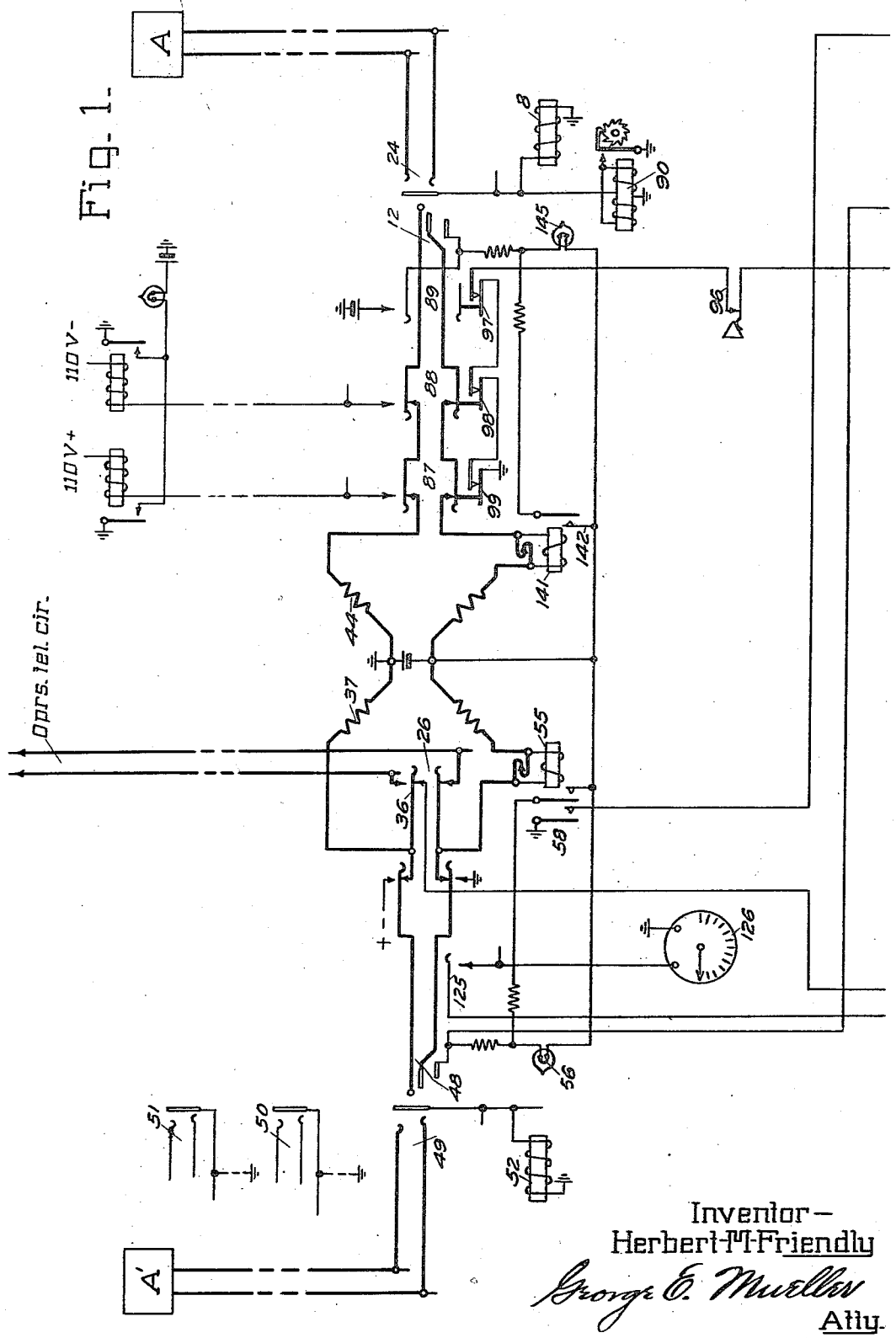
Sept. 3, 1929. H. M. FRIENDLY 1,726,982

TELEPHONE SYSTEM

Filed May 16, 1927 3 Sheets-Sheet 1

Fig. 1.



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TELEPHONE SYSTEM

Filed May 16, 1927 3 Sheets-Sheet 2

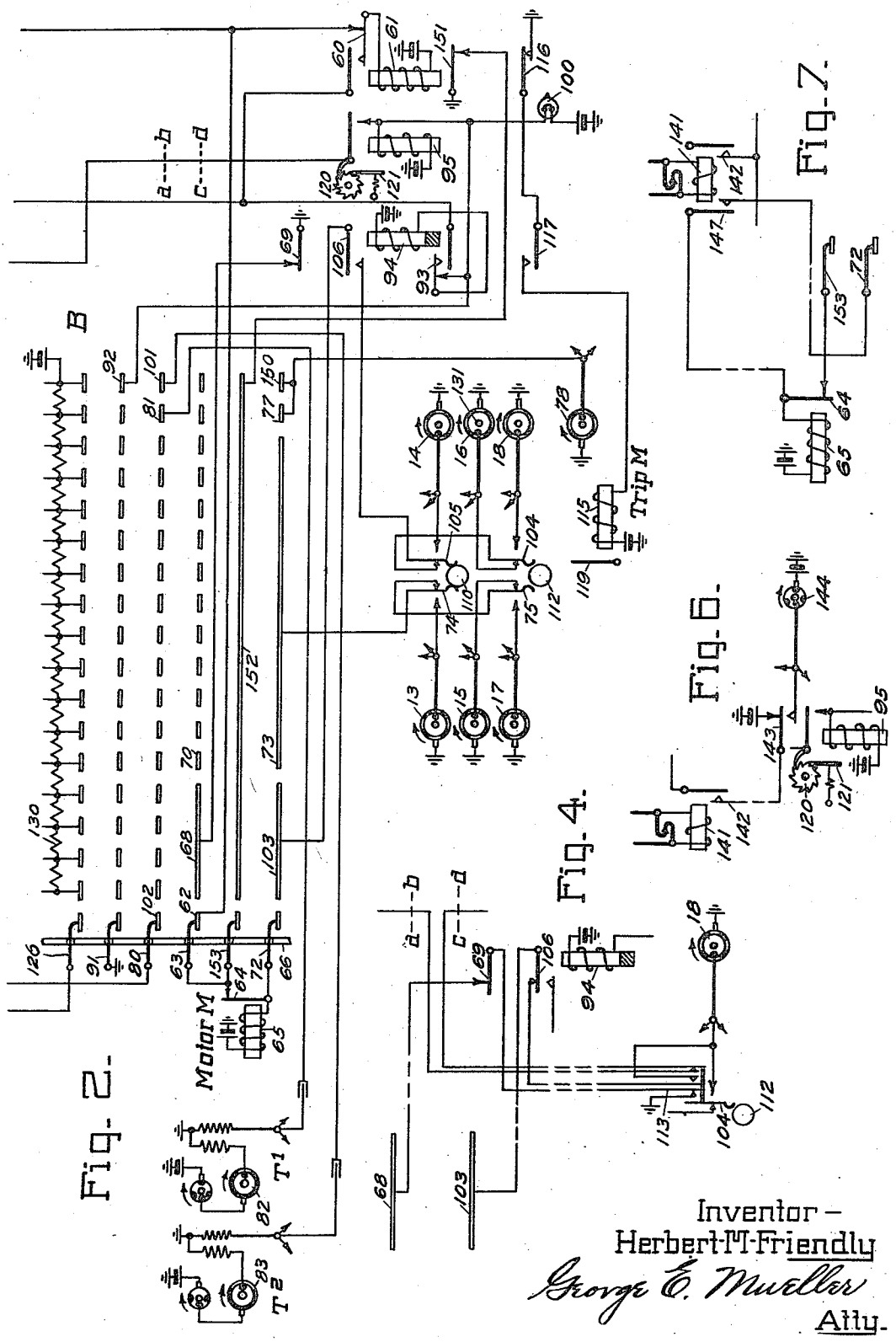


Fig. 2.

