

Feb. 19, 1946.

L. F. CRABTREE ET AL

2,395,168

SIGNALING SYSTEM

Filed May 27, 1944

6 Sheets-Sheet 1

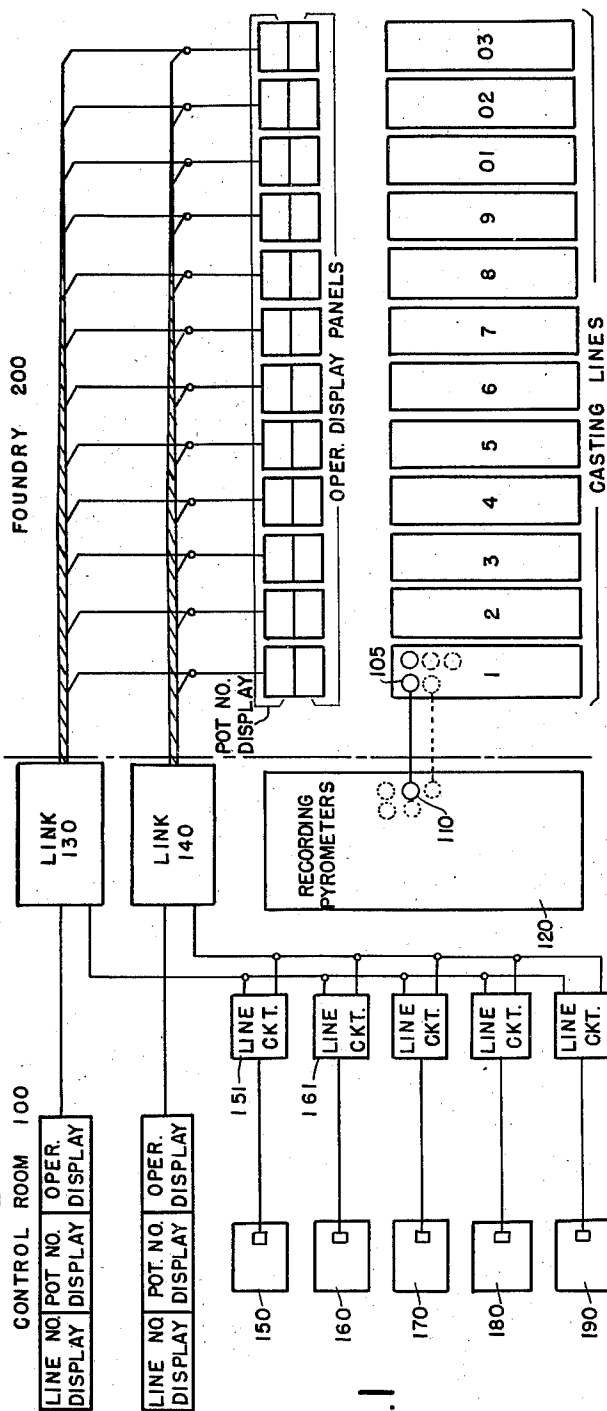


FIG. 8

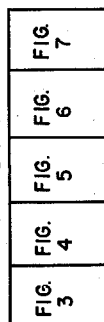
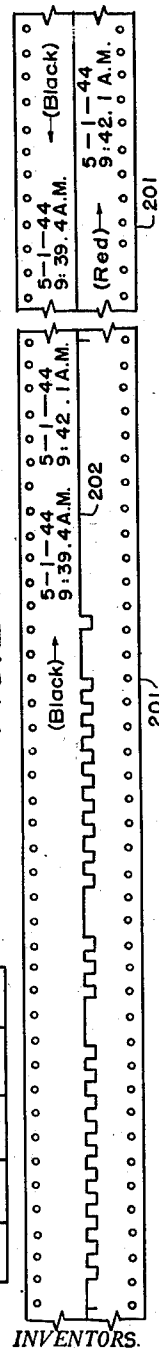


FIG. 2A

FIG. 2B



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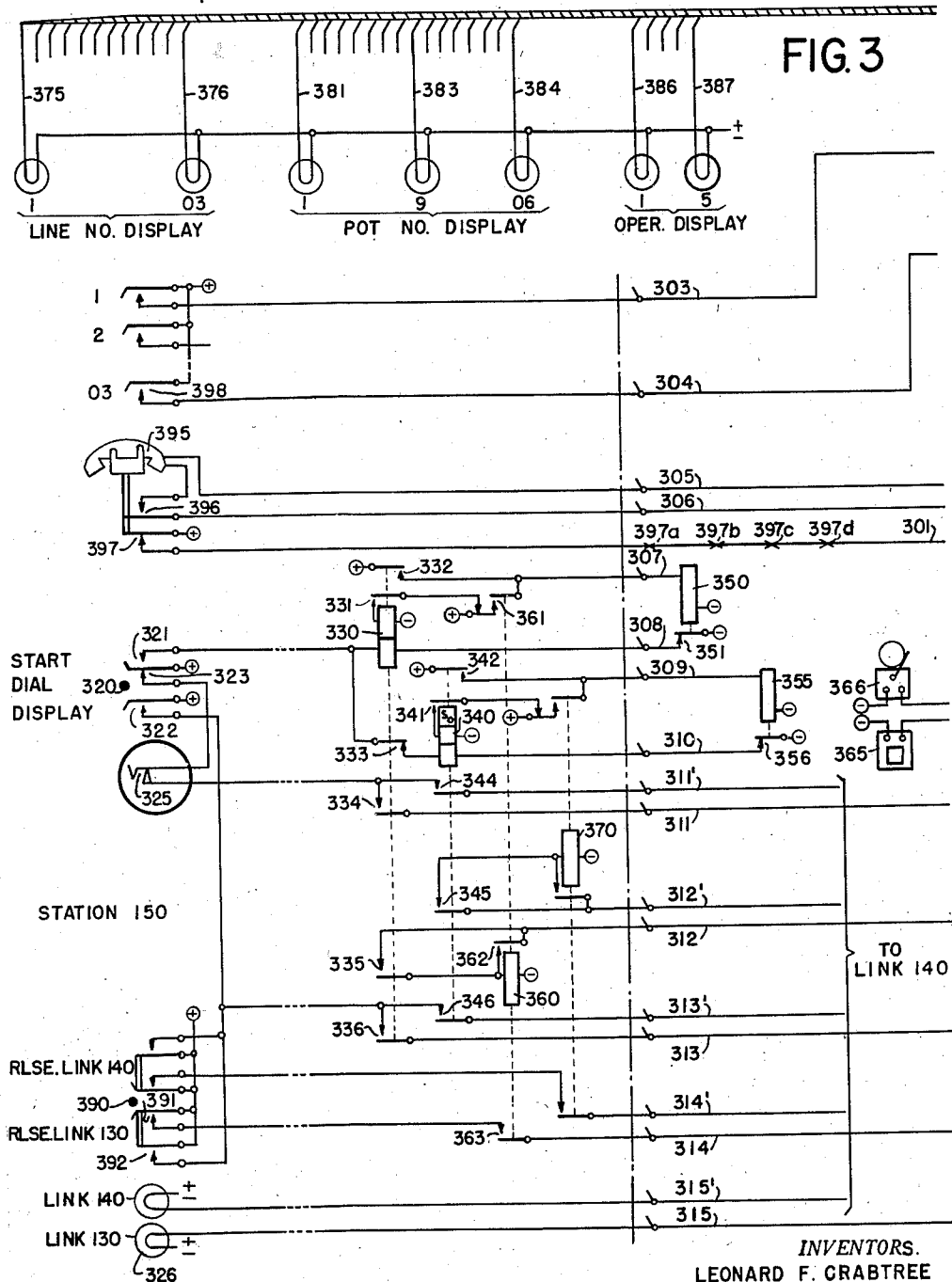
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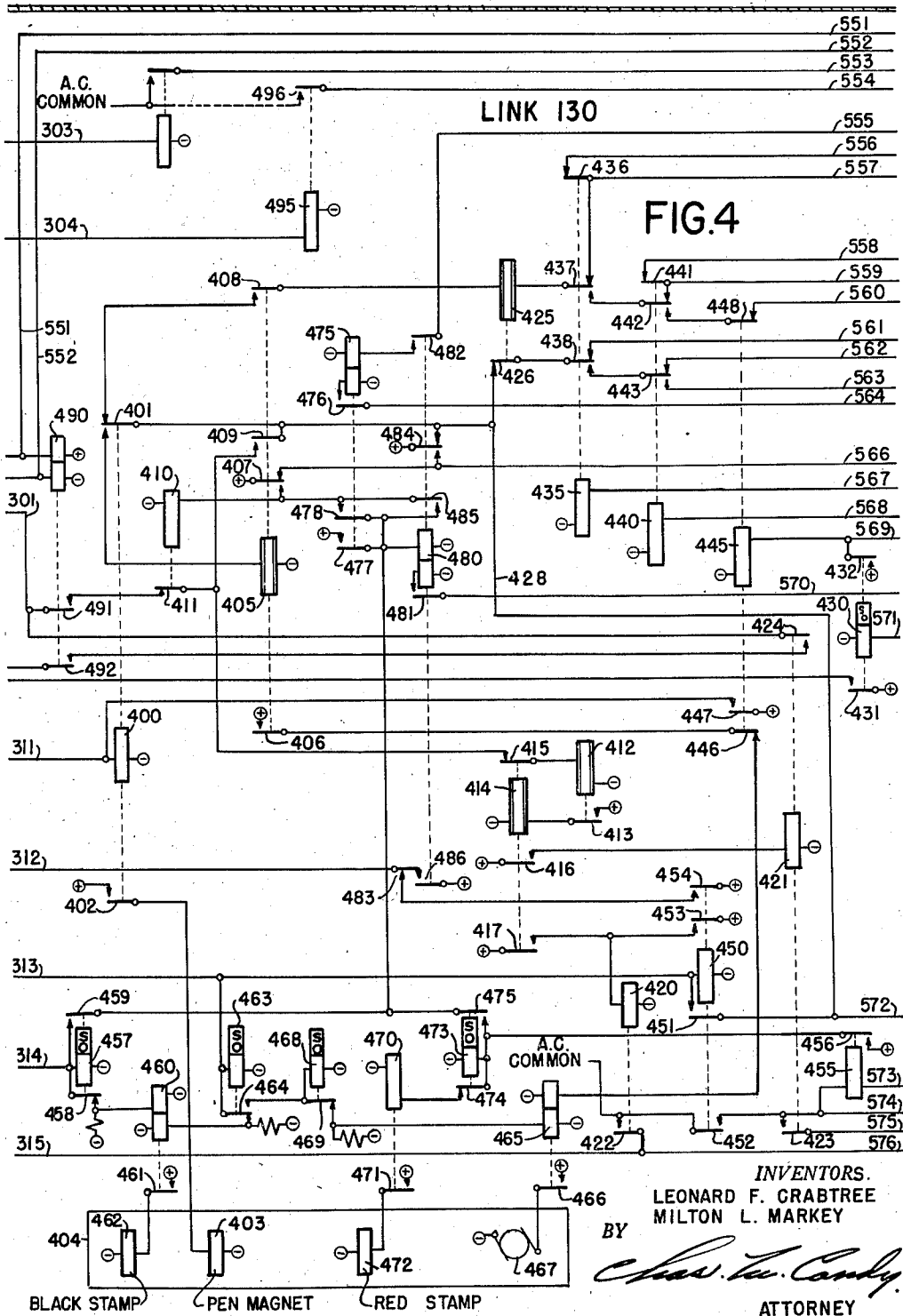
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SIGNALING SYSTEM

