H. L. KRUM.

TELEGRAPH SYSTEM AND APPARATUS.

APPLICATION FILED JUNE 30, 1916.

1,434,290.

Patented Oct. 31, 1922.

5 SHEETS—SHEET 1.

Fig. 1.

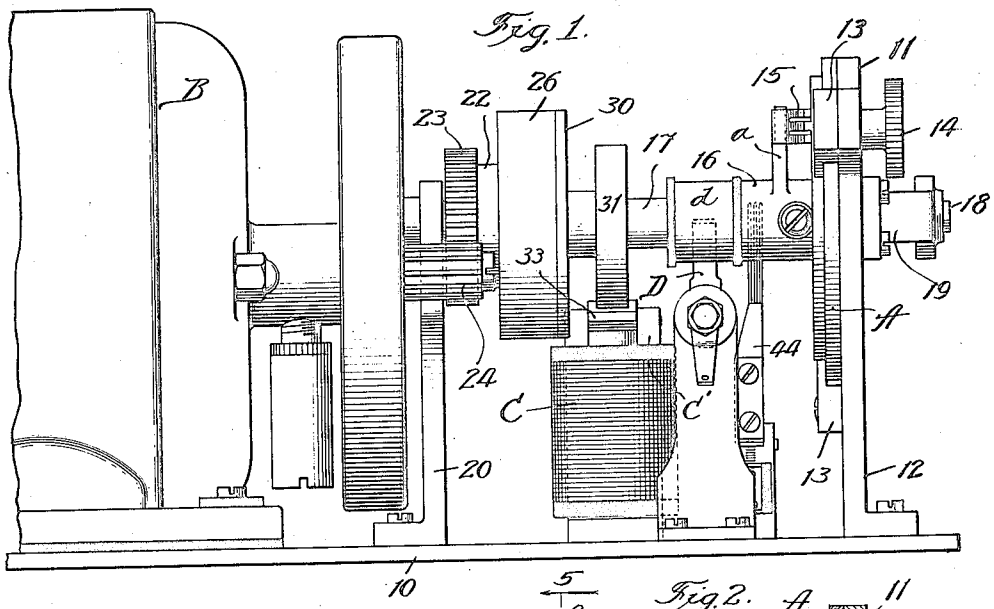


Fig. 2.

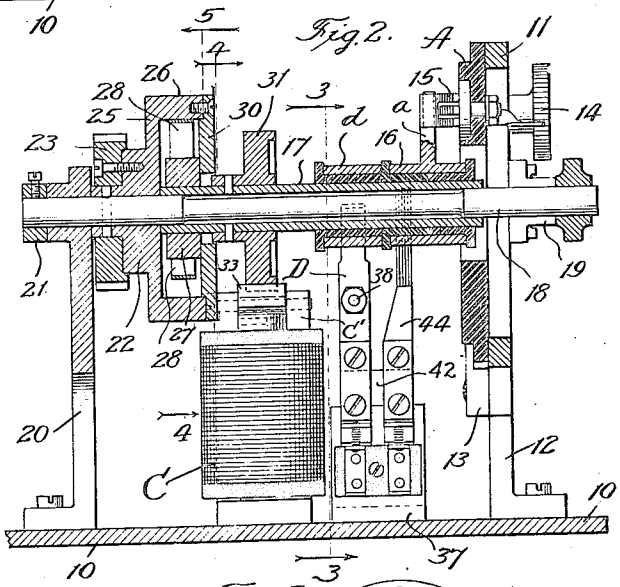


Fig. 3.

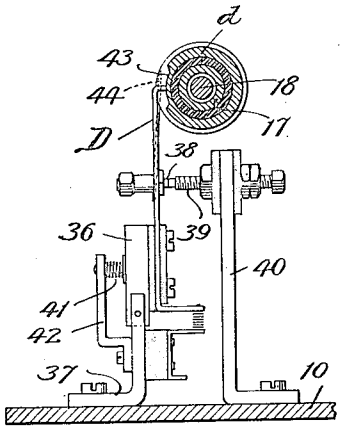


Fig. 4.

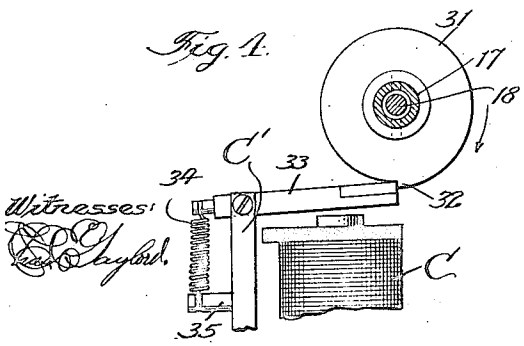
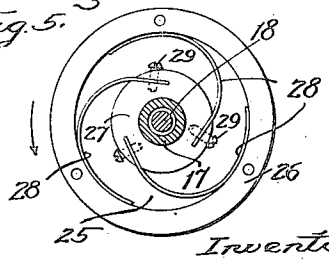


Fig. 5.



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5 SHEETS—SHEET 2.

Fig. 6.

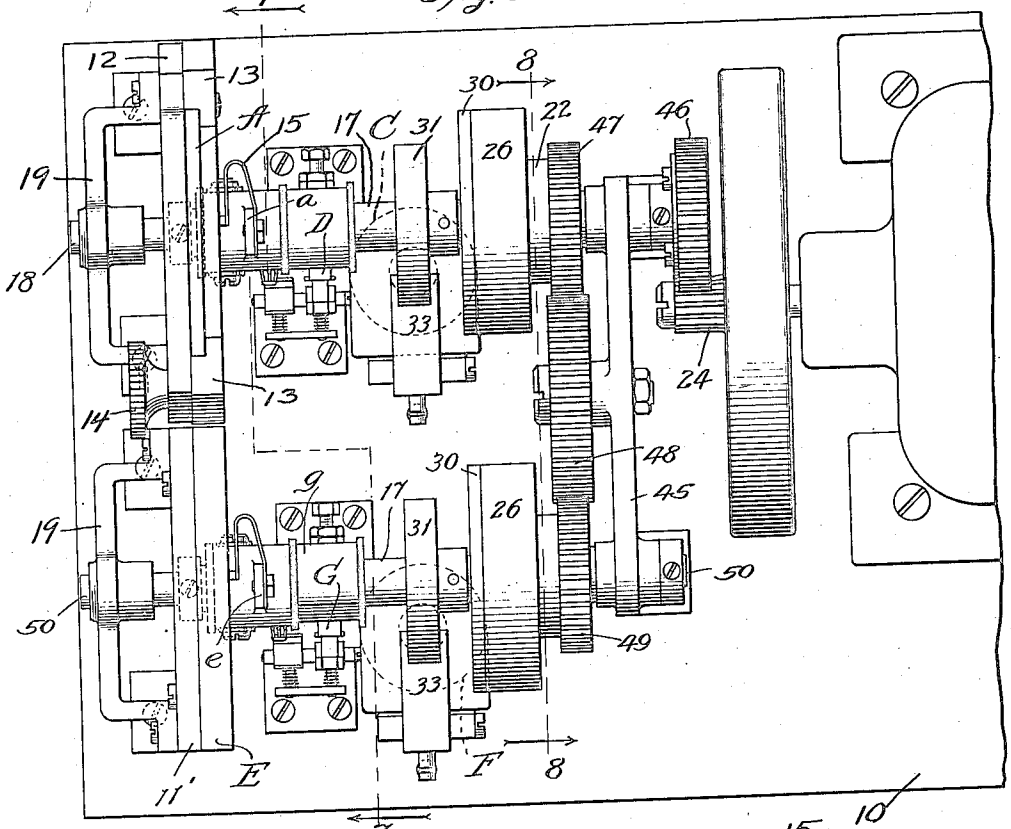
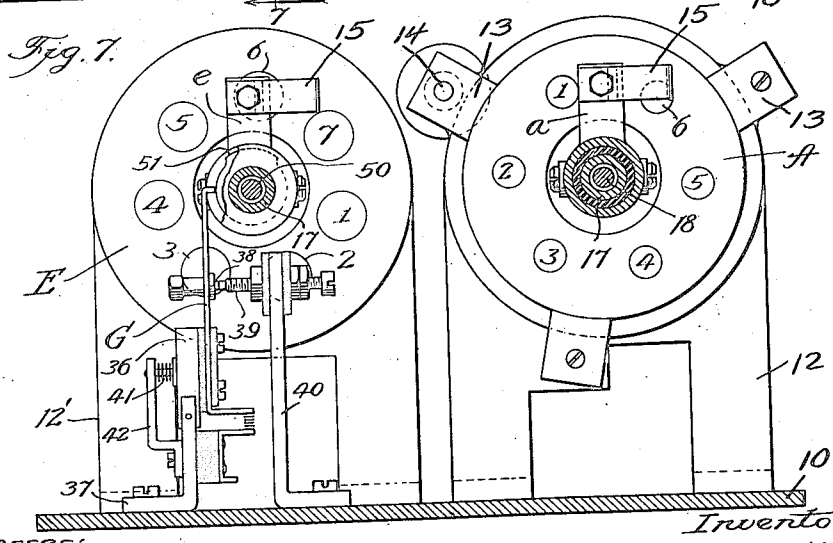


Fig. 7.



