March 18, 1941. H. BARTH 2,235,006

TELEPRINTING SYSTEM

Filed Jan. 7, 1938 6 Sheets-Sheet 1

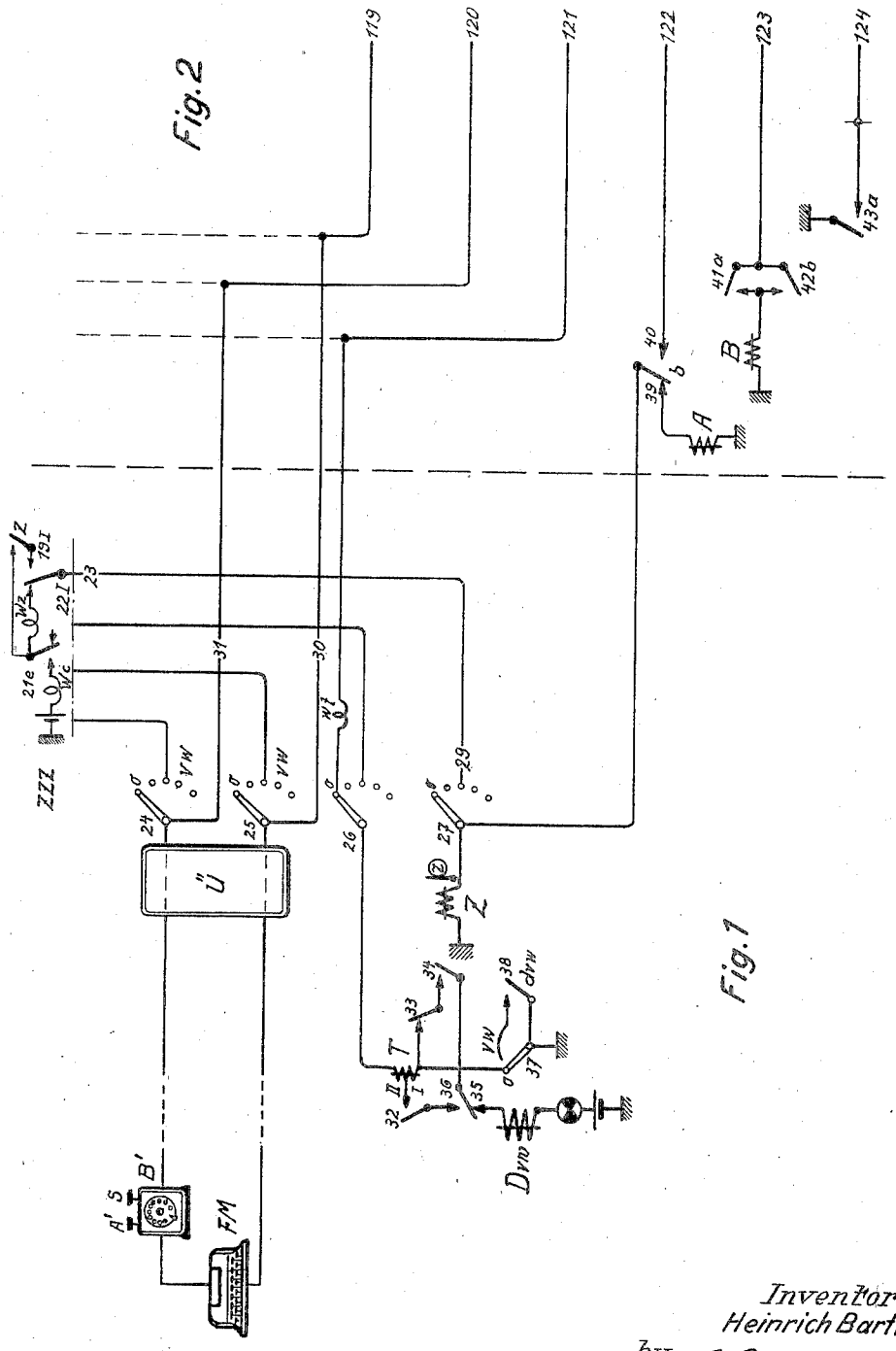

Fig. 1

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TELEPRINTING SYSTEM

Filed Jan. 7, 1938 6 Sheets-Sheet 2

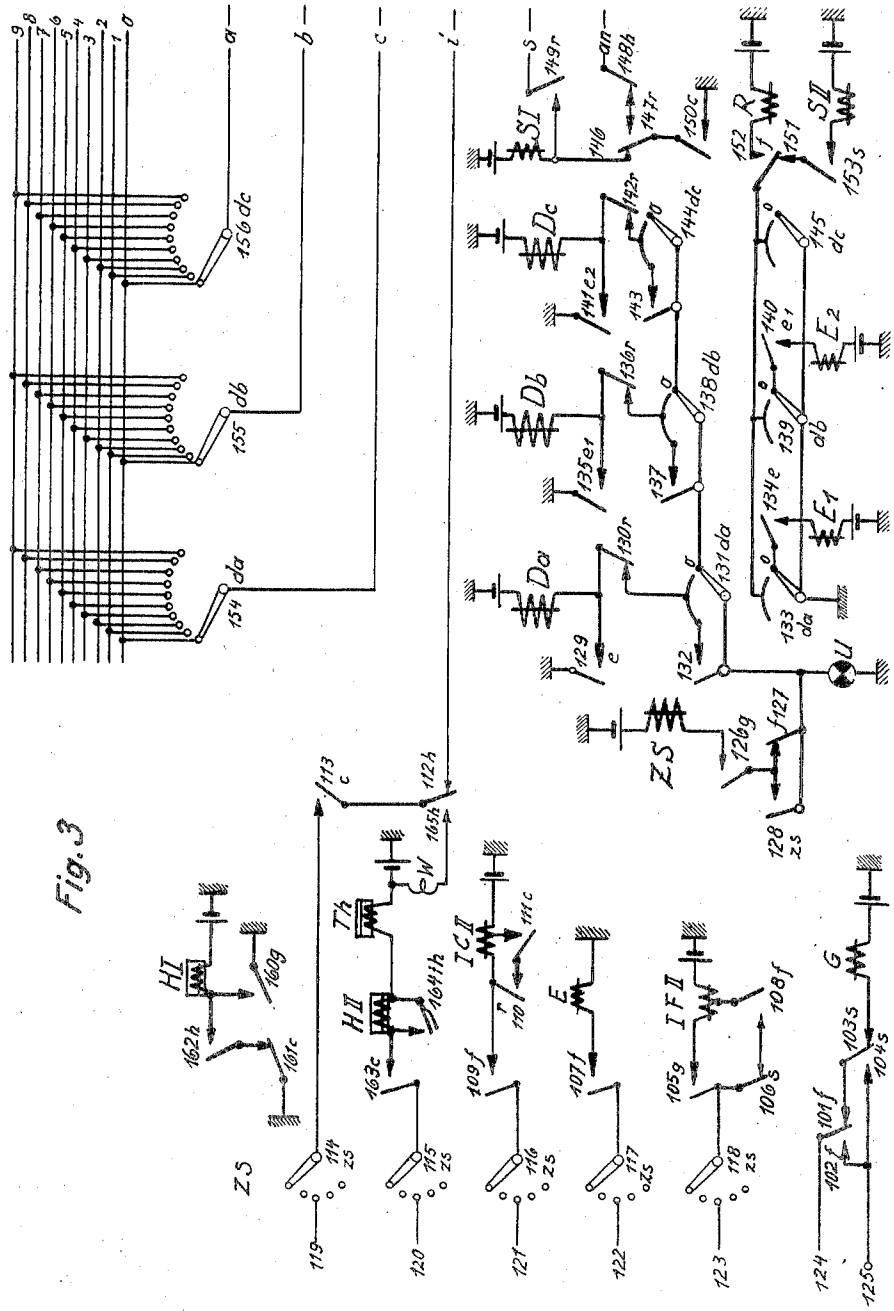

Fig. 3