Fig. 4.

Fig. 6.

Fig. 7.

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TELEPHONE SYSTEM

Filed May 16, 1927 3 Sheets-Sheet 3

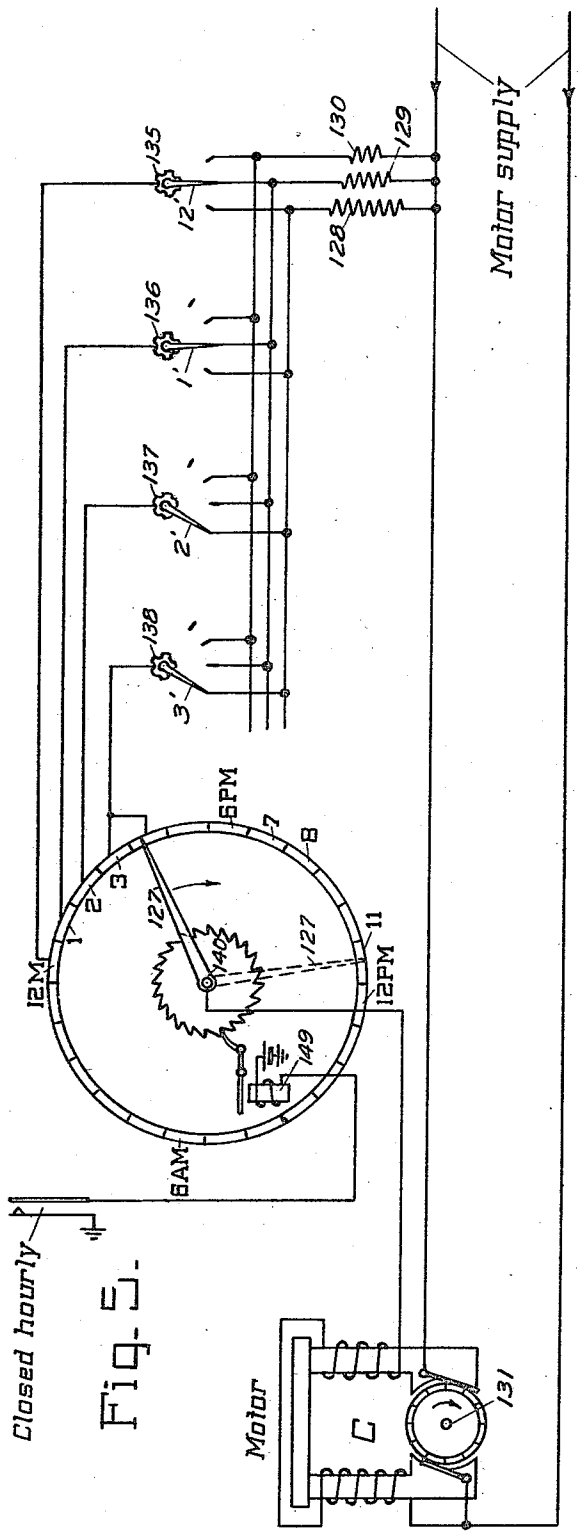


Fig. 5.

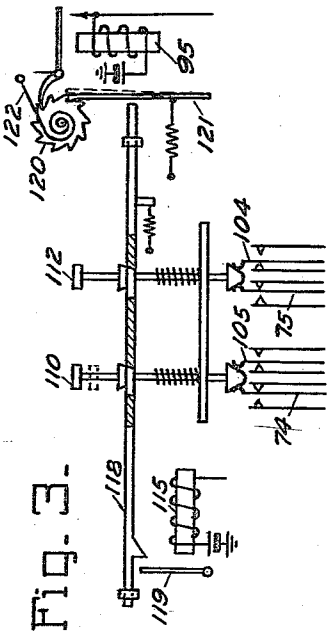


Fig. 3.



Fig. 5A.



Fig. 5B.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed May 16, 1927. Serial No. 191,578.

The present invention relates to telephone systems; more particularly such systems as employ manual switching apparatus at the central office wherein an operator wholly or partly manually extends desired connections. However, features of the present invention have adaptations to so-called automatic or machine switching systems, and other uses.

General objects.

The general object of the present invention is to enable the operator to respond to calls, complete the desired connections and time the connections with the minimum delay to the calling party and with the least manual effort and watchfulness on the part of the operator.

A salient feature of the present invention relates to the timing of calls wherein the length of time a connection may endure for a specific sum or charge will vary in accordance with the time of day the connection endures through and also between what zones or districts of the exchange system the completed connection is effected.

It is well known to have so-called pre-payment telephone subscriber stations provided with mechanism for receiving a five-cent or other coin (or token) before or after an operator responds to the subscriber's call for service. This coin or token may be deposited in the company till of the mechanism, or it may be refunded to the subscriber any time after it is deposited for service at the will of the operator. If the connection cannot be completed it is refunded. If the connection is completed the specific coin (or token) entitles the subscriber to a predetermined length or duration of conversation or service connection. The operator is therefore charged with watching each connection made so that she may intrude on the connection when the said predetermined time has elapsed to inform the calling subscriber that his time paid for has expired and thereupon cause the coin to be deposited in the company till. The said subscriber can then hang up his receiver to terminate the service and cost to him, or he can elect to continue it by depositing another coin covering the duration of another period.

It is also well known to have a so-called meter register companion to and specific to each subscriber's line; the operator depressing a key at will to register a charge for a connection on the meter register for a service of predetermined duration. However, these meter registers are usually arranged so that but a single registration can be made for a call without first withdrawing the operator's answering plug of the cord-pair used, though the latter is not essential and may be done away with by omitting a specific locking winding provided on the register magnet of the meter.

An embodiment of the present invention contemplates that the subscribers' stations having a pre-payment coin mechanism referred to as well as the stations having the meter registers, or both, be employed without change so far as the respective subscribers' stations are concerned. However, a salient object of the present invention is the provision for automatically varying through the agency of clock or time unit controlled apparatus and signals the time a connection may endure for a specific charge, subject to the operator, depending upon the time of day the service is rendered.

It is also well known that the cost of manually establishing a connection between a calling and a called subscriber by an operator or operators is a relatively small portion of the total costs to the operating concern for rendering the service. That is to say, the carrying charges on the investment converted by the calling subscriber because of the service may, depending upon the size of the exchange and the route of the call, amount to several times the mere manual effort costs entailed in effecting the specific connection. The said carrying charges may include interest, depreciation, plant operating, maintenance and other fixed and variable charges attaching to the portion of the plant exclusive of the part for providing service connections to subscribers and not service itself.

Where a subscriber does not call for service the portion of the plant provided for common use in inter-switching is not called for by him, and therefore should not be charged against the subscriber. Of course, practically all subscribers do call for service at one time or another, but the divergency of traffic factor has been found to conform to averages which permit of the operating company anticipating the demand for switching service and providing for the necessary amount within reasonably close limits, so that the fact that a subscriber does not call for service at all does not follow that any plant used in inter-

switching is held in idleness or readiness to serve awaiting his call for switching service.

It is found that during certain hours of the day calls will be made in greater numbers than at others, and this call characteristic will vary with the class of subscriber. Obviously, business subscribers will, in general, call exclusively during the few intense business hours of the day. Other subscribers not governed by the characteristics of business will also call during these hours in place of anticipating or deferring such calls to non-business hours.