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5 SHEETS—SHEET 3.

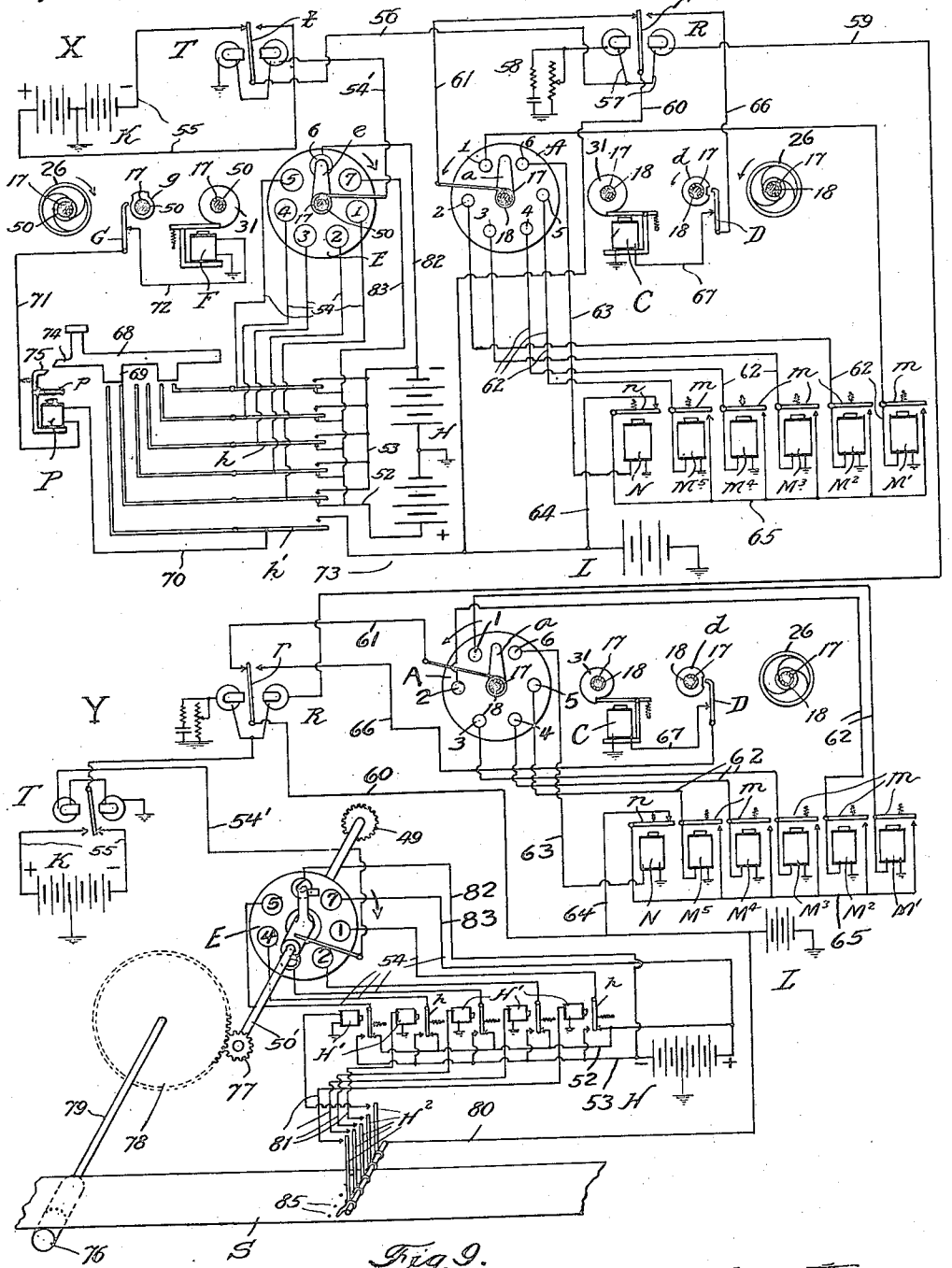

Fig. 9.

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5 SHEETS—SHEET 4.

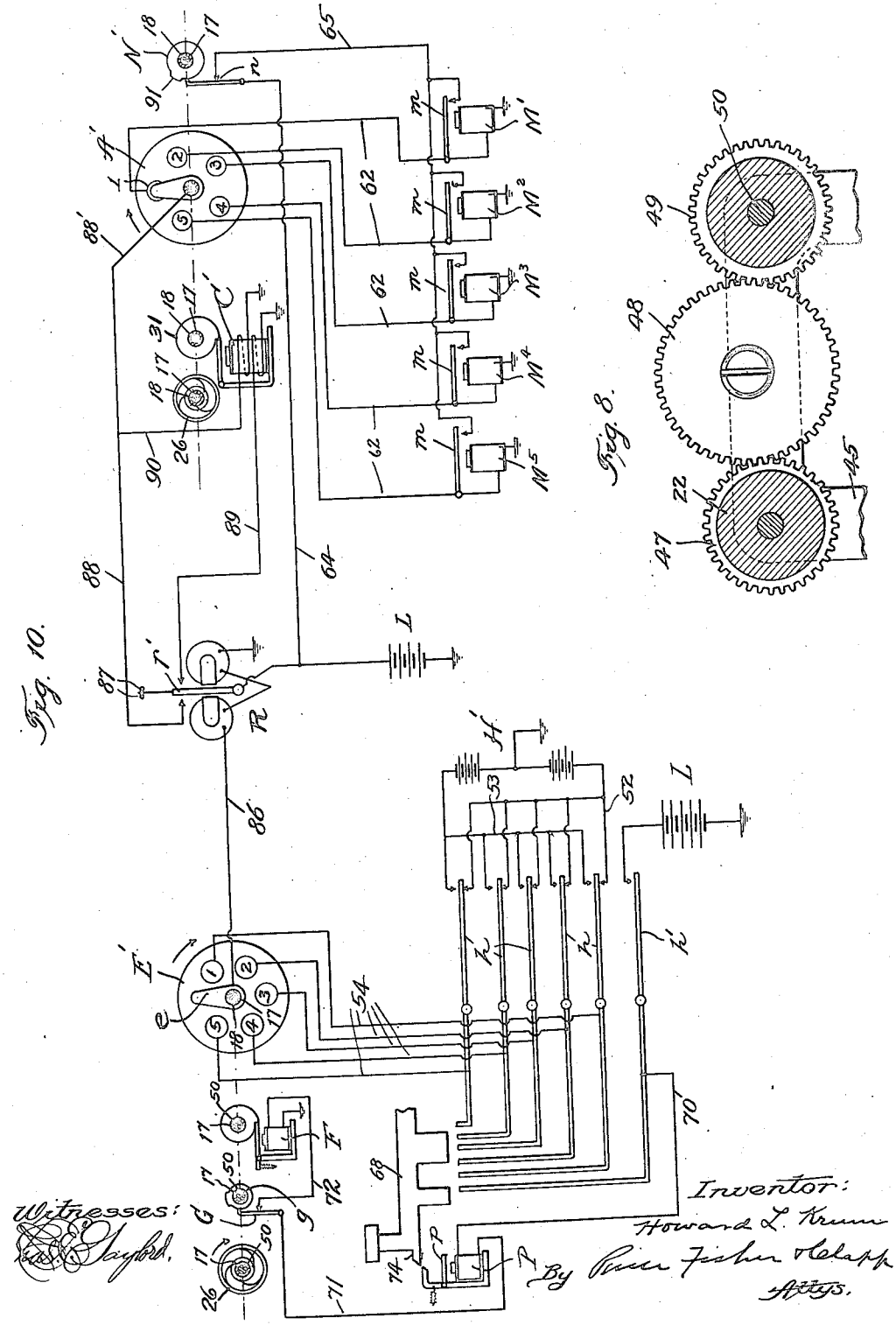

Fig. 10.