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TELEPRINTING SYSTEM

Filed Jan. 7, 1938 6 Sheets-Sheet 3

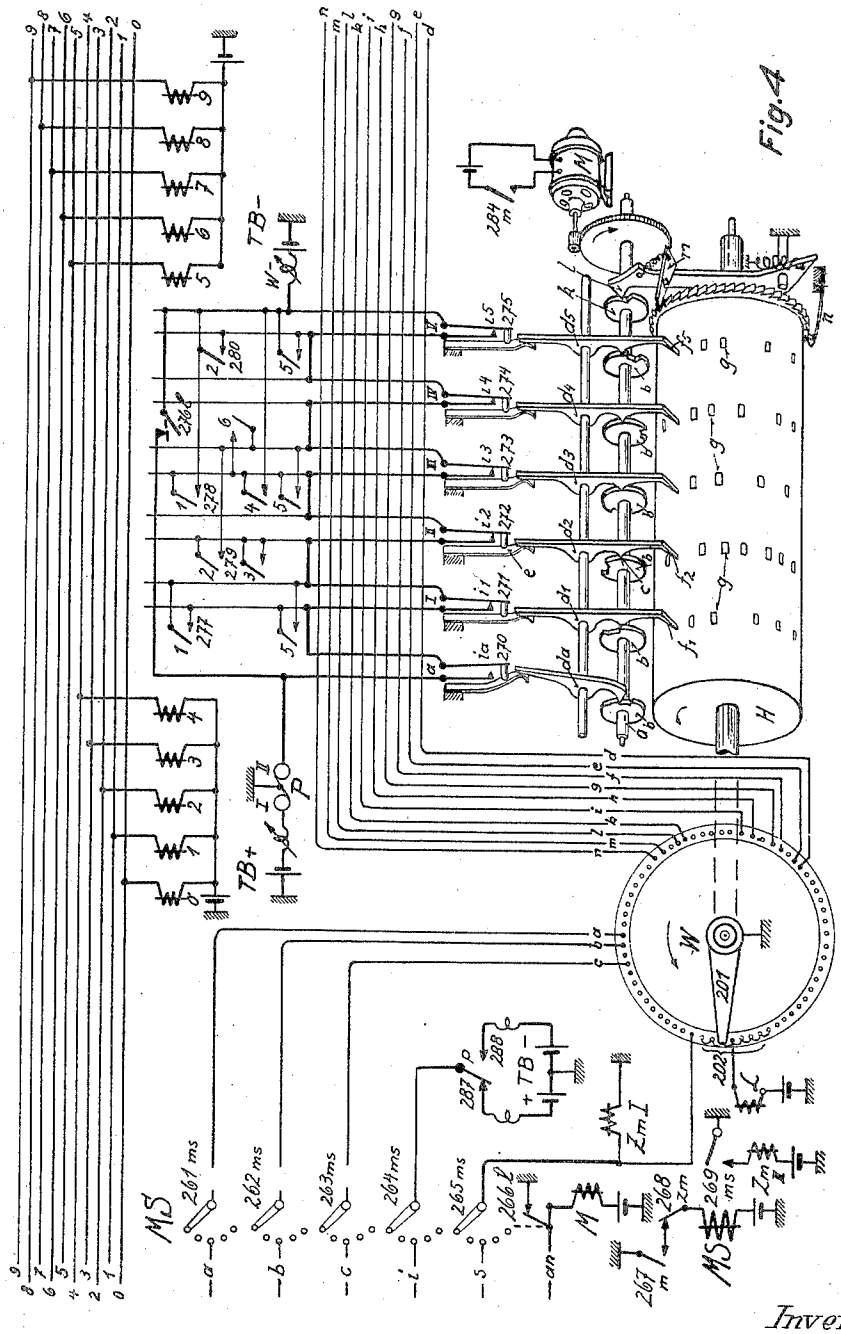

Fig. 4

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TELEPRINTING SYSTEM

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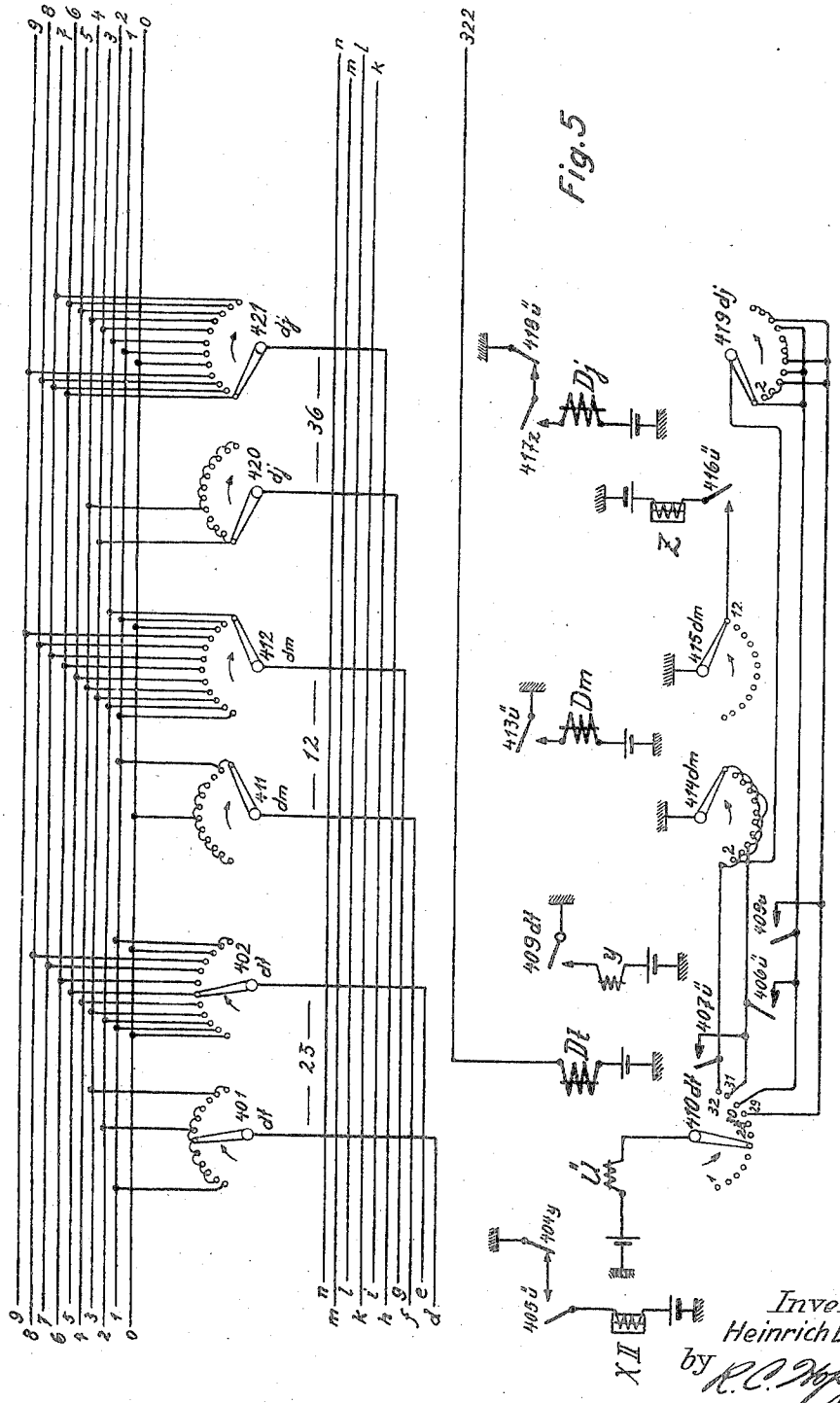

