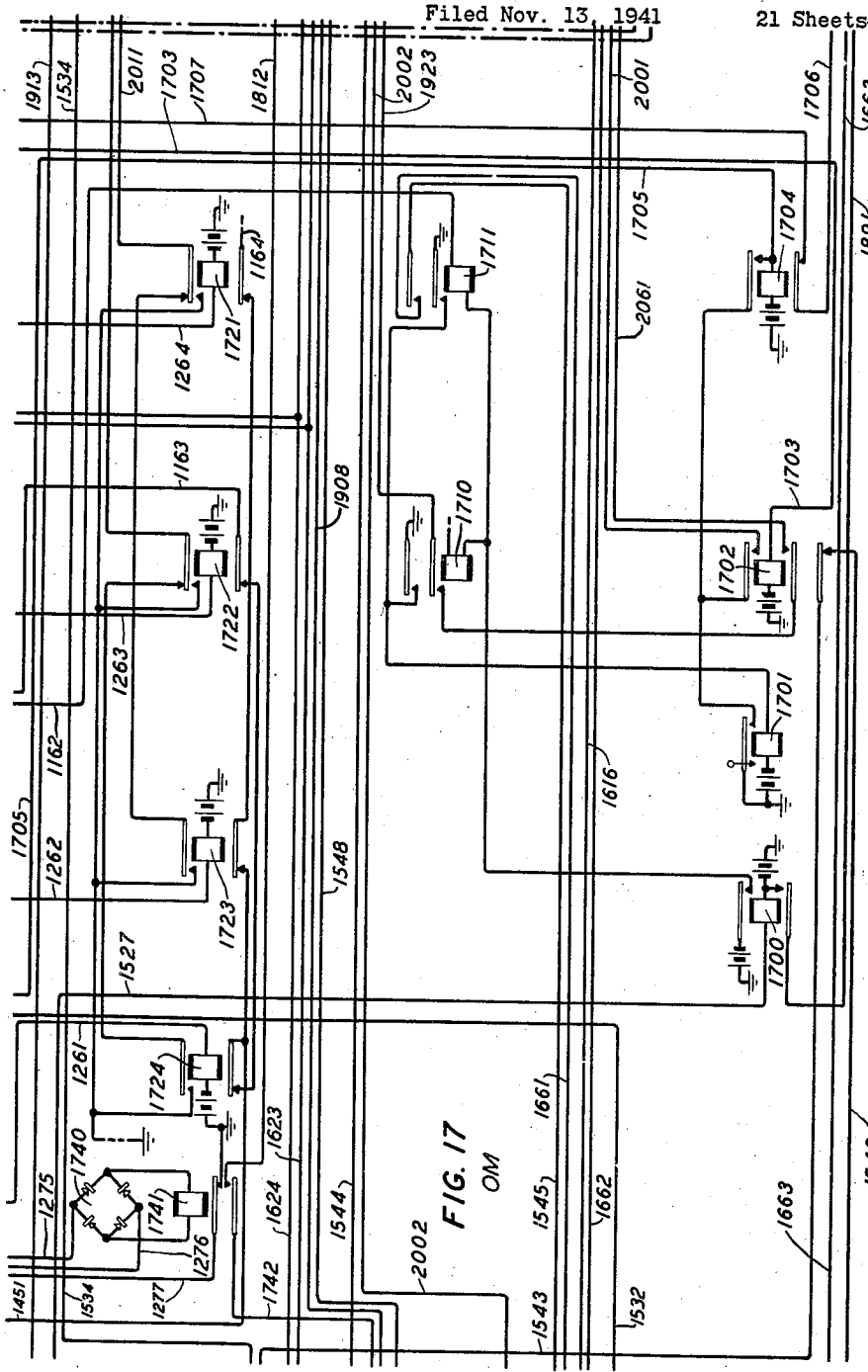


FIG. 17

OM

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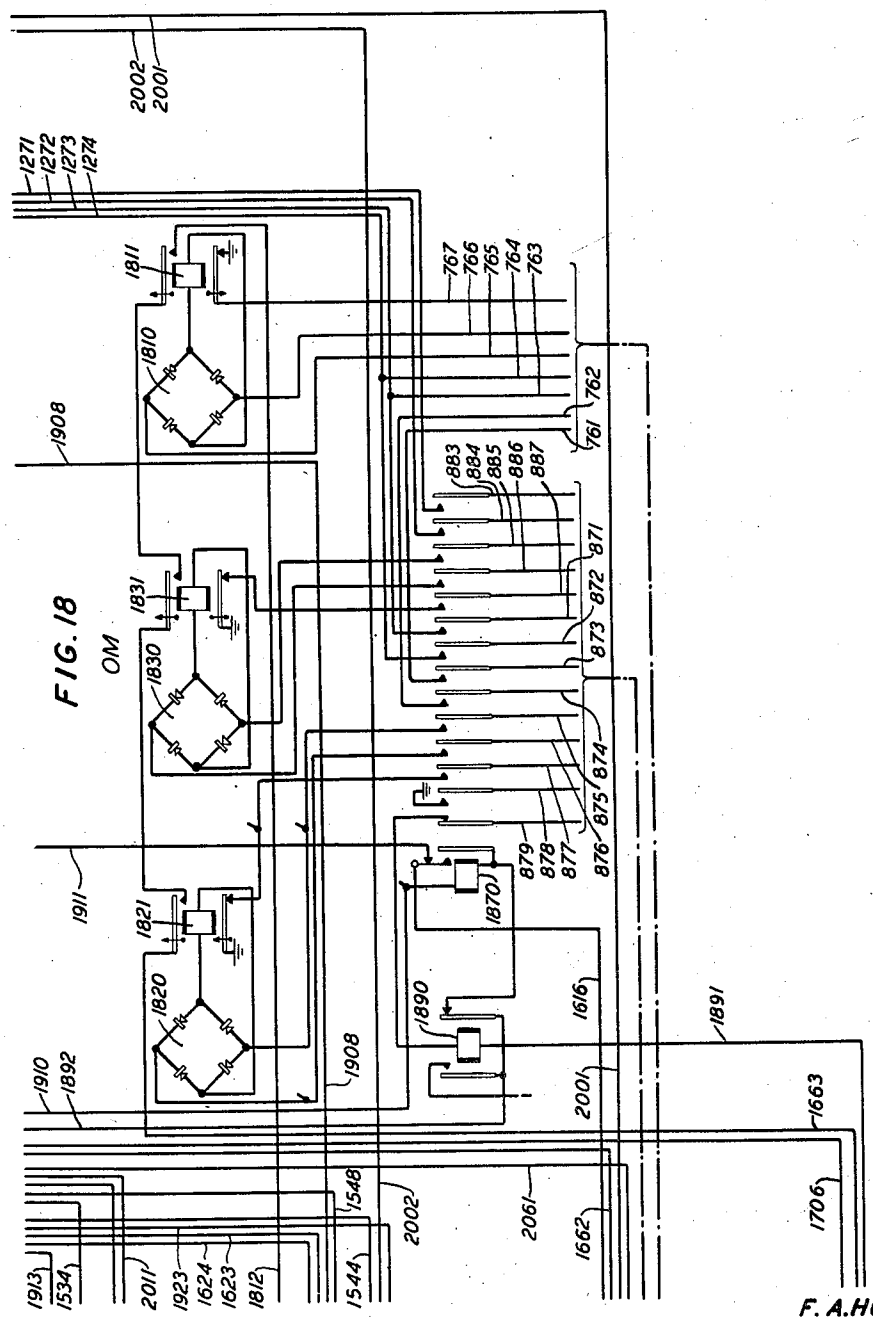


FIG. 18

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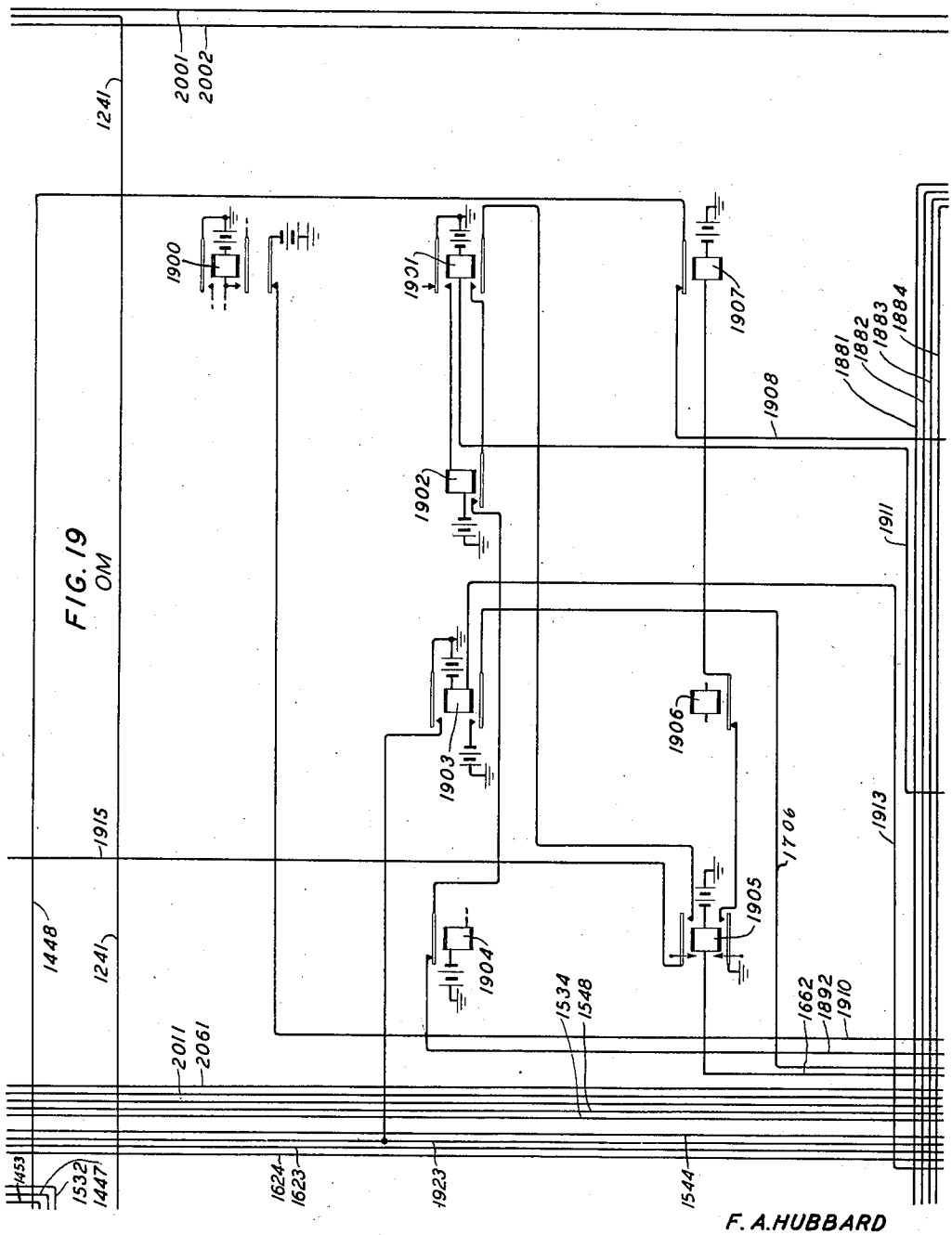


FIG. 19
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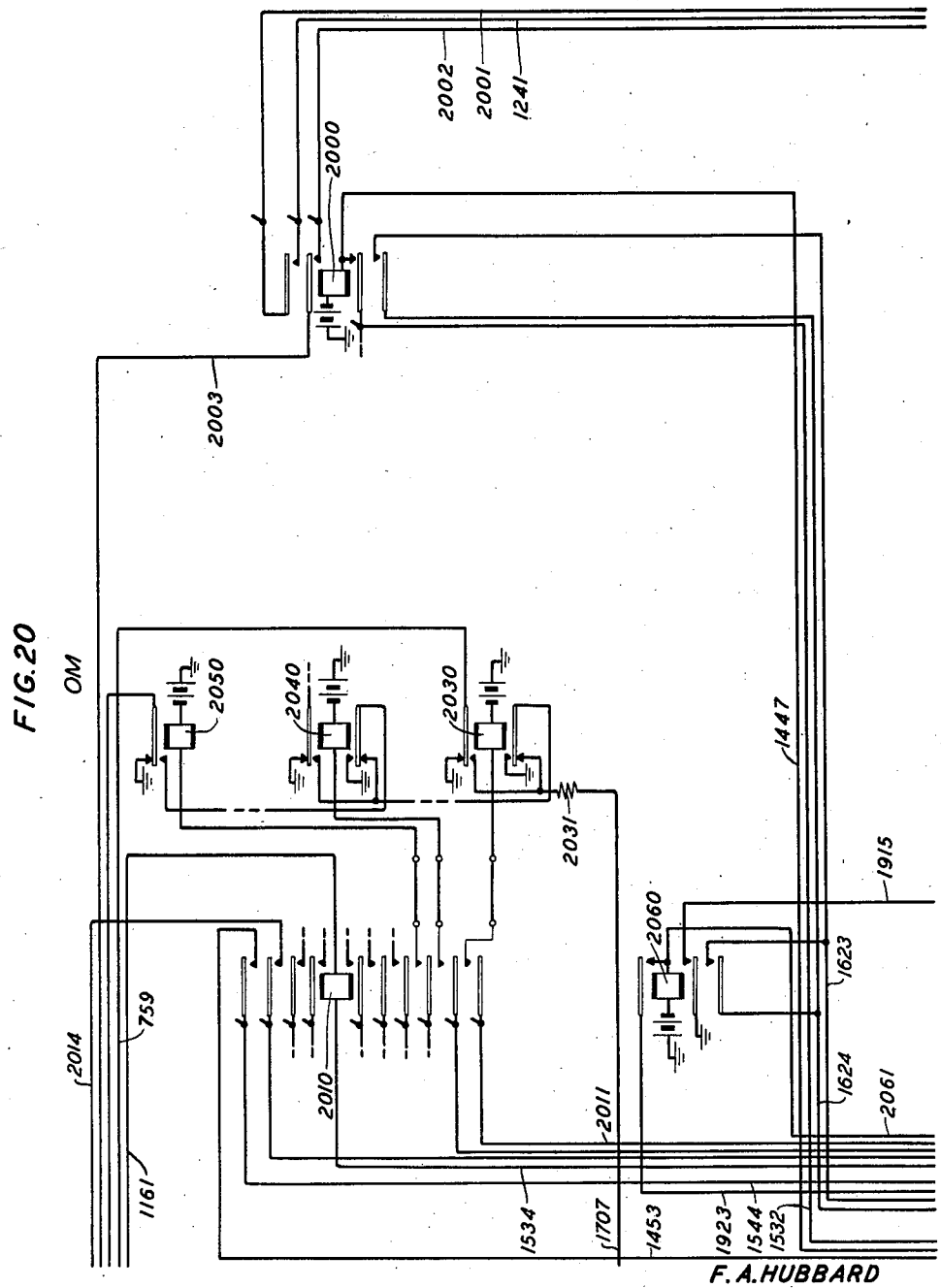