Fig. 8.

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5 SHEETS—SHEET 5.

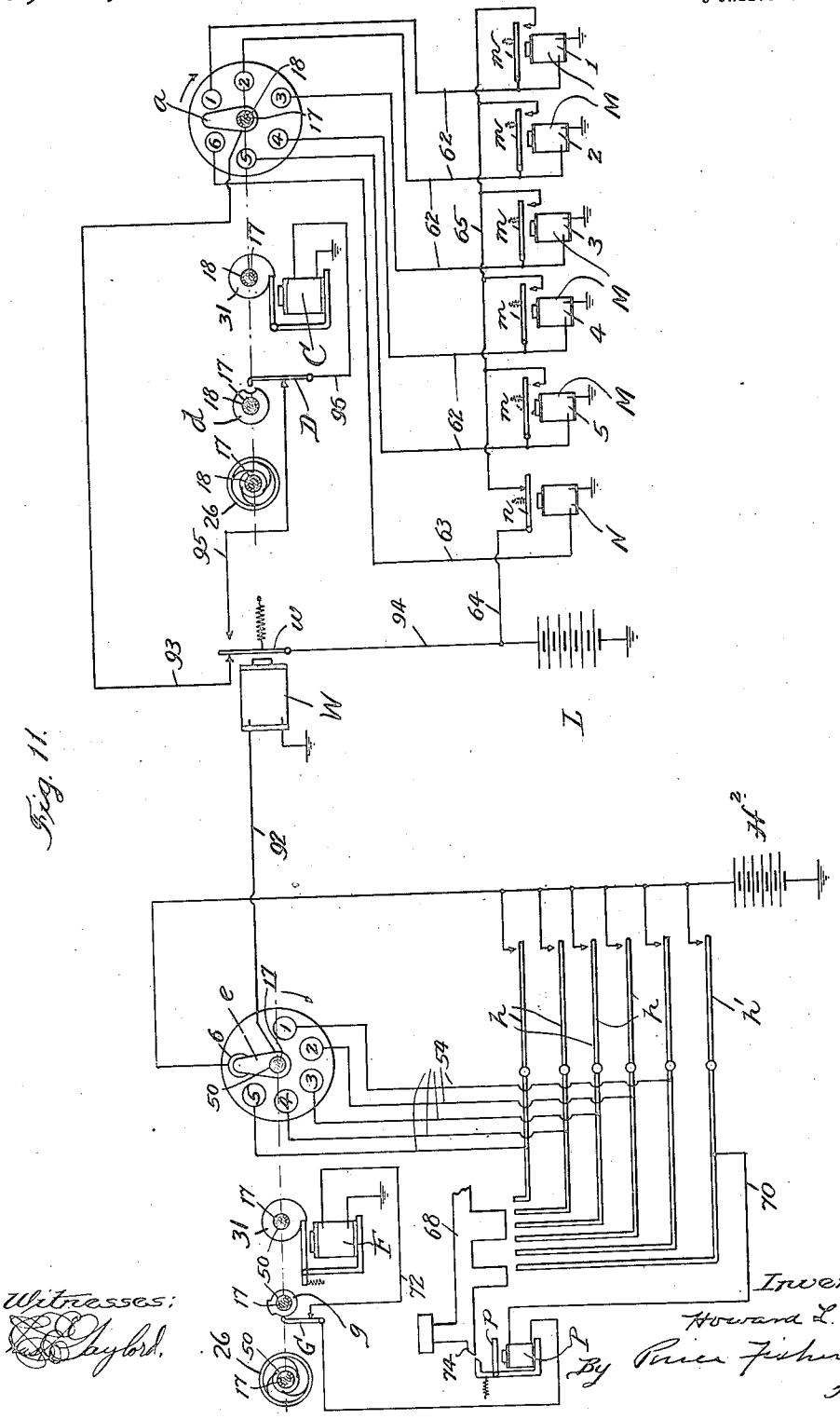

Fig. 11.

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UNITED STATES PATENT OFFICE.

HOWARD L. KRUM, OF CHICAGO, ILLINOIS, ASSIGNOR TO MORKRUM COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF MAINE.

TELEGRAPH SYSTEM AND APPARATUS.

Application filed June 30, 1916. Serial No. 106,925.

To all whom it may concern:

Be it known that I, HOWARD L. KRUM, a citizen of the United States, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telegraph Systems and Apparatus, of which the following is a specification.

The invention relates to selective or automatic printing telegraphs having selective transmitting and receiving switch mechanisms and means for maintaining the receiving switch mechanism at one station in synchronism with the transmitting switch mechanism at another station.

The present invention seeks to provide a selective telegraph system of this sort in which improved means is provided for effecting the synchronous operation of the transmitter and receiver switch mechanisms at the connected stations, which is simple and effective in construction and will not readily get out of order. The invention particularly relates to rotary motor driven transmitter and receiver switch mechanisms and seeks to provide simple and effective means for maintaining the same in proper operative relation, which, while operating with accuracy, does not require any great nicety of adjustment, and which will permit considerable variation in the speed of the motors which respectively drive the transmitting and receiving switch mechanisms. A further object of the invention is to provide an improved receiver switch mechanism which can be readily maintained in proper relation either with a keyboard transmitter or with an automatic, tape-controlled transmitter.

With these and other objects in view, as will presently appear, the invention consists in the features of improvement hereinafter set forth, illustrated in the preferred form and arrangement in the accompanying drawings, and more particularly pointed out in the appended claims.

In the drawings: Figure 1 is a view in elevation of the improved receiver switch mechanism. Fig. 2 is a vertical section thereof. Figs. 3, 4 and 5 are detail cross-sections taken on the lines 3—3, 4—4 and 5—5, respectively, of Fig. 2. Fig. 6 is a plan view of a station instrument in which the improved receiver is combined with a transmitter switch mechanism. Figs. 7 and 8 are detail cross sections on the lines 7—7 and 8—8, respectively, of Fig. 6. Fig. 9 is a diagram of the arrangement of the circuits at two connected stations arranged to transmit signals in opposite directions over a duplexed line circuit. Figs. 10 and 11 illustrate diagrams of modified arrangements of the circuits, showing only the transmitter at one station and the receiver at another station.

The improved receiver switch mechanism, as shown in Figs. 1–5 inclusive, is mounted on a base plate 10 and comprises a rotating switch arm *a* and a circular series of contacts fixed to an insulating disk A. The latter is mounted upon the upper annular or ringlike portion 11 of an upright bracket 12 secured to the base plate 10. Preferably, the disk is held in place by a series of clips 13 which overlap the reduced or rabbeted edge portion of the disk, so that the latter can be rotatably adjusted. One of the clips is provided with a clamp-screw 14 for securely holding the disk in adjusted position.

The switch arm *a* is provided with a brush 15 which is arranged to engage the contacts of the disk A, and the hub 16 of the switch arm is mounted upon one end of a sleeve 17, but is insulated therefrom, as clearly shown in Fig. 2. Sleeve 17 is mounted upon a shaft 18 having a portion reduced in diameter within the sleeve. This reduced portion, as shown in Fig. 2, is shorter than the sleeve, and the large end portions of the shaft loosely fit within the sleeve. As shown, one end of the sleeve 17 and one end of the shaft 18 extend through a central opening in the contact disk A, and the projecting end of the shaft is journaled in a U-shaped member 19 that is fixed to and extends across the annular portion or ring 11 of the bracket 12. The opposite inner end of the shaft is journaled in the upper portion of an upright bracket 20 that is secured to the base plate 10. A collar 21 is fixed to the extreme inner end of the shaft and a hub 22 is also fixed to the shaft, the hub and collar being arranged on opposite sides of the bearing on the upper end of the bracket 20 to thereby hold the shaft against endwise movement.

The hub 22 is provided with a reduced inner end portion and a gear 23 is fixed thereto. The latter meshes with a pinion 24 on the shaft of a small electric motor B which is mounted on the base plate 10, so that, when in operation, the shaft is continuously driven by the motor. The latter is provided with a suitable governor (not shown) for maintaining the speed of the shaft 18 constant. Sleeve 17, which carries the receiver switch arm *a*, is loosely mounted on the shaft, but is driven thereby through the medium of a yielding friction device.