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TELEPRINTING SYSTEM

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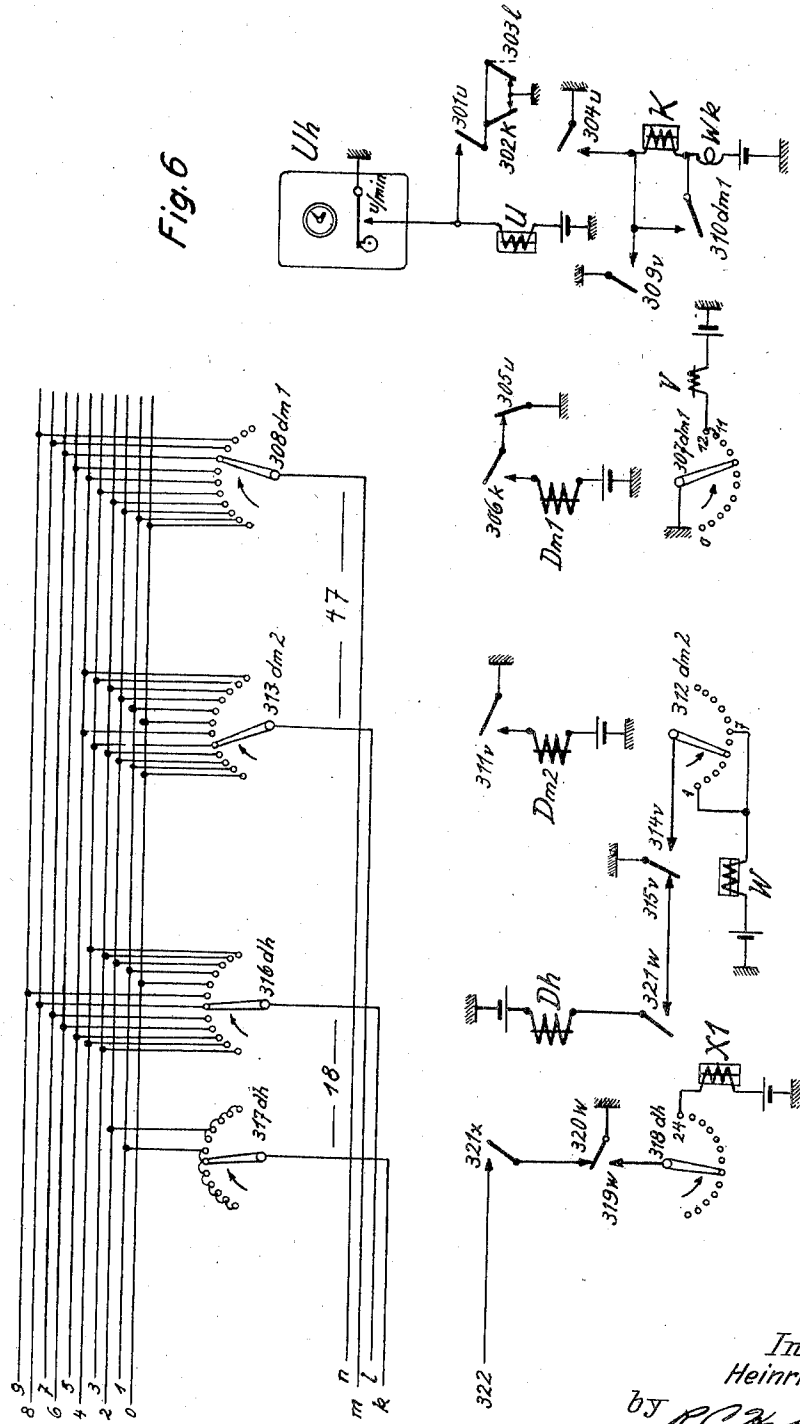
Fig. 6



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TELEPRINTING SYSTEM

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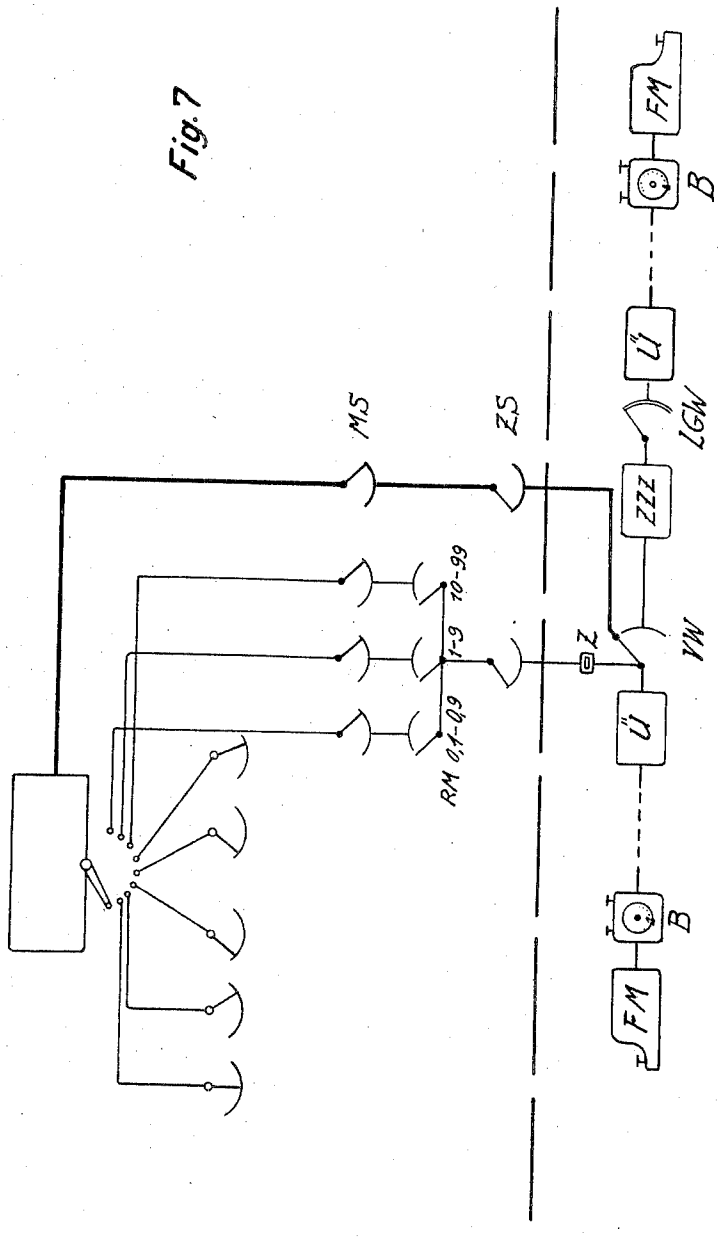
Fig. 7



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Patented Mar. 18, 1941 2,235,006

UNITED STATES PATENT OFFICE

2,235,006

TELEPRINTING SYSTEM

Heinrich Barth, Munich, Germany

Application January 7, 1938, Serial No. 183,924
In Germany January 7, 1937

8 Claims. (Cl. 178—2)

In telephone systems arrangements are known which are provided with a device acting in the exchange or central office thereof to store up or register an indication of the fee charge for a call and automatically to transfer such indication to the subscriber's station over the group selectors and line finders or the like. For this purpose apparatus are employed by which on the one hand the fee zone, on the other hand the time is ascertained and which at a predetermined instant cause these two items to be conveyed over the exchange equipment to an apparatus associated with the subscriber's station. This additional subscriber's apparatus is arranged to be restored to the zero position before the next following call is initiated, and then at the conclusion of the call to be stepped on by current impulses, the final positions of the moveable parts thereof indicating the fee that has been charged. Each such current impulse signifies a tariff unit. A special characteristic feature of such an arrangement is that this is in part located in the exchange and in part associated with the subscriber's station. Arrangements of this kind have the disadvantage that the indications will disappear in default of means for recording them.

In teleprinting systems it has been experienced that it is desirable to provide arrangements of the kind employed in telephone systems. It is well known to equip teleprinting systems with arrangements in which predetermined invariable texts, such as addresses or names, are obtained from a storage device when this is released. Such texts are prepared for transmission by adjusting pin barrels, for instance, and are not altered until another predetermined text is wanted. This arrangement thus only allows of sending the text prepared in this way. The invention, however, has for its object automatically to transfer at the conclusion of a teleprinting transmission an indication of the respective fee, that is an indication subject in a sense to infinite variation. Preferably, in addition to such fee calculation the hour and day-time, that is, indications likewise subject to variation, are transmitted too. No solutions regarding objects of this kind have been proposed so far. Of course, invariable indications intended for reiterative use may be added to such varying indications or transmitted separately.

In arrangements as provided by the invention a solution of the said problem is attained by means of a device connected in parallel with the integrating meter and which does not become effective until the teleprinting call becomes chargeable, and which then receives current impulses from the time zone meter, thus controlling stepping switches. The problem now is, to convert the stored impulses into telegraph signals in order that such current combination may be able to operate the subscriber's telegraph apparatus in a manner to produce printed characters. To such end the storage devices are joined to a converting device which in the case of digit 5, for instance, acts to produce the telegraph signals necessary to represent this digit. The telegraph signals thus produced—in practice a number thereof will be concerned—are now conveyed one after another to the calling subscriber after the junction line has been disconnected. They cause his teleprinting machine to respond, which prints in readable characters the indication that informs him of the fee or other particulars. In addition to this varying indication, communications not subject to variation may be transmitted in company therewith, this being accomplished with the aid of switching means well known per se.