However, it is found in the larger exchanges, that a pronounced peak in traffic occurs during relatively short periods during the mid-morning and mid-afternoon, and the operating company must provide inter-switching plant to meet these relatively short periods of large service demand, while much of this plant remains in idleness the rest of the time as non-productive investment.

Of course, rates, in general, must be made which will support the investment through its non-productive hours, regardless of how brief the period of its actual employment, because plant must be provided to take care of the peak demand.

Heretofore, so far as I am aware, no inducement has been made to subscribers charged a specific minimum toll for a call to make their calls at off-peak times or to limit the holding of inter-switching plant involved in the call to the minimum during the hours of peak traffic density so that a given capacity of switching plant will handle more calls in total and also during the peak hours or periods.

It will take practically the same amount of inter-switching equipment to handle a predetermined number of individual calls during the peak traffic hour or "busy hour" wherein the average holding time of the equipment is five minutes as twice this number of calls held during the same time wherein the average holding time of the equipment for each call is two and one-half minutes, because in a stated time wherein the calls endure only two and one-half minutes twice as many subscribers are enabled to use the total installed inter-switching equipment, or twice as many calls may be made by the subscribers at large.

It is thus clear that if subscribers will reduce the average holding time of calls over the busy-hour or peak periods, a lower total plant investment for handling the peak traffic will result which will be reflected in lower costs or rates to subscribers without prejudice to the operating concern. The investment in traffic handling plant is more than twice that of the subscriber plant in large exchanges.

By making the time a connection may be held for a specific charge vary inversely with respect to the busy hour will discourage long conversations being made during times of the day when there is large demand for service and wherein equipment must be installed expressly in contemplation of this demand and which in large part remains in idleness at other times.

Again, long conversations, perhaps including many of a social nature, will be anticipated to or deferred to off-peak times where a longer conversation may be held for the specific charge for a conversation, out of purely pecuniary considerations. This will reduce the amount of traffic handling equipment necessary to handle the peak traffic since it shifts the demand from logical peak time and therefore reduces the plant investment and attendant costs of furnishing solely switching service to subscribers at large. In other words, the present invention looks to raising the load or traffic density factor of the traffic handling portion of the system whereby a lower investment will suffice to handle a given total traffic in number of calls and aggregate duration of calls throughout a twenty-four hour period. It encourages profitable off-peak traffic handled by available equipment and it discourages on-peak traffic which must be handled by equipment that has to be installed expressly for such traffic, in large part.

In order for the operating concern to receive pay for the plant investment not used solely in handling traffic, a flat rental charge would be made all subscribers covering plant investment specifically entailed in their instruments or equipments and lines terminating in the central office in subscribers' equipment. This rental will then cover the subscriber plant costs as distinct from traffic handling plant costs.

Thus, one portion of the plant investment and carrying charges attendant upon same is supported by a flat rental charge apportioned among the subscribers at large, and which charge may be governed by distance and special equipment peculiar to each subscriber within certain limits of classification. The subscriber not calling for service thus pays his equitable share towards the investment occasioned by him as nearly as can be practicably ascertained. A subscriber, though he may not be a user of the service in making outgoing calls (his incoming calls being paid for by the calling party who may be assumed to the one benefited) will still be a profitable subscriber to the operating concern.

The traffic handling portion of the plant and attendant operating and carrying charges is apportioned to the subscribers as and when they call, having in mind that off-peak traffic uses switching equipment which was primarily installed for peak traffic, regardless of off-peak traffic.

The present invention thus provides for apportioning costs to subscribers in the relationship of the investment, operating and car-

rying costs occasioned by them individually, because of the peculiar requirements and traffic demands made by each. It thus equitably classifies the various subscribers, so that charges to them are an actual index of their demands upon the operating concern, taking each call into consideration, as distinct from charges or rates based upon general averages of total exchange costs and which operate in favor of the user of on-peak traffic and prejudices the user of off-peak traffic.

The method and means contemplated by the present invention thus enables each call to be classified by the time of calling as distinct from methods and means employed heretofore which seek to classify in advance by the nature of the subscribers' endeavors without considerations of personal inclinations in demanding service by the subscribers individually. The present invention thus looks to making costs to subscribers based upon the circumstances of every call made and the specific facilities provided the individual subscribers in the way of equipment individual to them.

Another feature of the present invention is the provision for the operator to variably set for different zones so that specific rates may be made for various distances within the exchange area and to suburban or long distance points. This is done by means of zone keys for the respective cord-pairs so that by setting the proper key will cause the call to be specifically timed and rated in accordance therewith.

There are a number of additional operative features of the present invention which will be described in part in descriptions to follow relating to the exemplary embodiment of the present invention chosen to explain it, having in mind that other features not specifically mentioned will be apparent from the descriptions, the invention being capable of varied modification without departing from its scope as defined by the claims.

Drawings.

With reference to the accompanying drawings:—

Fig. 1 shows an "A" operator's cord circuit and accessible lines, and operator's telephone and other equipment common to a plurality of similar cord-pairs not shown.

Fig. 2 shows a timing switch B and devices companion to the cord-pair shown in Fig. 1.

Fig. 3 shows meter mechanism and shift-plate restoring mechanism for the zone keys shown in Fig. 2.

Fig. 4 shows a preferred modification of the circuits for use in certain classes of calls so that the second period will be the same length as the first period, and moreover, conform to absolute clock time, within the accuracy of the timing apparatus.

Fig. 5 shows a detail circuit scheme for varying the speed by clock or timing unit control of one of the ground interrupters (16) for operating the timing switch (B) in Fig. 2.

Fig. 5A shows a plan view of two indicated hour segments, also shown in Fig. 5, somewhat enlarged.

Fig. 5B shows an edge view of the segments shown in Fig. 5A.

Fig. 6 shows a preferred modification of the circuits to flash the regular answering cord supervisory lamp (145) in place of glowing a specific lamp (100) to attract the operator when the period pre-paid for has expired, or the unit subject to being registered on the meter (120) has expired.

Fig. 7 shows a preferred modification wherein the stepping of the timing switch B is dependent upon the calling subscriber holding the receiver off the switchhook.

Equipment.

The operator's cord-pair shown in Fig. 1 is of the well known "A" operator's common-battery type used extensively in large city exchanges in the Bell telephone system, such as Chicago, however, modified by the introduction of circuits in accordance with the present invention.

The switch B in Fig. 2 is of the well known class used in automatic telephone exchanges as individual so-called line switches, and generally described on page 53 of the third edition of Hershy's Automatic Telephone Practice, however, modified in details in accordance with the present invention. It will be noted that the motor magnet (65) causes the set of wipers on the shaft to advance only upon the retraction of the armature of the motor magnet, and also that the said set of wipers have only an advance movement. However, in accordance with the present invention, the wipers have a normal or idle home position, as shown in the drawing, to which the wipers return when the cord-pair companion to the switch becomes out of service, as by removing the completing plug (as 48) of the cord-pair from a jack.

The ground interrupters 13 to 16 are each driven by an electric motor (as C) or other suitable driver, controlled by a clock or manually so that the speeds of the said interrupters 13 to 16 will each independently vary in accordance with the time of day in correspondence with a schedule prepared by the operating concern. The latter is so that the timing operations controlled by the various ground interrupters will provide for a charge based upon a determination thereof in view of costs and other factors of rendering service, looking toward rendering service that will equitably proportion the total costs therefor to the subscribers calling for the investments involved, having in mind that the subscriber does not expressly occasion invest-

ment in switching or traffic handling equipment unless he actually calls for service. The investment covering this traffic handling equipment, and therefore the cost of rendering any service actually called for will be determined by the time of day the individual subscribers call for this service and the duration thereof.

While the amount of switching equipment will be directly determined by the subscribers calling at the times of peak or maximum traffic density, since the equipment is also used by those subscribers demanding off-peak service, the latter calls will properly pay a smaller proportion of this carrying charge consistent with their subordinated demands upon the investments and costs of the operating concern as determined by rate-making bodies as equitable.