For this purpose, the hub 22 on the shaft is provided with an enlarged, disk-like portion 25 having a laterally projecting edge flange 26 and a hub 27 fixed to the adjacent end of the sleeve 17 is provided with a series of curved springs, each of which engages the inner face of the flange 26 through an arc of considerable size. The friction disk 25 and flange 26 are preferably formed of cast iron and the springs of hardened steel. The inner ends of the latter extend within tangentially disposed slots in the hub 27 and are fixed thereto by screws 29. The springs are pressed snugly against the inner face of the flange 26 and the parts afford a secure connection between the shaft and the sleeve, so that the latter is properly driven. But the connection is such that the sleeve and receiver switch carried thereby can be arrested, since the connection between the sleeve and the shaft afforded by the springs 28 and the friction disk will yield or slip. The space within the flange 26 is preferably enclosed by a cap-plate 30 fixed thereto and abutting against the adjacent face of the hub 27, and the space thus enclosed is filled with petroleum jelly or like lubricant to prevent undue wear of the springs 28.

A disk 31 fixed to the sleeve 17 adjacent the hub 27 is, as most clearly shown in Fig. 4, provided with a shoulder 32 which normally engages a stop-arm 33. The latter constitutes the armature of a trip magnet C and is pivotally mounted on the upper end of the frame C′ of this magnet, the latter being fixed at its lower end to the base plate 10. A spring 34, extending between the outer end of the stop-arm 33 and a pin 35 on the frame C′, holds the inner end of the arm against the periphery of the stop disk 31.

By this means, the sleeve 17 and switch arm *a* are held against movement, but when the trip magnet C is energized, the stop arm 33 is disengaged from the shoulder 32. The friction connection between the shaft and sleeve is then effective to rotate the sleeve and switch arm through a single revolution when they are again arrested by the engagement of the shoulder 32 with the stop-arm 33. The friction drive connection set forth operates effectively to quickly pick up and rotate the switch-arm as soon as the trip magnet is energized.

The sleeve 17 also preferably carries an insulated cam *d* which is arranged to operate a spring switch-arm D, (see Fig. 3). The lower end of this switch-arm is mounted upon but is insulated from a block 36, the latter being pivoted to an angle bracket 37 on the base plate. A contact 38 on the switch-arm cooperates with an insulated screw contact 39 carried on an upright bracket 40 secured to the base plate 10. A spring 41 interposed between the block 36 and a lug 42 fixed to the angle bracket 37 tends to hold the contacts in engagement. Cam *d* is shown as provided with a recess 43 and, when the parts are in the position shown, with the sleeve held against movement by the stop-arm 33, the upper bent end of the switch D projects within the recess 43, so that the contacts 38 and 39 are in engagement. But during the greater part of the revolution of the sleeve 17, the cam *d* holds these contacts out of engagement. An insulated contact brush 44 engages the hub of the switch-arm *a* and, like switch-arm D, is mounted in a similar manner on an angle bracket 37.

The receiver switch mechanism above described is preferably combined with a transmitter switch mechanism and such a combined station instrument is shown in Figs. 6, 7 and 8. The receiver switch mechanism shown in this instrument is similar in all respects to that heretofore described, except that the inner end of the shaft 18 is journaled in a bracket 45 and carries two gears 46 and 47. The gear 46 at the extreme inner end of the shaft meshes with the pinion 24 on the motor shaft and the gear 47, which is fixed to the hub 22, meshes with an idler gear 48 which is centrally mounted upon the upper portion of the bracket 45. This gear meshes with a gear 49 fixed to a shaft 50.

Shaft 50 forms the driving element of a transmitter switch mechanism which comprises a rotary switch-arm *e* and an annular contact disk E.

The arrangement of the transmitter disk E is similar to that of the receiver disk A, except that the transmitter disk, instead of being adjustably mounted, is fixed to the upper ring-portion 11′ of a bracket 12′. Like the receiver switch-arm *a*, the transmitter switch-arm *e* is mounted on a sleeve 17 and is connected to its drive shaft through a similar yielding friction connection, and the sleeve is provided with a like controlling disk 31 and stop arm 33, the stop-arm of the transmitter switch mechanism being controlled by a trip magnet F.

The sleeve 17 of the transmitter switch mechanism is also provided with a cam *g* which controls a switch G similar in construction to the switch D previously de-

scribed, but the cam *g* is reduced in diameter through the greater portion of its periphery, as shown in Fig. 7, being provided with a lug 51. Thus the switch G is in closed position through the greater portion of the revolution of the transmitter switch, but is momentarily opened just before this switch completes a revolution.

Fig. 9 illustrates diagrammatically the circuits at two connected stations, the arrangement of the circuits and parts at each station being alike, except that the selecting switches at station "X", which control the transmitted impulses, are operated by a set of finger keys, while at station "Y" automatic tape controlled means is provided for selecting the impulses which represent different characters or signals.

As shown in Fig. 9, each transmitter disk is provided with seven uniformly spaced contacts, and each receiver disk is provided with six uniformly spaced contacts, that is to say, the contacts travelled over by the switch arms during each revolution are uniformly spaced. A set of selecting switches *h* serve to variably connect contacts 1, 2, 3, 4 and 5 of the transmitter disk to a source of current to thereby determine the combinations of impulses imparted to the line as the transmitter switch-arm *e* passes over these contacts. Preferably, the signals are represented by permutations of five positive and negative impulses and the switches are, therefore, in the form of pole changers, the normally engaged contacts thereof being connected by conductors 52 to the positive side of a divided battery H, and the normally disengaged, or front contacts thereof being connected by conductors 53 to the negative pole of the battery. At station "X" the selecting switches *h* are directly connected to the contacts 1, 2, 3, 4 and 5 of the transmitter disk by a set of conductors 54, and the transmitter switch arm *e* could be connected directly to the line circuit, but is preferably connected by a conductor 54′ to the coils of a transmitting relay T. The tongue *t* of this relay is provided with opposite contacts which are connected by conductors 55 to the terminals of a divided line battery K. Tongue *t* of the transmitting relay is connected by a conductor 56 to a pair of branch conductors 57 that lead, respectively, to the coils of a local polarized main line relay R. One coil of this relay is connected to a grounded, artificial line conductor 58 and the other to a line conductor 59 which extends to the distant station "Y".

The switch tongue *r* of the line relay at each station is connected to a conductor 60 which leads from a local battery L. Its normally engaged contact is connected by a conductor 61 to the receiver switch-arm *a*. A set of branch conductors 62 connect the contacts 1, 2, 3, 4 and 5 of the receiver disk at each station to a set of five selecting relays or magnets M, and a conductor 63 connects the contact 6 of the receiver disk to an unlocking or releasing magnet N. Magnet N operates a normally closed switch *n* the contact of which is connected to the local battery by a conductor 64, and the switch itself is connected by a conductor 65 to the contacts of a series of normally open locking switches *m* that are operated respectively by the magnets M and are connected to the conductors 62 that lead to the coils of these magnets M. The contacts of these switches are connected by a branched conductor 65 to the normally closed locking switch *n*. The arrangement is such that when any of the selecting magnets M are operated, they will remain connected to the local battery until the unlocking switch *n* is opened.

The normally disengaged contact of the line relay R is connected to the coil of the trip magnet but, in the preferred form shown, the cut-out switch D is interposed in the circuit of this magnet. The normally disengaged contact of the line relay, as shown, is, therefore, connected by a conductor 66 to the switch D, and the contact of this switch is connected by a conductor 67 to the coil of the trip magnet C. The coils of the magnets C, M and N are grounded or connected by a suitable return wire to the local battery L.

The arrangement of the receiver switch mechanism and circuits, shown in Fig. 9, is the same at both stations "X" and "Y." The transmitter at each station also includes a set of selecting switches which, at station "X," are manually controlled, and at station "Y" are automatically controlled by means of a suitably perforated tape. At station "X" the selecting switches *h* are variably operated by a set of finger keys, one of which is shown at 68, and which are arranged like the keys in an ordinary typewriter. The keys are provided with lugs 69, these lugs being so arranged that the depression of each key will operate a particular combination of the selecting switches which correspond to the character represented by the key. Each finger key of the transmitter is also arranged to operate a switch *h′* which is connected to the coil of the trip magnet F, and also to the coil of a magnet P. Preferably, the cut-out switch G, is arranged in the circuit of the trip magnet F. As shown in the diagram, the switch *h′* is connected by a conductor 70 to the coil of the magnet P, and the latter is connected by a conductor 71 to the switch G, the contact *g* of which is connected to the coil of the magnet F by a conductor 72. Switch *h′* has only one normally disengaged contact which is connected by a conductor 73 to the local battery L. One terminal of the magnet F

is grounded or connected by a return wire to the battery L.