It has been experienced that the start-stop printer is the telegraph apparatus best adapted for unskilled persons, because the construction and operation thereof are similar to the widely known typewriter. This fact has led to arranging the start-stop printer as a teleprinting apparatus in public teleprinting systems in like manner to telephone stations. Thus, teleprinting systems on a principle similar to that involved in automatic telephone systems have been devised inter alia.

In systems of this kind a teleprinting connection is set up by impulse action, the subscriber manipulating a dial of the teleprinting station. The fees due on such teleprinting connections are automatically calculated by the so-called time zone meter of the teleprinting exchange. An indication of the fee is by the requisite number of current impulses transmitted from the time zone meter to a fee meter allotted to the calling set of the teleprinting station, each such impulse corresponding to a tariff unit. In the case of wrong connections or errors no charge is made, provided that the connection is released shortly thereafter.

The invention described hereafter is concerned with a self-acting fee-indicating device for teleprinter stations of automatic teleprinting systems. The indication transmitted to a subscriber of such system is in the nature of a printed communication received by him immediately after the last chargeable call and from a device disposed in the exchange, whence the communica-

tion is conveyed over the teleprinting line and the start-stop printer of his station. In company with the fee indication an indication as to the day, hour and minute may be transmitted. These indications are received only by the station from which the call has been initiated and are not transmitted until the connection is released. It will be convenient also to have the fee indication preceded or followed by the name of the sending station or by any reiterative communication of invariable wording. An indication thus composed may read as follows:

T-OFF WASH 12.25.36 T 18.47 FEE 17.80+

The communication relating to time and fee may be transmitted with the aid of the telegraph signals usually employed in teleprinting methods, that is, by the emission of five impulses which are of the same length and are characterized in a well known manner by a certain combination of "Current" and "No current," that is, marking impulses and so-called spacing impulses. An essential feature of the invention is the fact that contrarily to the fee indication effective in telephone systems by means of electro-mechanically acting fee indicators which are in the nature of an additional device fitted to the subscriber's telephone station, in the novel arrangement no special device whatsoever is at the subscriber's station needed for the reception of the communications relating to time and fee, such communications being indicated here by the teleprinting means present at the subscriber's station. Such means acts to convert the telegraph signals into characters written down so as to remain visible.

The invention will be understood from the following description, reference being had to the accompanying drawings in which Figs. 1 to 7 are wiring diagrams illustrating one embodiment of the invention.

Figs. 1 and 2 represent an additional device that comprises a relay arrangement A, B peculiar to each teleprinting station FM intended to receive indications as to time and fee. Allotted to this additional device is a switch box B' provided with a calling key A' and a clearing key S. Fig. 3 shows a fee-indication register which shares in the fee-indication-pulsing from the time zone meter ZZZ to the fee meter Z of the exchange and acts to store up the metering impulses as rotary steps with the aid of several rotary selectors D*a*, D*b*, D*c* until the fee indication is transmitted, such storage action being such that one step of the selector D*a* shall characterize one tariff unit while one step of selector D*b* shall characterize ten tariff units and one step of selector D*c* characterize hundred tariff units. In order to reduce the fee indication registers to an economical degree each such register is provided with a rotary selector having several wipers and arranged as a line finder ZS intended to establish the connections to the respective teleprinting line.

The converting device A*bw* shown in Fig. 4 has for its object to obtain from the register the time values and fee values, then to convert these values into the respective telegraph signals and finally to send these to the teleprinting station. For economical reasons the converting device is likewise associated with a line finder MS which has to find the fee register ready for effecting the signal transmission, and to switch the converting device to the teleprinting line. The telegraph signals are conveyed over the fee register, represented in Fig. 3, and the subscriber's line to station FM.

Fig. 5 shows the automatic adjusting device intended to reproduce an indication of the respective year and day by producing a combination of numerals. This device is caused to step in accordance with the day indications and under the influence of rotary selectors D*t*, D*m*, D*j*. The adjustment of a month indication to 30 or 31 days, as the case may be, and also the adjustment of February to 29 days in the case of a leap year is effected automatically.

The hours of the day are reproduced by the arrangement shown in Fig. 6. The adjustment of the rotary selectors D*h*, D*m*2, D*m*1 is likewise automatic. A clock U*h* not forming part of the circuit arrangement causes a current impulse to act by contact u/min on this arrangement each minute, thus controlling the selectors D*h*, D*m*2, D*m*1 in compliance with time.

From Fig. 7 it will appear how the novel arrangement is interposed in the trunking scheme of a teleprinting system, the representation here being purely schematic.

The time zone meter ZZZ, Fig. 1, controlling the setting up of a teleprinting call, comprises switching members which inter alia act to determine a call to be chargeable. From the first operation, intended to initiate a metering, up to the occurrence of the first recording impulse acting on the fee meter Z disposed in the calling set of the teleprinting station, an idle time of several seconds will elapse during which a teleprinting call can be undone without the fee meter responding. As soon as device ZZZ has received the criterion of initiating the metering operation a relay thereof is energized for some seconds in company with another relay. The switching operations occurring in the device ZZZ are not shown in the drawings. The said relay of the device ZZZ causes the relay contact shown at **22** I to complete a circuit from **23** over the recording or metering line to bank contact **29** and thence to the fee meter Z of station FM, the resultant current also flowing through a relay A connected in series or in parallel with the device Z. The intensity of this current is so limited by a resistance W*z* that relay A connected in parallel with the meter Z shall respond while device Z shall not be affected. The circuit here is as follows: ground, battery, resistance W*c*, closed contact **21***e*, resistance W*z*, contact **22** I, exit point **23** of ZZZ, lead to bank contact **29** of the preselector VW, wiper **27**, conductors to Z and to A over contact **39***b*, ground. Before the said idle time of device ZZZ has elapsed, relay contact I changes from position **22** to position **19**, whereupon the first metering impulse occurs if the call has not been released.

In the meantime relay A has been energized over switched contact **21***e*. The relays A, B, or a marginal relay suitable for two operations, are intended for establishing the connection of the line finder. The energized relay A acting over a collecting line **124** causes a relay G of the next idle fee register, Fig. 3, to respond, being energized over resting contacts **101***f* and **103***s*, the circuit here being: ground, contact **43***a*, line **124**, contacts **101***f*, **103***a*, winding of G, battery, ground. If this register were busy then contacts **102***f* and **104***s* would switch the arrangement to the next idle fee register over line **125**. The energized relay G connects the stepping magnet Z*s* of the line finder to ground over an interrupter U, the circuit being as follows: ground,

battery, magnet coil Zs, contact 126g, contact 127f, interrupter U, ground. Owing to the interrupter U the stepping magnet Zs receives current impulses, in order to move the wipers of the selector Zs. Contact 128zs is merely to ensure that the last impulse shall occur even if contact 127f has been opened prematurely. The wipers of selector Zs are stepping from one bank contact to the next following contact until the testing relay F finds the calling set of that subscriber's station which is in condition for metering. When wiper 118zs arrives at the bank contact belonging to that station, then in accordance with Figs. 2 and 3 the following circuit is completed: ground, battery, windings F II, F I, contact 105g, wiper 118zs, exit line 123, contact 41a, winding of relay B, ground. The relays B, F are therefore energized. Contact 127f acts to break the circuit of the stepping magnet Zs. Relay B by its contact 39b breaks the circuit of relay A and by its contact 40b connects the line 122 over wiper 117zs and switched contact 107f to relay E. Relay B holds itself energized over its contact 42b, contact 41a then becoming opened. Relay E acts to transfer the received metering impulses to storage magnet Da. The circuit here is: ground, contact 129e, magnet coil Da, battery, ground. Magnet Da thus acts to step the appertaining wipers. Each step causes these wipers to arrive at the next following bank contact. Each step of the selector Da corresponds to a tariff unit. By the tenth impulse the wiper 133da of selector Da is brought to reassume its home position O, whereby a current impulse is caused to act on relay E1, the circuit being: ground, wiper 133da in position O, contact 134e closed, relay E1, battery, ground. Now in addition to selector da also selector Db receives an impulse in accordance with the circuit: ground, contact 135el, magnet coil Db, battery, ground. Selector Db characterizes ten tariff units by each step. After this selector itself has received ten impulses, then in the same manner as selector Db has been influenced selector Dc receives a current impulse over contact 141e2 of relay E2 after this relay has responded over ground, wiper 139db, selector exit O, contact 140el, winding of relay E2, battery, ground. Selector Dc by each step characterizes one hundred tariff units. In this way three rotary selectors allow of storing or registering 999 tariff units. By enlarging the storage devices the storage capacity of the fee registers will be increased accordingly.