The extra charge made for preferential time of service involved in the restricting of line holding time by the influence of rates during logical peak periods will conduce towards fewer lines being encountered as busy at the peak periods whereby many calls are futile notwithstanding the usual effort applied in successful call connections has been expended in an effort to complete them without specific compensation to the operating concern.

Operation.

Upon the subscriber at telephone A removing his receiver to initiate a call the well known line relay (not shown) associated with the line-cut-off relay 8 will operate and thereby cause the well known calling lamp (not shown) to glow as a calling signal. The operator upon noting the glowing lamp will insert the plug 12 into the jack 24, operating the line-cut-off relay 8 to extinguish the calling lamp. The operator then manipulates her listening key 26 in order to connect her telephone circuit (not completely shown, but indicated) in talking relation with the calling line. The apparatus thus far brought into service is well known, used extensively by "A" operators in common-battery manual operation in the Bell system.

The operator will now use the completing plug 48 to extend the connection to the jack 49 of the desired line leading to telephone A' within her reach or through a jack 50 or 51 and over a respective "B" operator's trunk in the direction of the called line in the well known manner. The operator may now restore the listening key 26.

Response of called subscriber.

Upon response of the called subscriber at telephone A' (or other called subscriber), the supervisory relay 55 will energize to extinguish lamp 56 in the well known manner, and further, apply ground from armature 58, make-before-break spring 60 to the winding of relay 61, the latter relay actuating and locking to the winding of line-cut-off relay 52. The ground from armature 58 is also applied through bank contact 62 of switch B, wiper 63, interrupter armature 64 of the motor magnet 65 to the winding thereof, causing the six wipers rigid on shaft 66 to advance off the resting position as shown in the drawing, to the next position whereat wiper 63 rests on the left-hand end of bar 68 and wherein due to the latter bar being grounded through armature 69 the motor magnet will rapidly operate by interrupting its winding to step the wiper 63 to bank contact 70, the other wipers on the shaft 66 occupying corresponding aligned bank positions.

At this time wiper 72 is resting upon the left-hand end of bar 73. A circuit can now be traced from motor magnet 65, wiper 72, bar 73, springs 74 and 75 to ground interrupter 15. The motor magnet 65 is thus now under the control of the ground interrupter 15, which causes the wipers on the shaft to step advance consistent with the speed of rotation and number of live segments of the interrupter 15, remembering that this speed will vary in a predetermined way in accordance with the time of day, as will appear presently.

Advance tone to apprise conversers that end of period is near.

When the wiper 72 reaches bank contact 77 it becomes under the influence of the ground interrupter 78 and the latter interrupter preferably, though obviously not necessarily, revolves at a uniform rate irrespective of the time of day for a definite object, as will appear presently. At this time the wiper 80 is resting on bank contact 81, so that tone from source T^1 is being applied through listening key spring 36, audible to the parties talking through the cord-pair.

Advance and initial period terminating tone timed for brief application.

In this connection, it is to be particularly noted that the interrupter commutators 78, 82 and 83 are linked together by the same revolving shaft or through any kind of gearing and timed so that the tone from the source T^1 or T^2 will only be applied from the bank contacts 81 and 101, respectively, through wiper 80 one time for a relatively brief period while wiper 80 is resting longer on bank contact 81 and 101 at about the time the wiper 80 is set upon the concerned contact, so as to not unduly annoy the conversers connected through the cord-pair. The said interrupter 78 may apply ground impulses at say fifteen second intervals so wiper 80 will rest for this time on each of contacts 81 and 101. The tone applied from source T^1 indicates to the connected subscribers that a predetermined time, fifteen seconds in the present assumed in-

stance, remains before the termination of the period covered by the initial charge. The latter may constitute a single registration on the call meter 90 or be the collection of a coin inserted before the conversation started. If the latter, the coin mechanism at the subscriber's station A may be any well known coin-collecting mechanism. The well known mechanism used extensively for five-cent prepayment subscribers in the Bell system wherein the coin is collected by the operator at will by applying 110 volts of plus polarity or refunded by the apperator applying 110 volts of minus polarity through the agency of keys 87 and 88, respectively, will answer the stated requirement.

Tone is applied when initial period has terminated.

When the wiper 91 reaches bank contact 92 ground is thereby applied through make-before-break spring 93 to the winding of slow-releasing relay 94, the latter relay actuating and locking to the winding of the line-cut-off relay 52. The ground applied by wiper 91 to bank contact 92 also operatively energizes relay 95, locking it through the springs 96, 97, 98 to grounded spring 99, the cord-pair time lamp 100 glowing to indicate to the operator that the initial period has expired, while the distinctive tone applied from tone source T^2 through bank contact 101, wiper 80, listening key spring 36 to the tip conductor of the cord-pair notifies the subscribers of the connection that the initial period has expired.

Timing of tone applications.

The interrupter 83, timed with reference to the interrupter 82, has its live segment somewhat longer that the live segment on the interrupter 82 so that the tone from source T^2 will not only be distinctive in character, but will be applied somewhat longer than the tone from source T^1. The tones while discernable to the users are preferably as unintrusive as is consistent with serving the stated purpose.

Deposit of coin for succeeding period.

The calling subscriber now being in readiness to make deposit of an additional coin, or understands that the operator will register an additional call charge on the meter if he desires to continue the connection, having in mind that if the meter magnet 90 has a locking circuit as shown in the drawings it will be necessary to momentarily withdraw the plug 12 to unlock the meter magnet before a second registration can be effected. The locking winding of the meter magnet 90 (on left-hand end of core) will therefore be preferably omitted in order to obviate withdrawing the plug 12.

When the wiper 80 leaves bank contact 101 it next engages bank contact 102, upon which it normally rests. However, since bank contact 62 is grounded by armature 58 the shaft 66 will forthwith advance its wipers one step so that wiper 72 rests upon the left-hand end of bar 103.

Successive period longer than initial period.

If it is assumed that the subscribers elect to continue the conversation into the second period, the operator having thereafter collected the second toll, or will as soon as she notices the glowing of the time lamp 100, which remains glowing until one of springs 97, 98 or 99 is operated incidental to effecting a collection of the coin or the call meter charge, or a specific key having spring 96 is operated. The motor magnet 65 will now be under the control of ground interrupter device 16 and bar 103 in lieu of ground on armature 69 and bar 68, because relay 94 is locked to the winding of relay 52. The wipers on shaft 66 will then advance in accordance with the rate of speed of ground interrupter device 16, the circuit being traceable through key springs 104 and 105, armature 106 to bar 103. In any event, it will now require a longer time than initially for the wipers on shaft 66 to advance over the space defined by bars 68 and 103, which latter two bars occupy like circumferential space, and thus provides for a longer connection holding time, assuming for the present that the same rate of travel of the wipers on shaft 66 over the space defined by the bar 73 controlled by ground interrupter 15 will ensue. This arrangement thus provides for allowing a longer holding time for successive periods than for the initial period because the manual effort and loss of equipment time in first establishing the connection is not entailed in successive periods. The lowered cost to the operating concern for successive periods is thus reflected in the longer time the subscriber may hold the connection for a specific charge.

Advance notice of period about to terminate always the same.

In case the rate change with correspondence to the time of day occurs during the progress of a connection the change affects the duration in proportion to the time occupied under the different rates because the change in accordance with the time of day simply varies the stepping rate of the wipers on shaft 66 up to the angular position of bank contact 81. The time taken to advance the wiper from the angular position of bank contact 81 to the normal position shown in the drawing, driven under the control of ground interrupter 78 will always be the same so that the subscribers will always have the same, definite advance notice, regardless of the length of the period allowed for the unit of charge. However, as adverted to before, the speed of the interrupt-

er 78 may be varied in accordance with the time of day, as are interrupters 13 to 16, and under certain traffic conditions this may be desirable.