Each finger key 68 is provided with a projecting lug 74 which is arranged to co-operate with a locking device 75 on the armature p of the locking magnet P.

The transmitter at station "Y" is designed to be controlled by a suitably perforated tape, such as described in the prior U. S. Letters Patent of C. L. and H. L. Krum, No. 1,326,456, dated December 30, 1919, and No. 1,360,231, dated December 22, 1919. For this purpose, transmitter shaft 50′ is connected to a tape feed wheel 76 by suitable speed reducing gearing. The speed reducing gearing shown comprises a small pinion 77 on the transmitter shaft 50′ which meshes with a relatively large gear 78 on the shaft 79 of the tape feed wheel. In this transmitter the switch-arm e is fixed to the shaft 50′ and rotates continuously therewith.

As in the switch mechanism previously described, the contacts 1, 2, 3, 4 and 5 of the transmitter disk are connected by a set of conductors 54 to a set of selecting switches or pole changes h; but in this transmitter these pole changes are automatically operated by a set of magnets H′, and the latter in turn are controlled by a set of pivoted, tape operated switches H^2. These switches are connected by a conductor 80 to the local battery L, and the contacts thereof are connected by a set of conductors 81 to the magnets H′, the other terminals of which are grounded or connected by a return wire to the local battery.

The transmitter disks are provided with contacts 6 and 7 which are connected, respectively, by conductors 82 and 83 to the opposite terminals of the divided battery H, so that a negative impulse, followed by a positive impulse, is transmitted over the line between each complete signal.

The shafts 18, 50 and 50′ are continuously rotated, and the transmitter switch at station "Y" is also continuously rotated; but the receiver switches at both stations, and the transmitter switch at station "X", are connected to the motor by the friction clutch devices described, so that they are normally held against movement. When a finger key is depressed at station "X", certain of the pole changing, selecting switches h are shifted, so that as the transmitter switch e passes over the contacts 1, 2, 3, 4 and 5, a permutation of five positive and negative impulses, corresponding to the depressed key, is transmitted to the line. The key also shifts the switch h', so that current flows from local battery L, by conductor 73, switch h', conductor 70, through magnet P; thence by conductor 71, switch G and conductor 72 through the trip magnet F. Magnet F is thus energized to permit the operation of the transmitter switch e, and magnet P is also energized to operate the lock device 75. This lock device holds down the shifted key and prevents premature operation of the other keys. Just before the transmitter switch completes its revolution, the cam g opens the switch G and the magnets P and F are de-energized. The transmitter switch is arrested at the end of a revolution and after it has passed over a number of contacts sufficient to transmit the combination of impulses corresponding to a single character. It should be noted however that, since switch G is opened to release the locking device 75 before the rotary transmitter switch member reaches its normal position, messages may be rapidly transmitted without appreciable pauses between the signals.

The line circuit is normally closed and the tongue r of the line relay R at the distant station is held against its normally engaged or back contact. The selecting impulses of each signal is preceded by a positive impulse as the transmitter switch passes over the contact 7 of the transmitter disk. This uniform starting impulse will throw the tongue r of the line relay at the distant station into engagement with its front contact and circuit can be traced from local battery L, conductor 60 switch tongue r, conductor 66, switch D and conductor 67 through trip magnet C. The stop-arm 33 is then released and the receiver switch at once commences to rotate over the contacts of the receiver disk. As soon as this occurs, cam d opens the cut-out switch D and the magnet C is de-energized, so that the stop-arm 33 arrests the receiver switch at the end of a single revolution. This switch is connected to the back contact of the switch tongue r and operates in proper phase relation with the transmitter switch at the distant station, so that the magnets M are variably operated in accordance with the permutations of impulses; that is to say, if the first selecting impulse is negative, the switch tongue r will be held against its back contact as the receiver switch a passes over contact 1 and magnet M′ will be operated. If the first selecting impulse is positive, the circuit of the magnet M′ will not be closed when the switch-arm a passes over contact 1, since at this time the relay switch tongue r will be against front contact. In a similar manner, the other magnets M^2, M^3, M^4 and M^5 are variably operated in accordance with the different permutations of five positive and negative impulses.

Whenever one of the magnets is operated, its switch m closes a circuit from battery L, through conductor 64, normally closed switch n, conductor 65, switch m and conductor 62, through the coil of the magnet which thus remains energized until

the unlocking or releasing magnet N is energized. This occurs when the receiver switch passes over contact 6, since at that time the transmitter switch at the distant station passes over its contact 6 and a negative impulse passes over the line and holds relay switch tongue r against its back contact. Thus, when any signal is completed, the transmitter and receiver switch mechanisms and the selecting magnets M are restored to normal condition, ready for the next signal. The variable operation of the magnets M', M^2, M^3, M^4 and M^5 can be employed, as will be readily understood, to operate a suitable printing instrument.

The friction clutch device for operating the receiver switch is such that the latter picks up quickly and commences to operate as soon as the positive starting impulse, which precedes the selecting impulses of each signal, is received, to thereby operate the trip magnet C. It should be noted that the members of this friction clutch or coupling are constantly engaged and slip past each other when the stop-arm 33 engages the shoulder of the disk 31. The parts of the frictional connection, however, pick up and operate the receiver switch as soon as the trip magnet is energized.

The shaft 18 of the receiver switch is driven somewhat faster than the shaft 50 of the transmitter switch at the distant station, but as the receiver switch is arrested at the completion of each signal, it is operated in proper operative relation with the transmitter switch. Preferably, as shown, the contacts of the receiver disk engaged by the switch arm at each revolution are angularly spaced farther apart than the corresponding contacts of the transmitter disk, so that the receiver switch arm can run faster and be arrested at the end of each signal, when the transmitter is rapidly operated without appreciable pauses between the signals. Obviously the difference in the relative angular spacing of the receiver and transmitter contacts should accord with and thus compensate for the relative difference in speeds at which the respective contact arms are usually operated.

By accelerating the operation of the receiver switch arm relatively to that of the transmitter at the distant station or having its period of operation relatively shorter, the receiver switch arm will be invariably arrested in normal position at the end of each signal and again started in proper phase with the impulses received from the distant station at the beginning of each signal. It should also be noted that not only is the angular spacing of the contacts of the receiver disc relatively greater than those of the transmitter disc but the receiver contacts are also considerably smaller and that, by adjusting the receiver disc, the relation between its contacts and the normal arrested position of the receiver switch arm can be so adjusted that the latter can be started and caused to register with the contacts during the mid-portions only of the selecting impulses or intervals of the received signals.

Since the operation of the rotary transmitter member is local controlled independently of the line conditions and by its movement during each signal period establishes all the changes in the line conditions including the starting intervals, the receiver contacts need only be adjusted relatively to the normal rest position of the rotary receiver switch member to take care of variations in the time of operation of its own starting means. Furthermore, no great frequency of speed adjustment is required to maintain the receiver member in proper operative relation with the transmitter member at the distant station. Thus, the speed of the shaft 18, which operates the receiver, can vary as much as ten or fifteen per cent without affecting its proper operation. For example, in practice, the speed of the shaft 50 of the transmitter switch is usually set at about 360 revolutions per minute, and that of the shaft 18 of the receiver switch at 390 revolutions, but the relative speed of the two can vary as much as ten or fifteen per cent without interfering with the proper transmission of messages.

This is a particular advantage in lines having receiver mechanism at a number of different stations all acting in response to a transmitter at a single station, since it is not necessary to accurately adjust or attune the receiver at each station in accordance with the speed of the transmitter. The improved station instrument shown in Fig. 6 combines the transmitter and receiver. In the particular form shown, the gear 47 has thirty-six teeth and gear 49 has thirty-nine teeth, so that the receiver shaft is driven faster than the transmitter shaft and in the ratio of 39 revolutions for each 36 revolutions of the transmitter shaft. If two such instruments are employed at connected stations and the station motors are operated at substantially the same speed, the rotary receiver member at each station will be driven faster than the transmitter member at the distant station, and by means of the start and stop clutch individual thereto can be brought into proper phase relation with the transmitter at the distant station between successive signals. While the rotary transmitter and receiver members of a complete station instrument are driven from a common motor, separate, individual start and stop clutches are provided for arresting the same in normal position. With this arrangement the transmitter clutch can be, and is, controlled locally and independently

of the line impulses, while the receiver clutch is controlled by the first impulse imparted to the line by the movement of the distant transmitter from normal position.