The wipers of selectors Da, Db, Dc when adjusted remain in their respective position until the converting device shall have tapped them and till the transmission has been effected.

When the teleprinting operation has been finished, then the clearing key S is depressed by the subscriber. Hereby the teleprinting call is released, the selectors, over which the call has been set up and over which the teleprinting operation has been effected, thus being restored to normal. Preselector VW of the calling set likewise reassumes its position of rest.

Before describing now the conversion of the adjusted values and the transmission thereof to the subscriber's station, the arrangement for adjusting the time values will be referred to hereafter.

An example of the time adjusting device intended to transmit the respective day of the year and the hour thereof by a combination of numerals, and also an example of the means for effecting the conversion into telegraph signals is represented in Figs. 5 and 6. The switching means here employed are merely rotary selectors, having several wipers, and relays. The wipers may be moved, however, by purely mechanical means. The wipers of the rotary selectors are so adjusted by current impulses acting on the stepping magnets at predetermined instants of time that at a certain moment predetermined numerical values, intended to reproduce the calendar time and hours, may be obtained and converted by the device Abw in accordance with the position of the wipers. The bank contacts of the rotary selectors are by collecting lines connected to ten relays of a relay group 0–9 of the device Abw, Fig. 4. The insulated wipers of the rotary selectors are joined to the bank contacts of the stepping mechanism W of the converting device Abw. As soon as the wiper of the mechanism W arrives at a bank contact connected to a wiper of a selector intended for the time adjustment, this wiper acts to establish a connection to one of the ten relays of relay group 0–9, this relay thus being energized. The influence of this relay group on the converting device will appear further on from the description of the converting device itself. In the first place the operation of the device intended for adjusting the hours shall be explained now.

A switching clock Uh indicated in Fig. 6 is arranged to actuate a mechanically acting contact u/min each minute, thus causing a current impulse to influence relay U, the circuit being: Ground, closed contact u/min, relay U, battery, ground. Relay U is hence energized, switching its contacts. By contact 301u relay U again receives earth potential over the contacts 302k and 303l, which are connected in parallel. Contact 303l forms part of the relay L of the converting device Abw represented in Fig. 4. Relay L is connected in circuit as long as the converting device is in its resting position or the wiper of the mechanism W is moving over the contacts of the rest positions 202. Contact 303l is opened in this event. If, however, relay L has dropped its armature, this being the case when the converting device Abw is rotating, then contact 303l is closed. Due to this provision an impulse acting on stepping magnet Dm1 does not become effective until device Abw has finished its period of rotation. In this way it is ensured that during the operation of the converting device wrong results, caused by an intervening adjusting impulse, are avoided.

Relay contact 304u acts to energize relay K, the circuit being: Ground, contact 304u, winding of relay K, resistance Wk, battery, ground. Relay K has a copper jacket, thus being slow to release. As long as relay U is energized relay K is energized too. Relay K, however, drops its armature somewhat later than relay U. The time elapsing until relay K drops its armature after relay U, is sufficient to produce an impulse acting on the stepping magnet Dm1. The circuit here is: Ground, contact 305u (resting), contact 306k (closed), winding of magnet Dm1, battery, ground. By each impulse the wipers 307 and 308dm1 are advanced by one step. While with the aid of wiper 308dm1 the connection to the collecting lines of relay group 0–9 is established, wiper 307dm1 by making step 11 acts to energize relay V, if the selectors employed are of the 12 steps type, as is the case in the embodiment here shown. Relay K is now again energized with the aid of contact 309v. Relay K has immediately before energized the stepping magnet

Dm1 by means of contact **306***k* and is hereupon soon deenergized by its winding becoming short-circuited through contact **310***dm1*. Relay U, however, is not affected by this new current impulse. When relay K has dropped its armature stepping magnet *Dm1* is cut out. Contact **310***dm1* now again opens the short circuiting connection by which relay K has been influenced. Since, however, relay V remains energized over wiper **307***dm1* during the passage from step **11** to step **12**, also contact **309***v* is still closed. The impulse acting on magnet *Cm1* is therefore repeated. Magnet *Dm1* makes a new step, wiper **307***dm1* thus arriving in position O. Relay V is now deenergized. From this moment the stepping magnet *Dm1* is controlled by the relays U, K again until the eleventh step is made. Each rotary step of wiper **308***dm1* thus characterizes a minute unit. After each tenth minute relay V responds, as stated before. Relay V transfers an impulse to magnet *Dm2* by means of contact **311***v*. This action is likewise repeated after each tenth minute, one step of the wiper **313***dm2* thus characterizing a time unit of ten minutes.

When wiper **312***dm2* completes step **1** or step **7** contact **314***v* acts to energize relay W, the circuit being: Ground, contact **313***v*, wiper **312***dm2*, exit **1** or **7** of the contact bank, winding of relay W, battery, ground. Relay W is slow to release. As soon as contact **314***v* reassumes its position of rest while relay W is still energized, stepping magnet *Dh* is for a short time supplied with current. The circuit here is: Ground, contact **315***v*, contact **321***w*, magnet *Dh*, battery, ground. Magnet *Dh* thus after each sixth adjustment of *Dm2* makes a step forward and thereby characterizes the sixtieth minute, that is, the hour. Selector *Dh* is arranged for 24 steps and has two wipers. It may, however, comprise a 12 steps contact bank. In this case the six wipers are subdivided, one half of the bank then characterizing the hours from 0 to 12 o'clock while the other half corresponds to the time from 12 to 24 o'clock. Let us assume that 24 steps selectors are employed then a rotary selector *Dh* equipped with three wipers **316**, **317**, **318** *dh* is necessary in order to characterize the hours from 0 to 24, this being the arrangement adopted in the case represented. Wiper **316***dh* has to characterize the units digits while wiper **317***dh* shall characterize the tens digits in relation to the converting device *Abw*. When wiper **318***dh* assumes position **24** then relay winding **I** is energized over contact **319***w* of the relay W arranged to respond each hour. Relay X after 24 hours acts to produce a current impulse by which the device for adjusting the day of the year is energized, as will be seen from Fig. 5. The automatic adjusting device for the conversion and reproduction of the calendar indication regarding the day, month and year is represented in Fig. 5. This device is here shown to comprise three rotary selectors *Dc*, *Dm*, *Dj*, which so influence each other that after 30 or 31 days, for instance, or in February after 28 days, or 29 days in the case of leap years the day adjuster *Dt* shall make the first step along its bank while at the same time also the month adjuster *Dm* is advanced by one step. After 12 months the wipers of the year adjusting device are caused to make one step. The rotary selector intended for the day indication, that is, selector *Dt*, has either 16 or 32 steps. If it is arranged for 32 steps then the day indication is adjusted with the aid of two wipers. The third wiper automatically causes the bank contacts of the last month days, which may be missing, to be tapped in dependence upon the month wiper **414***dm*.

The day switching of selector *Dt* is in accordance with Fig. 6 effected by the hour adjusting device producing a current impulse for the stepping magnet *Dt*. The circuit here is: Ground, contact **320***w*, switched contact **321***x*, line **322** (Fig. 5), magnet *Dt*, battery, ground. Each step of selector *Dt* causes the wipers **401** and **402***dt* to be set to the respective collecting lines of relay group **0–9**. The movement of the wipers of selector *Dt* over the last bank contact is initiated by wiper **410***dt*. For instance, if this wiper in February of the year 1937 is stepping from **28** to **29**, then relay Ü is energized in the circuit: Ground, wiper **414***dm*, exit **2** of selector *Dm*, wiper **419***dj*, step **2** (to step **1** the year 1936 corresponds in a given case), inlet at step **29** of selector segment *Dt*, wiper **410***dt*, relay Ü, battery, ground. Relay Ü thus responds and hereby energizes winding II of the relay X by means of contact **405***ü*. the circuit being as follows: Ground, contacts **404***y*, **405***ü*, winding II of relay X, battery, ground.