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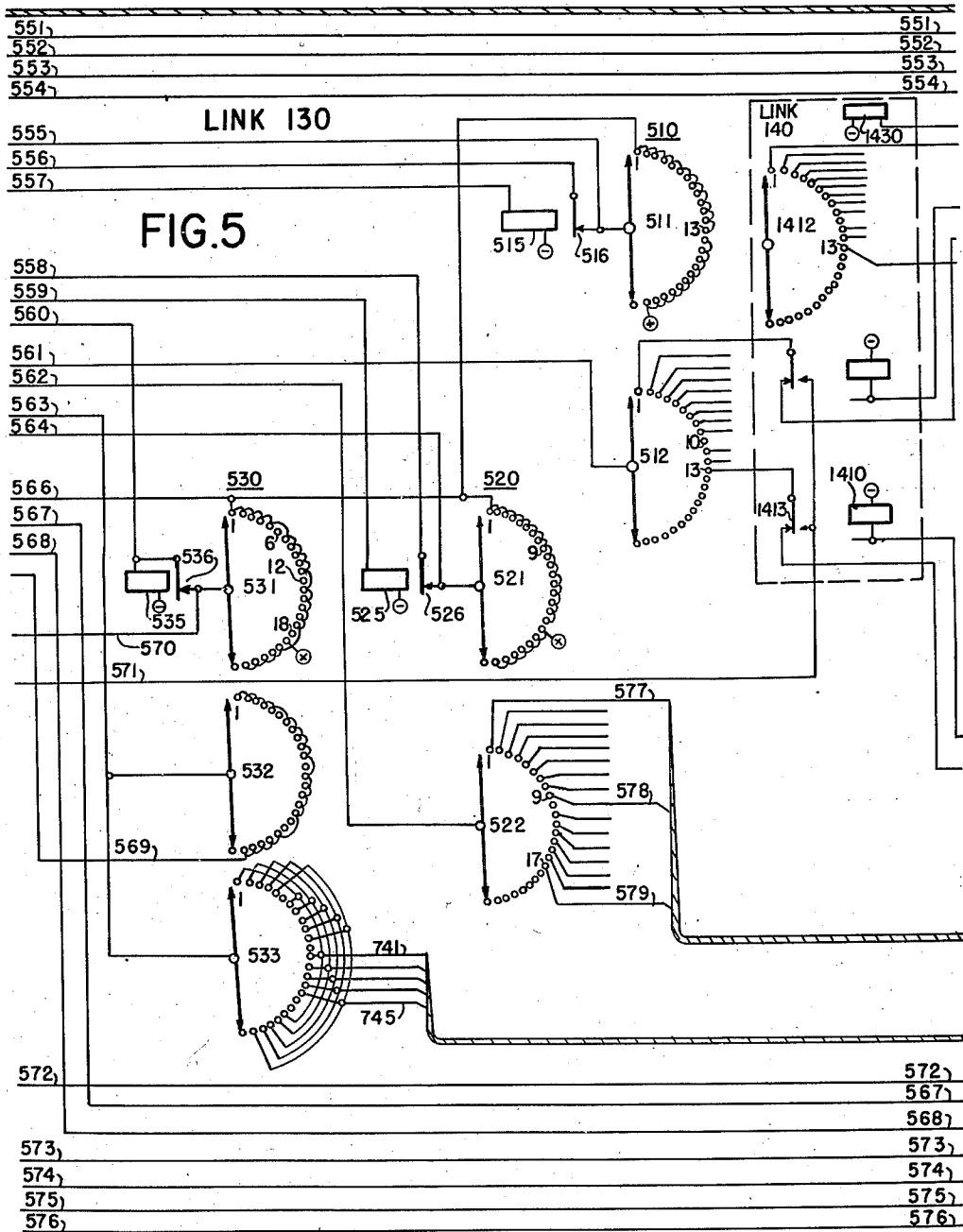
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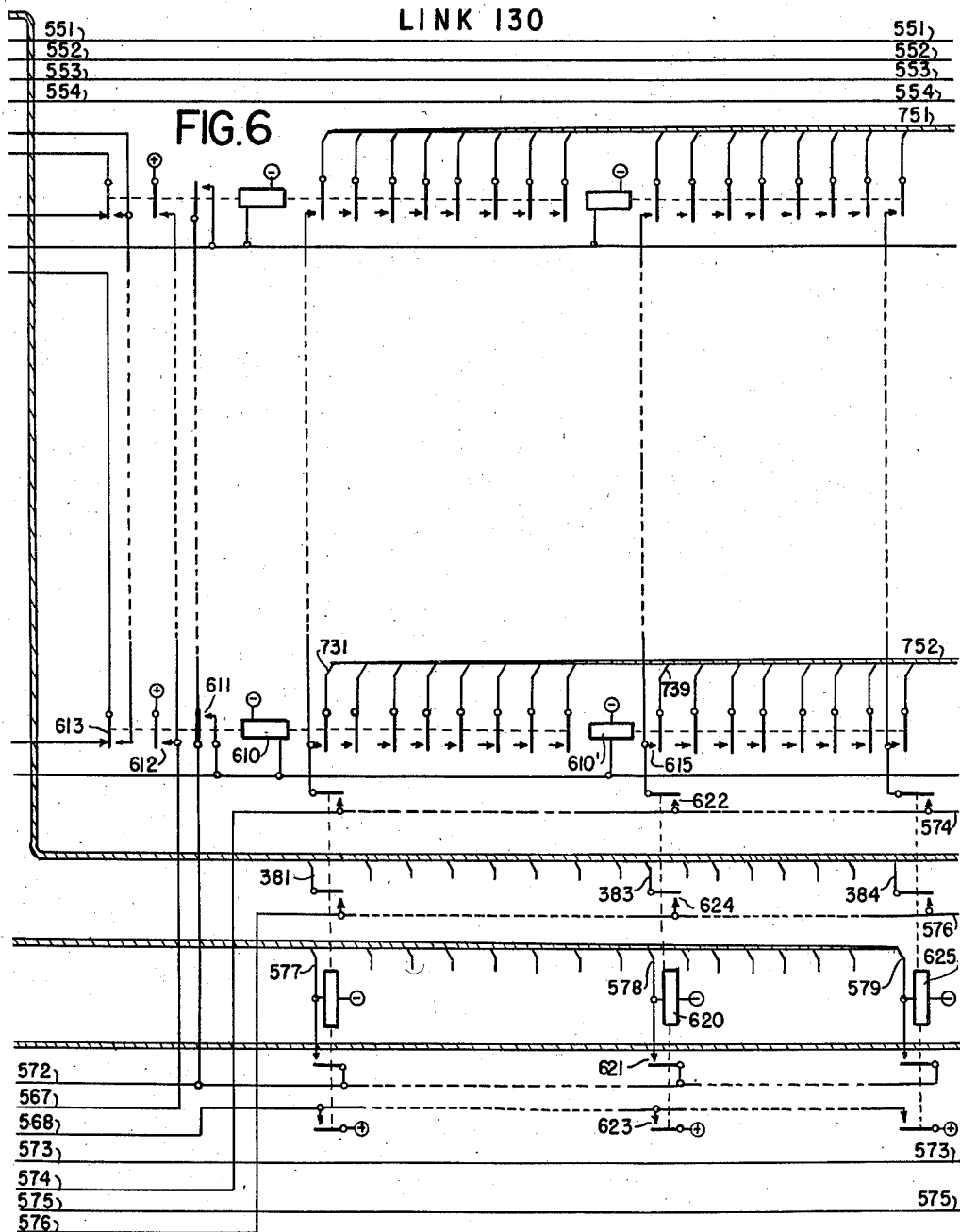
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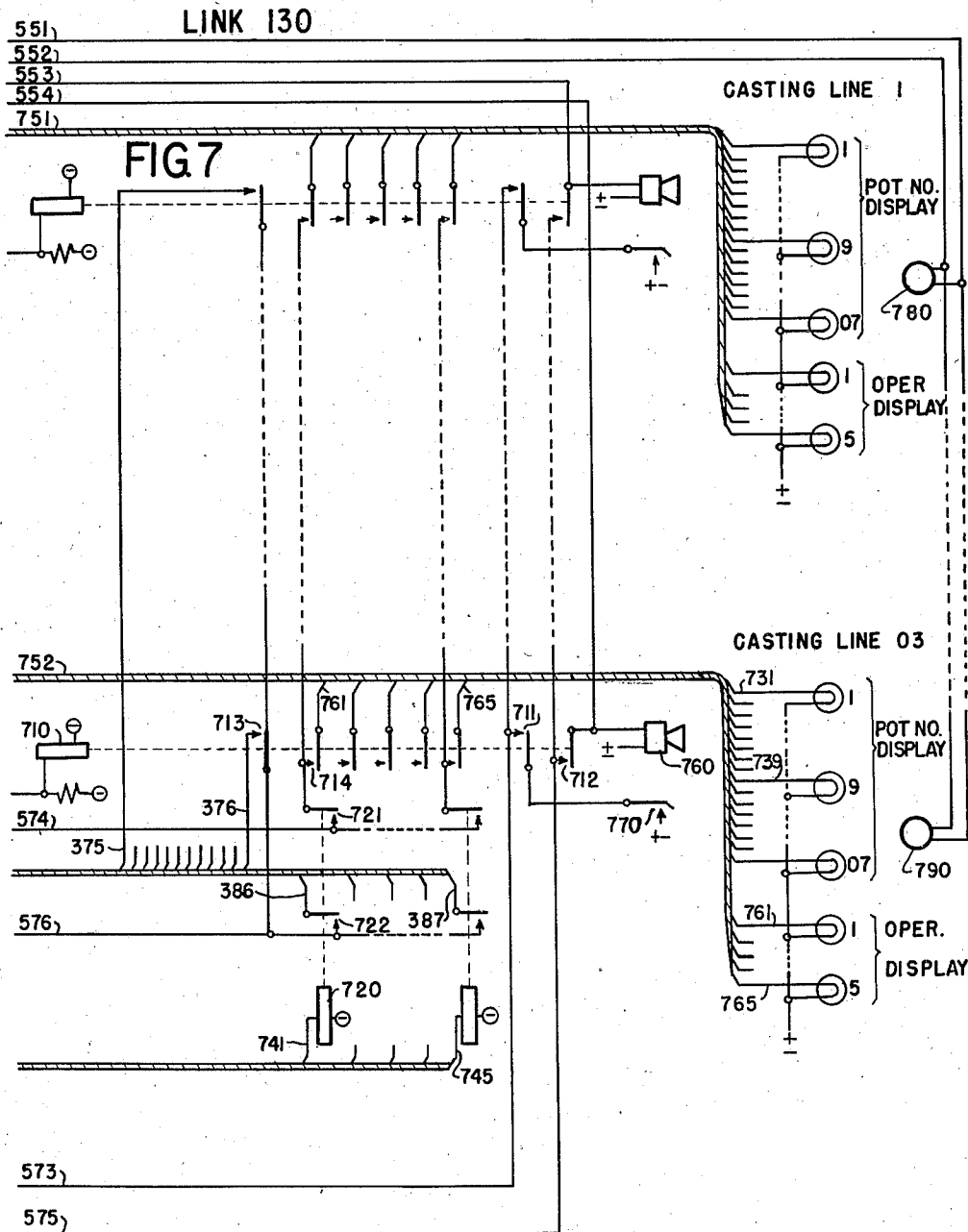
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6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,395,168