Zone keys for variously altering duration for specific charge.

With respect to the feature of the present invention which provides for the operator variably setting the zone keys for the different zones, the keys for this purpose operated by plungers 110 and 112 in Fig. 3 are shown normal for the exampled call to a subscriber's line (jack 49) within the same office district. Were the call to some other district or zone, one of the key plungers 110 or 112 would be depressed to correspond to the zone or rate applying. This latter substitutes ground interrupters 13 and 14 for interrupters 15 and 16, respectively, or interrupters 17 and 18 for interrupters 15 and 16, respectively, depending upon which key plunger 110 or 112 is depressed. At the time completing plug 48 is withdrawn in taking down the connection and relays 61 and 94 are thereby unlocked consistent with the slow-releasing characteristic of relay 94, a momentary operative energization of the trip-magnet 115 occurs over the path from grounded armature 116 through armature 117. The key 110 or 112 is thus restored.

By referring to Fig. 3, certain details of the zone key mechanism will be clear. The key plungers 110 and 112 are locked down and unlocked to restore by the well known so-called shift-plate action, wherein depressing any one key thereby unlocks any other operated key by a movement of the shift-plate 118 while the last depressed plunger is locked down by the shift-plate. The shift-plate is also operated to unlock any depressed key through the agency of armature 119 of the trip-magnet 115, so that the plungers 110 and 112 will be in the up position normally; that is, when the plug 48 is not in a jack. While but two zone-key plungers 110 and 112 are shown, it will be understood there may be any greater or less number of them, together with specific ground interrupters generally like interrupters 13 to 18, but having time of day variable speeds with correspondence to the zones represented by the added zone keys.

Number of periods meter.

A meter wheel 120 is operated by the magnet of relay 95 and the dog 121 is disengaged by the operation of the shift-plate 110 under the influence of the trip-magnet 115 or a key plunger as 110 or 112, so that while the wheel 120 is stepped forward at each operation of relay 95, signifying a successive charge period for the particular time of day has expired, it will be restored to normal by its return-spring 122 when the operator withdraws the plug 48. The operator thus has a record of the number of periods the call or conversation durated through, having in mind that the numerical indications on the meter-wheel 120 will start at "2", since the meter does not operate for the initial charge. While the meter-wheel may not be necessary for ordinary calls wherein pre-payment is made, or registration of the call is made on a subscriber's call meter, it becomes useful in saving clerical work for the operator on calls to suburban and other distant points, for example, where prepayment or registration on a subscriber's meter is not made.

Absolute timing of calls.

In this connection, while the different ground interrupter devices 13 to 16 have been said to have variable rates of speed depending upon the time of day, it is preferred in the exampled instance, to have the interrupter devices 17 and 18 operate at definite, constant rate of speed and be used for suburban or long distance calls, and moreover, that in place of ground being always normally applied to bar 68 from armature 69 it will be thus applied from spring 113 only when key plunger 112 is at normal, and bar 103 connected to ground interrupter 18 when key plunger 112 is operated, so that the second duration period (with zone key plunger 112 depressed) will be the same as the first; that is, the first period will not be shortened by the rapid movement of the wiper 63 by interrupter action caused by ground from armature 69. This preferred modification is shown in Fig. 4.

Under the last said modification (key 112 depressed) the time of successive cycles of the wipers of the switch B is constant and has a definite time significance corresponding to the speed of the ground interrupter 18. This may be five minutes, for example. So the operator upon observing the meter wheel 120 before taking down the connection obtains a record of the number of five-minute periods. However, she has no record of any fractional period following the last registration of the meter-wheel 120. The record of the fractional period she may obtain by manipulating the key 125 to apply the voltmeter 126, which is common to all the cord-pairs of the operator's position, to the wiper 126, the voltmeter needle indicating the relative position of wiper 126 and consequently the duration with respect to a full period. Of course, the voltmeter may be graduated in minutes or other convenient units. The resistor 130 is tapped at uniform points to consecutive bank contacts cooperative with the wiper 126; the said resistor being common to all switches similar to B for the operator's position by reason of the individual corresponding bank contacts of the switches cooperative with the wipers corresponding to 126 being in multiple relation. The drawings do not show the

said bank contacts of the other switches as B of the operator's switchboard (other switches not being shown) to avoid involving the drawings. The operator would not operate more than one key as 125 at a time.

The auxiliary contacts on the right operated by plunger 112 in Fig. 4 (in lieu of key 96 provided for this purpose otherwise) is used to open the locking circuit for relay 95 to extinguish the time lamp 100 on such calls as last referred to wherein the switch B serves as an agency to enable the operator to determine elapsed time, independent of the time of day variations, assuming the ground interrupters 17, 18 and 78 are operating at such rates of speeds that the time taken for the wipers on shaft 66 to move from the drawn positions off the right-hand set of bank contacts has a known time interval; five minutes, for instance, one-fourth minute being between the last two bank contacts.

It will be noted, by reference to Fig. 4, that the conductor leading through key 96 is looped through a set of normally closed auxiliary contacts operated by plunger 112 so that the time lamp 100 (or lamp 145 will flash with Fig. 6 introduced, as will appear presently) will not permanently glow, since relay 95 will then not lock, the parties to the call talking without interruption from the operator, though receiving the periodic tones from sources T^1 and T^2 to keep them advised of the periods transpiring.

In this connection, it will be understood that the tone supplied to the bank contacts 81 and 101 of switch B from sources T^1 and T^2 may optionally have normally closed key contacts opened when operating plunger 112, so that under the condition of plunger 112 being depressed the tone sources T^1 and T^2 will be disconnected from the bank contacts 81 to 101 of switch as B corresponding to the specific key plunger as 112 depressed. This will be the arrangement at certain operators' switchboards in an exchange where toll connections to long distance lines are made.

Variable speed of ground interrupters.

With reference to Fig. 5, this shows a motor C having a speed control apparatus operated by a clock driven revolving contact-arm 127 wherein through the agency of resistors 128, 129 and 130 the speed of the motor may be varied. It will be noted that the contact-arm 127 has twenty-four cooperating contact segments; one for each hour of the day. Each said contact segment (only five being shown connected) has a conductor leading therefrom to a subordinate switch-arm, excepting for 3 and 4 o'clock, which hours have the same rate and are common to switch-arm 3′. The contact segments corresponding to 12 m. 1, 2 and 3 o'clock p. m. lead to switch-arms 12′, 1′, 2′ and 3′, respectively. The latter said switch-arms are commonly accessible to the resistors 128, 129 and 130, so that the latter said switch-arms may be set at will to cause the motor C to have a pre-determined speed variable at will for every hour of the day, it being borne in mind that each of the twenty-four segments cooperative with contact-arm 127 leads to a switch-arm as those shown (excepting segments for 3 and 4 o'clock as shown, as well as others not shown) and that they also have common access to the resistors 128, 129 and 130. The motor C drives on its shaft 131 a ground interrupter such as 16, for example, so that the frequency of ground interruptions will vary in accordance with the position of the contact-arm 127 corresponding to the concerned time of day.

It will be clear that different days of the week, as well as different legal and other holidays may each have a specific rate schedule, variable from hour to hour at will or in accordance with a prearranged rate schedule authorized and published for the information of subscribers. The exchange attendants will see that the switch-arms 12′, 1′, 2′ and 3′ (and switch-arms for other hours of the day, not shown) are properly set by handles 135, 136, 137 and 138, respectively, in advance of the hour they become effective.