Contact **321***x* acts to energize the stepping magnet *Dt* in accordance with the circuit: Ground, contacts **320***b*, **321***x* (Fig. 6), line **322** (Fig. 5), magnet *Dt*, battery, ground. By contact **409***dt* of magnet *Dt* relay Y is energized, whereupon contact **404***y* acts to deenergize winding II of the relay X. Relay X thus drops its armature and by contact **321***x* breaks the circuit of magnet *Dt*. Wiper **410***dt* has thus been stepped to **30**. The bank contacts **29** and **30** are bridged over by the relay contact **408***ü*, this being still switched. Consequently selector *Dt* can be stepped on by relay X. The described action therefore is repeated afresh, whereupon the wiper steps to **31**. Bank contacts **31** and **32** are bridged over by the contacts **406***ü* and **407***ü*. Selector *Dt* does not arrive in its home position until wiper **410***dt* thereof arrives at step **1**. Relay Ü is thereby deenergized Relay X therefore cannot respond over contact **405***ü*.

The short interval during which relay X is energized, that is, the interval between the moment when wiper **410** leaves the bank contact of the last day of a month and the moment when it reaches the bank contact of the first day of a month, serves for energizing the selector *Dm* by means of contact **413***ü*. Selector *Dm* moves its wipers one step, which signifies the conversion to the next month. Selector *Dm* likewise acts to characterize with the aid of two wipers the correct month indication by two numerals of the numeral range 01–12.

After 12 months wiper **415***dm* steps to position **12** of its contact segment. Relay Ü responds each month, as stated before. Since wiper **415***dm* is arranged to tap bank contact **12** once every twelve months, the year adjuster *Dj* undergoes conversion on January 1 at 0 o'clock, that is once a year, the circuit being: Ground, wiper **415***dm*, exit at step **12** of selector *Dm*, switched contact **416***ü*, relay Z, battery, ground. Relay Z responds and by contact **417***z* acts to influence selector *Dj* by means of a current impulse effective during the release time of its armature, relay contact **418***ü* having been restored to normal. In this way the year adjuster *Dj* shares in the impulsing originated each minute by the switching clock *Uh* shown in Fig. 6.

One embodiment of the converting device *Abw*, which comprises a translating device and a send-

er of telegraph signals, is represented in Fig. 4. This device *Abw* as compared with known arrangements of this kind has to fulfil a much wider problem than to reproduce in a purely mechanical manner a series of the same telegraph signals recurring in the same regular order. On a former-like switching barrel H, provided with apertures *g*, contact levers *da*, *d1*—*d5* are acting which in accordance with the position of these apertures act to produce telegraph signals by cooperating with a series of sending contacts *ia*, *i1*–*i5*, these telegraph signals being at the receiver converted into visible characters which reproduce a teleprinting communication sent from the exchange.

The wider problem of the invention now is, that in addition to the reproduction of predetermined telegraph signals (letters or numerals), such reproduction depending upon the nature of the former-like switching barrel H, telegraph signals which recur in an irregular order are produced in order to effect the translation into numerals, or groups of numerals etc. The reproduction is made in dependence on the positions of the rotary selector wipers, that is, the positions by which the correct calendar time and day time and also the fee charged for a call are represented as rotary steps. The irregular telegraph signals are with the aid of relays, for instance those of a relay group **0**–**9**, and by a cooperation thereof with the series of sending contacts, first formed and then transferred to the receiving station FM by relay P over the contacts **287** or **288***p* thereof. The setting-up of these telegraph signals occurs in dependence upon the respective positions of the time and fee adjusters. The succession of the regularly and irregularly formed signals depends upon a stepping mechanism W clutched to the switching barrel H. The relays of relay group **0**–**9** are arranged to influence by their contacts the sending contacts *i1* to *i5* in such a manner that by bridging over one or another of these contacts that telegraph signal is formed which accords with the designation of that relay of relay group **0**–**9** which aids in forming the signal concerned. The positions of the rotary selector are in a special succession tested by wiper **201** of the stepping mechanism W in order to obtain from the time and fee adjusters the respective indications. At the moment when such testing takes place the respective relay of the relay group **0**–**9** is energized. The cutting in or out of one of these relays is effected during that time in which the locking and starting impulses of a telegraph signal are produced by the device *da*, *ia* of the signal sender.

A shaft *a* which is connected with a motor M by a suitable gearing, thus having a predetermined rotational speed, is provided with six cam discs *b* having grooves mutually displaced by the seventh part of a revolution. Contacting with the circumferences of these discs are projections *c* of the contact levers *da*, *d1* to *d5* held in engagement therewith by springs *e*. Each projection *c* will enter the groove or notch of the respective cam disc depending upon the tappet *f* (*f1* to *f5*) of the respective lever *d* (*d1* to *d5*) being in the reach of the respective aperture *g*, thus being able to enter this aperture. In such case lever *d4*, for instance, is operated to actuate the sending contact *i4*. This contact then breaks the circuit and holds it interrupted as long as projection *c* of the appertaining lever *e* is in engagement with the notch of the respective cam disc *b*. As soon as projection *c* is caused to leave the notch, lever *d4* acts to close the contact *i4*. The levers *d* enter their notches one after another. The lever *da*, shown in Fig. 4 to be in its operative position, has no tappet *f*. This lever *da* is to produce the starting impulses with the aid of its sending contact *ia*. Lever *da* thus is the first to enter the respective notch after each revolution of the shaft *a* and during the seventh part of a revolution thereof opens its contact *ia*. Immediately after this action lever *d1* is on the point of entering the notch of its cam disc. If the tappet of lever *d1* is allowed to enter this notch its contact *i1* is opened, whereby the first current impulse, designated as "No current" or spacing impulse, is produced. If, however, this tappet cannot enter the notch, then the current impulse designated as "Current" or marking impulse is originated. Now the second contact lever *d2* is dealt with, and so on, until at last contact lever *d5* will enter the notch of the respective cam disc. The locking impulse necessary to form a telegraph signal is produced by no interruption of the contact row *ia*, *i1* to *i5* occurring during the last seventh part of a revolution of shaft *a*.

Contrarily to the signal sending contacts of known arrangements the contacts of the novel arrangement are broken one after another whereas in the known arrangements they are closed one after another. After each revolution of the shaft *a* a cam disc *k* and lever *l* provided with latch or pawl *m* act to advance the barrel H the distance of one step. This movement is finished before one of the sending contacts *da* to *d5* is subject to an engagement of its tappet with an aperture *g*. According to whether the telegraph signal "Current" or "No current" is to be formed by the contact levers *da* to *d5* an aperture *g* is provided. In this way the telegraph signals intended to be produced in a regular order, such as T-OFF WASH, are formed.

If it is desired to produce irregular telegraph signals with the aid of relay group **0**—**9** barel H allows each of the five contact levers *da* to *d5* to enter the notches, that is to say, the tappets of these levers are engaged one after another by the apertures *g*. The signal "Current" is effected by a relay contact of one of the relays of group **0**—**9** which acts to bridge over the interrupting impulse contact. "No current" is merely originated by the levers *da* to *d5* entering the notches without such bridging taking place, whereas the telegraph signal "Current" is formed by bridging the sending contact with the aid of a contact of one of the relays of group **0**—**9**.

During the time required for starting the motor M the whole of the row of sending contacts *da*, *d1* to *d5* is short-circuited by a contact **276***l* until the necessary speed of the motor has been obtained. The circuit here is: Ground, wiper **201**, rest contacts **202**, relay winding L, battery, ground. Wiper **201** does not leave the rest contacts **202** until some revolutions have been made, when the motor will be working with the highest number of revolutions. By wiper **201** leaving the contacts **202** relay L is deenergized. At the next moment the signal impulsing is automatically started. A contact **266***l* of the relay L prevents the supply circuit of the motor from being broken prematurely, because this contact acts to keep the starting relay of M energized until the motor is to be disconnected. Such is the case when wiper **201** again reaches the contact **202**, thus again energizing relay L.

The transmission of the telegraph signals to the teleprinting station FM is as follows.