A further advantage is, that the switch mechanism can be operated in connection with a key-board transmitter, such as shown at station "X" in Fig. 9, or with an automatic tape transmitter, such as indicated at station "Y". As set forth in the prior patents referred to, the tape S is provided with a longitudinal row of openings which engage the pin teeth of the tape feed wheel 76 and advance the tape in definite timed relation with the operation of the transmitter switch *e*. The tape is provided with transverse rows of perforations 85, one row for each character signal, and these openings variably operate the switches H^2, and the latter in turn variably operate the magnets H′ and the selecting pole changers *h*. The transmitter switch *e* at this station operates continuously, but, except as indicated, its operation is like that of the key-board transmitter.

In the arrangement shown in Fig. 10, the transmitter and receiver disks E′ and A′ are provided with but five contacts, and the transmitter switch *e* is connected directly, or through a transmitter relay, to a line conductor 86 that leads to the line relay R at the distant station. The line is normally open, as shown, and the relay switch tongue *r′* is provided with a spring arranged between two stop pins 87, so that it is held in central position. The positive and negative impulses shift the switch tongue *r′* in opposite directions and connect one of two conductors 88 and 89 to the local battery L. The trip magnet C′ in this construction is provided with two coils, one of which is connected to the conductor 89 and the other to a branch 90 of the conductor 88. The opposite ends of these coils are grounded or connected by a return wire to battery L. By this arrangement the first selecting impulse imparted to the line when the transmitter switch *e* passes over its contact 1, and which may be either positive or negative, serves to energize the trip magnet C′. With this arrangement it is not necessary to employ an additional starting impulse, as in the normally closed line circuit shown in Fig. 9. The arrangement of the contacts 1, 2, 3, 4 and 5 and of the magnets M′, M^2, M^3, M^4 and M^5 of the receiver, shown in Fig. 10, is like that previously described. The normally closed, unlocking switch *n* in this form is operated by a cam N′ which is connected to the receiver switch arm *a* and operates therewith. A projection 91 on this cam opens the unlocking switch just before the receiver switch completes its movement.

In the arrangement shown in Fig. 11, instead of permutations of a number of positive and negative impulses, the operation of the transmitter switch *e* and the selecting switches *h* serve to variably connect and disconnect the line conductor 92 to and from the battery H^2, the selecting switches having normally disengaged contacts only. The normal or rest position of the transmitter switch, as in the form shown at station *x* in Fig. 9, is in engagement with contact 6 and the switch itself is connected to the line conductor 92 so that current is normally maintained upon the line. The line conductor 92 extends through a neutral relay W at the distant station, which normally holds its spring-held tongue against its front contact, this contact being connected by conductor 93 to the receiver switch arm *a*, and the tongue being connected to the local battery L by the conductor 94. A space is left between the contacts 6 and 1 of the transmitter disk, so that no current is on the line as the switch arm *e* passes between them. When this occurs, line relay W is de-energized and its tongue *w* is drawn by its spring into engagement with its back contact and closes the circuit from the local battery L by conductor 94 and the switch tongue *w*, conductor 95, switch D and conductor 96 to the trip magnet C. The latter is thus actuated at the beginning of each transmitted signal. In other respects the arrangement of the receiver is the same as that shown in Fig. 9.

It is obvious that numerous changes may be made in the details set forth without departure from the essentials of the invention as defined in the claims.

I claim as my invention:

1. In a printing telegraph system in which the signals are represented by permutations of two different line conditions extending through a definite number of successive time intervals, the combination of a rotary transmitter member adapted by its movement to establish all the changes in line condition of the transmitted signals, a receiver comprising a set of magnets operable in different combinations to effect the character selections, a set of contacts relatively shorter than the corresponding postions of the transmitter member, a cooperating rotary switch member, a motor-driven clutch comprising slip friction members constantly spring-pressed into engagement and adapted to continuously advance said switch member during each signal period, stopping means releasable in response to the first change in line condition of each signal for arresting said switch member in a normal position at the end of each signal and means for effecting a relative adjustment between said contacts as a whole and the normal rest position of said switch member to compensate for variations in the local starting operation thereof, the arrangement being such that said

rotary switch member is adapted to cooperate with said contacts to associate the selecting magnets in order with the line during the mid-portions only of the corresponding signal intervals.

2. In a selecting telegraph in which the signals comprise definite interval permutations of two different line conditions, each preceded by a starting line condition, the combination of a transmitter comprising a rotary member and means controlled by the movement of said member during each signal period to apply the initial starting and selecting conditions to the line, a receiver comprising a set of selectors and a rotary member adapted to operatively associate the same in order with the line during the selecting intervals of the signals, the operating positions of the receiver member being relatively shorter than the corresponding positions of the transmitter member and the former having means for effecting a relative adjustment between its operating positions and a normal rest position, and means for actuating and controlling the operation of said rotary members comprising motor-driven clutches adapted to continuously advance the same during each signal period and trips cooperating with said clutches and operative only between completed signals to initiate and arrest the movement of said members, said receiver trip being releasable in response to the starting conditions imparted to the line by the movement of the transmitter member, the said actuating and controlling means of both members being otherwise operable independently of the line conditions and that of the transmitter member having a period of operation slightly longer than that of the receiver member to insure the stopping of the latter at the end of each signal.

3. In a selecting telegraph system employing code signals each consisting of a definite interval permutation of two different line conditions, the combination of a transmitter at the sending station comprising a set of permutation selectors and a rotary member adapted by its movement from a normal position during each signal period to initially establish a starting line condition and then operatively associate said selectors in order with the line to transmit a signal, a set of selectors at the receiving station and a rotary member for operatively associating the same in order with the line, the operating positions of the rotary receiver member being relatively shorter than the corresponding positions of the transmitter member and adjustable as a whole relatively to a normal rest position of the receiver member, and start-stop actuating and timing means for each of said rotary members, that of the receiver member being initiated in operation in response to the starting line conditions, both said means beng otherwse operable solely under local control, adapted to continuously advance said members during each signal period and operative to initiate and arrest the movement of the members in normal position only between completed signals and the receiver actuating and timing means having a period of operation slightly shorter than that of the transmitter to insure the starting and stopping of the receiver member at the beginning and end respectively of each signal.

4. In a selecting telegraph system in which the code signals are permutations of two different line conditions extending through the same number of successive time intervals, a station equipment comprising sets of transmitting and receiving selectors operable in different combinations, a rotary member adapted by its movement from a normal position to impart a starting condition to the line and by its further movement cooperate with said transmitting selectors to transmit a code signal, a second rotary member adapted by its movement from a normal position to operatively associate said receiver selectors in order with the line, and means for actuating and timing the operation of said rotary members comprising a common continuously operating motor, separate start and stop clutches and individual controlling devices therefor and arranged to continuously advance said members during a signal period and complete the cycle of operations of said receiver member in less time than that of said transmitter member, said transmitter controlling device being operable locally only and that of said receiver being responsive to the starting line conditions.

5. A station instrument comprising a shaft continuously motor driven, a hollow shaft or sleeve thereon, a receiver switch arm on said sleeve, a yielding coupling comprising slip friction clutch members constantly spring pressed into engagement for connecting said shaft and said sleeve, a circular series of contacts cooperating with said switch arm, a shouldered disk on said sleeve, a stop arm engaging said disk and adapted to abut against the shoulder thereon to arrest and hold said sleeve and switch arm in normal position, and a magnet for tripping said stop arm, said contacts being adjustable relatively to normal position of said switch arm.

6. In a selecting telegraph in which the signals are represented by definite interval permutations of two different line conditions, the combination of a rotary transmitter member adapted by its movement during each signal period to establish all the changes in line condition of the corresponding signal, a set of receiving selectors op-

erable in different combinations to effect the character selections, a rotary receiver member for successively associating said selectors with the line as each permutation or signal is received, motor-actuated means for said members adapted respectively to continuously rotate said transmitter member solely under local control through successive signal periods and continuously advance the rotary receiver member under local control during each character selection, and means for maintaining said members in operative relation comprising a clutch device and controlling means therefor arranged to arrest said receiver member at the ends of the signals, said controlling means being responsive to the first change in line condition of each signal to start said receiver and the relative angular spacing of the operating positions of the receiver member being greater than that of the corresponding positions of the transmitter member to permit the former to be driven at a relatively greater angular speed to insure its stopping at the end of each signal.