FIG. 20

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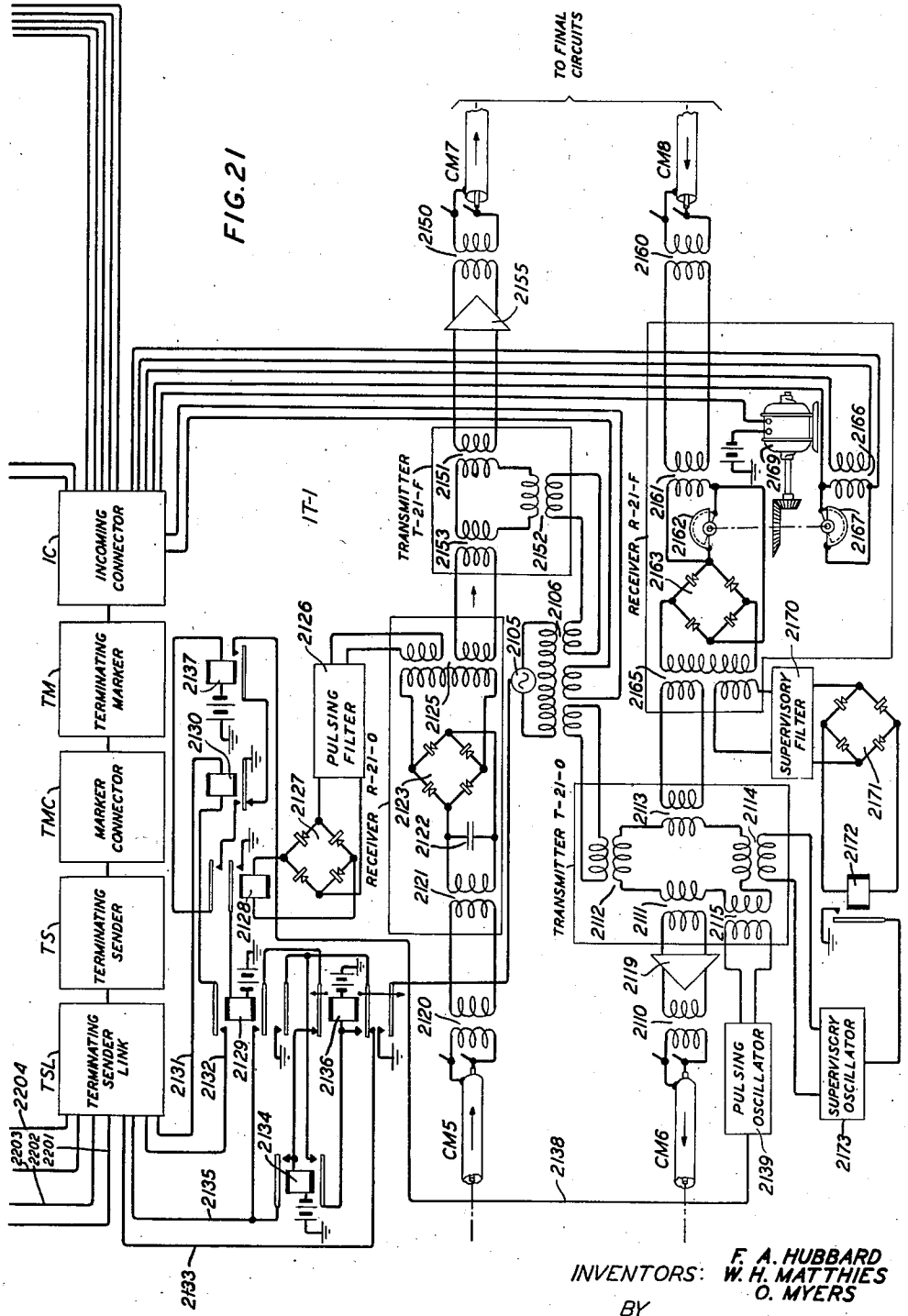
FIG. 21

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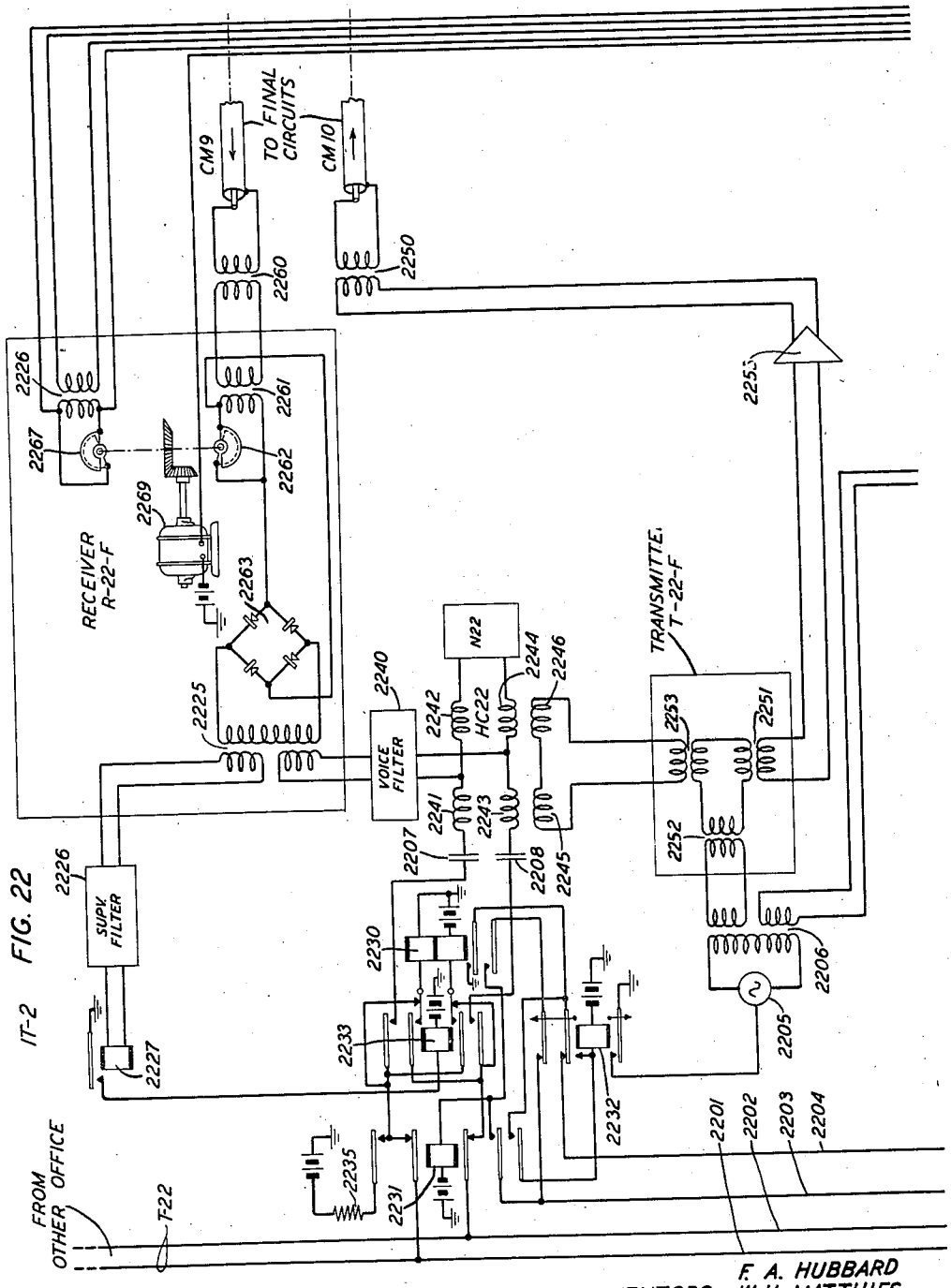


FIG. 22

IT-2

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Patented Mar. 28, 1944 2,345,048

# UNITED STATES PATENT OFFICE

2,345,048

## COMMUNICATION SYSTEM

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Application November 13, 1941, Serial No. 418,900

41 Claims. (Cl. 179—18)

This invention relates to telephone systems and particularly to systems in which connections between calling and called lines are established by subscriber controlled automatic selection of idle channels through multichannel communication media.

Among the objects of the invention are the provision of a more efficient and reliable common medium multichannel exchange system, the use of multichannel conductors or other common media in place of switches comprising wipers and terminal banks for establishing local and interoffice connections in telephone exchanges, and the provision of economical and reliable control means for controlling the selection of the various channels of common media through which desired connections are established.

According to various features of the invention multichannel conductors or other common media are provided for connecting calling lines with outgoing trunks, for connecting incoming trunks with called lines, and for connecting calling lines with called lines; and control means is provided for automatically controlling the selection of channels and establishment of talking connections therethrough.

A feature of the invention is the use of a common marker for controlling the selection of channels through which calling and called lines and trunks may be connected and for controlling the establishment of the talking connections.

A clear and complete understanding of the invention will be facilitated by considering a telephone system embodying the features of the invention. One such system is represented schematically in the drawings which form a part of this specification. The invention is, however, not limited in its application to the particular system disclosed but is generally applicable to automatic telephone systems in which there is a multichannel medium for interconnecting calling and called lines.

Referring to the drawings:

Fig. 1 shows schematically a telephone system comprising crossbar type switches for connecting with calling and called lines, common media for connecting calling lines with called lines, and sender and marker means for controlling the establishment of connections;

Fig. 2 shows a trunking arrangement employing channels of a common medium for establishing connections between calling lines and outgoing trunks;

Fig. 3 shows another trunking arrangement employing channels of a common medium for establishing connections between calling lines and outgoing trunks and for establishing connections between incoming trunks and called lines;

Fig. 4 shows schematically a subscriber's station A, line L—4 and line switch LS—4;

Fig. 5 shows a district circuit D—1 and a district sender link DSL;

Fig. 6 shows a junctor circuit J—1;

Figs. 7 and 8 show a subscriber's register sender RS and a district and junctor conector DJC;

Fig. 9 shows an outgoing trunk circuit OT—2 associated with a two-wire trunk to another office;

Fig. 10 shows an outgoing trunk circuit OT—1 associated with a trunk consisting of channels of common media CM5 and CM6;

Fig. 11 shows an outgoing trunk connector OTC;

Figs. 12 to 20 show an originating marker arranged to control the establishment of connections through channels of common media between calling and called lines;

Fig. 21 shows an incoming trunk circuit IT—1 associated with a trunk consisting of channels of common media CM7 and CM8;

Fig. 22 shows an incoming trunk circuit IT—2 associated with a two-conductor trunk incoming from another office; and

Fig. 23 shows the relative positions in which Figs. 4 to 22 are to be placed to form an operative arrangement and represent a system arranged according to the invention.

### *General description of system and apparatus*

The subscriber's station A is of the usual type provided in common battery systems and includes a dial or other impulse sender for use in controlling the establishment of desired connections.

The line switch LS, number group connector NGC, line choice connector LCC, district sender link DSL, subscriber's register sender RS, and originating marker connector OMC shown in Fig. 1 are all similar to like units shown in the patents to Carpenter No. 2,089,921, granted August 10, 1937, and No. 2,093,117, granted September 14, 1937; and reference may be had to these patents for a complete description of the operation of such elements in systems in which switches of the crossbar type are employed for connecting district circuits with outgoing trunks and for connecting incoming trunks with final selectors.

The district circuit D—1 includes a transmitter T—5 for use in transmitting outgoing signaling and talking currents over a particular car-

rier channel of a multichannel transmission medium CM1 and a receiver R—5 which can be tuned to the frequency of any one of the carrier frequencies of the channels of common medium CM2. A plurality of such districts are common to a multichannel transmission medium the transmitter of each district being tuned for a different one of a corresponding plurality of carrier channels. A single common transmission medium may be used for both directions of communication or a separate medium may be provided for each direction.

The outgoing trunks through which originating calls are routed may be two-conductor trunks or may be carrier channels in a common transmission medium. The trunk circuit OT—1, shown in Fig. 10, is connected to transmission media CM5 and CM6 which are associated with a plurality of such trunk circuits; and the trunk circuit OT2, shown in Fig. 9, is connected to a two-conductor trunk. To give any calling line access to all groups of trunks, each district may be provided with a crossbar switch or equivalent means for selecting any one of a plurality of multichannel transmission media as shown schematically in Fig. 3. Alternatively an intermediate switching stage consisting of intermediate trunk circuits, herein referred to as junctor circuits, are provided for connecting the districts with outgoing trunk circuits as indicated in Fig. 1 and Fig. 2. As many groups of similarly connectable districts, junctors and outgoing trunks may be provided as are necessary to take care of the originating traffic. Each district is tunable to all the junctors to which it has access. The junctors are tunable to the districts and also to the outgoing trunks and are divided into subgroups. As shown in Fig. 2, there are two district frames each consisting of one hundred districts, two junctor frames each consisting of one hundred twenty junctors and two outgoing trunk frames each consisting of two hundred outgoing trunks. All of the districts on district frame 0 have access through one hundred twenty carrier channels of a common medium to all junctors or junctor frame 0; and all districts on district frame 1 have access through one hundred twenty carrier channels of a common medium to all junctors on junctor frame 1. The junctors on junctor frame 0 are divided into two subgroups, one subgroup of sixty having access in common with a subgroup of sixty junctors on junctor frame 1 through one hundred twenty carrier channels of a common medium to all outgoing trunks on outgoing trunk frame 0; and the other subgroup of sixty junctors on junctor frame 0 have access in common with the other subgroup of sixty junctors on junctor frame 1 through another one hundred twenty carrier channels of a common medium to all outgoing trunks on outgoing trunk frame 1. The outgoing trunks may be multiplied to a plurality of trunk frames. Other groups of districts, junctors and outgoing trunks are similarly connectable. Thus both of the trunking plans shown in Figs. 2 and 3 can be enlarged to reach as many points as are desired.