The commencement of the signal transmission is effected by the subscriber depressing the clearing key S of his station FM, Fig. 1. The selectors of the teleprinting exchange which have served for setting up the printing connection are released thereby, thus returning into their normal position. Preselector VW, to which the time and fee communications are to be transferred, likewise returns into its home position. When wiper **26** of the preselector VW arrives in its normal position the following circuit is established: Ground, wiper **37** of the preselector, resting contact **0** of the preselector, windings I and II of relay T, wiper **26** of the preselector, preselector exit O, resistance W*t*, inlet **121** of the metering register, wiper **116***zs*, closed contact **109***f*, windings I and II of relay C, battery, ground. Relay T of the preselector VW and relay C of the line finder ZS belonging to the fee storage device therefore respond. Relay T acts to connect the subscriber's line to the transmission assembly over transformer Ü. The action of this transformer is known per se and is not represented in the drawing.

By the subscriber at FM depressing the key S his line is broken as long as this key is held depressed. Telegraph signals produced during this time will therefore not arrive in station FM. If now the converting device A*bw* would commence signalling before key S is restored to normal, then the signals would be mutilated. By arranging a relay H I, H II it may be ensured that the signal sender of device A*bw* does not become effective until key S is released. The operation entailing this result is as follows.

By the response of relay G which is energized as soon as the fee register is engaged, winding H I is energized over contact **160***g*. By means of contact **162***h* winding H I holds itself energized over contact **161***c*.

When key S is depressed, the teleprinting call thus being released, preselector VW returns into position O. Relay C now responds and by means of contact **161***c* acts to deenergize winding H I. H I is provided with release retardation. If now key S should still be depressed a relay of transformer Ü responds, thus supplying current from the plus-grounded exchange battery to H II as long as key S is being depressed.

Relay H1, H2, which is still energized owing to its release retardation thus again receives current over winding II as long as key S is being depressed. By releasing S the armature of relay B is switched, thus causing positive potential to be applied to winding II of relay H. Since this relay is already connected to the positive potential, the current by which it has been energized ceases to flow, relay H therefore being deenergized after its release retardation has been overcome. Relay contact **148***h* now clears line *an* whereby the assembly of relay contacts **150***c*, **147***r*, **148***a* becomes effective over line *an*, thus influencing relay M of the converting device A*bw*. Contact **164***th* in this case acts to deenergize winding II of relay H by short-circuiting this winding.

The responding relay C, whose winding I may be short-circuited by contacts **110***r* and **111***c*, acts to initiate the transmission of the fee indication. To such end in the first place the line finder MS of the device A*bw* is caused to find the fee register, the following circuit being established: Ground, contacts **150***c*, **147***r*, **148***h*, collecting line *an*, relay M (Fig. 4), battery, ground. Relay M becomes effective and thereby with the aid of relay Z*m* sets the selector M*s* rotating, the circuit here being: Ground, contact **267***m*, contact **268***zm*, magnet coil M*s*, battery, ground. Magnet M*s* acts to energize the relay winding II of relay Z*m* by means of its contact **269***ms*. Contact **268***zm* now again opens the said circuit in which selector M*s* is included, the selector thus being deenergized. Hereupon also relay Z*m*, winding II, is freed by contact **269***ms*. Such cooperation between rotary magnet M*s* and relay Z*m* is continued until wiper **265***ms* stepping from one bank contact to the other arrives at that bank contact, which is connected to the calling fee register and the relay C of which has been energized. The circuit here is: Ground, winding I of relay Z*m*, wiper **265***ms*, selector exit *s*, inlet *s* of the fee register, switched contact **149***r*, winding I of relay S, battery, ground. Relay Z*m* which now remains energized stops the rotary selector *Ms* by means of contact **268***zm*. The resistance of the magnet coil of this relay, however, is so great that the relay S of the fee register is flown through by a current by which it cannot be energized, the winding of this relay having a comparatively small number of turns.

Relay M by contact **284***m* applies potential to the motor M of the signal sender, the motor thus being started. As soon as rest relay L, which with the normal state of the arrangement is energized, drops its armature signal impulses are transferred to the polarized telegraph relay P in accordance with the circuit: Ground, winding II of relay P, row of contacts **270**, **271**, **272**, **273**, **274**, **275***i*, variable resistance W, battery, ground. The contact levers are in accordance with the location of the apertures *g* of barrel H opened or remain closed. Winding II of relay P is accordingly acted upon by current impulses. The impulse combination accords with the international telegraph code intended for start-stop apparatus.

Relay P transfers the received impulses by switching its armature to the positive or negative side of the telegraph battery, this armature being moved either to the contact side **284***p* or **288***p*. The positive or negative impulses, starting from relay contacts **287***p* or **288***p*, flow over wiper **264***ms*, selector exit *i*, inlet *i* of the fee register, contacts **112***h* and **113***c*, wiper **114** of the line finder Z*f*, exit **119**, line **30** to wiper **25** of the preselector and thence to a polarized relay of the transformer and back to ground over earth. This polarized relay is not shown in the drawing. The polarized relay of the transformer Ü has to transmit the sender impulses to the start-stop printer magnet of the teleprinting machine FM. Here the telegraph signals are written down by the start-stop printer.

As regards the succession of the transmitted signals, the telegraph signal first produced is that intended for the return of the carriage of the teleprinting machine, whereupon a signal intended for the line feed follows. Now a signal is produced by which the printing device is changed to print letters, whereupon the letters of the indication T-OFF WASH are given after one another with intervening spacing signals. Then an additional spacing signal follows which in its turn is followed by the signal intended to change the printing device of the start-stop printer to the production of numerals. These signals are produced in a purely mechanical manner, that is to say, by the arrangement comprising barrel H and the lever assembly *d1* to *d5*

controlling the sending contacts *i1* to *i5*. As soon as the expression T-OFF WASH has been given the telegraph signal intended for the change to numerals is originated. Wiper **201** now arrives at that contact which is connected to wiper **401***dt* of the time adjuster over line *d*. Hereupon the position of this wiper is ascertained in accordance with the circuit: Ground, wiper **201***w*, line *d*, wiper **401***dt* (this being assumed to be in position 6), relay collecting line **2**, relay **2**, battery, ground. Relay **2** of the relay group **0–9** therefore responds. With the aid of this relay **2**, in order to send the telegraph signal **2** the sending contacts *i1* to *i5* are so influenced by the contacts of this relay **2** as to form the telegraph signal **2** in accordance with the numeral indication of such relay. The succession of the five current impulses employed for forming the telegraph signal **2** then is:

Current impulse *a*=contact opened=no current=starting impulse
Current impulse 1=contact opened=no current
Current impulse 2=contact closed= current
Current impulse 3=contact closed= current
Current impulse 4=contact opened=no current
Current impulse 5=contact closed= current
Current impulse *b*=contact closed= current=lock ing impulse

All the contact levers have switched their contacts one after another because their tappets have been able to enter the apertures *g* of barrel H, so that the current would be broken if the sending contacts **272** and **273** were not bridged over by a contact **279** of relay **2** and if sending contact **275** were not bridged over by a contact **280** of the same relay **2**. During the time in which the said contacts are actuated the following state is established:

(1) No current=starting impulse, (4) Current,
(2) No current, (5) No current,
(3) Current, (6) Current.

The locking impulse is produced by all the contact levers remaining closed during the last seventh part rotation of shaft *a*. In this way the characteristic for producing the telegraph signal **2** inclusive of starting and locking impulse is formed.

After the impulse series that serves for forming the telegraph signal **2** has been finished barrel H is again rotated by the distance of one step. Wiper **201** of the stepping mechanism W now acts to establish the connection *i* which leads to wiper **402***dt* of the time adjuster. Line *d* which leads to wiper **401** having been cleared before, relay **2** now drops its armature. Wiper **402***dt* of the time adjuster is able to join the line **5**, for instance, which over relay **5** of the relay group **0–9** is connected to battery. The next series of impulses is now so influenced by relay **5** as to form the telegraph signal **5**. After this signal too has been formed, the dot signal is produced. The telegraph signal serving this purpose is merely transferred to the contact levers of the row of sending contacts by barrel H. The transmission of the telegraph signal **2** and of the other signals, intended for indicating day, month and year, is now effected in the same manner as before. The regular intermediate signals are again given mechanically with the aid of barrel H. The operation of testing the hour and minute adjusting device and finally the fee register are the same as before described.

After the last telegraph signal, that is, the clearing signal "+" has been transmitted the fee register is automatically released while the converting device is automatically disconnected from this register.