SIGNALING SYSTEM

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Application May 27, 1944, Serial No. 537,700

46 Claims. (Cl. 179—2)

The present invention relates in general to signaling systems, and more particularly to the use of such systems for producing displays of information at remote points.

It is an object of the invention to provide an improved system wherein a common control center can select display panels situated in different zones and cause any panel to display different items of information. Another object of the invention is the provision of a system of this character, wherein the information displayed upon the panel in any zone is based upon information received in the control center from that zone. Still another object is to provide a system of the character described, wherein a plurality of items of information, each selected from a larger group of items, may be displayed concurrently upon any one of said panels.

A further object of the invention is to provide, at the control center in such a system, a plurality of stations each capable of controlling the display panels in the manner indicated; another object is to provide facilities common to said stations whereby different ones of said stations may control different ones of said panels at the same time.

One feature of the invention resides in the improved circuit arrangement by means of which the common facilities are taken into use by any station at the control center. In accordance with another feature of the invention, the facilities employed to produce a display upon any panel may be released, and the display consequently wiped out, either under control of the station which caused the display to be produced or under control of means at the display panel itself. In accordance with still another feature, a register is operated differently to indicate in which of these ways the facilities have been released.

In accordance with another feature of the invention the information selected to be displayed is also displayed at the control center together with an indication of which remote panel has been selected to carry the display of that information; in accordance with a further feature, the display at the control center is produced first, and the information thereafter is displayed upon the selected remote panel only in response to a further manual operation than performed at the control center.

In accordance with another feature of the invention, arrangements are provided for registering the time at which a display upon any panel is initiated and the time at which the display thereafter is wiped out.

In accordance with still another feature of the invention, impulses are transmitted from a station at the control center to select the desired remote panel and to select the information to be displayed thereon. In accordance with a further feature, a permanent record of the selecting impulses is made, together with a permanent record of the time at which the selected display is actually produced at the remote panel, and the time at which the display is wiped out, the latter record being made in such a way as to indicate whether the display was wiped out from the control center or from the remote panel.

Another feature of the invention resides in the provision of a telephone system to supplement the display system, and in the provision of certain equipment common to both systems.

Other objects and features of the invention will appear from the following description taken in connection with the drawings in which:

Fig. 1 is a schematic diagram of the system,

Figs. 2A and 2B show sections of a paper tape marked by the recorder employed in the system, and,

Figs. 3 to 7, when assembled as shown in Fig. 8, comprise a detailed circuit diagram of the system. More particularly, Fig. 3 shows one of the stations at the control center and the line equipment individual thereto, as well as a pair of link seizure relays common to all such control stations and the lamp display panel individual to one link; Figs. 4, 5, 6 and 7 together show one of the links; and Fig. 7 also shows the lamp display panel and other equipment situated in each of two remote zones.

Referring to Fig. 1, the invention will be described as being applied to an arrangement for supervising and guiding the work done in a large foundry 200 from a centralized control room 100. Located in twelve different zones in the foundry are twelve casting lines numbered as shown. Each casting line is assumed to have sixteen individual furnaces or heating pots such as 105 in which metal is brought to the proper molten state to be poured into flasks for casting the desired objects. Because it is important for the metal to be at the proper temperature not only when it is poured but also at certain stages in the process of preparing it to be poured, each pot is connected to its own recording pyrometer, such as 410, which is mounted upon a common pyrometer panel 420 in the control room. Stationed in the control room are expert attendants who, guided by the pyrometers, decide how the

different pots should be treated, and instruct the foundry workers accordingly.

The instructions are given through the medium of lamp panels situated at the head of each casting line. The workers in any line thus may be directed to carry out any one of a group of predetermined operations (such as raising the pot temperature, lowering the pot temperature, pouring the metal, etc.) by displaying upon the panel at the head of that casting line a number or a legend indicative of the desired operation, and, at the same time, displaying a number indicative of the pot to which the instruction pertains.

The arrangements for controlling the lamp panels now will be outlined briefly. In the control room are five identical control stations 150, 160, 170, 180 and 190, each having an individual line circuit such as 151 over which access may be had to either of two links 130 or 140. The transitory operation of a key at any station will cause link 130 or link 140, whichever happens to be idle at the moment, to be seized, and will make that link temporarily inaccessible to the other four stations. At the same time a lamp identifying the seized link will be lighted at each station. This lets the operator know which link is under his control and also serves to keep the other attendants informed as to the availability or unavailability of links for their own use.

At the seizing station a dial or other impulse sender no will be operated to transmit to the link three numbers, one indicative of a particular casting line, another indicative of a particular pot in that line, and a third indicative of a particular operation to be performed with respect to that pot. Each of the first two numbers may consist of either one digit or two digits.

As each number is received the link causes that number to be registered upon a display panel in the control room, by intermittently flashing an appropriate lamp therein. It also selects certain lamps in the display panel at the head of the particular casting line whose number was dialled, but the lighting of these lamps is withheld pending the further operation of a key at the control station. When the operator thereafter actuates the latter key the lamps thus selected will light, displaying the pot number and the operation number which were dialled. The actuation of this key causes the link also to operate a horn or other audible signal at the head of the casting line in question, in order to call the attention of the foundry workers to the display. At the same time it changes the condition of the lighted lamps in the control room from flashing to steady, to inform the operator there that the equipment has functioned properly to bring up the display in the foundry.

The display in the foundry and in the control room will persist until the link is released. A foundry worker may bring about such release by operating a release key associated with the panel in which the display appears, whereupon the consequent wiping out of the display in the control room, accompanied by the extinguishment of the link seizure lamps at the five control stations, will signify to the operator in the control room the foundry worker's acknowledgment of the instructions transmitted. Alternatively, the link may be released by operating a release key at the control station; as a matter of fact the latter key is capable of releasing the link at any time after its seizure, and hence may also be employed, for example, to restore the link to normal before the operation has been

performed to bring in a display in the foundry, if the operator discovers that he has made a mistake in dialling.

Recording equipment under the control of the link makes a permanent record of the digits dialled, the time at which the display was initiated, and the time at which the link was released. It also indicates upon the record whether the release was initiated in the foundry or in the control room.

It will be clear that the provision of two links makes it possible for directions to be given to the workers in any two of the casting lines at the same time. Should an attempt be made, however, to so control one of the links as to cause a display to appear at any casting line at a time when the other link already is in use for a display at the same line, the attempt will be unsuccessful. This prevents any confusion from arising in the directions given to the foundry workers in that line.

With the aid of the circuits disclosed in Figs. 3 to 7, inclusive, the mode of operation now will be described more in detail. Referring to Fig. 3, the equipment shown to the left of the vertical dot-and-dash line is individual to station 150 in the control room, and it will be appreciated that identical equipment for each of the four remaining control stations is connected in multiple to the conductors 303 to 315, inclusive. Of the latter conductors, 311 to 315 extend to link 130, shown in detail in Figs. 4 to 7, inclusive, while the conductors 311' to 315' extend in corresponding fashion to link 140, as indicated. Relays 350 and 355 are common to all five control stations, the former relay being individual to link 130 and the latter being individual to link 140, as will be made clearer presently.

For purposes of explanation, it will be assumed that an operator in the control room wishes to transmit an instruction from station 150 to the foundry. To do so, he momentarily operates key 320 to its "start" position, whereupon, if link 130 is idle, relay 330 will operate over the following circuit: positive battery, contact 321, lower winding of relay 330, conductor 303, contact 351, and negative battery. Upon operating, relay 330 closes contacts 334, 335 and 336 to prepare circuits which extend over conductors 311, 312 and 313 to link 130. At contact 331 it completes a locking circuit for its upper winding, while at contact 332 it completes an energizing circuit for relay 350. Contact 333 opens the circuit to the lower winding of slow-to-operate relay 340.

Relay 350, upon operating, opens contact 351 to disconnect negative battery from common conductor 303, thereby to characterize link 130 as busy. This has no effect upon relay 330 which remains operated over its upper winding, but it prevents the corresponding relays for the four other control stations from being energized in the event that the "start" operation should now be performed at any of the latter stations.

It will be appreciated that, had link 130 been thus characterized as busy at the time key 320 was operated, relay 330 could not have operated over its lower winding as described, due to the absence of negative battery on common conductor 303. Under these circumstances if link 140 were idle, slow-to-operate relay 340 would operate after a delay, over the following circuit: positive battery, contacts 321 and 333, lower winding of relay 340, common conductor 310, contact 356, and negative battery. Thereupon con-

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tacts 344, 345 and 346 would be closed to prepare circuits to link 140. Contact 341 would complete a locking circuit for the upper winding of relay 340 while contact 342 would complete an obvious circuit for relay 355. The latter relay upon operating disconnects negative battery from common conductor 310 thereby to characterize link 140 as busy in the same way that relay 350 functions to characterize link 130 as busy.