7. A station instrument for selecting telegraphs employing signals consisting of definite interval permutations of different line conditions, comprising sets of transmitting and receiving selectors operable in different combinations according to the signals sent and received, separate rotary switch mechanisms cooperating respectively with said sets of selectors, a common continuously operating motor and connecting gearing adapted to continuously rotate said switch mechanisms during a signal period and advance the receiver switch mechanism at a relatively greater angular speed and thereby operatively associate the corresponding sets of selectors in order with the line, yielding friction couplings individual respectively to said switch mechanisms, stops operable to arrest said switch mechanisms between completed signals, means responsive to the initial line condition of each signal for releasing said receiver stop and means solely under local control for setting and releasing said transmitter stop.

8. In a printing telegraph system in which the character signals are distinguished by five interval permutations of two different line conditions, the combination with a line, a rotary transmitter member at the sending station having a normal position for maintaining current on the line and other operating positions through which it is continuously advanced during each signal period to establish a uniform starting line condition followed by a character signal, a line relay and a set of five selecting magnets at the receiving station, a rotary receiver switch and a cooperating set of contacts relatively shorter than the corresponding positions of the transmitter member for connecting said selecting magnets in order with the contacts of the line relay during portions only of the signal intervals, a power-driven start and stop clutch adapted to continuously advance said switch during each signal period, a cooperating stop device for arresting said switch in normal position at the end of each signal, a magnet responsive to the starting intervals of the line signals for tripping said clutch and means for effecting a relative adjustment between the normal position of rest of said receiver switch and all of said cooperating contacts to compensate for variations in the local starting operation of said switch.

9. A station instrument for selecting telegraphs employing signals consisting of definite interval permutations of different line conditions, comprising sets of transmitting and receiving selectors operable in different combinations according to the signals sent and received, separate rotary switch mechanisms cooperating respectively with said sets of selectors, a common continuously operating motor and connecting gearing adapted to continuously rotate said switch mechanisms during a signal period and advance the receiver switch mechanism at a relatively greater angular speed and thereby operatively associate the corresponding sets of selectors in order with the line, and a start-stop clutch individual to said receiver switch mechanism, initiated in operation in response to the initial line condition of each received signal and adapted to arrest said receiver member at the end of each signal.

10. In a selecting telegraph, the combination with a line relay, of a rotating receiver switch arm, a set of magnets successively connected to the contacts of said line relay by said switch arm and arranged to be operated in different combinations to effect the character selection, a drive member for said switch arm, constantly engaged slip friction clutch members connecting said drive member and said switch arm, a stop for holding said switch arm against movement, a magnet for controlling said stop, a cam connected to said switch arm, and two sets of contacts in the energizing circuit of said magnet and controlled respectively by said line relay and said cam to trip and restore said stop.

11. A station instrument for selecting telegraphs comprising sets of transmitting and receiving selectors operable in different combinations in accordance with the signals sent and received, a rotary member adapted to cooperate successively with the transmitting selectors and by its movement establish all the changes in the line conditions of the transmitted signals, a separate rotary member for operatively associating the receiver selectors in order with the line during the

selecting intervals of the received signals and actuating and timing means for said members comprising a common continuously operating motor, separate start and stop clutches and individual controlling means therefor, the receiver clutch being initiated in operation in response to the first change in line condition of each received signal, said clutches being otherwise operable solely under local control, adapted to continuously advance said members during a signal period and operative to start and stop the same only between completed signals, the arrangement being such that the cycle of operations of said receiver member is completed in slightly less time than that of said transmitter member.

12. In a selecting telegraph in which the signals are distinguished by different permutations of line conditions extending through a definite number of successive time intervals, a station equipment comprising sets of transmitting and receiving selecting elements adapted to be operated in different permutations according to the signals sent and received, separate rotary transmitter and receiver members each adapted to be continuously advanced from normal position during a signal period to operatively associate the corresponding selecting elements in order with the line, a common, continuously operating motor and connecting gearing adapted to rotate said members and advance said receiver member at an angular speed relatively slightly greater than that of said transmitter member, and separate start and stop clutches individual respectively to said transmitting and receiving members.

13. In a selecting telegraph employing code signals comprising definite interval permutations of different line conditions, a station instrument comprising sets of transmitting and receiving elements selectable in different combinations in accordance with the signals sent and received, corresponding sets of contacts, separate rotary members each having a normal position of rest and adapted by its movement from normal to cooperate with the corresponding sets of contacts to successively connect the associated set of elements to the line, said receiver contacts being relatively shorter than the transmitter contacts and adjustable as a whole relatively to the normal rest position of said receiver member, means also controlled by the movement of said transmitter member for establishing a uniform starting line condition and for restoring the line to normal at the beginning and end respectively of each signal, and actuating and controlling means for said rotary members comprising a common continuously operating motor and separate slip friction clutches arranged to continuously advance said members during a signal period and co-operating stops operative to arrest the same between signals, a locally controlled magnet for releasing said transmitter stop and a magnet controlled by the starting line conditions for tripping said receiver stop.

14. In a selective printing telegraph system employing code signals consisting of five interval permutations of two different line conditions, the combination, at each of two communicating stations, of a transmitter and a receiver comprising sets of five each of selectable elements and separate rotary members, each having a normal rest position and other operating positions for associating the corresponding set of selectors in order with the line, the operating positions of said receiver member being relatively shorter than those of said transmitter member and corresponding to portions only of the signal intervals and being adjustable as a whole relatively to the normal rest position of the receiver member, said transmitter member being adapted in normal position to hold the line closed and having an additional operating position for establishing a starting line condition at the beginning of each signal, and means for actuating and timing the operation of the members at each station comprising motor-driven clutches adapted to continuously advance the same through their respective operating positions during a signal period and cooperating trips operative only between completed signals to start said members and arrest the same in normal position, the receiver trips being releasable in response to the starting line conditions, the said actuating and timing means of each member being otherwise operable solely under local control and that of the transmitting member at each station having a period of operation slightly longer than that of the receiver member at the other station.

15. In a selective telegraph in which the signals are represented by combinations of impulses, the combination with a line, of a set of transmitter contacts, a rotary switch mechanism normally at rest but operative to successively connect said contacts to said line, driving means for said rotary switch mechanism, means for rendering said driving means ineffective when said rotary switch mechanism is in normal position, an electro-magnet and mechanism for locking said transmitter contacts in actuated position, an electromagnet for controlling said rendering means, a switch open slightly in advance of the normal position of said rotary switch mechanism and closed in other positions of said mechanism, and an energizing circuit for said magnets including said switch and windings of said magnets.

16. A station instrument comprising a motor, a shaft continuously driven by said motor, upright brackets in which said shaft

is journaled, a base for said brackets, a sleeve on said shaft, a yielding friction coupling between said shaft and sleeve, a disk on said sleeve having a shoulder thereon, a stop arm spring pressed into engagement with said disk and adapted to abut against said shoulder to hold said sleeve in normal position, a magnet on said base beneath said disk for tripping said stop arm, a hub on said sleeve, a switch arm extending from said hub, a brush secured to said base and conductively engaging said hub, a rotatably adjustable contact disk surrounding said shaft and secured to one of said brackets, and cooperating contacts on said switch arm and contact disk.

17. In a selective system for printing telegraphs in which the character signals are five interval permutations of two different line conditions, a transmitter comprising a set of tape controlled selectors, a rotary member cooperating therewith and adapted to be continuously rotated to impart successive character signals to the line, each preceded by a uniform starting interval and means for advancing the tape in timed relation with said rotary transmitting member, a receiver comprising a set of five selectors and a rotary member adapted to be continuously advanced to associate the same in order with the line as each character signal is received, driving motors for said members adapted to rotate said receiver member slightly faster than said transmitter member, and a stop and start clutch controlled by the starting intervals imparted to the line by the rotary transmitter member and arranged to start and stop said receiver member at the beginning and end respectively of each signal.

18. In a selective system for printing telegraphs in which the character signals are five interval permutations of two different line conditions, each preceded by a starting interval, a station instrument comprising sets of five each transmitting and receiving selectors adapted to be operated in different permutations according to the signals sent and received, separate rotary transmitting and receiving members each adapted to be continuously advanced from a normal position during a signal period to thereby operatively associate the corresponding set of selectors in order with the line, means also controlled by the movement of said transmitter member from normal for establishing the starting interval on the line at the beginning of each signal, a continuously operating motor for actuating said rotary members, separate stop and start clutches individual respectively to said transmitting and receiving members operative to start and arrest the same in normal position only between completed signals, means for tripping said transmitter clutch independently of line conditions, and means controlled by the starting interval of each received signal for tripping said receiver clutch, the operating positions of the receiver member being relatively shorter than the corresponding positions of said transmitter member and adjustable as a whole relative to its normal rest position.