Before wiper **201** reaches the rest positions **202**, ground is connected over the last free bank contact, wiper **265** and line *s* to the fee register, the circuit here being: Ground, wiper **201**, wiper **265***ms* connected to winding I of relay Z*m*, line *s*, contact **149***r*, winding I of relay S, battery, ground. Relay S being provided with a comparatively small number of turns is not energized by the current supplied to relay Z*m*, winding I. It is not until winding I of relay Z*m* is short-circuited by the earth applied to wiper **201** that relay S, winding I, receives the voltage necessary for energizing it.

Relay S of the fee register acts to deenergize relay F by means of contact **106***s*. Relay F dropping its armature, contact **152***f* is freed while contact **151***f* is closed. Relay R which has been energized over the wipers **133***da* or **139***dt* or **145***dc* drops its armature. Owing to contact **151***f* winding II of relay S is energized over contact **153***s* and remains energized until the return of the selectors D*a*, D*b*, D*c* has been finished. The circuit here is: Ground, wipers **133***da*, **139***db*, **145***dc*, contact **151***f*, contact **153***s*, winding II of relay S, battery, ground. Relay R returning into its normal position breaks the connection which leads to the signal sender, this being effected by means of the contacts **147***r* and **149***r* of that relay. Contact **106***s* has broken the connection leading to the two relays F, B. The deenergized relay F has in its turn broken the connection between metering device Z and relay E by means of contact **107***f*. Equally, contact **109***f* in its position of rest acts to separate relay C from relay T of the calling set. Relay C by its contacts **163***c* and **113***c* breaks the lines which lead to the *a* and *b* lines of the calling set.

In the meantime the deenergized relay R has by its contacts **130***r*, **136***r*, **142***r* connected the stepping magnets D*a*, D*b*, D*c* to the contact banks thereof, whereby now the selectors D*a*, D*b*, D*c* are returned to normal. The circuit is: Ground, interrupter U, wiper **131***da*, contact **130***r*, magnet coil D*a*, battery, ground. Selector D*a* returns to normal. After wiper **131***da* has arrived in the home position O, the connection is changed from interrupter U to wiper **138***db* of selector D*b*, whereupon this acts to apply earth over wiper **138***db* and contact **136***r* to the magnet D*b*. Finally selector D*c* is connected to earth over the wipers D*a*, D*b*, returned to normal, and over wiper **144***dc* and contact **142***r*, whereupon also this selector returns into its home position. In this way the connections over the contact banks *da*, *db*, *dc* are disconnected from ground, winding II of relay S thus becoming deenergized. In this way also the last relay of the fee register has been restored to normal, this register thus being ready for a new engagement. This fact is indicated by the contacts **101***f* and **103***s* returning into their normal position.

The line finder of the converting device and the line finder of the metering register have no position of rest, both these selectors remaining in the position they have been given.

The motor starting relay M of the converting device is disconnected from earth by relay L responding and thus opening contact **266***l*. Relay M drops its armature and by means of its contact **284***m* disconnects the motor from the current source. The motor then comes to a standstill, thus stopping the converting device. By means of contact **276***l* the row of sending contacts is again bridged over.

As stated before, there is a certain idle time before the time zone meter ZZZ becomes effective. If the call is released within this idle time

then the fee recording device is not switched by device ZZZ. Consequently none of the storage selectors is caused to leave its home position, relay R of the fee register thus remaining in its state of rest. When then with the preselector returning into its position of rest relay C becomes energized, relay contact 150c immediately causes release relay S, winding I, to respond, the fee register thus being separated from the calling set. The fee register in this case was not engaged, and since the winding I of relay C being of high resistance, has not been short-circuited by contact 110r over contact 111c, relay T of the preselector does not respond. Relay C, however, has responded, thus entailing the release by means of contact 150c.

Whenever the converting device is busy while at the same time a second time and fee communication becomes due, the signal sender causes the time and fee communication to be transferred over the metering register that has been connected first. Hereupon the second time and fee communication is given over the fee register which is ready for operation. The converting device being able to give about 390 signals each minute, a time and fee communication is accomplished with about 50 telegraph signals and about 16 spare and rest steps in say 10 seconds. The waiting time will thus be no longer than 10 seconds. If three or more time and fee communications should become due at the same time, then the metering registers nearest to the wipers *ms* in the direction of rotation of the selector are employed one after the other for transmitting the communication to the teleprinting stations.

What is claimed is:

1. A teleprinter system comprising an exchange, a calling station having teleprinter signal transmitting equipment and teleprinter signal receiving and printing equipment, a single signalling circuit connecting said equipment with said exchange, a called station having teleprinter signal transmitting equipment and teleprinter signal receiving and printing equipment, means for establishing a two-way teleprinter connection from said calling station over said single signalling circuit and through said exchange to said called station whereby teleprinter communications can be sent from the transmitting equipment of said calling station to the receiving and printing equipment of said called station and from the transmitting equipment of said called station to the receiving and printing equipment of said calling station, means for initiating a release of such connection, automatic storage means at such exchange for registering fee value units, means for automatically integrating these units, switching devices at such exchange automatically operative in response to initiation of such release to convert said integrated units into teleprinter signals of the type receivable by said receiving and printing equipment of said calling station, and means at such exchange for transmitting said converted signals over said single signalling circuit to said teleprinter signal receiving and printing equipment of said calling station.

2. A system according to claim 1, wherein said automatic storage means and said means for integrating comprise a metering device, selectors, disposed in the said exchange, to control this said metering device in decade fashion, means to supply metering impulses to said metering device when in its initial position, means for causing said metering device then to step on, wherein said exchange further comprises means to disconnect the lines of the subscribers' stations, while still maintaining the value indications in readiness for transmission.

3. A system according to claim 1, wherein said automatic storage means and said means for integrating comprise a metering device, selectors, disposed in the said exchange, to control this device in decade fashion, means to supply metering impulses to said metering device when in its initial position, means for causing this device then to step on, wherein said exchange further comprises means to disconnect the lines of the subscribers' stations and at the same time to actuate a device adapted to derive from the said storage means the registered value indications.

4. A system according to claim 1, wherein said automatic storage means and said means for integrating comprise a metering device, selectors, disposed in the said exchange, to control this device in decade fashion, wherein said switching devices automatically operate to convert said integrating units comprise means for deriving from the said storage means the numeric values of the indications registered therein, a relay assembly, an arrangement of contacts, levers adapted to control these contacts, and a barrel adapted to control these levers, such relay assembly, contacts and levers being adapted by their cooperation to produce telegraphic signals in accordance with the said numeric values.

5. A system according to claim 1, wherein said automatic storage means and said means for integrating comprise a metering device, selectors, disposed in the said exchange, to control this device in decade fashion, wherein said switching devices automatically operate to convert said integrating units comprise means for deriving from the said storage means the numeric values of the indications registered therein, a relay assembly, an arrangement of contacts, levers adapted to control these contacts, a barrel adapted to control these levers, and relay contacts adapted to bridge over the first said contacts in accordance with the numeric values to be obtained.

6. A system according to claim 1, wherein said automatic storage means and said means for integrating comprise a metering device, selectors, disposed in the said exchange, to control this device in decade fashion, wherein said switching devices automatically operate to convert said integrating units comprise means for deriving from the said storage means the numeric values of the indications registered therein, a relay assembly, an arrangement of contacts, levers adapted to control these contacts, a mechanism for operating these levers, and a switching device for effecting in cooperation with this mechanism a signal transmission representative of said numeric values.

7. A system according to claim 1, said switching devices automatically operative to convert said integrating units comprise an assembly of contacts, levers adapted to control these contacts, a barrel adapted to actuate these levers in predetermined succession, and wherein said exchange further comprises means for transmitting predetermined series of current impulses, produced by means of said contacts, to a subscriber's station.

8. A system according to claim 1, wherein said automatic storage means and said means for integrating comprise a metering device, selectors, disposed in the said exchange, to control this device in decade fashion, wherein said switching de-

vices automatically operate to convert said integrating units comprise means for deriving from the said storage means the numeric values of the indications registered therein, a relay assembly, an arrangement of contacts, levers adapted to control these contacts, a barrel adapted to control these levers, such relay assembly, contacts and levers being adapted by their cooperation to produce telegraphic signals in accordance with the said numeric values, and wherein said exchange further comprises a switching device under control of said barrel and adapted for the transmission of predetermined signals.

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