In this connection, it will be understood that while a single motor C and its specific contact-arm 127 and switch-arms such as 12′, 1′, 2′ and 3′ refer to a single ground interrupter 16, there will be a similar motor and speed control arrangement, perhaps having a different inherent speed, for each of the ground interrupters 13, 14, 15 and 16, the shaft 140 carrying the contact-arm 127 being preferably common to other contact-arms like 127, but the arms as 127 being specific to each of said ground interrupters. Under the latter condition, the shaft 140 revolving by clock or other time control or manually set each hour through the agency of the magnet 149 will serve to change all the interrupter speeds simultaneously, and therefore becomes a convenience and safeguard against overlooking any interrupter.

The exampled embodiment contemplates three speeds of the motor C, controlled by the resistors 128, 129 and 130. Obviously, more rates of speeds by the use of corresponding additional resistors may be employed. The embodiment therefore contemplates three different charge rates, any one of which may be made the unit for any hour, depending upon the positions of the switch-arms as 12′, 1′, 2′ and 3′ corresponding to the concerned hour or hours. The exampled embodiment shows the hours 3 and 4; that is from after 2 o'clock p. m. to 4 o'clock p. m. involving the same speed for interrupter 16.

There is a set of switch-arms like 12′, 1′, 2′ and 3′ for each ground interrupter 13 to 16. Of course, if it is known that certain hours of the day or night will always have the same

rate of charge (as 3 and 4 o'clock p. m.) the segments cooperative with the contact-arm 127 concerning the same rate of charge will be connected in multiple and thereby obviate the necessity for having a specific switch-arm as 3′ for each said hour, though it will be understood that the speed of all the ground interrupters will not necessarily vary correspondingly from hour to hour. The hours from 1 a. m. to 6 a. m. may have like charges, so that the segments engaged by the contact-arm 127 for the said hours may be tied together in multiple and a single switch-arm will then suffice for the said hours.

While the foregoing descriptions have referred to changing by hourly degrees, it is manifest that the stages may be shorter or longer than an hour; fifteen minutes, or three hours, for example. Under these conditions the segments will span a corresponding angular space, having in mind that for some parts of the day the changes may refer to fractional hours and for other parts of the day the changes may refer to a plurality of hours. Moreover, a segment may span the angular space of fractional and even hours, as from 1:30 p. m. to 4:45 p. m. The magnet 149, in stepping the contact-arm 127 will step from intermediate of one segment to intermediate of a successive segment, having in mind that where a long segment, perhaps spanning several hours is used, several steps will be required to pass over it. The angular space constituting a "step" will conform to the shortest segment. The latter may be fifteen minutes (the segment subtending 3.75 angular degrees), or it may be four hours (the segment subtending 15 angular degrees), for example. Under this arrangement the steps will be at 15-minute intervals of 3.75 angular degrees each, the four-hour segment requiring sixteen steps of the contact-arm 127 in passing over it since it involves a total of 60 angular degrees.

It will be understood that any well known means for varying the speed of rotation of the ground interrupters 13 to 16 may be employed, the variation of the resistance in the shunt winding of the motor C being shown merely by way of example.

With further reference to Fig. 5A and also to Fig. 5B which show a plan view and an edge view of the circumferential edge of the two contact segments corresponding to 11 and 12 o'clock p. m. together with the cooperating contact arm 127. The said segments are slightly beveled in thickness upward in the direction of travel of the slightly flexible contact-arm 127 and the long edge of the segments over-hang slightly to insure that when the contact-arm 127 clears a segment it will snap into place on the successive segment, clear of the antecedent segment.

Flashing cord supervisory lamp.

With reference to Fig. 6 which shows a preferred modification affecting the cord-pair supervisory relay 141, wherein the contact 142 on relay 141 is disconnected from solid battery and applied through the added armature 143 of relay 95 to battery. When the relay 95 actuates responsive to wiper 91 engaging bank contact 92 the added armature 143 will be locked attracted so that the battery applied through the added interrupter 144, armature 143, make contact 142, armature of relay 141, will cause the supervisory lamp 145 of the answering cord to flash rapidly to attract the operator's attention that the period has terminated so that a new toll may be charged the subscriber. The time lamp 100 will not be required under this condition, though it may be employed. It will be noted that if the operator fails to respond to the flashing of lamp 145 (or time lamp 100) promptly and the calling party terminates the service before being informed by the operator that the period has expired the operator may by operating key 125 note by the pointer on the voltmeter 126 how far the time has exceeded into the next period not yet collected or charged for at the time the operator makes the latter observation. Of course, observing the position of wiper 126 will give this, particularly if a scale is provided, but the switch B will not ordinarily be located in view of the operator.

Timing stopped when calling subscriber hangs up.

Fig. 7 shows a preferred modification wherein the conductor leading to wiper 72 in Fig. 2 is looped through a set of normally open contacts 147 on supervisory relay 141. This is so that if the calling subscriber hangs up to terminate the service it will cause the switch B to stop stepping. Then when the operator depresses the key 125 at a later time the time only until the calling subscriber replaced his receiver is recorded against him as indicated by the voltmeter 126. When the operator withdraws plug 48 from a jack and thus permits relay 61 to unlock, ground on its armature 151 will be applied to restoring bar 152, so if wiper 153 and its shaft 66 is not in its normal position as drawn it will cause the motor magnet 65 to operate from its interrupter armature 64 to restore the shaft 66 to its normal position.

Modifications incorporated in preferred embodiment.

While the preferred embodiment disclosed herein only as an exemplary one will incorporate the modifications shown in Figs. 4, 6 and 7, it will be understood that said modifications may be omitted without departing from the contemplated invention or use thereof, because conditions of service will

necessarily determine and influence the commercial embodiment, not only by curtailing the said preferred embodiment, but also by amplifying and further modifying it. For example, the bank contacts 77 and 150 are shown commonly connected to the ground interrupter 78, and under this condition the wiper 72 will rest for the same length of time on each of said contacts. It is preferred to have the bank contact 150 individually connected (in common with other corresponding contacts on other switches) to a faster ground interrupter (not shown) like 78. The said faster interrupter will be timed with respect to interrupter 78 so that when the wiper 72 moves off bank contact 77 onto bank contact 150 it will remain on bank contact 150 for say half as long as on bank contact 77. That is, after the tone for the termination of the period is applied the subscribers will have a short time, less than the time between the advance tone and the final tone, to close the conversation before the wiper 77 steps to the normal position and off to the first off-normal position. That is, there will be a brief time left after the final tone belonging to the period paid for or included in the period transpiring.

Also, it is noted that the momentary ground impulse to the motor magnet is all that is required to step it from one bank contact (as 77) to another (as 150).

Also, the switch B has 18 bank positions. Obviously, this may be made more or less as well as varied as to operative contacts in the bank, bank contacts being possibly introduced intermediate of bank positions shown in order to extend the period between operations.

Also, in place of the spring 99 being applied to direct ground, it may be connected to the sleeve of the plug 12 so ground will be derived through the winding of relay as 8 so that relay 95 will be unlocked by withdrawing plug 12 when taking down the connection.

Having described the exemplary embodiment in its general operations and structure, and having indicated the preferred embodiment incorporating illustrated as well as simply described modifications thereof, what I claim is:—

1. In a telephone system, a calling line, a called line, means for connecting the calling line to the called line, a timing device for indicating the length of service between said lines, means for causing said timing device to indicate by signal when a predetermined period of service has elapsed, means for maintaining said signal operated regardless of subscriber control on the calling line in terminating the service, and clock-controlled automatic means differently operative depending upon during what period of the day the service durates for altering the length of said predetermined period.