It will be clear that whenever both links are in use, relays 350 and 355 both will be operated, making it impossible for any other control station to gain access to the links. If both links are idle at the time the "start" operation is performed at one of the stations, the lower windings of relays 338 and 340 in the line equipment individual to that station will be energized in parallel, but, being faster to operate, relay 330 will pull up and open the circuit to relay 340 at contact 333 before the latter relay can operate.

In the present instance it will be assumed that link 130 is idle. After the operation of relays 330 and 350 as described, nothing further will occur until key 320 is restored to its normal, or "dial," position. Upon such restoration the following circuit is completed: positive battery, contact 323, dial contact 325, contact 334, conductor 311, winding of relay 400, and negative battery. Relay 400 operates over this circuit and at contact 402 energizes a pen control magnet 403 in the recorder 404. At the same time it energizes slow-to-release relay 405 over the following circuit: positive battery, resting armature 484, operated armature 401, winding of relay 405 and negative battery. Relay 405 operates and at contact 406 completes a circuit extending over contact 446 and the upper winding of relay 465, whereupon the latter relay operates, closing contact 466 to initiate the operation of the motor 467 in the recorder 404.

The recorder is assumed to be of the well known type wherein the motor 467 by means of a sprocket drive moves a paper tape 201 (see Figs. 2A and 2B) under a pen which is adapted to be moved transversely of the tape by the pen control magnet 403. This causes the pen to trace upon the tape a line 202 (Fig. 2A) whose lateral position at any point along the tape's length indicates whether magnet 403 was energized or de-energized at that point. The recorder also includes a pair of clock-controlled time stamping mechanisms of well known character; one is actuated by the energization of magnet 462 to stamp the date and time in black ink on the tape above the line 202, while the other is actuated by energization of magnet 472 to stamp the date and time in red ink below the line 202.

Returning now to the operation of relay 405, this at contact 407 completes an obvious circuit for relay 410 which in turn opens contact 411. Contact 408 prepares a circuit to relay 425 while contact 409 completes the following circuit: positive battery, resting armature 484, contacts 409 and 415, winding of slow-to-release relay 412, and negative battery. Relay 412 operates over this circuit and at contact 413 completes an obvious circuit for slow-to-release relay 414. The latter relay upon operating opens the circuit for relay 412 at contact 415, causing relay 412 to restore after a delay; this in turn opens contact 413, causing relay 414 to restore after a further delay, whereupon at contact 415 relay 412 is reenergized. Relays 412 and 414 continue to interact in the manner described, whereby relay 414 alternately operates and releases in cyclic fashion.

Each time relay 414 operates it closes contacts 416 and 417, thereby to energize relays 420 and 421. Accordingly the latter relays operate and re-release in unison with relay 414. Relay 421 performs no useful function at this time, but relay 420, at contact 422, periodically connects alternating current to common conductor 315, causing the link seizure lamp 326 at station 150 (and the corresponding lamps at the remaining four stations) to flicker. This indicates to the operator at station 150 that link 130 is prepared to receive impulses from his dial, while it serves to inform the operators at other stations in the control room that link 130 is in use.

The operator now will dial the number of the casting line at the head of which is the display panel he wishes to control. For identification purposes the twelve lines are assigned the following numbers:

1	4	7	01
2	5	8	02
3	6	9	03

In the present instance it will be assumed that the operator dials the number "03" which is indicative of the last one of the twelve casting lines. Since this is a two digit number, two manipulations of the dial are required. Upon dialling "0" the impulse contact 325 momentarily interrupts the circuit for the relay 400 ten times in succession, and upon thereafter dialling "3" the circuit is interrupted three further times in succession.

When contact 325 opens for the first time, relay 400 restores to normal, causing contact 401 to complete the following circuit: positive battery, resting armatures 484 and 401, contact 408, winding of the slow-to-release relay 425, resting armature 437, conductor 557, rotary switch magnet 515, and negative battery. Relay 425 operates, opening contact 426, while magnet 515 operates to prepare the reverse drive switch 510 for its first step. When contact 325 recloses to terminate the first impulse, relay 400 reoperates and at armature 401 interrupts the above-traced circuit for relay 425 and magnet 515. The consequent deenergization of magnet 515 causes wipers 511 and 512 of rotary switch 510 to advance to contact 1 of their respective banks.

In similar fashion relay 400 responds to the subsequent nine impulses in the first train and repeats them to magnet 515, causing the switch wipers to be advanced step by step; concurrently, at contact 402, relay 400 repeats the incoming impulses to the pen control magnet 403, causing them to be recorded upon the tape driven by motor 467.

Upon each impulse, contact 401 momentarily interrupts the circuit for slow-to-release relay 405, but these interruptions are too brief to permit the relay to restore. Slow-to-release relay 425 likewise remains operated throughout reception of the train of impulses, but at the end of the train it restores to normal due to the prolonged opening of its circuit at armature 401. Accordingly contact 426 thereupon closes, connecting positive battery over resting armature 484, contacts 426 and 433 to wiper 512. In the present case wiper 512 will be standing upon contact 10 in its associated bank (ten impulses having been transmitted from the dial at control station 150) and, since no circuit is connected to this particular bank contact, the connection of positive battery to wiper 512 will be of no effect.

Upon the first interruption of its circuit in the second impulse train, relay 400 restores and as previously described energizes relay 425 in series with rotary switch magnet 515. This train contains three impulses which are repeated to magnet 515 by contact 401, causing the wipers of switch 510 to take three additional steps. At the end of the train relay 425 again releases due to the prolonged opening of its circuit at contact 401, and thereupon the following circuit is completed: positive battery, resting armature 484, contact 426, resting armature 438, conductor 561, wiper 512 in position 13, resting armature 1413, the windings of relays 610, 610' and 710 in parallel, and negative battery. Accordingly, these three relays operate. It will be appreciated that if the number of any other casting line had been dialled wiper 512 would have stopped in such a position as to operate another set of relays identical to 610, 610' and 710, there being twelve such sets, of which only the first and last set are shown.

Link 140 (illustrated in part in Fig. 5) has twelve similar sets of relays which are adapted to be operated selectively over wiper 1412 in the same way the twelve sets in link 130 are selected and operated over wiper 512. Corresponding sets of relays in the two links are so interlocked that a particular set in one link cannot operate if its corresponding set in the other link is already in operated condition. If, for instance, the above-described seizure and transmission of the digits "0" and "3" to link 130 had been preceded by the seizure and transmission of the same two digits to link 140 under control of another station, relay 1410 (corresponding to relay 610 in link 130) would already be operated when relay 425 restored to normal at the end of the second digit received by link 130. Accordingly, the closing of contact 426 would not operate relay 610, 610' and 710 in the manner indicated above, due to the circuit for this set of relays being open at armature 1413; instead the following circuit would be completed: positive battery, resting armature 484, contact 426, resting armature 438, conductor 561, wiper 512 in position 13, operated armature 1413, conductor 571, winding of relay 430, and negative battery. Relay 430 upon operating would close contact 431 to sound the buzzer 365, while at contact 432 it would complete an obvious circuit for relay 445. The latter relay upon operating would close contact 447, locking up relay 400 to prevent any further control thereof by dial contact 325. At contact 446 the circuit for relay 465 would be opened causing the latter relay to release and halt the motor 467 of the recorder by opening contact 466.

Hearing the buzzer 365, the operator at station 150 would know that his attempt to reach the display panel for line 03 had been blocked due to that panel being under control of another station. Under such circumstances he ordinarily will then operate release key 390 whereupon the release of link 130 will take place in a manner hereinafter to be described. Alternatively, however, he may elect to hold link 130 until the display panel for line 03 becomes accessible to him; this will occur when, incident to the release of link 140, relay 1410 restores to normal. Thereupon, contact 1413 completes the above-traced circuit for relays 610, 610' and 710, and at the same time interrupts the circuit for relay 430, causing the buzzer 365 to cease sounding and causing relay 445 to release. The latter relay

opens contact 447 to place relay 400 again under control of the dial contact 325 and at contact 446 reoperates relay 465 to cause the motor 467 to resume operation.

In the present instance it will be assumed that link 140 is idle, or, if in use, is being used to produce a display before some casting line other than line 03. Accordingly relay 1410 is at normal, and, upon the release of relay 425 after the second digit has been received by link 130, relays 610, 610' and 710 operate as described. Relays 610 and 610' prepare circuits extending via cable 752 to sixteen lamps in the "pot number" display panel at the head of line 03, while relay 710 prepares circuits extending via cable 752 to five lamps in the "operation" display panel at the head of the same line. Contact 613 upon operating disconnects the thirteenth contact in bank 1412 from relay 1410 and connects it to relay 1430 (which corresponds to relay 430 in link 130); this bars link 140 from reaching the display panel at the head of casting line 03 until after link 130 has been released. Contact 611 completes the following locking circuit: positive battery, resting armature 484, conductors 428 and 572, contact 611, the windings of relays 610, 610' and 710 in parallel, and negative battery. At contact 612 the following circuit is completed: positive battery, contact 612, conductor 567, winding of relay 435 and negative battery. The latter relay by switching over its contacts prepares link 130 for the reception of the pot number from station 150. Although contact 438 opens the original operating circuit for relays 610, 610' and 710, these relays remain energized over the above-traced locking circuit.

At contacts 711 and 712, relay 710 prepares circuits for the horn 760 and the release key 770 at the casting line 03. Contact 713 completes the following circuit: alternating current source, the intermittently operated contact 422, conductor 576, contact 713, conductor 376, and lamp 03 in the "line number" display panel in the control room. This lamp flashes in accordance with the interruptions of its circuit by contact 422.

The operator now will dial the number of some one of the pots in the casting line. For identification purposes the sixteen pots in each line are assigned the following numbers:

1	5	9	04
2	6	01	05
3	7	02	06
4	8	03	07

It will be assumed that the operator dials the number "9". Relay 400 responds to the impulses from dial contact 325 as before, and upon its first deenergization completes the following circuit: positive battery, resting armatures 484 and 401, contact 408, winding of relay 425, operated armature 437, resting armature 442, conductor 559, magnet 525 of the reverse drive switch 520, and negative battery. Over this circuit, relay 400 repeats the received impulses to magnet 525, causing switch 520 to take nine steps. Slow-to-release relay 425 operates in series with magnet 525 upon the first impulse of the train, and remains operated until the prolonged opening of its circuit by armature 401 at the close of the train. When it releases it completes the following circuit: positive battery, resting armature 484, contact 426, operated armature 438, resting armature 443, conductor 562, wiper 522 in position 9, conductor 578, winding of relay 620, and

negative battery. Relay 620 operates, and at contact 621 completes the following locking circuit for itself: positive battery, resting armature 484, conductors 428 and 572, contact 621, winding of relay 620 and negative battery.