The junctor J—1 includes a transmitter T—6—D for use in transmitting signaling and talking currents over a particular carrier channel of the multichannel transmission medium CM2 to any one of the districts with which the medium is associated, a transmitter T—6—O for use in transmitting signaling and talking currents over a particular carrier channel of a multichannel transmission medium CM3 to any one of the outgoing trunks with which the medium is associated, a receiver R—6—D tunable to any one of the carrier channels of the common medium CM1 for receiving signaling and talking currents from any one of the associated districts, and a receiver R—6—O tunable to any one of the carrier channels of common medium CM4 for receiving signaling and talking current from any one of the associated outgoing trunks.

The district and junctor connector DJC and the outgoing trunk connector OTC comprise multicontact relays and are similar in function and operation to the district and office connectors disclosed in the aforementioned Carpenter patents.

The incoming trunks through which terminating calls are received may be two-conductor trunks or may be carrier channels in a common transmission medium. The trunk circuit IT—1 is shown connected to transmission media CM5 and CM6 common to a plurality of such trunk circuits; and another incoming trunk circuit IT—2 is shown connected to a two-conductor trunk. The incoming trunk circuits are connected by multichannel transmission media CM7 and CM8 to final selectors having access to the subscribers' lines.

The various multichannel transmission media are shown as coaxial cables; but any equivalent media may be used between the districts, junctors, outgoing trunks, incoming trunks and final selectors.

The originating marker, which is shown in Figs. 12 to 20, inclusive, is similar to the originating marker disclosed in the aforementioned Carpenter patents except that it is arranged to control the tuning of the carrier receivers of district, junctor, and outgoing trunk circuits.

On a call initiated at a subscriber's station A the line switch is operated to connect the calling line to an idle district; the district sender link is operated to connect the district to an idle register sender; the sender registers are operated in response to the dialing of the directory number of the called subscriber's station; a marker connector connects the sender to an idle originating marker; the sender passes the route information to the marker; the marker tests the outgoing trunks of the called route, and selects an idle outgoing trunk and an idle junctor through which the district may be connected to the selected outgoing trunk; the district and junctor connector connects the district to the marker and connects the selected junctor to the marker; and an outgoing trunk connector connects the selected outgoing trunk to the originating marker. The marker thereupon controls the tuning of the receiver of the district to the fixed carrier frequency of one of the transmitters of the selected junctor, tunes one of the receivers of the junctor to the fixed carrier frequency of the transmitter of the district, tunes the other receiver of the junctor to the fixed carrier frequency of the transmitter of the outgoing trunk circuit, and tunes the receiver of the outgoing trunk circuit to the fixed carrier frequency of the other transmitter of the junctor. When all of this tuning is complete, the marker is dismissed. The subscriber's register sender thereupon sends, over the selected outgoing trunk, the information necessary to identify the called line.

The trunks to the called office, which office may be the same office as the calling office or be

a distant office, may be channels of common media or may be two-wire trunks. The trunk circuit OT—1 of Fig. 10 is one of a group connected by common media CM5 and CM6 to incoming trunk circuits in the same office, the transmitters and receivers in each of these outgoing and incoming trunk circuits being permanently tuned to corresponding frequencies so that a pair of outgoing trunk and incoming trunk circuits terminate each of the channels of the common media. The trunk circuit OT—2 of Fig. 9 is one of a group connected by two-wire trunks to incoming trunk circuits in a distant office which may be a manual office or a dial office equipped with panel or step-by-step switches, or may be another office in which common media are employed for connecting an incoming trunk circuit with a final selector having access to the called line. Two incoming trunk circuits are shown, IT—1 being one of a group of incoming trunk circuits connected by common media CM3 and CM4 with an outgoing trunk circuit such as OT—1 in the same office; and IT—2 being an incoming trunk circuit connected by a two-wire trunk to an outgoing trunk circuit such as OT—2 in a distant office. The distant office in each case may be a manual office or a dial office of any type, the number of the called line being transmitted by the register sender in the calling office over the selected trunk to the called office. If the called office is a dial office equipped with terminating markers, the incoming trunk circuit associated with a seized trunk responds to seizure of the trunk to initiate the operation of a terminating sender link, to connect the incoming trunk circuit to a terminating register sender; the sender registers the information transmitted by the originating sender; a terminating marker connector connects the terminating sender to an idle terminating marker; and the terminating sender passes the necessary information to the terminating marker. If the switches in the called dial office are of the crossbar type, reference may be had to the aforementioned Carpenter patents for a detailed description of the equipment and its operation. If the called office is one comprising common media for connecting the incoming trunk circuits with final selector switches having access to the called lines, the terminating marker will be arranged to tune the receivers of the incoming trunk and final selector circuits to the frequencies of a pair of channels therebetween in similar manner to that in which the originating marker tunes the receivers of the district, junctor and outgoing trunk circuits in the originating office as hereinafter described in detail.

The allotment of channel frequencies through the common media is similar to that described in the patent to H. W. Dudley No. 2,009,438 of July 30, 1935. Each channel may be allotted a band of 5000 cycles, within which a band of 3000 cycles is used for talking transmission, a band of 100 cycles is used for selective signaling, another band of 100 cycles is used for supervisory signaling, and the remainder of the band is used for separation between channels.

*Detailed description*

Assume that a call has been initiated at station A and that the calling subscriber's line has been extended through contacts of the primary and secondary switches 410 and 420 of line switch LS—4 to district circuit D—1, thence through link circuit DSL to the subscriber's register sender RS. Upon connection of the district D—1 with a sender RS, a circuit is closed from ground in the sender, through conductors 583 and 507, to operate relay 506; and ground is connected to conductor 503 to hold magnets 411 and 421 of the line switch. The impulse receiving relay 790 in the sender is operated in series with the dial at the calling subscriber's station and dial tone is transmitted from the sender to the calling station. The subscriber then dials the called subscriber's number and as soon as the office code digits have been registered, the sender is connected through a marker connector OMC to an idle originating marker OM. The district frame number is transmittted into the subscriber's sender from the link DSL, prior to transmission of dial tone; and, upon connection with the marker, the sender transmits the office code and the district frame number to the marker. All of these operations are effected in the manner disclosed in the aforementioned Carpenter patents. The checking relays in the marker, of which only the relay 1410 is shown, are operated, as described in the Carpenter patents, to check the register leads from the sender for false grounds. There being no false grounds, relay 1410 is operated; and the route relay corresponding to the office dialed by the calling subscriber is operated. Only one route relay, relay 1340, is shown. The operating circuit for this relay includes a front contact of relay 1330, which is one of the register relays which receive the third or units digit of the office code, and including front contacts of relays 1320 and 1310, the last-mentioned relays being the tens and hundreds relays which are operated corresponding to the second and first digits of the office code, as described in detail in the Carpenter patents. The operation of relay 1410 connects the windings of relays 1511 and 1903 in parallel, to ground at a back contact of relay 1620, operatively energizing both of these relays. Operation of relay 1511 closes a circuit for operating the district frame relay corresponding to the frame number registered by the operation of relays 1441 to 1446, inclusive. Assuming the frame relay which is thus operated to be relay 2000, the operating circuit is traced from the winding of relay 2000, through conductor 1447, back contacts of relays 1446, 1443, 1441, 1442, 1444, 1443 in the order named, conductor 1448, a back contact of relay 1907, conductor 1906, back contacts of relays 1526 and 1514, through conductor 1532 to ground at a front contact of relay 1511. Relay 2000 locks directly to conductor 1532. Relay 1511 closes a circuit for operating slow-to-release relay 1517, and relay 1517 closes a circuit through conductor 1527, for operating relay 1700. Relay 1511 also closes a circuit including conductor 1533, a back contact of relay 1615, conductor 1616, and a back contact of relay 1870, for operating relay 1901; and relay 1901 closes a circuit for operating relay 1902. Relay 1511 also closes a circuit for operating relay 1702, this circuit being traced from ground at a front contact of relay 1511, through conductor 1532, back contacts of relays 1221, 1222, 1223, 1224 and each of the other trunk selection relays not shown in the drawings, through conductor 1703 to the winding of relay 1702.

The aforementioned operation of route relay 1340 effects transmission of the information required by the sender for completion of the call as described in detail in the aforementioned Carpenter patents; and closes a circuit for operating one of a plurality of route group relays in

the marker, which group is represented by relays 1600, 1601, 1605 and 1609. Assuming the particular one of these relays which is operated to be relay 1601, the operating circuit is traced from battery through the windings of relays 1600 and 1601 in series, conductor 1341, a front contact of route relay 1340, a back contact of route group relay 1350, conductor 1351, back contacts of relays 1514 and 1516, conductor 1621, to ground at the upper back contact of relay 1620. The operation of route relay 1340 also closes a circuit for operating, in the outgoing trunk connector circuit OTC, a relay 1101 which is operatively associated with the marker being used on the call in question. This operating circuit is traced from battery through an upper front contact of relay 1511, through back contacts of relays 1518, 1519, 1513 and 1516, conductor 1354, a back contact of relay 1350, a front contact of route relay 1340, conductor 1344, and through the winding of relay 1101 to ground. The operation of relay 1101 closes circuits for operating, in the connector OTC, relay 1160 for connecting the marker with the even frame and a like relay (not shown) for connecting the marker with the odd frame of a pair of outgoing trunk frames. Relay 1160 closes circuits for operating the associated relays 1170 and 1190 in the connector OTC and the frame relay 2010 in the marker. The circuit for operating relay 1170 of the odd-numbered frame of the selected pair is traced through a front contact of relay 1160, conductor 1163, back contacts of the even frame relays 1722 and 1724 in the marker, conductor 1451, back contacts of relays 1450 and 1460, and through conductor 1531, to ground at a front contact of relay 1511. A like circuit is closed for operating the corresponding relay (not shown) of the even-numbered frame of the selected pair of outgoing trunk frames; this circuit includes conductor 1164, back contacts of the odd frame relays 1721 and 1723 in the marker, thence through conductor 1451 to ground at a front contact of relay 1511. The circuit for operating relay 1190 of the connector OTC is traced through a front contact of relay 1160, conductor 1150, to ground at a front contact of relay 1601 in the marker. With relays 1170 and 1190 operated in the connector OTC, forty trunks are connected to the marker for test as hereinafter described. The aforementioned circuit for operating the associated frame relay 2010 is traced from ground at the inner left front contact of relay 1160, through conductor 1161, winding of relay 2010, conductor 1534, a front contact of relay 1511, conductor 1611, and through the winding of relay 1610, to battery. The operation of relay 1190 closes a circuit through conductor 1191, the middle left contacts of relay 1160, and conductor 1162 for operating relay 1711 in the marker, this relay being associated with the odd frame of the selected pair of outgoing trunk frames. In like manner, a circuit (not shown) is closed for operating relay 1710 associated with the even frame of the associated pair of outgoing trunk frames. The operation of each of relays 1710 and 1711 closes a circuit for operating relay 1701. With relay 1710 operated, the aforementioned operation of relay 1702 closes a circuit for operating relay 2060; this circuit is traced from the winding of relay 2060, through conductor 2061, front contacts of relays 1702 and 1710, through conductor 1923 to ground at a front contact of relay 1903. Relay 2060 locks to conductor 1923.

Upon operation of relays 1160, 1170 and 1190 of a pair of outgoing trunk frames, the test leads of forty trunks are connected to the marker, all or a part of the forty being trunks to the called office. In order to test only those trunks which terminate in the called office, operation of the route relay 1340 indicates the first and last of the forty sets of trunk relays in the marker which are to be employed in the test. Only four sets of trunk relays are shown in the drawings, these sets consisting of relays 1201, 1211 and 1221, relays 1202, 1212 and 1222, relays 1203, 1213 and 1223, and relays 1204, 1214 and 1224. It will be assumed that relays 1211 and 1214 are operated to indicate the trunks to be included in the test. The circuit for operating relay 1211 includes conductor 1342, a front contact of relay 1340, a back contact of relay 1350, conductor 1352, back contacts of relays 1514 and 1516, conductor 1621 to ground at a back contact of relay 1620. The circuit for operating relay 1214 includes conductor 1343, a front contact of relay 1340, a back contact of relay 1350, conductor 1353, back contacts of relays 1514 and 1516, to ground at a back contact of relay 1620. Since the test conductors of busy trunks are connected to ground, the corresponding test relays are operated. Assuming trunk OT—1 of Fig. 10 to be the trunk being tested by test relay 1204, the test circuit is traced from the winding of this relay, through a back contact of relay 1224, conductor 1179, front contacts of relays 1170 and 1190 of connector OTC, conductor 1079, to a front contact of relay 1091 of trunk circuit OT—1. If this trunk is busy, relay 1091 is operated and ground is connected to conductor 1079 to operate test relay 1204; but, if trunk OT—1 is idle, relay 1091 is normal and test relay 1204 does not operate. If all test relays, between the operated group start and group end relays (on this call relays 1211 and 1214), are operated, relay 1704 is operated to indicate an all-trunks-busy condition. The circuit for operating relay 1704 includes a front contact of the first group relay which is operated, front contacts of the test relays of the trunks tested, back contacts of intermediate group relays, and a front contact of the last group relay which is operated, and a front contact of the operated district frame relay. With group relays 1211 and 1214 operated to indicate the start and end of the trunks to be tested, the circuit for operating relay 1704 is traced from the winding of relay 1704, through conductor 1705, a front contact of relay 1211, front contacts of test relays 1201 and 1202, a back contact of relay 1213, front contacts of relays 1203 and 1204, a front contact of relay 1214, conductor 1241, a front contact of relay 2000, conductor 2001, a front contact of relay 1702, to ground at a front contact of relay 1701. If operated, relay 1704 locks directly under control of relay 1701; and the marker is thereupon operated to operate a second choice regular route relay, an alternate route relay, or an overflow route relay as described in detail in the aforementioned Carpenter patents.