2. In a telephone system, a timing device for measuring variable periods of service time occupied by parties of a call connection, automatic means for recording the number of elapsed periods for a said call connection, automatic means operated in accordance with the time of day for varying the length of said periods, and automatic means operated in accordance with the time of day for applying a signal audible on said connection to apprise the auditor thereof that a substantially definite interval of time remains before the termination of the ensuing period regardless of the length of the ensuing period.

3. In a telephone system, calling and called lines, a link circuit for connecting said lines, a supervisory signal operative for indicating a specific condition of one of said connected lines, means governed by last said means for timing the duration of said connection, and means for successively flashing said supervisory signal responsive to a predetermined duration of the connection elapsing regardless of said specific condition.

4. In a telephone system, calling and called lines, a link for connecting said lines for service, means for timing the duration of said connection under control over one of the said lines, a signal device, means for operating said signal device responsive to a predetermined duration of the connection elapsing, time controlled automatic means for varying said predetermined duration in accordance with the time of day, and means for maintaining the signal operated regardless of control over either of the lines.

5. In a telephone system, a timing device for measuring variable periods of service time occupied by parties of a call connection, time controlled automatic means for varying the length of said periods, and time controlled automatic means for applying a signal audible on said connection to apprise the auditor thereof that a substantially definite interval of time remains before the termination of the ensuing period regardless of the length of the ensuing period.

6. In a telephone system, a toll assessing device, means for starting said device from rest to indicate when a substantially predetermined elasped period terminates following said starting, automatic means for varying the speed of said device to in turn vary the length of the said period in accordance with the time of day, and means for at the same time varying the speed of said device by manual setting at will in accordance with which one of a plurality of keys is operated.

7. In a telephone system, lines, an operator's cord-pair for connecting said lines, a timing device specific to said cord-pair, a normal speed of operation of said device for measuring elapsed time of connection by said cord-pair, setting keys for varying said normal speed, and automatic means for restoring

the setting for operating at the said normal speed responsive to disconnecting the cord-pair from one of the connected lines.

8. In a telephone system, a calling and a called line, a connecting link for joining said lines, a timing device, an impulse contact for operating said timing device in correspondence with the number of impulses applied from said contact, means automatically controlled over the called one of said lines for operatively connecting said impulse contact to said timing device, a signal operated by said timing device responsive to a predetermined plurality of said impulses having been applied operatively effective to said timing device, and time controlled automatic means for varying the speed of sending said impulses by said contact so as to vary the elapsed time required to operate said signal device responsive to said predetermined plurality of impulses whereby the elapsed time occupied from the time of applying said control over the called line to the time of operating the signal device will be determined by the time of day the connection durates through.

9. In a telephone system, a calling line, a called line, a connecting link for joining said lines, a progressively movable switch, a plurality of tone sources, means for starting the movement of said switch responsive to control over the connection, automatic means for applying a first one of said tone sources audible on the calling line responsive to a predetermined time elapsing after said starting wherein said predetermined time will vary dependent upon the time of day, and automatic means for thereafter applying the second of said tone sources audible on the calling line responsive to a specific time elapsing after the application of said first tone source regardless of the time of day.

10. In a telephone system, a calling line, a called line, a connecting link for joining said lines, a progressively movable switch having a wiper, automatic means for successively driving said wiper a predetermined distance from normal starting position indicative of a corresponding specific toll charge for each said progression, automatic means for starting the movement of the said wiper from normal starting position responsive to control over the called line, and automatic means for varying the extent of said wiper movement for a specific time duration depending upon if the wiper progressed from normal starting position and returned thereto since the said control over the called line occurred.

11. In a telephone system, a calling line, a called line, a connecting link for joining said lines, a timing device for measuring elapsed time, means controlled over the called line for starting the operation of said timing device, a supervisory signal device, means operated over the called line for successively operating said signal device as a supervisory indicator to indicate the responded or non-responded condition of the called line, and means governed by the timing device for successively operating said signal device after a predetermined lapse of time after said control is effected to signal that the said predetermined lapse of time has terminated.

12. In a telephone system, a calling line, a called line, a connecting link for joining said lines, a timing device for measuring elapsed time, means controlled over the called line for starting the operation of said timing device, a supervisory signal device individual to said link, means operated over the called line for successively operating said signal device as a supervisory indicator to indicate the responded or non-responded condition of the called line, and means governed by the timing device for successively operating said signal device after a predetermined lapse of time after said control is effected to signal that the said predetermined lapse of time has terminated.

13. In a telephone system, a calling line, a called line, a connecting link for joining said lines, a timing device, said timing device operating in successive cycles responsive to control over the called line by the act of response on the called line to initiate its said cyclic operation, a signal device, means responsive to the completion of the first said cycle for operating said signal device to indicate the termination of the cycle, means for causing the signal to continue to display regardless of the fact the timing device is then operating in the next successive cycle, means for then effacing the operated state of the signal device, and means for again operating the signal device responsive to the completion of the next following cycle regardless of the fact that the signal may have been effaced intermediate of last said cycle.

14. In a telephone system, a calling line, a called line, a connecting link for joining said lines, a timing device, said timing device operating in successive cycles responsive to control over the called line by the act of response on the called line to initiate its said cyclic operation, a signal device, means responsive to the completion of the first said cycle for operating said signal device to indicate the termination of the cycle, means for causing the signal to continue to display regardless of the fact the timing device is then operating in the next successive cycle, means for then effacing the operated state of the signal device, means for again operating the signal device responsive to the completion of the next following cycle regardless of the fact that the signal may have been effaced intermediate of last said cycle, and indicating means for disclosing the number of whole cycles and the extent of excess thereover that the responded condition of the called line was maintained through regardless of the time

the responded condition was terminated with respect to the time the said disclosure is observed.

15. In a telephone system, a calling line, a called line, a link for temporarily connecting said lines, a timing switch individual to the link, means operated over the called line for starting the operation of said switch, means for continuing the operation of said switch in cycles from normal starting position and back to normal starting position, and means for predetermining the time consumed for each cycle wherein the time of day is a factor.

16. In a telephone system, a calling line, a called line, a link for temporarily connecting said lines, a timing switch, means operated over the called line for starting the operation of said switch, means for continuing the operation of said switch in cycles from normal starting position and back to normal starting position, means for predetermining the time consumed for each cycle wherein the time of day is a factor, and means also controlled by the number of cycles which have transpired since said initiation for determining the time consumed for cycles following.

17. In a telephone system, a calling line, a called line, a link for temporarily connecting said lines, a timing switch, means operated over the called line for starting the operation of said switch, means for continuing the operation of said switch in cycles from normal starting position back to normal starting position, an impulse sender for operating the switch at predetermined speed by impulses from said sender to progress the switch in effecting said cycles of operation, and means exclusive of the impulse sender and depending upon the cycle being the first cycle of operation after said initiation for causing the switch to operate through a part of said first cycle irrespective of impulses applied.

18. In a telephone system, a calling line, a called line, a link for temporarily connecting said lines, a timing switch, means operated over the called line for starting the operation of said switch, means for continuing the operation of said switch in cycles from normal starting position back to normal starting position, manually operated pre-setting means for varying the time for completing the respective cycles, and means responsive to completing each said cycle for assessing a toll charge for the connection.

19. In a telephone system, a calling line, a called line, a link for temporarily connecting said lines, a timing switch, means operated over the called line for starting the operation of said switch, means for continuing the operation of said switch in cycles from normal starting position back to normal starting position, pre-setting means operated before said starting for varying the time for completing the respective cycles, and means responsive to completing each said cycle for assessing a toll charge for the connection.

20. In a telephone system, a calling line, a called line, a link for temporarily connecting said lines, a timing switch, means operated over the called line for starting the operation of said switch, means for continuing the operation of said switch in cycles from normal starting position back to normal starting position, and manually operated pre-setting means for varying the time for completing each respective cycle of a plurality of successive cycles by a setting operation performed before the first of said cycles has started.