It will be clear that if, instead of the digit "9," the number of some other pot, such as "07," had been dialled, no circuit would have been completed over wiper 522 at the end of the first digit since the tenth contact in the bank accessible to that wiper is blank; upon the dialling of the digit "7" however, a circuit would have been completed over wiper 522 and conductor 579 to operate relay 625.

Returning to the operation of relay 620, this at contact 622 prepares a circuit over operated contact 615 and conductor 739 for lamp 9 in the "pot number" display panel for casting line 03. Contact 623 completes an obvious circuit over conductor 568 for operating relay 440, which thereupon switches over its contacts in preparation for the reception of the "operation" number from station 150. Relay 440 also opens the original operating circuit for relay 620 at contact 443, but relay 620 remains energized over its locking circuit. At contact 624 the following circuit is established: alternating current source, interrupter contact 422, conductor 576, contact 624, conductor 383, and lamp 9 in the "pot number" display panel in the control room. Lamp 9 therefore flashes in accordance with the interruptions of its circuit by contact 422.

The operator now will dial any digit from 1 to 5, depending upon which one of five predetermined operations he wishes to have performed with respect to the pot whose number has been transmitted. Assuming that he dials the digit "1," the impulse contact 325 will open a single time, causing relay 460 to release briefly and then resume its operated position. Upon the release of relay 460, the following circuit is completed: positive battery, resting armatures 434 and 491, contact 409, winding of relay 425, operated armatures 437 and 442, contact 448, conductor 569, rotary switch magnet 535 and negative battery. Relay 425 and magnet 535 operate. When armature 491 reopens this circuit at the end of the impulse, magnet 535 deenergizes causing the reverse drive switch 530 to advance to position 1. A moment later slow-to-release relay 425 restores to normal, completing the following circuit: positive battery, resting armature 484, contact 426, operated armatures 438 and 443, conductor 563, wiper 532 in position 1, conductor 569, winding of relay 445, and negative battery. Relay 445 thereupon operating opens contact 446 to release relay 465, which relay in turn opens contact 466 to halt the motor 467 of the recorder; contact 447 also closes, thereby locking up relay 490 to prevent any further operation thereof by the dial contact 325. Contact 448 opens the circuit to magnet 535.

The restoration of relay 425 to normal also completes the following circuit: positive battery, resting armature 484, contact 426, operated armatures 438 and 443, conductor 563, wiper 532 in position 1, conductor 741, winding of relay 720, and negative battery. Relay 720 operates and at contact 721 prepares a circuit over operated contact 714 and conductor 761 for lamp 1 in the "operation" display panel for casting line 03. Contact 722 completes the following circuit: alternating current source, interrupter contact 422, conductor 576, contact 722, conductor 386, and lamp 1 in the "operation" display panel in the

control room. This lamp flashes in accordance with the interruptions of its circuit at contact 422.

In the display panel at the control room, the following lamps now are flashing:

Line lamp	-----	63
Pot lamp	-----	9
Operation lamp	-----	1

Verifying the correctness of the numbers dialed from these lamps the operator now will momentarily move key 320 to its "display" position. This connects positive battery over contacts 322 and 336 to conductor 313, thereby energizing relays 450, 460 and 463 in parallel. Relay 460 operates more quickly than slow-to-operate relay 463, but when relay 463 pulls up after a brief delay, it opens the circuit for relay 460 at contact 464, causing the latter relay to restore. The momentary energization of relay 460 causes contact 461 to deliver an impulse to the time stamp magnet 462, whereupon the time that the display was initiated is stamped in black ink upon the tape. Upon operation, contact 464 connects the positive battery on conductor 313 to the windings of relays 455 and 463 in parallel. Relay 455 operates first and when slow-to-operate relay 463 pulls up after a brief delay it opens the circuit for relay 455 at contact 463, causing the latter relay to restore. The brief operation of relay 455 causes contact 465 to energize the motor 467 just long enough to advance the tape in recorder 464 a sufficient distance to insure that, in the event magnet 462 now should be reoperated in a manner presently to be described, the two records will not occur at the same point on the tape.

Responsive to the aforesaid connection of positive battery to conductor 313, relay 450 operates and at contact 451 completes the following circuit: positive battery, resting armature 464, conductor 428, and contact 451 to conductor 313. This locks up relay 450 and insures that the above-described operations of relays 460, 463, 465 and 463 will be carried out even in the event that the original source of positive battery on conductor 313 should be disconnected therefrom (either at key contact 322, or, in a manner to be described, at contact 336) before such operations are complete. Contact 452 connects alternating current to conductor 574 and thence over contact 622, contact 615, and conductor 739 to lamp 9 in the "pot number" display panel for casting line 03; the alternating current connected to conductor 574 also extends over contact 721, to conductor 714 and conductor 761 to lamp 1 in the "operation" display panel for line 03. Accordingly these two lamps light.

At the same time, a circuit is completed from the alternating current source over contact 452, interrupter contact 423, conductor 575 and contact 712, to horn 760, causing the horn to sound intermittently in accordance with the interruptions of its circuit by contact 423. Contact 453 locks up relay 420 which at contact 422 now maintains alternating current connected steadily to conductors 315 and 576, thereby to change the condition of the link seizure lamps such as 326 and the three lighted lamps in the display panel in the control room, from flashing to steady.

Relay 450 also completes the following circuit: positive battery, contact 454, contact 483, conductor 312, contact 335, winding of relay 360 and negative battery. Relay 360 thereupon operates. At contact 362 it locks up independently of con-

tact 335, while at contact 363 it prepares a release circuit for link 130. Contact 361 connects positive battery to conductor 397 to maintain relay 350 operated, and at the same time interrupts the holding circuit for relay 330. The latter relay accordingly restores to normal, but this has no present effect upon the rest of the system, since relay 350 is locked up at contact 361, relay 400 is locked up at contact 447 and relays 463 are locked up via contact 451, conductor 428, and contact 484.

At the casting line 03, a foundry worker, hearing the horn 760, will take notice of the display and perform the operation indicated thereby upon pot 9. The link now may be released either under control of the operator at station 150 or under control of the worker at line 03. Assuming first that the foundry worker wishes to release the link, he will operate key 770, thereby completing a circuit which extends over contact 711, conductor 573, winding of the alternating current relay 455 and contact 452 to the A. C. source. Relay 455 operates, and at contact 456 establishes an obvious circuit for the windings of relays 470 and 473 in parallel. Relay 470 operates more quickly than slow-to-operate relay 473, but when the latter pulls up it interrupts the circuit for relay 470 at contact 474, causing relay 470 to restore. This momentary energization of relay 470 causes contact 471 to deliver an impulse to the time stamp magnet 472, which thereupon records upon the tape in red ink the time at which release of the link was initiated. At contact 475 the following circuit is completed: positive battery, contacts 456 and 475, upper winding of relay 480, and negative battery.

Relay 480 operates, opening contact 483 and closing contact 486 to maintain relay 360 operated independently of contact 454. Contact 484 completes the following circuit: positive battery, operated armature 484, conductor 566, wiper 511 in position 13, conductor 555, contact 482, upper winding of relay 475, and negative battery; relay 475 thereupon operates and locks up over contact 476, conductor 564, wiper 521 in position 9, conductor 566, and operated armature 484. Contact 477 completes obvious holding circuits for relays 400, 410 and 473. Contact 484 also establishes the following circuit: positive battery, operated armature 484, conductor 566, wiper 531 in position 1, interrupter contact 536, magnet 535, and negative battery. Magnet 535 operates self-interruptedly in this circuit, driving switch 530 step by step until it reaches position 6; throughout this movement of the switch the lower winding of relay 480 is energized over contact 461 and conductor 570, from the positive potential encountered by wiper 531 on its associated bank. The potential will not be encountered, however, when wiper 531 reaches contact 6, hence the switch thereupon comes to a halt and the lower winding of relay 480 becomes deenergized. Relay 480 now remains operated over its upper winding alone.

The operation of contact 484 opens the circuits for relays 405, 412, 445, 450, 463, 468, 620, 610, 610', 710 and 720, causing these to restore to normal. Relay 445 opens contact 447, whereupon relay 400 also restores to normal; contact 446 closes a brief interval before contact 406 of the slow-to-release relay 405 is opened, and hence relay 465 is momentarily reoperated. This at contact 466 briefly reenergizes motor 467, which thereupon advances the tape a short distance. When relay 412 releases due to the opening of

its circuit by contact 484; it causes the interaction between relays 412 and 414 to cease, and relay 414 permits relays 420 and 421 to restore to normal. Relay 610, upon releasing, opens the circuit for relay 435 at contact 612, while at contact 613 at once more conditions link 140 to extend a connection to the display panel for casting line 03. At contact 623, relay 620 opens the circuit for relay 440, and at contact 711 relay 710 opens the circuit for relay 455. Relays 435, 440 and 455 therefore release.

Upon returning to normal, relay 435 completes the following circuit: positive battery, operated armature 484, conductor 566, wiper 511 in position 13, interrupter contact 516 of magnet 515, conductor 556, contact 436, conductor 557, magnet 515 and negative battery. The magnet energizes, opening its own circuit at contact 516, and thereupon advances the switch wipers to position 14. There, wiper 512 encounters positive battery connected in multiple to contacts 14 to 24, inclusive, and hence the switch continues to operate self-interruptedly until its wipers reach position 25, where it halts.

Relay 440 upon returning to normal completes the following circuit: positive battery, operated armature 484, conductor 566, wiper 521 in position 9, interrupter contact 526 of the magnet 525, conductor 553, contact 441, conductor 553, magnet 525, and negative battery. Magnet 525 operates self-interruptedly in this circuit, hence switch 520 is advanced step-by-step until wiper 521 reaches position 25, where the switch halts.