Assuming, however, that all of the trunks tested are not busy, the operation of relay 1701 closes a circuit for operating the select relay of the first trunk which is idle. Assuming further that test relay 1204 is the first test relay (between group relays 1211 and 1214) which is not operated, the circuit for operating the associated select relay 1224 is traced from ground at the front contact of relay 1701, through the front contact of relay 1702, conductor 2001, front contact of district frame relay 2000, conductor 1241, front contact

of relay 1214, lower back contact of relay 1204 (which is not operated if the trunk tested by this relay is idle), winding of relay 1224, conductor 1251, through contacts of junctor allotter relays which are not shown, conductor 1707, back contact of relay 1704, and through conductor 1705, to battery at a front contact of relay 1903. With one of the select relays operated, relay 1702 releases, opening the operating circuit of the select relays; but the operated select relay, 1224, is locked through the front contact of its continuity spring, through back contacts of the continuity springs of select relays 1223, 1222 and 1221, through conductor 1532, to ground at a front contact of relay 1511. Relay 1224 closes a circuit for operating one of relays 1721, 1722, 1723 and 1724 depending upon the location of the selected trunk. Assuming the trunk OT—1 to be on the odd-numbered frame of the pair and on the right side, the operation of select relay 1224 closes a circuit for operating relay 1721, thereby causing the release of the relay (not shown, but corresponding to relay 1170) in the connector OTC of the even frame of the selected pair of outgoing trunk frames on which trunks were tested, as described in detail in the aforementioned Carpenter patents. The circuit for operating relay 1721 is traced from the winding of relay 1721 through conductor 1264, a front contact of relay 1224, through conductor 1250, to ground at a front contact of relay 1511. Assuming the selected trunk to be trunk OT—1 of Fig. 10, the operated select relay, relay 1224, connects control conductors 1271 to 1277, inclusive, of the marker, to control conductors 1171 to 1177, inclusive, thence through contacts of relays 1170 and 1190 of connector OTC, to conductors 1071 to 1077, inclusive, of the selected trunk circuit. The operation of relay 1224 also opens the trunk test circuit through conductor 1179 and connects ground to conductor 1178, thence through contacts of relays 1170 and 1190, to conductor 1078 to operate relay 1001 of trunk circuit OT—1 and thus mark this trunk as busy.

The aforementioned operation of relay 1101 of the outgoing trunk connector OTC also closes a circuit for operating, in the district and junctor connector circuit DJC, the relay 701 which is associated with the marker being used on the call in question, the operating circuit being traced from battery through the outer lower front contact of relay 1101, conductor 1111, a back contact of relay 1515, conductor 2002, inner upper front contact of relay 2000, conductor 2003, through the winding of relay 701 in connector DJC, to ground. The operation of relay 701 closes circuits for operating relays 760, 770 and 810 in the connector DJC. Relay 701 also closes a circuit from ground at its inner upper front contact, through conductor 711, back contacts of relays 1520, 1460 and 1450, conductor 1452, back contacts of relays 1518, 1519, 1516, 1515 and 1513, conductor 1412, front contact of relay 1410, conductor 1416, through the originating marker connector OMC, and through conductor 793 to operate relay 792 in the register sender. Relay 792 extends this operating circuit through a front contact, over conductor 587, through the district sender link DSL, to operate relays 560 and 570 of the district circuit D—1. Relay 570 further extends this circuit through a front contact, conductor 569, through a front contact of relay 760 of connector DJC, and through conductor 769 to operate relay 1522 in the marker. Relay 1522 connects ground through conductor 768 to start the oscillator 505 of district D—1. When all of the information dependent upon the operated route relay has been transmitted to the register sender, as indicated by the operation of relay 1523 and in the manner described in the aforementioned Carpenter patents, a circuit is closed for operating relay 1521 in the marker, this circuit including a front contact of relay 1522, conductor 1542, back contact of relay 1702 (relay 1702 having released upon selection of a trunk to the called office), conductor 1543, front contact of relay 1523, conductor 1544, a front contact of frame relay 2010, conductor 1453, back contact of relay 1450, to ground at a back contact of relay 1460. Relay 1521 locks under control of relays 1511 and 1620, closes holding circuits for all relays whose function has not been completed, closes a circuit for operating relay 1514, and connects ground from the inner upper front contact of relay 1410, through conductor 1411, back contacts of relays 1650, 1660 and 1630, conductor 1631, a front contact of relay 1521, back contacts of relays 1513 and 1515, conductor 1497, through the marker connector OMC, to conductor 797 to operate relay 798 in the register sender RS. The sender thereupon effects the release of all the register relays and the release of relay 1410 in the marker in the manner described in the aforementioned Carpenter patents. Relay 1511 is held under control of relays 1521 and 1620; and the release of relay 1410 causes the operation of relays 1513 and 1515, in succession. Relay 1513 locks under control of relays 1511 and 1620. The operation of relays 1513 and 1515 causes the release of relay 798 in the register sender and opens the operating circuits of relay 792 in the register sender and relays 560 and 570 in the district, relays 792, 560 and 570 being held operated through the locking contact of relay 570; conductor 569, contact of relay 760, conductor 769, front contacts of relays 1522 and 1521, conductor 1546, a back contact of relay 1660, conductor 1661, front contact of relay 1711, conductor 1545, a front contact of relay 1521, conductor 758, and through front contacts of relays 760 and 890, to ground.

After selection of an idle outgoing trunk, as above described, an idle junctor is selected to interconnect the district D—1 and the selected trunk OT—1. The aforementioned operation of relay 1721 in the marker closes a circuit for operating one of a group of junctor control relays in the marker, only three of which are shown, namely, relays 2030, 2040 and 2050. Assuming relay 2030 to be the junctor control relay which is operated on the call in question, the operating circuit is traced from its winding through a front contact of office frame relay 2000, conductor 2011, through junctor group allotter relays which are not shown, front contact of relay 1721, to ground. Relay 2030 closes a circuit for operating a junctor control relay 890 in the district junctor connector DJC. This circuit is traced from ground through the winding of relay 890, through a front contact of relay 760, conductor 759, upper front contact of relay 2030 in the marker, resistor 2031, conductor 1707, and through a back contact of relay 1704, to battery at a front contact of relay 1903. The test conductors of a group of junctors are thereby connected, through contacts of relays 890 and 810 of the connector DJC, to the marker to enable selection of an idle junctor through which the district D—1 can be connected to the selected trunk OT—1. The test conductor of an idle junctor, for instance junctor

J—1, is not connected to ground potential; but, when the junctor is busy, ground at the front contact of relay 691 is connected through conductor 679, contacts of relays 890 and 810 in the connector DJC, through conductor 879 to the marker, through a back contact of one of the twenty channel relays, such as relay 1870, thence through the winding of a junctor test relay, such as relay 1890, conductor 1891, to battery at a front contact of relay 1700.

The aforementioned operation of relay 890 in connector DJC connects ground at its left front contact, through a contact of relay 760, through conductor 758, through a front contact of relay 1521 in the marker, conductor 1545, a front contact of relay 1711, conductor 1661, a back contact of relay 1660, to conductor 1662 to operate relay 1905 and hold relay 1522 under control of relay 1521. Relay 1905 is slow in operating to allow time for the test relays in the marker, such as relay 1890, corresponding to all tested and busy junctors, to operate. When relay 1905 operates, it closes a circuit for operating the channel relay, such as relay 1870, associated with the first idle trunk. Assuming the relay 1870 to be the relay thus operated, the operating circuit is traced from battery at the back contact of relay 1900, conductor 1910, winding of relay 1870, back contact of the associated test relay 1890, conductor 1892, back contact of relay 1904, front contacts of relays 1902 and 1901, front contact of relay 1905, conductor 1915, to ground at a front contact of relay 2060. Relay 1870 locks through conductor 1616, a back contact of relay 1615, conductor 1533, to ground at a front contact of relay 1511. Relay 1870 opens its operating circuit and disconnects the associated test relay 1890 from the test conductor 879. The operation of relay 1870 also connects ground to conductor 878, thence through front contacts of relays 810 and 890 in the connector DJC, and through conductor 678 to operate relay 691 of the selected junctor J—1. Relay 1870 also connects control conductors 871 to 877, inclusive, and 883 to 887, inclusive, in the marker, through contacts of relays 810 and 890 in the connector DJC, to control conductors 671 to 677, inclusive, and 683 to 687, inclusive, in junctor J—1. The aforementioned operation of relay 1905 also closes a circuit for operating relay 1907. Relay 691 in junctor J—1 connects ground to conductor 679 to mark the junctor busy and connects ground to conductor 602 to start the operation of oscillator 605.

A talking and signaling connection between the district D—1 and the selected outgoing trunk OT—1 is now effected through junctor J—1 by tuning the receiving elements of these circuits to the carrier frequencies of the associated transmitting elements. With the control conductors of district D—1 and junctor J—1 connected to the marker, through contacts of relays 760, 810 and 890 of connector DJC, and with relays 560 and 570 of the district operated as above described, energy from the oscillator 505 is transmitted through the left and lower right windings of transformer 532, through front contacts of relay 560, conductors 561 and 562, contacts of relay 760, through conductors 761 and 762 to the marker, through front contacts of relay 1870, conductors 873 and 874, through contacts of relays 810 and 890 of connector DJC, through conductors 673 and 674, through the windings of transformer 626 of receiver R—6—D of junctor J—1, back through conductors 675 and 676, contacts of relays 890 and 810, conductors 875 and 876, contacts of relay 1870, through rectifier 1820 to the winding of relay 1821 in the marker. A variable condenser 627 is connected in parallel with one winding of transformer 626 to form a tunable network controlled by motor 629; and the network can be tuned under control of the marker to the frequency of the oscillator 505 of the district D—1, with which it is desired to establish a talking connection. A circuit for operating tuning motor 629 of this receiver is closed through conductor 677, contacts of relays 890 and 810 of connector DJC, conductor 877, to ground at the back contact of relay 1821 in the marker. The motor is thereupon operated to vary the capacity of condenser 627 until the resonant frequency of the network comprising condenser 627 is the same frequency as that of oscillator 505. Until the network is so tuned, the current through the winding of relay 1821 is not sufficient to effect the operation of this relay; but as soon as the network is tuned to the frequency of oscillator 505, relay 1821 operates, thereby stopping the motor 629. At the same time that the capacity of condenser 627 is being varied to tune the network comprising this condenser to the frequency of oscillator 505, the capacity of another variable condenser, condenser 622, is being varied to tune the network consisting of the condenser 622 and one winding of transformer 621 to the same frequency, so that the receiver R—6—D of junctor J—1 is now in tune with the transmitter T—5 of district D—1.

At the same time, energy from oscillator 605 of junctor J—1 is transmitted through the upper and middle lower windings of transformer 606, through conductors 671 and 672, contacts of relays 890 and 810 of connector DJC, conductors 871 and 872, contacts of relay 1870 in the marker, conductors 763 and 764, contacts of relay 760 of connector DJC, conductors 563 and 564 of district D—1, contacts of relay 560, windings of transformer 546 of receiver R—5, back through contacts of relay 560, conductors 565 and 566, contacts of relay 760 of connector DJC, conductors 765 and 766, through rectifier 1810 in the marker to the winding of relay 1811. A variable condenser 547 is connected in parallel with one winding of transformer 546 to form a tunable network controlled by motor 549; and the network can be tuned under control of the marker to the frequency of the oscillator 605 of junctor J—1. A circuit for operating tuning motor 549 of receiver R—5 is closed through a front contact of relay 560, conductor 567, a front contact of relay 760 of connector DJC, conductor 767, to ground at a back contact of relay 1810 in the marker. The motor 549 is thereupon operated to vary the capacity of condenser 547 until the resonant frequency of the network comprising condenser 547 is the same frequency as that of the oscillator 605. Until the network is so tuned, the current through the winding of relay 1811 is not sufficient to effect the operation of this relay; but as soon as the network is tuned to the frequency of oscillator 605, relay 1811 operates, thereby stopping motor 549. At the same time that the capacity of condenser 547 is being varied to tune the network comprising condenser 547 to the frequency of oscillator 605, the capacity of another variable condenser, condenser 542, is being varied to tune the network consisting of condenser 542 and one winding of transformer 541 to the same frequency, so that the receiver R—5 of district D—1 is now in tune with the transmitter T—6—D of junctor J—1.

Energy from oscillator 605 of junctor J—1 is also transmitted through transformer 606, conductors 671 and 672, contacts of relays 890 and 810, conductors 871 and 872, contacts of relay 1870, conductors 1273 and 1274, contacts of trunk select relay 1224, conductors 1173 and 1174, contacts of relays 1170 and 1190 of connector OTC, conductors 1073 and 1074, windings of transformer 1026 of receiver R—10—J of trunk circuit OT—1, back through conductors 1075 and 1076, contacts of relays 1190 and 1170, conductors 1175 and 1176, contacts of relay 1224 in the marker, conductors 1275 and 1276, through rectifier 1740 to the winding of relay 1741. A variable condenser 1027 is connected in parallel with one winding of transformer 1026 to form a tunable network controlled by motor 1029; and this network can be tuned under control of the marker to the frequency of the oscillator 605 of junctor J—1. A circuit for operating motor 1029 of receiver R—10—J is closed through conductor 1077, contacts of relays 1190 and 1170 of connector OTC, conductor 1177, contact of relay 1224 in the marker, conductor 1277, to ground at a back contact of relay 1741. The motor 1029 is thereupon operated to vary the capacity of condenser 1027 until the resonant frequency of the network comprising condenser 1027 is the same frequency as that of the oscillator 605. Until the network is so tuned, the current through the winding of relay 1741 is not sufficient to effect the operation of this relay; but as soon as the network is tuned to the frequency of oscillator 605, relay 1811 operates, thereby stopping motor 1029. At the same time that the capacity of condenser 1027 is being varied to tune the network comprising condenser 1027 to the frequency of oscillator 605, the capacity of another variable condenser, condenser 1022, is being varied by motor 1029 to tune the network consisting of condenser 1022 and one winding of transformer 1021 to the same frequency, so that the receiver R—10—J is now in tune with the transmitter T—6—O of junctor J—1.