19. In a selective system for printing telegraphs in which the signals consist of permutations of a definite number of two different line conditions, the combination of a transmitter and a receiver each comprising a set of selectors and a cooperating rotary member for associating said selectors in order with the line during each signal period, separate power driven start and stop clutches for continuously advancing said members during each signal period, and trips cooperating with said clutches and operative only between completed signals to start and stop said members, said transmitter trip being locally controlled independently of line conditions, said receiver trip being responsive to the first change in line condition of each signal, the angular spacing of the operating positions of the receiver member being relatively slightly greater than that of said transmitter member to permit the receiver member to be driven at a relatively greater speed and be invariably arrested at the end of each signal.

20. In a selecting telegraph system employing two different line conditions and code signal comprising definite interval permutations of the line conditions, the combination of an automatic transmitter comprising a set of tape-controlled selectable elements, a cooperating rotary member adapted to be continuously advanced during each signal period, contacts controlled by such movement for establishing a starting line condition followed by a code signal as determined by the selection of said elements and a tape-feeder timed in operation with said rotary member, a receiver comprising a set of selectors operable in different combinations to effect the selections and a rotary member having a series of operating positions adjustable relatively to a normal rest position and through which it is adapted to be continuously advanced during a signal period to operatively associate said selectors in order with the line during the mid-portions only of the selecting intervals of the signal, and means for actuating and timing the operation of said rotary members, that of said transmitter member being adapted to automatically operate the same solely under local control to impart successive signals to the line and that of said receiver member being initiated in operation in response to the starting line conditions but otherwise operative solely under local control and having a period of operation slightly shorter than

that of said transmitter member to insure the stopping of the receiver member in normal position at the end of each signal.

21. In a selecting telegraph system employing code signals comprising definite interval permutations of two different line conditions, the combination of an automatic transmitter comprising a set of tape-controlled selectors, a rotary member adapted by its movement during each signal period to initially establish a starting line condition and then cooperate successively with said selectors to transmit a code signal and a tape-feeder timed in operation with said member, a receiver comprising a set of selectors operative in different combinations to effect the selections and a rotary member for associating the same in order with the line during the selecting intervals of the signals, actuating motors for said members adapted respectively to continuously rotate said transmitter member solely under local control through successive signal periods and continuously advance said receiver member under local control during each selecting operation, and cooperating stops adapted to be released in response to the starting line condition of each signal for positively arresting said rotary receiver member between signals, the angular spacing of the operating positions of the receiver member being relatively greater than that of the corresponding positions of the transmitter member to permit the former to be driven at a relatively greater angular speed and be invariably arrested at the end of each signal.

22. In a selecting telegraph system employing code signals each comprising a five interval permutation of two different line conditions, the combination of a transmitter at the sending station comprising a rotary member and means controlled by the movement of said member from a normal position during each signal period for establishing a starting line condition followed by a code signal, a set of five elements at the receiving station operable in different combinations to effect the selections and rotary member for operatively associating the same in order with the line during the corresponding signal intervals, motor-driven clutches for actuating said members, that of the receiver member being initiated in operation in response to the starting line condition of each signal, said clutches being otherwise operable solely under local control, adapted to continuously advance said members during each signal period and operative to arrest the same in normal position only between completed signals, the operating positions of the rotary receiver member being relatively shorter than the corresponding positions of the transmitter member and also having a relatively greater angular spacing to permit the receiver member to be advanced at a relatively greater angular speed and be invariably arrested at the end of each signal.

23. In a selecting telegraph system employing signals comprising definite interval permutations of two different line conditions, each preceded by a starting interval, the combination, at each of two communicating stations, of a transmitter comprising a rotary member and means controlled by the movement of said member from a normal position during each signal period for establishing the starting and selecting line conditions of the corresponding signal, a receiver comprising a set of selectors and a rotary member for operatively associating the same in order with the line, the operating positions of the receiver member being relatively shorter than the corresponding positions of the transmitter member, and adjustable relatively to a normal rest position of the receiver member, and start-stop actuating and controlling means for each of the rotary members at each station, that of the receiver members being initiated in operation by the starting intervals of the signals, each said means being otherwise operable solely under local control, adapted to continuously advance the corresponding member during a signal period and operative only between completed signals to start and stop the same, the angular spacing of the operating positions of the receiver members being relatively greater than that of the corresponding positions of the transmitter members to permit the former to be driven at relatively greater angular speeds and be invariably arrested at the end of each signal.

24. In a printing telegraph system employing two different line conditions and signals each consisting of a uniform starting interval followed by a definite number of selecting intervals, the combination with a line, of a transmitter at the sending station comprising a set of elements for determining the selecting intervals of the signals, a rotary member cooperating therewith and adapted by its movement during each signal period to establish all the changes in line condition of the corresponding signal and restore the line to normal at the end of each signal and means timed in operation with said rotary member controlling the selection of said elements and preventing mutilation of the signals but adapted to permit the continuous rotation of said member through successive signal periods, a receiver at another station on said line comprising a set of selecting elements operable in different combinations to effect the character selections and a cooperating rotary member adapted to successively associate the same with the line during the mid-portions only of the selecting intervals of the signals, driving motors for said rotary members adapted respectively to continuously rotate the transmitter member

under local control through successive signal periods and continuously advance the receiver member during each signal period at a relatively greater angular speed, a stop for positively arresting said receiving member at the end of each signal, and means responsive to the starting intervals imparted to the line by the movement of said transmitter member for releasing said stop.

25. A station instrument for selecting telegraphs comprising sets of transmitting and receiving selectors operable in different combinations in accordance with the signals sent and received, a rotary member adapted to cooperate successively with said transmitting selectors during each signal period and by its movement establish all the changes in the line conditions of the transmitted signals, a separate rotary member for operatively associating the receiver selectors in order with the line during the selecting intervals of each received signal, the relative angular spacing of the operating positions of said receiver member being greater than that of the corresponding positions of said transmitter member, a common continuously operating motor and connecting gearing adapted to continuously advance said members during a signal period and rotate said receiver member at a relatively greater angular speed, start-stop clutches individual to said members and independently operable to initiate the movement thereof and arrest the same between completed signals, means responsive to the first change in line condition of each received signal for initiating the operation of said receiver clutch and locally controlled means for initiating the operation of the transmitter clutch independently of line conditions.

26. In combination in a selecting telegraph system employing signals each comprising a starting interval followed by a definite interval permutation of two different line conditions, a line, a rotary transmitter switch member having a normal position for holding the line closed and adapted by its movement from normal to establish the starting and selecting intervals of each signal, a set of elements for determining the selecting intervals of the signals, means timed in operation with said rotary member for controlling the selection of said elements, a line relay, a set of selecting magnets, a rotary receiver member adapted by its movement from a normal rest position to operatively associate said magnets in order with the contacts of said line relay during the mid-portions only of the permutation intervals of the signals, motor-driven start-stop clutches for continuously advancing and locally timing the operation of said members during a signal period, starting magnets for said clutches, means including normally closed contacts controlled by said rotary transmitter member for energizing its start magnet independently of the line conditions, and means including normally closed contacts controlled by said rotary receiver member and normally open contacts controlled by said line relay for energizing said receiver start magnet.

27. In a printing telegraph system, the combination of a main line, a transmitter comprising a start-stop rotary member operable solely under local control and adapted to be continuously advanced from a normal position during each signal period, means controlled by such movement for applying a starting condition followed by a definite interval permutation of two different conditions to the line and for restoring the line to normal at the end of each signal, a set of elements selectable to vary the line conditions and means timed in operation by said rotary member for controlling the selection of said elements and arranged to prevent the mutilation of signals but permitting the selection of the succeeding signal before the said member reaches its normal position, a line controlled magnet and a receiver comprising a set of selectors operable in different combinations to effect the character selections and a start-stop rotary member initiated in operation by the first change in line condition of each signal but otherwise operable solely under local control and adapted to be continuously advanced from a normal position of rest during each signal period to operatively associate said selectors in order with the said line controlled magnet during the selecting intervals of the received signals, the operating positions of said receiver member being relatively shorter than the corresponding positions of the transmitter member and adjustable as a whole relatively to the normal rest position of the receiver member.

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