When switches 510 and 520 both have reached their twenty-fifth position, relay 475 restores to normal, since now the circuit for its upper winding is open at wiper 511 and the circuit for its lower winding is open at wiper 521. Accordingly contact 477 opens, causing relays 480, 410 and 473 to release. All of the relays and rotary switches in the link now occupy their normal positions, it being understood in the case of switch 530 that positions 6, 12, 18 and 25 are all home positions. The link seizure lamps, such as 326, and the display lamps in the control room and in the foundry all have been extinguished due to the opening of their respective circuits by various ones of said relays upon release; and horn 760 has been silenced by the opening of its circuit at contacts 712, 423 and 452.

Upon the restoration of relay 480 to normal, contact 486 opens the circuit for relay 360. This relay releases, and at contact 361 opens the circuit for relay 350 which thereupon also returns to normal. Accordingly contact 351 reconnects negative battery to common conductor 308, which has the effect of making link 130 again accessible to all five of the control stations. Seizure and control thereof in the manner described above therefore now may be repeated.

As an alternative to the mode of release set forth above, the link may be released under control of the operator at station 150. For this purpose a two-way release key 390 is provided at the station. In order to release link 130, the key will be moved downward, closing contacts 391 and 392. The latter contact will have no effect in the present instance, but at contact 391 the following circuit is completed: positive battery, contact 391, contact 363, conductor 314, windings of relay 457 and 460 in parallel, and negative battery. Relay 460 operates more quickly than slow-to-operate relay 457, but when relay 457 pulls up it causes relay 460 to release by opening

contact 458. The momentary energization of relay 460 causes contact 461 to deliver an impulse to time stamp magnet 462 which thereupon records, in black ink, the time at which the release was initiated. At contact 459 the following circuit is completed: positive battery, contacts 391 and 363, conductor 314, contact 459, upper winding of relay 480, and negative battery. Relay 480 operates and, as hereinbefore explained, brings about the restoration to normal of switches 510, 520 and 530 and the release of relays 400, 405, 412, 414, 420, 421, 435, 440, 445, 450, 463, 468, 475, 620, 610, 610', 710 and 720. Relay 457 remains operated until key 390 and relays 475 and 495 all return to normal, then it too releases. When key 390, switch 530, and relays 405 and 475 all have returned to normal, relay 480 releases, causing relays 410, 360 and 350 to restore as previously described. This places the link in condition to be seized by any control station and used once more to produce a display before any desired casting line.

Fig. 2A shows a section of tape 201 containing the record produced by recorder 404 in response to the dialling of the digits 0391, as described, followed by the operation of the display key and then, after an interval, by the operation of the release key at station 150. Each received impulse appears as a tooth extending downwardly from the base line 202, traced by the pen, and it will be self-evident that the first group contains ten impulses (corresponding to the digit "0"), the second group contains three impulses, and so on. Both legends following the last recorded impulse are made by the time stamping mechanism controlled by magnet 462, the first legend indicating the time at which the display was initiated, while the second indicates the time of release. The fact that the time of release is recorded in the same color (black) and on the same side of line 202 as the time of display, indicates that the link was released under control of station 150. If the link is released under control of the key associated with the display panel in the foundry, the record will be identical to that shown in Fig. 2A except that the second legend will be stamped by magnet 472, and hence will be in a different color and positioned below the line 202, as shown in Fig. 2B.

It will be observed that release key 390 may also be employed to release the link at any time before a display has been produced by it in the foundry. Assume, for instance, that the link has just been seized, and that the operator, without yet having dialled any digits, wishes to release. Relays 330, 350, 400, 405, 410, 465 are energized, while relays 412, 414, 420 and 421 are operating intermittently as described. Upon operation of key 390 to release link 130, the following circuit is completed: positive battery, contacts 392 and 336, conductor 313, windings of relays 450, 460 and 463 in parallel, and negative battery. Relay 460 operates, and then after a brief interval restores to normal upon the opening of contact 464, when the slow-to-operate relay 463 pulls up. The momentarily closing of contact 461 causes time stamp magnet 452 to record the time. The operation of contact 464 connects positive battery to relay 468 which energizes but produces no useful effect at this time.

Relay 450, upon operation, at contact 451 completes the following locking circuit: positive battery, resting armature 434, conductor 428, contact 451, windings of relays 450, 463 and 468 in parallel, and negative battery. Contact 453 locks

up relay 420, which at contact 422 changes the condition of lamp 326 from flashing to steady. Contact 454 completes an obvious circuit over contact 403, conductor 312 and contact 335 for operating relay 360. Relay 360 locks itself up at contact 362, while at contact 361 it locks up relay 350 and opens the circuit for relay 330. The latter relay upon restoring to normal opens contact 334 and consequently relay 400 also releases. This initiates the release of relay 405 by opening its circuit at contact 401.

Meanwhile, returning to a consideration of the operation of relay 360, contact 363 completes the following circuit: positive battery, contacts 391 and 363, conductor 314, the windings of relays 457 and 460 in parallel, and negative battery. Relay 460 operates and then, after a brief interval, restores to normal due to the opening of its circuit at contact 458 when slow-to-operate relay 457 pulls up. The momentary operation of contact 451 causes time stamp magnet 462 again to record the time. Upon operating, relay 457 also completes a circuit from positive battery on conductor 314 over contact 459 to energize relay 480.

Relay 480 operates, and, if the release of relay 405 has not yet taken place, locks up over contact 485 to positive battery on contact 407. Contact 483 is opened, and contact 486 closed to maintain relay 360 operated independently of contact 454. The operation of contact 484 opens another point in the circuit of relay 405, and opens the circuit for relays 412, 450, 463, and 468. When relay 412 releases due to the opening of contact 484, it causes the interaction between relays 412 and 414 to cease, and relay 414 permits relays 420 and 421 to restore to normal.

Relay 457 releases responsive to the opening of its circuit at contact 391 when release key 390 is restored to normal. When key 390 and relay 405 both are at normal, relay 430 releases, causing relays 410, 360 and 350 also to release as previously described. Link 130 having thus been restored completely to normal, now is once more accessible to all control stations.

In the event that release key 390 is operated to restore link 130 to normal after part or all of the digits have been transmitted to it, but before key 320 has been operated to its "Display" position, the release will take place in substantially the same way as just described, the only difference being due to the fact that when release key 390 is operated one or more of the switches 510, 520 and 530 will be off-normal, one or more of the relays 435, 440 and 445 will be operated, and certain of the relays in Figs. 6 and 7 will have been selected and operated. All of these latter devices will be returned to normal under control of relay 480 in the manner hereinbefore explained.

Associated with the display facilities described above is a direct line telephone system by means of which any station in the control room may communicate with any casting line in the foundry. This permits the instructions given via the lamp panels to be supplemented by verbal instructions whenever necessary, and it enables the foundry workers to inform operators in the control room of any circumstances arising which may demand special attention.

Each station in the control room has a set of twelve selections keys numbered to correspond to the twelve casting lines. If the operator at station 150 should wish to talk to a worker at line 03, for example, he will lift the handset 395 from its cradle and momentarily operate selection key

398. Contact 396 bridges the telephone set across conductors 365 and 306, thereby causing battery feed relay 499 to operate in the usual way, but the consequent closing of contacts 491 and 492 has no effect. Key 398 connects positive battery to conductor 304, operating relay 495. Relay 495 in turn connects alternating current over contact 496 and conductor 554 to horn 760 at casting line 03. Hearing the horn sound, a worker will answer the call by means of the usual telephone instrument, shown schematically at 790. Both the calling station and the called station are supplied with talking current via the windings of battery feed relay 490, which will, of course, return to normal when both stations hang up.

On the initiation of a call from the foundry, the bridging of the telephone equipment at the calling station (for example, 790) across conductors 551 and 552 causes battery feed relay 490 to operate. Assuming that link 130 is not at the time in use for display purposes, the following circuit will be completed upon operation of relay 490: positive battery, contact 397 of the hook-switch at station 150, the corresponding hook-switch contacts 397a, 397b, 397c and 397d at the other four control stations, conductor 301, contacts 491, 411 and 415, winding of relay 412, and negative battery. Relay 412 energizes and operates relay 414, whereupon relays 412 and 414 interact in the manner previously described. Upon each operation, relay 414 closes contacts 416 and 417, causing relays 420 and 421 to operate and release in unison with relay 414. Contact 422 connects alternating current periodically to conductor 315, causing lamp 326 and the corresponding lamps at the four remaining control stations to flicker. The following circuit also is completed: positive battery, contacts 397, 397a, 397b, 397c, 397d, conductor 301, interrupter contact 424, contact 492 and gong 366. Accordingly the gong sounds intermittently in accordance with the interruptions of its circuit by contact 424.

The call may be answered at any one of the control stations. Assuming that an operator, hearing gong 366, answers the call at station 150, it will be observed that contact 397 opens the circuit for the gong when the handset 395 is lifted, thereby causing it to be silenced; contact 397 also opens the circuit for relay 412, whereupon the interaction between relays 412 and 414 ceases, and relays 420 and 421 restore to normal. The calling and called stations now are in direction connection, their respective telephone instruments being supplied with talking current over the windings of battery feed relay 490.

If, in the above case, link 130 had been in use for display purposes at the time the call was instituted from the foundry, the operation would have been the same as described except that, due to contact 411 being open, the functioning of relays 412, 414, 420 and 421 would not have been initiated by the closing of contact 491 nor halted by the opening of contact 397. These four relays would be functioning prior to the closing of contact 491, (due to a circuit for relay 412 which extends over contacts 484 and 409) and they would continue so to function after contact 397 opened. The energization of relay 490 would, however, by closing contact 492 initiate the intermittent operation of gong 366 as described, while contact 397 of the hook-switch at station 150 would silence the gong when handset 395 was lifted.

Having fully described the invention, what we

consider new and desire to protect by Letters Patent will be set forth in the appended claims.