Meanwhile, energy from oscillator 1005 of trunk circuit OT—1 is transmitted through windings of transformer 1006, conductors 1071 and 1072, contacts of relays 1190 and 1170 of connector OTC, conductors 1171 and 1172, contacts of relay 1224 in the marker, conductors 1271 and 1272, contacts of relay 1870, conductors 883 and 884, contacts of relays 810 and 890 of connector DJC, conductors 683 and 684, windings of transformer 666 of receiver R—6—O of junctor J—1, back through conductors 685 and 686, contacts of relays 890 and 810 of connector DJC, conductors 885 and 886, contacts of relay 1870 in the marker, through rectifier 1830 to the winding of relay 1831. A variable condenser 667 is connected in parallel with one winding of transformer 666 to form a tunable network controlled by motor 669; and the network can be tuned under control of the marker to the frequency of the oscillator 1005 of trunk OT—1. A circuit for operating tuning motor 669 is closed through conductor 687, contacts of relays 890 and 810 of connector DJC, conductor 887, contact of relay 1870 in the marker, to ground at the back contact of relay 1831. The motor 669 is thereupon operated to vary the capacity of condenser 667 until the resonant frequency of the network comprising condenser 667 is the same frequency as that of oscillator 1005. Until the network is so tuned, the current through the winding of relay 1831 is not sufficient to effect the operation of this relay; but as soon as the network is tuned to the frequency of oscillator 1005, relay 1831 operates, thereby stopping motor 669. At the same time that the capacity of condenser 667 is being varied to tune the network comprising condenser 667 to the frequency of oscillator 1005, the capacity of another variable condenser, condenser 662, is being varied to tune the network consisting of condenser 662 and one winding of transformer 661 to the same frequency, so that the receiver R—6—O of junctor J—1 is now in tune with the transmitter T—10—J of trunk circuit OT—1.

With a talking channel established between the district D—1 and outgoing trunk OT—1, the marker may be released. The operation of all of relays 1811, 1821, 1831 and 1741 in the marker closes a circuit for operating relay 1620. This circuit is traced from battery, through the winding of relay 1620, back contacts of relays 1640 and 1660, conductor 1663, front contacts of relays 1821, 1831 and 1811, conductor 1812, front contact of relay 1741, conductor 1742, a front contact of relay 1521, back contacts of relays 1519 and 1518, conductor 1452, back contacts of relays 1450 and 1460, conductor 1461, back contact of relay 1520, conductor 711, to ground at a front contact of relay 770 in connector DJC. Relay 1620 locks through front contacts of relays 1601, 1211, 1214, 2000 and 2060, and through front contacts of all other relays, the release of which is essential, through conductor 1623 to ground at its own front contact. Relay 1620 disconnects holding ground from conductors 1621 and 1622, thereby causing the release of relays 1511, 1903, 1513, 1514 and 1521, the release of relays 701, 760, 770, 780, 810 and 890 of connector DJC, the release of relays 1101, 1160, 1170 and 1190 of connector OTC, and the release of all other operated relays in the marker. With all of the relays in the marker released, the locking circuit of relay 1620 is opened and relay 1620 releases, thereby completing the release of the marker. When the locking circuit of relays 792 and 570 is opened due to the release of the marker, relays 792, 570 and 560 release. The release of relay 570 connects the winding of relay 508 to conductor 574 to await completion of the further operations of the register sender RS.

By means of the above-described tuning operations, carrier channels are established from the district D—1 through common media CM1 and CM2, to the junctor J—1; and connecting channels are established from the junctor J—1 through common media CM3 and CM4, to the outgoing trunk OT—1. Energy is transmitted from oscillator 505, through windings of transformer 532 of transmitter T—5, through amplifier 535 and transformer 530 of district D—1 through common medium CM1, through transformer 620 of junctor J—1, transformer 621 of receiver R—6—D and the network consisting of one winding of transformer 621 and condenser 622, through rectifier 623, windings of transformer 624, and through rectifier 600 to the locking winding of relay 601 so as to maintain the energization of this relay after the marker is released and until the connection is released by the calling subscriber. Energy is transmitted from oscillator 605 of junctor J—1, through transformers 606, 652 and 651 of transmitter T—6—O, through amplifier 655 and transformer 650 of junctor J—1, common medium CM3, windings of transformer 1020 of trunk OT—1, through transformer 1021 and the network consisting of a winding of transformer 1021 and condenser 1022,

through rectifier 1023, windings of transformer 1024, and through rectifier 1000 to the locking winding of relay 1001 of trunk OT—1 so as to maintain the energization of relay 1001 until the connection is released by the calling subscriber.

The register sender may be arranged to transmit the thousands, hundreds, tens and units digits of the called subscriber's number over the selected trunk by the revertive impulse method or by transmitting directive impulses over the trunk. The district D—1 is arranged for repeating revertive impulses received over the trunk to the register sender, a pulsing oscillator 550 being provided for transmitting a seizure signal to the incoming trunk circuit in the called office. The oscillator 550 generates an alternating potential of a frequency within the 100-cycle band allotted for signaling, out of the 5000-cycle band which constitutes the carrier channel over medium CM1 which is individual to the transmitter T—5 of district D—1. The aforementioned release of relay 792 closes a circuit including the winding of stepping relay 791, conductors 785 and 786, through link DSL, conductors 575 and 576, back contacts of relay 579, and the windings of relay 554 of district D—1. Relay 791 operates to control the counting relays (not shown) of the sender; and relay 554 operates to connect oscillator 550 to a winding of transformer 533 of transmitter T—5, whereby a seizure signal is transmitted through amplifier 535, transformer 530, and common medium CM1 to junctor J—1, through transformers 620 and 621, rectifier 623, and transformer 625 of receiver R—6—D, through transformers 653 and 651 of transmitter T—6—O, amplifier 655, transformer 650, through common medium CM3 to trunk circuit OT—1, through transformers 1020 and 1021, rectifier 1023 and transformer 1025 of receiver R—10—J, through transformers 1053 and 1051 of transmitter T—10—I, amplifier 1055, transformer 1050, through common medium CM5 to incoming trunk circuit IT—1, through transformers 2120 and 2121, rectifier 2123, and transformer 2125 of receiver R—21—O, through pulsing filter 2126 and rectifier 2127 to the winding of relay 2128. The right winding of transformer 2121 and fixed condenser 2122 constitute a network tuned to transmit the band of 5000 cycles width allotted to the channel of medium CM5 between trunks OT—1 and IT—1; and the filter 2126 transmits the seizure signal energy, incoming from oscillator 550, to operate relay 2128. Relay 2128 closes a circuit for operating relay 2129. Relay 2129 connects ground to conductor 2133 to start the operation of a link TSL to effect the connection of the trunk IT—1 to a terminating sender TS. Upon connection of the trunk IT—1 with a sender, ground is connected to conductor 2135, through a front contact of relay 2129 and back contact of relay 2136, to operate relay 2134. Relay 2134 locks to conductor 2135, and closes a circuit for operating relay 2136. Relay 2136 locks under control of relay 2129, independent of relay 2134. Relay 2136 is a slow-to-release relay which remains operated during the time relay 2129 is released between digits. The aforementioned operation of relay 2129 bridges the winding of relay 2130 across conductors 2131 and 2132 so that relay 2130 is operated in series with the line relay, not shown, of the terminating sender; and relay 2130 closes a circuit for operating relay 2137. It is assumed that the terminating sender TS is similar to the terminating sender disclosed in the aforementioned Carpenter patent, the advance of the registers being effective to control relay 2130 by revertive impulses whereby relay 2130 is released by each revertive impulse. Each release of relay 2130 connects ground to pulsing oscillator 2139 whereby an impulse is transmitted through transformers 2115 and 2111 of modulator T—21—O, amplifier 2119 and transformer 2110, through common medium CM6, to outgoing trunk circuit OT—1, through transformers 1060 and 1061, rectifier 1063 and transformer 1064 of receiver R—10—I, through transformers 1013 and 1011 of modulator T—10—J, through amplifier 1019, transformer 1010 and common medium CM4 to junctor J—1, through transformers 660 and 661, rectifier 663 and transformer 635 of receiver R—6—O, through transformers 613 and 611 of modulator T—6—D, through amplifier 615, transformer 610 and common medium CM2 to district D—1, through transformers 540 and 541, rectifier 543 and transformer 545 of receiver R—5, through pulsing filter 551 and rectifier 552 to the winding of relay 553. Each revertive impulse thus transmitted operates relay 553, and relay 553 closes a circuit for holding relay 554 while short-circuiting the stepping relay 791 in the register sender RS. When the stepping relay is in this manner released the number of times which indicates registration of a digit in the terminating sender TS, the sender RS opens the bridge across conductors 585 and 586 to cause the release of relay 554. The release of relay 554 disconnects the pulsing oscillator 550 from transformer 533, thereby causing the release of relays 2128, 2129 and 2137 in trunk circuit IT—1. The release of relay 2128 opens the bridge across conductors 2131 and 2132 to indicate to the terminating sender that the setting of the first register has been completed, and the sender thereupon prepares to advance the next register. When the sender again closes the circuit for operating relay 554, pulsing oscillator 550 is again connected to transformer 533, thereby causing the reoperation of relays 2128, 2129 and 2137 of trunk circuit IT—1 and the bridging of relay 2130 across conductors 2131 and 2132. The reoperation of relay 2129 prevents the release of slow-to-release relay 2136. Again relay 2130 is released each time a revertive impulse is to be transmitted, the release of relay 2130 connecting ground to conductor 2138 to transmit energy from oscillator 2139 to operate relay 553 in district D—1. In this manner trains of revertive impulses are transmitted from sender TS to sender RS until the called number is completely registered in the terminating sender, whereupon relay 554 of district D—1 is not reoperated and ground is connected to conductor 584 to operate relay 598 in the district D—1. Relay 598 locks to ground at the upper contact of relay 596, connects the calling line through back contacts of relay 599 and windings 511 and 512 of repeating coil RC5 to the windings of relay 510. Relay 510 closes a holding circuit for relay 596 to maintain relay 596 operated, after the register sender RS is disconnected from the district D—1, until the calling subscriber replaces the receiver at station A to release the connection. Relay 598 also reconnects pulsing oscillator 550 to transformer 533 so as to reoperate relays 2128 and 2129 of trunk circuit IT—1 so as to prevent the release of relay 2136 until the calling subscriber releases the connection. Relay 2136, therefore, maintains the connection of ground to the start conductor of oscillator 2125 so that the carrier frequency potential is supplied to transmitters T—21—O and T—21—F. The receiver

R—21—F and the variable frequency receiver of the final selector circuit, not shown, are tuned under the control of a terminating marker TM in similar manner to that in which the variable receivers of the district and outgoing trunk circuits are tuned by the originating marker OM. When the connection is thus established, talking current is transmitted from station A, through line L—4, through repeating coil RC5 and hybrid coil HC5 of district D—1, through modulator T—5, amplifier 535, common medium CM1, through receiver R—6—D and modulator T—6—O of junctor J—1, common medium CM3, through receiver R—10—J and modulator T—10—I of trunk circuit OT—1, common medium CM5, through receiver R—21—O and modulator T—21—F of incoming trunk circuit IT—1, through common medium CM7, thence through the final selector circuit, not shown, to the called line. Talking current from the called station is transmitted through the final selector circuit and common medium CM8, through receiver R—21—F and modulator T—21—O of incoming trunk circuit IT—1, through common medium CM6, through receiver R—10—I and modulator T—10—J of outgoing trunk circuit OT—1, common medium CM4, through receiver R—6—O and modulator T—6—D of junctor J—1, through common medium CM2, to district D—1, through transformers 540 and 541, rectifier 543 of receiver R—5, transformer 544, voice filter 520, hybrid coil HC5, repeating coil RC5, and through line L—4 to station A. Upon answer of the called station, a supervisory signal is received from the final selector circuit, through common medium CM8, transformers 2160 and 2161, rectifier 2163 of receiver R—21—F, transformer 2165, supervisory filter 2170, and rectifier 2171, operating relay 2172. Relay 2172 connects ground to oscillator 2173 to effect the transmission of a supervisory signal therefrom, through transformers 2114 and 2111 of modulator T—21—O, thence through common medium CM6, outgoing trunk circuit OT—1, common medium CM4, junctor J—1, common medium CM2, through transformers 540 and 541, rectifier 543 of receiver R—5, transformer 544, filter 577, rectifier 578, to the winding of supervisory relay 579. Relay 579 may control the charging operations for a completed call.

When the calling subscriber replaces the receiver at station A to release the connection, relay 510 releases. The release of relay 510 causes the release of relays 506 and 508. The release of relay 506 disconnects ground from the start conductor of channel oscillator 505 to cause the release of relay 601 of junctor J—1 and the release of relay 508 disconnects pulsing oscillator 550 from transformer 533 to cause the release of relays 2128 and 2129 of incoming trunk circuit IT—1. Since relay 2129 remains normal, relay 2136 releases thereby disconnecting ground from oscillator 2105 to effect release of the final selector. The aforementioned release of relay 601 disconnects busy marking ground potential from conductor 679 and disconnects ground from channel oscillator 605 thereby causing the release of supervisory relay 579 of district D—1, if not already released, and causing the release of relay 1001 of outgoing trunk circuit OT—1. The release of relay 1001 disconnects ground from oscillator 1005 to deenergize modulators T—10—J and T—10—I.

If, on the call in question, the trunk circuit OT—2 is selected, instead of trunk circuit OT—1, the receiver R—9—J is tuned under control of the marker OM to the frequency of oscillator 605 of junctor J—1 and receiver R—6—O of junctor J—1 is tuned to the frequency of oscillator 903 of trunk circuit OT—2, in the same manner that receivers R—10—J and R—6—O are tuned on a call through trunk circuit OT—1 as above described. Relay 901 is operated when this trunk is selected for use in the same manner that relay 1001 of trunk OT—1 is operated upon selection of trunk circuit OT—1. Upon completion of a connection between district D—1 and trunk circuit OT—2, the marker is released and relay 554 of district D—1 is operated to connect the oscillator 550 to transformer 533 of modulator T—5, whereby a signal is transmitted through common medium CM1, receiver R—6—D and modulator T—6—O of junctor J—1, common medium CM3, conductors 907 and 908, transformers 920 and 921, rectifier 923 of receiver R—9—J, transformer 925, pulsing filter 926, and rectifier 927 to the winding of relay 928. Relay 928 is thereby operated closing a loop from one conductor of two-conductor trunk T—9 through relay 929, front contact of relay 928, front contact of relay 901, windings of repeating coil 932 and relay 931, to the other conductor of the trunk. Relay 929 is thereupon operated if the trunk is in working order, but relay 931 is polarized and does not operate. Relay 929 closes a circuit for operating relay 930. When the first revertive impulse is transmitted from the terminating sender in the called office, relay 929 releases thereby connecting ground through the front contact of relay 930 to oscillator 917, current from this oscillator being thereby transmitted through transformer 915 to modulate the carrier from source 903 and thus transmit a signal through transformer 911, amplifier 919, transformer 910, conductors 905 and 906, common medium CM4, receiver R—6—O and modulator T—6—D of junctor J—1, common medium CM2, receiver R—5, transformer 545, filter 551, and rectifier 552 to the winding of relay 553. Thus revertive impulses are received by relay 553 during the transmission of the numerical code from the sender RS over the trunk T—9 to the called office. When the sender RS is released and relay 508 of district D—1 operated, energy is transmitted from oscillator 550 through modulator T—5, common medium CM1, receiver R—6—D and modulator T—6—O of junctor J—1, common medium CM3, conductors 907 and 908, through receiver R—9—J, to operate relay 928 and thereby close the outgoing trunk loop for talking. When the call is answered, relay 931 is operated by a reversal of the current in trunk T—9. Relay 931 connects ground to supervisory oscillator 916, to effect the transmission of energy through transformers 914 and 911 of modulator T—9—J through conductors 905 and 906, common medium CM4, junctor J—1, common medium CM2, and receiver R—5 to operate supervisory relay 579. When the connection is released at the calling station, the district D—1 and junctor J—1 are restored to normal as above described on the call through trunk circuit OT—1. Relay 901 releases when the junctor restores to normal and relay 928 is released when relay 508 in the district releases, thereby opening the loop across trunk T—9.

If a call is received over a two-wire trunk T—22 from a calling office, the line relay 2230 of trunk circuit IT—2 operates, the windings of this relay being normally connected through back contacts of relays 2233 and 2231 to the conductors of trunk T—22. The operation of

relay 2230 connects ground to conductor 2204 to effect the operation of a link DSL to connect the trunk circuit IT—2 to a terminating sender TS; whereupon the connection of ground to conductor 2203 causes the operation of relay 2231. Relay 2231 locks through conductor 2203 until the terminating sender is released and closes a circuit through resistor 2235 and the upper winding of relay 2230 to hold relay 2230 operated while connection is being established with the called line. Relay 2231 also closes a circuit for operating relay 2232 and relay 2232 locks under the sole control of relay 2230. Relay 2232, which is a slow-to-release relay, connects ground to oscillator 2205 to start the operation of the oscillator and disconnects ground from conductor 2204. The terminating sender receives the called number from the register sender of the originating office and a terminating marker controls completion of the connection. The terminating marker tunes the receiver R—22—F of trunk circuit IT—2 to the channel frequency of a final selector having access to the called line, and tunes the receiver of the final selector (not shown) to the frequency of oscillator 2205 of transmitter T—22—F of trunk IT—2. With the connection between the trunk and final selector thus established, and the selector having established connection with the called line, the marker and sender are restored to normal, ground being disconnected from conductor 2203 to release relay 2231 and thus reconnect the conductors of the trunk T—22 to the windings of relay 2230. When the call is answered, a supervisory signal is transmitted from the final selector circuit through common medium CM9, transformers 2260 and 2261, rectifier 2263, transformer 2225, and supervisory filter 2226 to the winding of relay 2227. Relay 2227 closes a circuit for operating relay 2233; and relay 2233 interchanges the connections between the conductors of trunk T—22 and the windings of relay 2230 to reverse the current over the trunk as an answering supervisory signal to the calling office. Talking current is transmitted from trunk T—22, through condensers 2207 and 2208, windings 2245 and 2246 of hybrid coil HC22, transformers 2253 and 2251 of modulator T—22—F, amplifier 2255, transformer 2250, through a channel of common medium CM10, to and through the final selector to the called line; and talking current from the called line is transmitted through the final selector and common medium CM9, transformers 2260 and 2261, rectifier 2263, transformer 2225, voice frequency filter 2240, hybrid coil HC22, condensers 2207 and 2208, to the conductors of trunk T—22. When the call is released by the calling subscriber, relay 2230 releases, causing the release of relay 2232. The release of relay 2232 disconnects ground from oscillator 2205, thereby causing the release of the final selector circuit.

Various modifications may be made in the selector and control circuits within the scope of the invention. For instance, in place of fixed frequency transmitters and variable frequency receivers, the system may comprise variable frequency transmitters and fixed frequency receivers, or both receivers and transmitters may be variable, idle frequencies being allotted by the marker. In offices in which common transmission media are provided for connecting calling lines with outgoing trunks and also for connecting incoming trunks with called lines, a single marker may be provided for controlling the tuning of all variable frequency receivers, or transmitters, or both receivers and transmitters.

What is claimed is:

1. In a communication system, lines, broad-band high frequency transmission media constituting a plurality of carrier channels, each channel adapted for use in interconnecting calling and called lines, control means common to all of said lines, means responsive to the initiation of a call over one of said lines for connecting the calling line to said control means, and means including said control means for selecting one of said channels and for rendering the selected channel effective to constitute a communication path in a connection between the calling line and a called line.

2. In a communication system, lines and trunks, broad-band high frequency transmission media constituting a plurality of carrier channels, each channel adapted for use in interconnecting said lines and trunks, control means common to said lines and trunks, means responsive to initiation of a call over one of said lines for connecting the calling line to said control means, and means including said control means for selecting one of said trunks and one of said channels and for rendering the selected channel effective to connect the calling line and selected trunk for communication therebetween.

3. In a communication system, lines and trunks, broad-band high frequency transmission media constituting a plurality of carrier channels, each channel adapted for use in interconnecting said lines and trunks, control means common to said lines and trunks, means responsive to initiation of a call over one of said trunks for connecting the calling trunk to said control means, and means including said control means for selecting one of said lines and one of said channels and for rendering the selected channel effective to connect the calling trunk and selected line for communication therebetween.

4. In combination in a telephone switching system, district circuits, outgoing trunk circuits, a broad-band high frequency transmission medium constituting a plurality of carrier channels adapted for use in establishing communication paths between said district and outgoing trunk circuits, a control device common to said district and outgoing trunk circuits, means in said device for identifying a particular one of said district circuits, means in said device for selecting an idle one of said outgoing trunk circuits, means in said device for selecting an idle one of said channels, and means in said district and selected outgoing trunk circuits controlled by said device to establish a communication path through said channel between said district and selected outgoing trunk circuits.

5. In combination, in a telephone switching system, a final selector circuits, incoming trunk circuits, a broad-band high frequency transmission medium constituting a plurality of carrier channels adapted for use in establishing communication paths between said selector and trunk circuits, a control device common to said circuits, means in said device for identifying a particular one of said trunk circuits, means in said device for selecting an idle selector circuit, and means in said trunk and selected selector circuits controlled by said device to establish a communication path through one of said channels between

said trunk circuit and the selected selector circuit.

6. In combination, a plurality of transmission circuits of one character, a plurality of groups of transmission circuits of another character, broad-band high frequency transmission media each constituting a plurality of carrier channels, a control device common to all of said circuits and channels, means in said device for identifying a particular one of said circuits of said one character and for selecting an idle circuit in a desired group of circuits of said other character, and means in said particular and selected circuits controlled by said device to establish communication paths between said particular and selected circuits through channels of said media.

7. In combination, a plurality of transmission units of one character, a plurality of groups of transmission units of another character, a broad-band high frequency transmission medium constituting a plurality of carrier channels, a different one of some of said channels being individual to each of said units of one character, and a different one of others of said channels being individual to each of said units of the other character, a control device common to all of said transmission units, means in said device for identifying a particular one of said units of said one character, means in said device for selecting an idle unit in a desired group of units of said other character, and means in said particular and selected units controlled by said device to establish communication paths through channels of said medium between said particular and selected units.

8. In a communication system, lines, a plurality of transmission units of one character, means for connecting a calling line with one of said units, trunks, a plurality of transmission units of another character, one for each of said trunks, a broad-band high frequency transmission medium constituting a plurality of carrier channels, a control device common to all of said transmission units, means in said device for identifying a transmission unit connected to a calling line and for selecting a transmission unit associated with an idle one of said trunks, and means individual to said identified and selected transmission units controlled by said device to establish communication paths between said connected and selected transmission units through channels of said medium.

9. In combination, a plurality of transmission circuit units of one character, a plurality of transmission circuit units of another character, a broad-band high frequency transmission medium constituting a plurality of carrier channels each individual to a different one of the units of said one character and common to the units of said other character, another broad-band high frequency transmission medium constituting a plurality of carrier channels each individual to a different one of the units of said other character and common to the units of said one character, a control device common to all of said units, means in said device for identifying any particular one of the units of said one character and for selecting an idle unit of said other character, means individual to said particular unit of said one character controlled by said device to establish a one-way communication path from said selected unit through the channel which is individual thereto to said particular unit, and means individual to said selected unit of said other character controlled by said device to establish a one-way communication path from said particular unit through the channel which is individual thereto to said selected unit.

10. In a communication system, lines, district circuits, means for individually connecting idle district circuits with calling lines, groups of outgoing trunks, a plurality of high frequency carrier channels for use in establishing communication paths between said districts and said trunks, a control device common to said district circuits and said trunks, means in said device for identifying a district connected to a calling line, means in said device for determining the group of trunks to one of which it is desired that the calling district be connected, means including means in said device for selecting an idle trunk in the desired group of trunks and for selecting one of said carrier channels, and means including tuning means controlled by said device for establishing a communication path through the selected channel between said calling district and selected trunk.

11. In a communication system, lines, district circuits, means for individually connecting idle district circuits with calling lines, groups of outgoing trunks, a plurality of high frequency carrier channels for use in establishing communication paths between said districts and said trunks, a control device common to said district circuits and said trunks, means in said device for identifying a district connected to a calling line, means in said device for determining the group of trunks to one of which it is desired that the calling district be connected, means in said device for selecting an idle trunk in the desired group of trunks and for selecting carrier channels for use in establishing two one-way communication paths between said calling district and selected trunk, and means, including tuning means individual to said calling district and tuning means individual to said selected trunk, controlled by said device for establishing communication paths through said selected channels between said calling district and selected trunk.

12. In a communication system, lines, district circuits, means for individually connecting idle districts with calling lines, groups of outgoing trunks, trunk circuits one for each of said trunks, junctor circuits, broad-band high frequency transmission media, one of which is common to a plurality of said districts and to a plurality of said junctors, another of which is common to a plurality of said junctors and to a plurality of said trunk circuits, each of said media constituting a plurality of carrier channels, each of some of the channels of said one medium being individual to a different one of said districts and common to said junctors, each of other channels of said one medium being individual to a different one of said junctors and common to said districts, each of some of the channels of said other medium being individual to a different one of said junctors and common to said trunk circuits, and each of other channels of said other medium being individual to a different one of said trunk circuits and common to said junctors, a control device common to all of said district, junctor and outgoing trunk circuits, means in said device for identifying a calling district, for selecting an idle trunk circuit in a desired one of said groups and for selecting an idle junctor circuit, and means including means individual to each of said calling district, selected junctor and selected trunk circuits controlled by said device to establish communication paths between said call-

ing district and selected trunk circuits through the channels which are individual to said calling district, selected junctor and selected trunk circuits.

13. In a communication system, lines, district circuits, means for individually connecting idle districts with calling lines, groups of outgoing trunks, trunk circuits one for each of said trunks, junctor circuits, broad-band high frequency transmission media, one of which is common to a plurality of said districts and to a plurality of said junctors, another of which is common to a plurality of said junctors and to a plurality of said trunk circuits, each of said media constituting a plurality of carrier channels, each of said districts and each of said junctors being individual to a different one of the channels of said one medium, each of said junctors and each of said trunk circuits being individual to a different one of the channels of the other medium, a control device common to all of said district, junctor and trunk circuits, means in said device for identifying a calling district, for selecting a desired one of said trunk groups, for selecting an idle trunk circuit, in the selected group and for selecting an idle junctor circuit, and means individual to each of said calling district, selected junctor, and selected trunk circuits controlled by said device to establish two-way communication between said calling district and said selected trunk through the channels which are individual to said calling district, selected junctor and selected trunk circuits.

14. In a communication system, lines, district circuits, means for individually connecting idle districts with calling lines, groups of outgoing trunks, trunk circuits one for each of said trunks, junctor circuits, broad-band high frequency transmission media, one of which is common to a plurality of said districts and to a plurality of said junctors, another of which is common to a plurality of said junctors and to a plurality of said trunk circuits, each of said media constituting a plurality of carrier channels, each of said districts and each of said junctors being individual to a different one of the channels of said one medium, each of said junctors and each of said trunk circuits being individual to a different one of the channels of the other medium, a control device common to all of said district, junctor and trunk circuits, means in said device for identifying a calling district, for selecting a desired one of said trunk groups, for selecting an idle trunk circuit in the selected group and for selecting an idle junctor circuit, and means including means individual to each of said calling district, selected junctor, and selected trunk circuits controlled by said device to establish a communication path between said calling district and said selected trunk through the channels which are individual to said calling district, selected junctor and selected trunk circuits.

15. In combination in a communication system, a plurality of transmission circuit units each comprising a fixed frequency transmitter and a variable frequency receiver, means for seizing one of said plurality of transmission units for use, a control device common to all of said transmission units, means for connecting said seized transmission unit with said device, means in said device for identifying said seized unit, other transmission circuit units each comprising a fixed frequency transmitter and a variable frequency receiver a broad-band high frequency transmission medium common to all of said transmission units and constituting carrier channels each of which is individual to a different one of said plurality of transmission units and common to said other transmission units, another broad-band high frequency transmission medium common to all of said transmission units and constituting carrier channels each of which is individual to a different one of said other transmission units and common to said plurality of transmission units, means including means in said device for selecting one of said other transmission units and for controlling the tuning of the variable frequency receiver of said seized and said selected transmission units to the fixed frequencies of the transmitters of said selected and said seized transmission units, respectively, thereby to establish communication through each of said common media between said connected transmission unit and said selected transmission unit.

16. In combination in a communication system, a plurality of transmission circuit units of a first character, a plurality of transmission circuit units of a second character, a plurality of groups of transmission circuit units of a third character, broad-band high frequency transmission media each constituting a plurality of carrier channels, each channel of a first one of said media being individual to a different one of said transmission units of said first character and common to the transmission units of said second character, each channel of a second one of said media being common to the transmission units of the first character and individual to a different one of the transmission units of said second character, each channel of a third one of said media being individual to a different one of the transmission units of said second character and common to the transmission units of said third character, each channel of a fourth one of said media being common to the transmission units of said second character and individual to a different one of the transmission units of said third character, a control device common to all of said units, means for seizing any particular one of the transmission units of said first character, means in said device for identifying the seized transmission unit, means in said device for selecting an idle one of the transmission units of said third character in any desired one of said groups, means including means in said device for selecting one of the transmission units of said second character, and individual means in each of said seized and said selected transmission units, controlled by said device to establish communication paths through the selected transmission unit of said second character between the seized transmission unit of said first character and the selected transmission unit of said third character through the channels which are individual to said seized and said selected transmission units.