What is claimed is:

1. In a signaling system, a primary station, a plurality of secondary stations, a display panel at each of said stations, switching equipment under the control of said primary station operated to select any desired one of said secondary stations and to condition the panel at the selected secondary station to display any particular one of a plurality of different items of information, check-back means in said equipment operated to cause the panel at said primary station to display an identification of the selected secondary station and the selected item of information, and means thereafter operated responsive to a manual operation performed at the primary station for causing said conditioned panel to display said selected item of information.
2. In a signaling system as claimed in claim 1, means at said selected secondary station operated at times to wipe out the display at that station.
3. In a signaling system as claimed in claim 1, means whereby the display at the selected secondary station can be wiped out under the control of either the primary station or the selected secondary station.
4. In a signaling system, a primary station, a plurality of secondary stations, a display panel at each of said stations, means under the control of said primary station operated to register the identity of any desired one of said secondary stations, other means under the control of said primary station operated to register any desired one of a plurality of different items of information, means controlled by said first registering means for conditioning the panel at said one secondary station to produce a display, other means controlled by said two registering means to cause the panel at said primary station to display both the identity of said one secondary station and said one item of information, and means at said primary station operated at will after said display thereat for causing said conditioned panel to display said registered item of information.
5. In combination with a plurality of groups of devices, each group being situated in a different zone and each device having a particular variable characteristic, a remote station, means at said station controlled by said devices to register the variations in said characteristic of each device, and means at said station controlled in accordance with the registered variations in said characteristic of any particular device for selecting the zone in which that device is located and causing a plurality of items of information to be displayed in that zone, one of said items being an identification of said particular device and another of said items varying in accordance with the registered characteristic of said particular device.
6. In a signaling system, a plurality of primary stations, a plurality of secondary stations, a plurality of groups of devices at each of said secondary stations, switching equipment common to all of said stations, means at each primary station for at times seizing said equipment and operating it to select any desired one of said secondary stations and also to select any desired device in each of said groups at the selected secondary station, and means in said equipment operated responsive to a single manual operation thereafter performed at the primary station by which said equipment was seized for operating all of the selected devices at the selected secondary station without oper-

ating any of said devices at any other secondary station.

7. In a signaling system, a primary station, a plurality of secondary stations, a plurality of groups of devices at each of said secondary stations, switching equipment under the control of said primary station operated to select any desired one of said secondary stations and also to select any desired device in each of said groups at the selected secondary station, means at said primary station controlled by said equipment to display the identity of the selected secondary station and also the identity of the selected device in each of said groups, and means in said equipment operated responsive to a single manual operation thereafter performed at said primary station for operating all of the selected devices at the selected secondary station.

8. In a signaling system, a calling station, a plurality of called stations, a plurality of groups of devices at each of said called stations, switching equipment under the control of said calling station operated to select any desired one of said called stations and also to select any desired device in each of said groups at the selected called station, means in said equipment for transmitting to said calling station an identification of the selected called station and an identification of the selected device in each of said groups, and means in said equipment operated responsive to a single manual operation thereafter performed at said calling station for operating all of the selected devices at the selected called station.

9. In a signaling system, a plurality of calling stations, a plurality of called stations, a plurality of groups of devices at each of said called stations, switching equipment common to all of said stations, means at each calling station for at times seizing said equipment and operating it to select any desired one of said called stations and also to select any desired device in each of said groups at the selected called station, means in said equipment for transmitting to said calling station an identification of the selected called station and an identification of the selected device in each of said groups, and means in said equipment operated responsive to a single manual operation thereafter performed at said calling station for operating all of the selected devices at the selected called station.

10. In a signaling system, a plurality of calling stations, a plurality of called stations, a plurality of groups of devices at each of said called stations, a pair of links each common to all of said stations, means at each calling station for at times seizing an idle one of said links and operating it to select any desired one of said called stations and also to select any desired device in each of said groups at the selected called station, and means in the seized link operated responsive to a single manual operation thereafter performed at the seizing station for operating all of the selected devices at the selected station without operating any other of said devices either at the selected station or at any other called station.

11. In a signaling system as claimed in claim 10, means in each link effective, responsive to that link being operated to select any one of said called stations, to temporarily so disable the other link that said other link cannot operate any of the devices at the called station selected by said first link but can operate any of the devices at any of the other called stations.

12. In a signaling system as claimed in claim 10, means in each link effective, responsive to

that link being operated to select any one of said called stations, to temporarily so disable the other link that said other link cannot operate any of the devices at the called station selected by said first link but can operate any of the devices at any of the other called stations, and a signal operated by said other link in the event that it is seized and operated to select the same called station which has been selected by said first link while said other link is thus disabled.

13. In a signaling system, a plurality of calling stations, a plurality of called stations, a plurality of groups of devices at each of said called stations, a pair of links each common to all of said stations, means at each calling station for at times seizing an idle one of said links, means controlled by the seized link for producing at the seizing station a visible indication of which link has been seized, means at the seizing station for operating the seized link to select any desired one of said called stations and also to select any desired device in each of said groups at the selected called station, and means in the seized link operated responsive to a single manual operation thereafter performed at the seizing station for operating all of the selected devices at the selected station without operating any other of said devices either at the selected station or at any other called station.

14. In a signaling system, a calling station, a plurality of called stations, means at said calling station for transmitting a first group of impulses indicative of any one of said called stations and a second group of impulses indicative of any one of a plurality of predetermined items of information, means for receiving and registering said impulses, means controlled by said registering means to display at said calling station the identity of said one called station and of said one item of information, display means at each of said called stations, and means controlled by said registering means for causing the display means at said one called station to display the item of information indicated by the registered impulses of said second group.

15. In a signaling system, a plurality of calling stations, a plurality of called stations, equipment common to said stations, means at each of said calling stations for at times seizing said equipment and transmitting thereto a first group of impulses indicative of any desired one of said called stations and a second group of impulses indicative of any one of a plurality of predetermined items of information, means in said equipment for registering said impulses, means controlled by said registering means to display at said calling station the identity of said one called station and of said one item of information, display means at each of said called stations, and means controlled by said registering means for causing the display means at said one called station to display the item of information indicated by the registered impulses of said second group.

16. In a signaling system; a calling station; a plurality of called stations; means at said calling station for transmitting a first group of impulses indicative of any one of said called stations, a second group of impulses indicative of any one of a plurality of predetermined items of information, and a third group of impulses indicative of any one of certain other predetermined items of information; means for receiving and registering said impulses; display means at each of said called stations; and means controlled by said

registering means for causing the display means at said one called station to display the two items of information indicated by the registered impulses of said second and third groups.

17. In a signaling system, a calling station, a plurality of called stations, means at said calling station for transmitting three groups of impulses corresponding respectively to three variable items of information, means controlled by said impulses for registering said three items of information, means controlled by said registering means for displaying said three items of information at said calling station, and other means controlled by said registering means for selecting a called station in dependence upon one of said items of information and displaying the remaining two items at the selected called station.

18. In a signaling system, a calling station, a plurality of called stations, means at said calling station for transmitting a first group of impulses indicative of any one of said called stations and a second group of impulses indicative of any one of a plurality of predetermined items of information, means for receiving and registering said impulses, means controlled by said registering means to display said one item of information at said calling station, other means controlled by said registering means for conditioning said one called station to wipe out said display, and means at said one called station effective only if operated after said one station has been thus conditioned for wiping out said display.

19. In a signaling system, a calling station, a plurality of called stations, means at said calling station for transmitting a first group of impulses indicative of any one of said called stations and a second group of impulses indicative of any one of a plurality of predetermined items of information, means for receiving and registering said impulses, means controlled by said registering means to display said one item of information at said calling station, other means controlled by said registering means for conditioning said one called station to wipe out said display, an audible signal at said one called station operated under control of said registering means when that station has been thus conditioned, and means at said one called station effective only if operated after said one station has been thus conditioned for wiping out said display.

20. In a signaling system, a calling station, a plurality of called stations, means at said calling station for transmitting a first group of impulses indicative of any one of said called stations and a second group of impulses indicative of any one of a plurality of predetermined items of information, means for receiving and registering said impulses, means controlled by said registering means to display at said calling station the identity of said one called station and of said one item of information, display means at each of said called stations, means controlled by said registering means for causing the display means at said one called station to display the item of information indicated by the registered impulses of said second group, and means at said one called station thereafter operated to wipe out the display at said one called station.

21. In a signaling system, a calling station, a plurality of called stations, means at said calling station for transmitting a first group of impulses indicative of any one of said called stations and a second group of impulses indicative of any one of a plurality of predetermined items of informa-

tion, means for receiving and registering said impulses, means controlled by said registering means to display at said calling station the identity of said one called station and of said one item of information, display means at each of said called stations, means controlled by said registering means for causing the display means at said one called station to display the item of information indicated by the registered impulses of said second group, and means at said one called station thereafter operated to wipe out the display at said calling station.

22. In a signaling system, a calling station, a plurality of called stations, means at said calling station for transmitting a first group of impulses indicative of any one of said called stations and a second group of impulses indicative of any one of a plurality of predetermined items of information, means for receiving and registering said impulses, means controlled by said registering means to display at said calling station the identity of said one called station and of said one item of information, display means at each of said called stations, means controlled by said registering means for causing the display means at said one called station to display the item of information indicated by the registered impulses of said second group, and means at said one called station thereafter operated to wipe out both the display at said calling station and the display at said one called station.

23. In a signaling system; a calling station; a plurality of called stations; means at said calling station for transmitting a first group of impulses indicative of any one of said called stations, a second group of impulses indicative of any one of a plurality of predetermined items of information, and a third group of impulses indicative of any one of certain other predetermined items of information; means for receiving and registering said impulses; means controlled by said registering means for display at said calling station the two items of information indicated by the registered improvements of said second and third groups; other means controlled by said registering means in accordance with the registered impulses of said first group to condition said one called station to wipe out said display, and means at said one called station effective only if operated after said one station has been thus conditioned for wiping out said display.

24. In a signaling system, a calling station, a plurality of called stations, a display panel at each of said stations, means under the control of said calling station operated to register the identity of any desired one of said called stations, other means under the control of said calling station operated to register any desired one of a plurality of different items of information, means controlled by said first registering means for conditioning the panel at said one called station to produce a display, other means controlled by said two registering means to cause the panel at said calling station to display both the identity of said one called station and said one item of information, means at said calling station operated at will after said display thereat for causing said conditioned panel to display said registered item of information, means controlled by said registration of the identity of said one called station for conditioning said one called station to wipe out the display at that station, and means thereafter operated responsive only to a manual operation performed at the conditioned called station for wiping out the display at that station.

25. In a signaling system, a calling station, a plurality of called stations, a display panel at each of said stations, means under the control of said calling station operated to register the identity of any desired one of said called stations, other means under the control of said calling station operated to register any desired one of a plurality of different items of information, means controlled by said first registering means for conditioning the panel at said one called station to produce a display, other means controlled by said two registering means to cause the panel at said calling station to display both the identity of said one called station and said one item of information, means at said calling station operated at will after said display thereat for causing said conditioned panel to display said registered item of information, means controlled by said registration of the identity of said one called station for conditioning said one called station to wipe out the display at that station, means thereafter operated responsive only to a manual operation performed at the conditioned called station for wiping out the display at that station, and alternative means operated responsive only to a manual operation performed at said calling station for wiping out the display at said one called station.