17. In combination in a communication system, a plurality of transmission circuit units of a first character, a plurality of transmission circuit units of a second character, a plurality of groups of transmission circuit units of a third character, broad-band high frequency transmission media constituting a plurality of carrier channels, a first group of said channels, each of the channels in said first group being individual to a different one of the transmission units of said first character and common to the transmission units of said second character, a second group of said channels, each of the channels in said second group being individual to a different

one of the transmission units of said second character and common to the transmission units of said first character, a third group of said channels, each of the channels in said third group being individual to a different one of the transmission units of said second character and common to the transmission units of said third character, a fourth group of said channels, each of the channels in said fourth group being individual to a different one of the transmission units of said third character and common to the transmission units of said second character, the channels of said first and third groups being adapted to transmit communication currents in one direction and the channels of said second and fourth groups being adapted to transmit communication currents in the opposite direction, a control device common to all of said units, means for seizing any one of the transmission units of said first character, means including means in said device for identifying the seized unit, means in said device for selecting an idle transmission unit of said third character in any desired one of said groups, means in said device for selecting a transmission unit of said second character, and means including individual means in said seized transmission unit of said first character, individual means in said selected transmission unit of said second character, and individual means in said selected transmission unit of said third character, all controlled by said device for establishing communication paths between the seized transmission unit of said first character and the selected transmission unit of said third character through the channels which are individual to said seized and said selected transmission units.

18. In combination in a communication system, transmission circuit units of a first character, transmission circuit units of a second character, a broad-band high frequency transmission medium common to all of said transmission units and constituting a plurality of carrier channels, each of said transmission units comprising a fixed frequency transmitter and a variable frequency receiver, a control device common to all of said transmission units, means for seizing a transmission unit of said first character, means in said device for identifying said seized transmission unit, means including means in said device for selecting an idle transmission unit of said second character, means in said seized transmission unit of the first character controlled by means in said device to tune the receiver of said seized transmission unit to the frequency of the transmitter of said selected transmission unit of the second character thereby to establish a one-way transmission path through a channel of said medium between said seized and said selected transmission units, and means in said selected transmission unit of the second character controlled by means in said device to tune the receiver of said selected transmission unit of the second character to the frequency of the transmitter of said seized transmission unit of the first character, thereby to establish another one-way transmission path through another channel of said medium between said seized and selected transmission units, said one-way transmission paths being in opposite directions.

19. In combination in a central office of a communication system, lines, district circuits, junctor circuits, groups of outgoing trunk circuits, broad-brand high frequency transmission media including first and second media common to said district and junctor circuits and including third and fourth media common to said junctor and outgoing trunk circuits, each of said district circuits comprising a fixed frequency transmitter connected to said first transmission medium and a variable frequency receiver connected to said second transmission medium, each of said junctor circuits comprising a fixed frequency transmitter connected to said second transmission medium, a variable frequency receiver conencted to said first transmission medium, a fixed frequency transmitter connected to said third transmission medium, and a variable frequency receiver connected to said fourth transmission medium, each of said outgoing trunk circuits comprising a fixed frequency transmitter connected to said fourth transmission medium and a variable frequency receiver connected to said third transmission medium, a control device common to said circuits, means for connecting a calling one of said lines to a district circuit, means including means in said device responsive to calling line control for selecting an idle trunk circuit in a desired one of said groups, means including means in said device for selecting an idle junctor, means in the receiver of said connected district circuit controlled by said device to tune said receiver to the frequency of the transmitter of said selector junctor which is connected to said second transmission medium, means in the receiver of said selected outgoing trunk circuit controlled by said device to tune said receiver to the frequency of the transmitter of said selected junctor, means in the receiver of said selected junctor which is connected to said first transmission medium controlled by said device to tune said receiver to the frequency of the transmitter of said connected district, and means in the receiver of said selected junctor which is connected to said fourth transmission medium controlled by said device to tune said receiver to the frequency of the transmitter of said selected outgoing trunk circuit, thereby to establish two communication paths, one in each direction, from said line through said connected district, said first and second transmission media, said selected junctor, and said third and fourth transmission media, to said selected outgoing trunk circuit.

20. In an automatic telephone system, subscribers' lines, district circuits for use in establishing connections between calling and called lines, a broad-band high frequency transmission medium common to said districts and constituting a plurality of carrier channels, each of said districts comprising a fixed frequency transmitter connected to said medium to constitute a channel individual to said district and comprising a variable frequency receiver connected to said medium and adapted to be tuned to the frequency of any one of a plurality of said carrier channels, means connecting a calling line to one of said districts, control means including an originating marker, means connecting said calling line and said one district to said control means, means in said marker for identifying said one district, means including means in said marker for selecting an idle one of said plurality of carrier channels, and means in the receiver of said one district controlled by said marker for tuning said receiver to the frequency of said selected one of said plurality of carrier channels.

21. In an automatic communication system, a plurality of transmission circuit units of a first

character, a plurality of transmission circuit units of a second character, a broad-band high frequency transmission medium common to said transmission units and constituting a plurality of carrier channels, each of said transmission circuit units comprising a fixed frequency transmitter and a variable frequency receiver, control means common to said cicuit units and comprising a marker circuit, means for seizing a circuit unit of the first character, means in said marker for identifying the seized circuit unit, means comprising means in said marker for selecting an idle circuit unit of the second character, the receiver of said seized circuit unit of the first character comprising a first tunable network connected to said medium, a second tunable network for indicating the frequency to which said first tunable network is tuned, and motor means for simultaneously varying the resonant frequency of both of said tunable networks, means in said marker effective upon selection of a circuit unit of the second character for starting the operation of said motor means, means including the carrier source in the transmitter of said selected circuit unit of said second character and including means in said marker for transmitting energy to said second tunable network, and means in said marker connected to said second tunable network and adapted to operate when said second tunable network is resonant to the frequency of the carrier source of the transmitter of said selected circuit unit of the second character for stopping the operation of said motor means.

22. In an automatic communication system, a plurality of transmission circuit units of a first character, a plurality of transmission circuit units of a second character, a broad-band high frequency transmission medium common to said circuit units and constituting a plurality of carrier channels, each of said circuit units comprising a fixed frequency transmitter and a variable frequency receiver, control means common to said circuit units and comprising a marker circuit, means for seizing a circuit unit of the first character, means in said marker for identifying the seized circuit unit, means comprising means in said marker for selecting an idle circuit unit of the second character, the receiver of said selected circuit unit comprising a first tunable network connected to said medium, a second tunable network for indicating the frequency to which said first tunable network is tuned, and motor means for simultaneously varying the resonant frequency of both of said tunable networks, means in said marker effective upon selection of a circuit unit of the second character for starting the operation of said motor means, means including the carrier source in the transmitter of said seized circuit unit of the first character and including means in said marker for transmitting energy to said second tunable network, and means in said marker connected to said second tunable network and adapted to operate when said second tunable network is resonant to the frequency of the carrier source of the transmitter of said seized circuit unit of the first character for stopping the operation of said motor means.

23. In an automatic communication system, a first plurality of transmission circuit units, a second plurality of transmission circuit units, each of said transmission circuit units comprising a fixed frequency transmitter and a variable frequency receiver, a broad-band high frequency transmission medium common to said circuit units and constituting a plurality of carrier channels, control means common to said circuit units and comprising a marker circuit, means for seizing a circuit unit of the first plurality, means in said marker for identifying the seized circuit unit, means comprising means in said marker for selecting an idle circuit unit of the second plurality, the receiver of each of said seized and said selected circuit units comprising a first tunable network connected to said medium, a second tunable network for indicating the frequency to which said first tunable network is tuned, and motor means for simultaneously varying the resonant frequency of both of said tunable networks, means in said marker effective upon selection of a circuit unit of the second plurality for starting said motor means in the receivers of each of said seized and selected circuit units, means including the carrier source in the transmitter of said selected circuit unit of the second plurality and including means in said marker for transmitting energy to the second tunable network of the receiver of said seized circuit unit of the first plurality, means in said marker connected to the second tunable network in the receiver of said seized circuit unit of the first plurality and adapted to operate when the second tunable network of said seized circuit unit is resonant to the frequency of the carrier source of the transmitter of said selected circuit unit of the second plurality for stopping the operation of the motor means in the receiver of said seized circuit unit of the first plurality, means including the carrier source in the transmitter of said seized circuit unit of the first plurality and including means in said marker for transmitting energy to the second tunable network in the receiver of said selected circuit unit of the second plurality, means in said marker connected to the second tunable network in the receiver of said selected circuit unit of the second plurality and adapted to operate when said second tunable network of said selected circuit unit is resonant to the frequency of the carrier source of the transmitter of said seized circuit unit of the first plurality for stopping the operation of the motor means in the receiver of said selected circuit unit of the second plurality.

24. In an automatic telephone system, district circuits, junctor circuits, groups of outgoing trunk circuits, broad-band high frequency transmission media each constituting a plurality of carrier channels, control means common to said circuits and comprising a marker circuit, each of said districts and each of said outgoing trunk circuits comprising a fixed frequency transmitter connected to one of said media and a variable frequency receiver connected to one of said media, each of said junctor circuits comprising a first fixed frequency transmitter connected to the medium to which the variable frequency receivers of said districts are connected, a second fixed frequency transmitter connected to the medium to which the variable frequency receivers of said outgoing trunk circuits are connected, a first variable frequency receiver connected to the medium to which the transmitters of said districts are connected and a second variable frequency receiver connected to the medium to which the transmitters of said outgoing trunk circuits are connected, means for seizing one of said districts and said control means for use, means in said marker for identifying the seized district, means includ-

ing means in said marker for selecting an idle outgoing trunk circuit in a desired one of said groups and for selecting an idle junctor circuit having transmitters and receivers connected to the media to which the transmitters and receivers of said seized district and selected outgoing trunk circuits are connected, each receiver in said district, junctor and outgoing trunk circuits comprising a first tunable network connected to one of said media, a second tunable network for indicating the frequency to which the first tunable network is tuned, and motor means for simultaneously varying the resonant frequency of both of said tunable networks, means in said marker effective upon selection of an outgoing trunk circuit and a junctor circuit for starting the motor means in the receivers in said seized district and selected junctor and outgoing trunk circuits, means including the carrier source in the transmitter of said seized district circuit and including means in said marker for transmitting energy to the second tunable network in the first receiver of said selected junctor circuit, means in said marker connected to the second tunable circuit in the first receiver of said selected junctor circuit and adapted to operate when said second tunable network is resonant to the frequency of the carrier source of the transmitter of said seized district circuit for stopping the motor means in the first receiver of said selected junctor circuit, means including the carrier source in the transmitter of said selected outgoing trunk circuit and including means in said marker for transmitting energy to the second tunable network in the second receiver of said selected junctor circuit, means in said marker connected to the second tunable network in the second receiver of said selected junctor circuit and adapted to operate when said second tunable network is resonant to the frequency of the carrier source of the transmitter of said selected outgoing trunk circuit for stopping the motor means in the second receiver of said selected junctor circuit, means including the carrier source in the first transmitter of said selected junctor circuit and including means in said marker for transmitting energy to the second tunable network in the receiver of said seized district circuit, means in said marker connected to the second tunable network in the receiver of said seized district circuit and adapted to operate when said second tunable network is resonant to the frequency of the carrier source of the first transmitter of said selected junctor circuit for stopping the motor means in the receiver of said seized district circuit, means including the carrier source in the second transmitter of said selected junctor circuit and including means in said marker for transmitting energy to the second tunable network in the receiver of said selected outgoing trunk circuit, and means in said marker connected to the second tunable network in the receiver of the selected outgoing trunk circuit and adapted to operate when said second tunable network is resonant to the frequency of the carrier source in the second transmitter of said selected junctor circuit for stopping the motor means in the receiver of said outgoing trunk circuit.

25. In an automatic telephone system, district circuits, junctor circuits, groups of outgoing trunk circuits, broad-band high frequency transmission media each constituting a plurality of carrier channels, control means common to said circuits and comprising a marker circuit, each of said districts and each of said outgoing trunk circuits comprising a fixed frequency transmitter connected to one of said media and a variable frequency receiver connected to one of said media, each of said junctor circuits comprising a first fixed frequency transmitter connected to the medium to which the variable frequency receivers of said districts are connected, a second fixed frequency transmitter connected to the medium to which the variable frequency receivers of said outgoing trunk circuits are connected, a first variable frequency receiver connected to the medium to which the transmitters of said districts are connected and a second variable frequency receiver connected to the medium to which the transmitters of said outgoing trunk circuits are connected, means for seizing one of said districts and said control means for use, means in said marker for identifying the seized district, means including means in said marker for selecting an idle outgoing trunk circuit in a desired one of said groups and for selecting an idle junctor circuit having transmitters and receivers connected to the media to which the transmitters and receivers of said seized district and selected outgoing trunk circuits are connected, each receiver in said district, junctor and outgoing trunk circuits comprising a first tunable network connected to one of said media, a second tunable network for indicating the frequency to which the first tunable network is tuned, and motor means for simultaneously varying the resonant frequency of both of said tunable networks, means in said marker effective upon selection of an outgoing trunk circuit and a junctor circuit for starting the motor means in the receivers in said seized district and selected junctor and outgoing trunk circuits, means including the carrier source in the transmitter of said seized district circuit and including means in said marker for transmitting energy to the second tunable network in the first receiver of said selected junctor circuit, means in said marker connected to the second tunable circuit in the first receiver of said selected junctor circuit and adapted to operate when said second tunable network is resonant to the frequency of the carrier source of the transmitter of said seized district circuit for stopping the motor means in the first receiver of said selected junctor circuit, means including the carrier source in the transmitter of said selected outgoing trunk circuit and including means in said marker for transmitting energy to the second tunable network in the second receiver of said selected junctor circuit, means in said marker connected to the second tunable network in the second receiver of said selected junctor circuit and adapted to operate when said second tunable network is resonant to the frequency of the carrier source of the transmitter of said selected outgoing trunk circuit for stopping the motor means in the second receiver of said selected junctor circuit, means including the carrier source in the first transmitter of said selected junctor circuit and including means in said marker for transmitting energy to the second tunable network in the receiver of said seized district circuit, means in said marker connected to the second tunable network in the receiver of said seized district circuit and adapted to operate when said second tunable network is resonant to the frequency of the carrier source of the first transmitter of said selected junctor circuit for stopping the motor means in the receiver of said seized district circuit, means including the carrier source in the

second transmitter of said selected junctor circuit and including means in said marker for transmitting energy to the second tunable network in the receiver of said selected outgoing trunk circuit, means in said marker connected to the second tunable network in the receiver of the selected outgoing trunk circuit and adapted to operate when said second tunable network is resonant to the frequency of the carrier source in the second transmitter of said selected junctor circuit for stopping the motor means in the receiver of said outgoing trunk circuit, and means effective upon operation of said means in the marker when the receivers of said seized district and selected outgoing trunk circuits are tuned to the frequency of the first and second transmitters of said selected junctor circuit and the first and second receivers of said selected junctor circuit are tuned to the frequencies of the transmitters of said seized district and selected outgoing trunk circuits to cause the disconnection of said marker from said seized district and selected junctor and outgoing trunk circuits.

26. In an automatic telephone system, subscribers' lines, district circuits for use in establishing connections between calling and called lines, a broad-band high frequency transmission medium common to said districts and constituting a plurality of carrier channels, means for connecting a calling line to a district circuit, each of said districts comprising a fixed frequency transmitter associated with one of said channels, a variable frequency receiver common to a plurality of said channels, and a hybrid coil for connecting the calling line to said transmitter and to said receiver for two-way communication, each of said receivers comprising a first tunable network connected said medium, a second tunable network for indicating the frequency to which said first tunable network is tuned, and motor means for simultaneously varying the resonant frequency of both of said networks, means connecting a calling line to one of said districts, control means common to said districts and comprising a marker, means connecting said control means to said one district, means in said marker for identifying said one district and for selecting one of the channels to which the receiver of said one district is common, means in said marker effective upon selection of a channel for starting the motor means of said receiver, means including means in said marker for impressing a potential of the carrier frequency of said selected channel across the second tunable network of the receiver of said one district, and means in said marker connected to said second tunable network and adapted to operate when said second tunable network is resonant to frequency of said selected carrier channel for stopping the operation of the motor means of the receiver of said one district.

27. In an automatic telephone system, subscribers' lines, district circuits for use in establishing connections between calling and called lines, a broad-band high frequency transmission medium common to said districts and constituting a plurality of carrier channels, means connecting a calling line to one of said districts, a register sender circuit, means connecting said calling line and said one district to said register sender, a marker circuit, means connecting said sender and marker circuits, each of said districts comprising a fixed frequency transmitter individual to one of said carrier channels and a variable frequency receiver common to a plurality of said carrier channels, means including means in said marker for selecting one of the channels to which said receiver is common and for tuning said receiver to the frequency of the selected channel, other register means for use in controlling completion of the connection between the calling and called lines, means in said district for sending a signal over the channel individual to the transmitter of said one district, means responsive to said signal connecting said selected channel to said other register means, said other register means arranged to transmit revertive impulses over said selected channel, means in said one district for repeating the received revertive impulses to said register sender, and means in said district effective upon completion of the registration of the number of the called line in said other register means for connecting the calling line to said transmitter and to said receiver for two-way communication.

28. In an automatic telephone system, subscribers' lines, district circuits for use in establishing connections between calling and called lines, a broad-band high frequency transmission medium common to said districts and constituting a plurality of carrier channels, means connecting a calling line to one of said districts, a register sender circuit, means connecting said calling line and said one district to said register sender, a marker circuit, means connecting said sender and marker circuits, each of said districts comprising a fixed frequency transmitter individual to one of said carrier channels and a variable frequency receiver common to a plurality of said carrier channels, means including means in said marker for selecting one of the channels to which said receiver is common and for tuning said receiver to the frequency of the selected channel, other register means for use in controlling completion of the connection between the calling and called lines, means in said district for sending a signal over the channel individual to the transmitter of said one district, means responsive to said signal connecting said selected channel to said other register means, said other register means arranged to transmit revertive impulses over said selected channel, means in said one district for repeating the received revertive impulses to said register sender, means in said district effective upon completion of the registration of the number of the called line in said other register means for connecting the calling line to said transmitter and to said receiver for two-way communication, and means in said district for responding to a supervisory signal received over said selected channel when the call is answered.

29. In an automatic telephone system, subscribers' lines, district circuits for use in establishing connections between calling and called lines, a broad-band high frequency transmission medium common to said districts and constituting a plurality of carrier channels, means connecting a calling line to one of said districts, a register sender circuit, means connecting said calling line and said one district circuit to said register sender, a marker circuit, means connecting said sender and marker circuits, each of said districts comprising a fixed frequency transmitter individual to one of said carrier channels and a variable frequency receiver common to a plurality of said carrier channels,

means including means in said marker for selecting one of the channels to which said receiver is common and for tuning said receiver to the frequency of the selected channel, other register means for use in controlling completion of the connection between the calling and called lines, means in said district for sending a signal over the channel individual to the transmitter of said one district, means responsive to said signal connecting said selected channel to said other register means, said other register means arranged to transmit revertive impulses over said selected channel, means in said one district for repeating the received revertive impulses to said register sender, means in said district effective upon completion of the registration of the number of the called line in said other register means for connecting the calling line to said transmitter and to said receiver for two-way communication, means in said district for responding to a supervisory signal receiver over said selected channel when the call is answered, means comprising the transmitter in said district for maintaining the connection between said calling and called lines, and means responsive to the release of the connection by the calling subscriber for rendering said transmitter ineffective to maintain the connection through the channel individual thereto and through said selected channel.

30. In a communication system, an incoming line, a plurality of outgoing lines, a broad-band high frequency transmission medium common to all of said lines, said medium constituting a plurality of carrier channels, each of which is individual to a different one of said outgoing lines, control means common to all of said lines, and means including tuning means individual to said incoming line rendered effective by said control means to establish a communication path between said incoming line and any desired one of said outgoing lines through the channel which is individual to said selected outgoing line.

31. In a communication system, a plurality of incoming lines, an outgoing line, a broad-band high frequency transmission medium common to all of said lines, said medium constituting a plurality of carrier channels, each of which is individual to a different one of said incoming lines, control means common to all of said lines, and means including tuning means individual to said outgoing line rendered effective by said control means to establish a communication path between a particular one of said incoming lines and said outgoing line through the channel which is individual to said particular incoming line.

32. In a communication system, a plurality of incoming lines, a plurality of outgoing lines, a broad-band high frequency transmission medium common to all of said lines, said medium constituting a plurality of carrier channels, each of which is individual to a different one of said incoming lines, and a plurality of carrier channels, each of which is individual to a different one of said outgoing lines, control means common to all of said lines, means including tuning means individual to each of said incoming lines rendered effective by said control means to establish a communication path through the channel which is individual to any particular one of said outgoing lines, and means including tuning means individual to each of said outgoing lines rendered effective by said control means to establish a communication path through the channel which is individual to any particular one of said incoming lines.

33. In combination in a telephone switching system, district circuits, outgoing trunk circuits, a broad-band high frequency transmission medium constituting a plurality of carrier channels adapted for use in establishing communication paths between said district and outgoing trunk circuits, a control device common to said district and outgoing trunk circuits, means in said device for identifying a particular one of said district circuits, means in said device for selecting an idle one of said outgoing trunk circuits, means in said device for selecting an idle one of said channels, and means including tuning means in said district and selected outgoing trunk circuits controlled by said device to establish a communication path through said channel between said district and selected outgoing trunk circuits.

34. In combination, in a telephone switching system, final selector circuits, incoming trunk circuits, a broad-band high frequency transmission medium constituting a plurality of carrier channels adapted for use in establishing communication paths between said selector and trunk circuits, a control device common to said circuits, means in said device for identifying a particular one of said trunk circuits, means in said device for selecting an idle selector circuit, and means including tuning means in said trunk and selected selector circuits controlled by said device to establish a communication path through one of said channels between said trunk circuit and the selected selector circuit.

35. In combination, a plurality of transmission circuits of one character, a plurality of groups of transmission circuits of another character, broad-band high frequency transmission media each constituting a plurality of carrier channels between the transmission circuits of one character and the transmission circuits of the other character, a control device common to all of said circuits and channels, means in said device for identifying a particular one of said circuits of said one character and for selecting an idle circuit in a desired group of circuits of said other character, and means including tuning means in said particular and selected circuits controlled by said device to establish communication paths between said particular and selected circuits through channels of said media.

36. In combination, a plurality of transmission units of one character, a plurality of groups of transmission units of another character, a broad-band high frequency transmission medium constituting a plurality of carrier channels between the transmission units of one character and the transmission units of the other character, a different one of some of said channels being individual to each of said units of one character, and a different one of others of said channels being individual to each of said units of the other character, a control device common to all of said transmission units, means in said device for identifying a particular one of said units of said one character, means in said device for selecting an idle unit in a desired group of units of said other character, and means including tuning means in said particular and selected units controlled by said device to establish communication paths through channels of said medium between said particular and selected units.

37. In a communication system, lines, a plu-

rality of transmission units of one character, means for connecting a calling line with one of said units, trunks, a plurality of transmission units of another character, one for each of said trunks, a broad-band high frequency transmission medium constituting a plurality of carrier channels, a control device common to all of said transmission units, means in said device for identifying a transmission unit connected to a calling line and for selecting a transmission unit associated with an idle one of said trunks, and means including tuning means individual to said identified and selected transmission units controlled by said device to establish communication paths between said connected and selected transmission units through channels of said medium.

38. In combination, a plurality of transmission circuit units of one character, a plurality of transmission circuit units of another character, a broad-band high frequency transmission medium constituting a plurality of carrier channels each individual to a different one of the units of said one character and common to the units of said other character, another broad-band high frequency transmission medium constituting a plurality of carrier channels each individual to a different one of the units of said other character and common to the units of said one character, a control device common to all of said units, means in said device for identifying any particular one of the units of said one character and for selecting an idle unit of said other character, means including tuning means individual to said particular unit of said one character controlled by said device to establish a one-way communication path from said selected unit through the channel which is individual thereto to said particular unit, and means including tuning means individual to said selected unit of said other character controlled by said device to establish a one-way communication path from said particular unit through the channel which is individual thereto to said selected unit.

39. In an automatic telephone system, subscribers' lines, district circuits for use in establishing connections between calling and called lines, a broad-band high frequency transmission medium common to said districts and constituting a plurality of carrier channels, means connecting a calling line to one of said districts, a register sender circuit, means connecting said calling line and said one district to said register sender, a marker circuit, means connecting said sender and marker circuits, each of said districts comprising a fixed frequency transmitter individual to one of said carrier channels and a variable frequency receiver common to a plurality of said carrier channels, means including means in said marker for selecting one of the channels to which said receiver is common and for tuning said receiver to the frequency of the selected channel, other register means for use in controlling completion of the connection between the calling and called lines, means in said district for sending a signal over the channel individual to the transmitter of said one district, said signal consisting of current of a particular frequency within the frequency band of the channel, means responsive to said signal connecting said selected channel to said other register means, said other register means arranged to transmit revertive impulses over said selected channel, each impulse consisting of current of a particular frequency within the frequency band of the channel, means in said one district for repeating the received revertive impulses to said register sender, and means in said district effective upon completion of the registration of the number of the called line in said other register means for connecting the calling line to said transmitter and to said receiver for two-way communication.

40. In an automatic telephone system, subscribers' lines, district circuits for use in establishing connections between calling and called lines, a broad-band high frequency transmission medium common to said districts and constituting a plurality of carrier channels, means connecting a calling line to one of said districts, a register sender circuit, means connecting said calling line and said one district to said register sender, a marker circuit, means connecting said sender and marker circuits, each of said districts comprising a fixed frequency transmitter individual to one of said carrier channels and a variable frequency receiver common to a plurality of said carrier channels, means including means in said marker for selecting one of the channels to which said receiver is common and for tuning said receiver to the frequency of the selected channel, other register means for use in controlling completion of the connection between the calling and called lines, means in said district for sending a signal over the channel individual to the transmitter of said one district, said signal consisting of current of a particular frequency within the frequency band of the channel, means responsive to said signal connecting said selected channel to said other register means, said other register means arranged to transmit revertive impulses over said selected channel, each impulse consisting of current of a particular frequency within the frequency band of the channel, means in said one district for repeating the received revertive impulses to said register sender, means in said district effective upon completion of the registration of the number of the called line in said other register means for connecting the calling line to said transmitter and to said receiver for two-way communication, and means in said district for responding to a supervisory signal received over said selected channel when the call is answered, said signal consisting of current of a particular frequency within the frequency band of the channel.

41. In an automatic telephone system, subscribers' lines, district circuits for use in establishing connections between calling and called lines, a broad-band high frequency transmission medium common to said districts and constituting a plurality of carrier channels, means connecting a calling line to one of said districts, a register sender circuit, means connecting said calling line and said one district circuit to said register sender, a marker circuit, means connecting said sender and marker circuits, each of said districts comprising a fixed frequency transmitter individual to one of said carrier channels and a variable frequency receiver common to a plurality of said carrier channels, means including means in said marker for selecting one of the channels to which said receiver is common and for tuning said receiver to the frequency of the selected channel, other register means for use in controlling completion of the connection between the calling and called lines, means in said district for sending a signal over

the channel individual to the transmitter of said one district, said signal consisting of current of a particular frequency within the frequency band of the channel, means responsive to said signal connecting said selected channel to said other register means, said other register means arranged to transmit revertive impulses over said selected channel, each impulse consisting of current of a particular frequency within the frequency band of the channel, means in said one district for repeating the received revertive impulses to said register sender, means in said district effective upon completion of the registration of the number of the called line in said other register means for connecting the calling line to said transmitter and to said receiver for two-way communication, means in said district for responding to a supervisory signal received over said selected channel when the call is answered, said signal comprising current of a particular frequency within the frequency band of the channel, means comprising the transmitter in said district for maintaining the connection between said calling and called lines, and means responsive to the release of the connection by the calling subscriber for rendering said transmitter ineffective to maintain the connection through the channel individual thereto and through said selected channel.

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