26. In a signaling system, a primary station, a plurality of secondary stations, a plurality of groups of devices at each of said secondary stations, switching equipment under the control of said primary station operated to select any desired one of said secondary stations and also to select any desired device in each of said groups at the selected secondary station, means at said primary station controlled by said equipment to display the identity of the selected secondary station and also the identity of the selected device in each of said groups, means in said equipment operated responsive to a single manual operation performed at said primary station for operating all of the selected devices at the selected secondary station, and means then operated under control of the selected secondary station for wiping out said display.

27. In a signaling system, a plurality of primary stations, a plurality of secondary stations, a plurality of groups of devices at each of said secondary stations, switching equipment common to all of said stations, means at each primary station for at times seizing said equipment and operating it to select any desired one of said secondary stations and also to select any desired device in each of said groups at the selected secondary station, means controlled by the selecting of said one secondary station for conditioning that station to release said switching equipment, means in said equipment operated responsive to a single manual operation performed at the primary station by which said equipment was seized for operating all of the selected devices at the selected secondary station without operating any of said devices at any other secondary station, and means dependent upon said conditioning means for thereafter releasing said switching equipment under the control of said one secondary station.

28. In a switching system, a plurality of primary stations, a plurality of secondary stations, a plurality of units of switching equipment common to said primary stations, means operated responsive to an operation performed at any one of said primary stations thereupon to seize an idle one of units, means controlled by the seized unit for producing at said one primary station a

visible indication of which unit has been seized, means in the seized unit controlled by said one primary station to select any one of said secondary stations and to condition that station to release said unit, and means at the selected secondary station, effective only if operated after it has been thus conditioned, for releasing said unit and consequently wiping out said indication.

29. In a signaling system, a primary station, a plurality of secondary stations, switching equipment operated under the control of said primary station to select any desired one of said secondary stations and to display at the selected secondary station any one of a plurality of predetermined items of information, means whereby said display can be wiped out at will under the control either of the primary station or the selected secondary station, and registering means operated differently in dependence upon whether said display is wiped out under the control of said primary station or under the control of the selected secondary station.

30. In a signaling system, a calling station, a plurality of called stations, means at said calling station for transmitting a first group of impulses indicative of any one of said called stations and a second group of impulses indicative of any one of a plurality of predetermined items of information, means for receiving and registering said impulses, means controlled by said registering means to display said one item of information at said calling station, other means controlled by said registering means for conditioning said one called station to wipe out said display, means at said one called station effective only if operated after said one station has been thus conditioned for wiping out said display, alternative means for wiping out said display under the control of said calling station, and registering means operated differently in dependence upon whether said display is wiped out by operation of said means at said one called station or under the control of said calling station.

31. In a signaling system, a primary station, a plurality of secondary stations, switching equipment operated under the control of said primary station to select any desired one of said secondary stations and to display at the selected secondary station any one of a plurality of predetermined items of information, means whereby said display can be wiped out at will under the control either of the primary station or the selected secondary station, means operated to register the time at which said display is wiped out if it is wiped out under the control of said primary station, and other means operated to register the time at which said display is wiped out if it is wiped out under the control of said selected secondary station.

32. In a signaling system, a calling station, a plurality of called stations, means at said calling station for transmitting a first group of impulses indicative of any one of said called stations and a second group of impulses indicative of any one of a plurality of predetermined items of information, means for receiving and registering said impulses, means controlled by said registering means to display said one item of information at said calling station, other means controlled by said registering means for conditioning said one called station to wipe out said display, means at said one called station effective only if operated after said one station has been thus conditioned for wiping out said display, alternative means for wiping out said display under the con-

trol of said calling station, means operated to register the time at which said display is wiped out if it is wiped out by operation of said means at said one called station, and other means operated to register the time at which said display is wiped out if it is wiped out under the control of said calling station.

33. In a signaling system, a calling station, a plurality of called stations, a display panel at each of said called stations, switching equipment operated under the control of said calling station for selecting any desired one of said called stations and conditioning the panel at that station to display any particular one of a plurality of different items of information, means operated responsive to a manual operation performed at the calling station for causing said conditioned panel to display the selected item of information, means thereafter operated for wiping out said display, and means controlled by said last two means for registering the time at which each of said last two means is operated.

34. In a signaling system, as claimed in claim 33, wherein said display can be wiped out under the control of either said calling station or the selected called station, means whereby said time registering means indicates the station under control of which said display is wiped out.

35. In a signaling system, means for transmitting a plurality of digits in succession, a pair of registers, means for causing one of said registers to register the first digit of said succession, and means controlled by said one register for causing the same register to register the second digit of said succession if the first digit registered is of a certain value and for causing the other of said registers to register said second digit if the first digit registered is of a different value.

36. In a signaling system, means for transmitting a plurality of digits in succession, a plurality of registers, means for causing one of said registers to register the first digit of said succession, means controlled by said one register if the first digit registered is of a certain value to cause the same register also to register the second digit of said succession and to cause a second one of said registers to register a digit subsequent to said second digit, said last means controlled by said one register to cause said second register to register said second digit if the first digit registered is of a different value, means controlled by said second register if the first digit registered by it is of a predetermined value to cause said second register also to register the digit following the first digit registered by said second register and to cause a third one of said registers to register a digit subsequent to the second digit registered by said second register, said last means controlled by said second register to cause said third register to register the next digit following the first digit registered by said second register if the first digit registered by said second register is of a value different than said predetermined value.

37. In a signaling system, means for transmitting a plurality of digits in succession, a plurality of registers, means whereby one of said registers at times registers only the first digit of said succession and at other times registers both the first digit and the second digit of said succession, means whereby a second one of said registers at times registers only the first digit following the last digit registered by said first register and at other times registers the next two digits fol-

lowing the last digit registered by said first register, and means whereby a third one of said registers registers at least one digit following the last digit registered by said second register.

38. In a signaling system, means operated at different times and effective at each of said times to transmit a plurality of digits in succession, a register, and means whereby said register at times registers only the second digit of said succession, at other times registers only the third digit of said succession, and at still other times registers both the second and third digits of said succession.

39. In a signaling system, means operated at different times and effective at each of said times to transmit a plurality of digits in succession, a register, and means whereby said register at times registers only the third digit of said succession, at other times registers only the fourth digit of said succession, and at still other times registers only the fifth digit of said succession.

40. In a switching system, a link, a plurality of control stations each having a relay, means effective responsive to a manual operation performed at any one of said stations for thereupon operating the relay corresponding to that station if said link is idle, means common to said relays operated responsive to the operation of said relay for making said link busy, thereby to prevent another of said relays from operating in the event that a corresponding manual operation should be performed at any other of said stations, a connection completed from said one station to said link by said relay upon its operation, a calling device at said one station operated to transmit impulses over said connection to operate said link directly, means individual to said one station thereafter controlled by said link to complete a different connection from said one station to said link and to cause said relay for that station to interrupt said first connection, and means controlled over said different connection from said one station for releasing said link.

41. In a switching system, a plurality of links, a plurality of control stations, each station having individual equipment including a relay for each of said links, means effective responsive to a manual operation performed at any one of said stations for thereupon operating the relay in that station's individual equipment which corresponds to an idle one of said links, means individual to said one link operated responsive to the operation of said relay for making said one link busy, thereby to prevent another of the relays corresponding to said one link from operating in the event that a corresponding manual operation should be performed at any other of said stations, a connection completed from said one station to said one link by said operated relay, a calling device operated to transmit impulses over said connection to operate said one link directly, means individual to said one station thereafter controlled by said one link to complete a different connection from said one station to said one link and to cause said operated relay to interrupt said first connection, and means controlled over said different connection from said one station for releasing said one link.

42. In a switching system, a plurality of control stations each having a fast operating relay and a slower operating relay, two units of switching equipment each common to all of said stations, means at each of said stations for at times simultaneously energizing both the fast relay and

the slower relay individual to that station and at other times energizing the slower relay alone, means controlled by the fast relay, upon operation, for preventing the operation of its associated slower relay, means controlled by the operation of the said fast relay for seizing a particular one of said units, and means controlled by the operation of said slower relay for seizing the other of said units.

43. In a switching system, a plurality of control stations each having a fast operating relay and a slower operating relay, two units of switching equipment each common to all of said stations, means individual to one of said units effective to maintain circuits prepared to all of said fast relays whenever said one unit is idle, means individual to the other of said units effective to maintain circuits prepared to all of said slower relays whenever said other unit is idle, means at each of said stations at times operated for simultaneously completing such circuits as are, at each of said times, thus prepared to the fast relay and the slower relay individual to that station, means thereupon controlled by the fast relay if it operates for seizing said one unit and making same busy, means controlled by said slower relay if it operates for seizing said other unit and making same busy, and a contact on each fast relay effective whenever such relay operates to disable the slower relay individual to the same station as that fast relay, thereby to prevent the fast relay and the slower relay individual to the same station from being operated concurrently.

44. In a switching system, a plurality of units of switching apparatus, a plurality of control stations, each station having individual equipment including a plurality of relays corresponding respectively to said units, means individual to each of said units maintaining circuits prepared to all of the relays corresponding to that unit whenever said unit is idle, means at each of said control stations at times operated for simultaneously completing all of the circuits which are thus prepared to relays in that station's individual equipment, means whereby no more than one of the relays in the equipment individual to

any particular station may operate responsive to the operation of said last means at that station, and means controlled by each relay which is operated responsive to such completion of its prepared circuit for thereupon causing the circuits for the other relays corresponding to the same unit as the operated relay to be disabled by the said means individual to that unit.

45. In a telephone system, two groups of substations, a line common to said substations over which speech may be transmitted from any one of the substations to any other, means at each substation of one group for selectively signaling any substation of the other group, an interrupter, means operated at random intervals for causing said interrupter to operate, means responsive to the initiation of a call at any substation of said other group for initiating the operation of said interrupter if it is not already in operation, a signal common to the substations of said one group operated intermittently by said interrupter responsive to the operation of said last means, means responsive to the answering of said call at any substation of said one group for at times terminating the operation both of said interrupter and of said signal, said last means effective at other times responsive to the answering of said call at any of said substations of said one group to terminate the operation of said signal without terminating the operation of said interrupter.

46. In a telephone system, two groups of substations, a line common to said substations over which speech may be transmitted from any one of the substations to any other, means at each substation of one group for selectively signaling any substation of the other group, an interrupter, means responsive to the initiation of a call at any substation of said other group for initiating the operation of said interrupter, a signal common to the substations of said one group thereupon operated intermittently by said interrupter, and means responsive to the answering of said call at any substation of said one group for terminating the operation of said interrupter and said signal.

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