21. In a telephone system, a calling line, a called line, a link for temporarily connecting said lines, a timing switch, means operated over the connection for starting the operation of said switch, means for continuing the operation of said switch in cycles from normal starting position back to normal starting position, pre-setting means operated before said starting for varying the time for completing the respective cycles, and means responsive to completing each said cycle for assessing a toll charge for the connection.

22. In a toll telephone system, means for establishing connection between a calling line and a desired called line, means for automatically assessing a specific unit toll for a substantially predetermined time of service from a random starting point, and time controlled automatic means for automatically varying the length of said period in accordance with the time of day the service is rendered.

23. In a toll telephone system, means for establishing connection between a calling line and a desired called line, means for automatically assessing a specific unit toll for a substantially predetermined time of service from a random starting point, the starting point being coincident with the response on the called line automatically, and time controlled automatic means for automatically varying the length of said period in accordance with the time of day the service is rendered.

24. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a timing mechanism, means for operating the timing mechanism from normal home position to home position in successive cycles, means controlled over the called line for initiating the operation of the timing mechanism from the home position, and means depending upon whether the cycle is the first or a successive cycle for determining the length of time for effecting the cycle.

25. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a timing mecha-

nism, means for operating the timing mechanism from normal home position to home position in successive cycles, means controlled over the called line for initiating the operation of the timing mechanism from the home position, means depending upon whether the cycle is the first or a successive cycle for determining the length of time for effecting the cycle, and means for recording a specific charge for each cycle regardless of the time occupied therein.

26. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a timing mechanism, means for operating the timing mechanism from normal home position to home position in successive cycles, means controlled over the called line for initiating the operation of the timing mechanism from home position, means depending upon whether the cycle is the first or a successive cycle for determining the length of time for effecting the cycle, and means for displaying an indication of a specific charge for each cycle and fraction thereof regardless of the time occupied therein.

27. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a timing mechanism individual to the connection, means for operating the timing mechanism from normal home position to home position in successive cycles, means controlled over the called line for initiating the operation of the timing mechanism from the home position, and means exclusive of the calling line for variably pre-setting the timing mechanism for pre-determining the length of time of a said cycle.

28. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a timing mechanism individual to the connection, means for operating the timing mechanism from normal home position to the home position in successive cycles, means controlled over the called line for initiating the operation of the timing mechanism from home position, and means exclusive of the calling line for presetting the timing mechanism for pre-determining the length of time of successive said cycles, the cycles having different length.

29. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a timing mechanism individual to the connection, means for operating the timing mechanism from normal home position to the home position in successive cycles, means controlled over the called line for initiating the operation of the timing mechanism from home position, means exclusive of the calling line for changing the setting of the timing mechanism for predetermining the length of time of successive said cycles, and means operated automatically responsive to destroying said established connection for effacing the changed pre-setting.

30. In a toll telephone system, means including a link circuit for establishing connection between a calling line and a desired called line, a cyclically operating timing mechanism of the link circuit having a home position, an impulse sending device, the timing mechanism operated through a definite distance from the home position to indicate a predetermined toll charge, means for driving the timing mechanism at a predetermined rate responsive to the impulse sending device to measure the time of a conversation charge period, and automatic means independent of said impulse sending device for advancing the timing mechanism over a portion of said distance, the operation of last said means depending upon if the movement of the timing mechanism from home position is the first one of the particular call or is a succeeding one, in order that a longer time will be allowed for a specific toll charge after the time allowed for the first toll charge has elapsed than was allowed for the first toll charge.

31. In a toll telephone system, means including a link circuit for establishing connection between a calling line and a desired called line, a cyclically operating timing mechanism of the link circuit having a home position, an impulse sending device, the timing mechanism operated through a definite distance from the home position to indicate a predetermined toll charge, means for driving the timing mechanism at a predetermined rate responsive to the impulse sending device to measure the time of a conversation charge period, means controlled over the called line for initiating the operation of the timing mechanism from its home position, and automatic means independent of said impulse sending device for advancing the timing mechanism over a portion of said distance responsive to the movement of the timing mechanism being initiated, the operation of last said means depending upon if the movement of the timing mechanism from home position is the first one of the particular call or is a succeeding one, in order that a longer time will be allowed for a specific toll charge after the time allowed for the first toll charge has elapsed than was allowed for the first toll charge.

32. In a toll telephone system, a plurality of link circuits, means including a random said link circuit for establishing a connection between a calling line and a desired called line, a timing mechanism for the link circuit, common time controlled means for successively operating the timing device through a predetermined range of movement from a starting point to indicate corresponding successive unit toll charges, means irrespective of the time controlled means for op-

erating the timing mechanism over a portion of its range in order to shorten the time occupied in operating through said range, and means for disabling last said means dependent upon how many times said last said means has operated.

33. In a toll telephone system, a plurality of link circuits, means including a random said link circuit for establishing a connection between a calling line and a desired called line, a timing mechanism for the link circuit, time controlled means for successively operating the timing device through a predetermined range of movement from a starting point to indicate corresponding successive unit toll charges, a meter of the link circuit for recording the number of said charges operated responsive to the completion of each operation of the timing device through said range, an adjustable resistor of the timing mechanism, means for varying the resistance included by the resistor in accordance with the position of the timing device with respect to the starting point, a source of current, a calibrated current indicator common to said links, means whereby the number of integral units will be indicated by the meter, and means whereby the relative value of any fractional unit may be determined by the indicator.

34. In a toll telephone system, means including a link circuit for establishing connection between a calling line and a desired called line, a step-by-step advancing timing switch individual to the link circuit, a plurality of impulse sending devices for operating the timing switch, a plurality of manually operated set-keys, automatic means for causing the timing switch to come under the control of one of said impulse sending devices, and means responsive to the operation of a random said set key for determining which corresponding one of said impulse sending devices will control said switch, subject to said automatic means.

35. In a toll telephone system, means for establishing connection between a calling and a called line, a step-by-step advancing timing switch for the connection, means for indicating a unit toll charge for a predetermined range of movement of the switch, automatic means controlled over the connection for causing the timing switch to initiate its operation, means for causing the switch to vary its rate of movement over certain predetermined portions of its range of movement depending upon an operation effected prior to the movement of the switch, and means whereby each said portion represents a charge element of the total charge represented by said range of movement.

36. In a telephone system, means for establishing a connection from a calling line to a called line, a timing switch, means for automatically starting the timing switch, means for assessing a toll charge for a predetermined extent of movement of the timing switch, means for varying the speed rate of said movement, and means for applying a signal to the connection at a substantially predetermined fixed time before the termination of said extent of movement regardless of said rate of the speed rate of said movement.

37. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a call toll register, a cyclically operative timing mechanism for the connection, means controlled over the called line for initiating the operation of the timing mechanism from idle resting position, means for registering a unit toll charge on the call register for the connection responsive to a predetermined portion of the cyclic movement of the timing mechanism, and automatic means for causing the timing mechanism to move over said predetermined portion in varied time duration, depending upon if the timing mechanism is operating in its first cycle after the initiation of its operation or is operating in a subsequent cycle.

38. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a call toll register, a cyclically operative timing mechanism for the connection, means controlled over the called line for initiating the operation of the timing mechanism from idle resting position, means for registering a unit toll charge on the call register for the connection responsive to a predetermined portion of the cyclic movement of the timing mechanism, and automatic means for causing the timing mechanism to move over said predetermined portion in varied time duration, depending upon the time of day the connection endures through.

39. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a call toll register, a cyclically operative timing mechanism for the connection, means controlled over the called line for initiating the operation of the timing mechanism from idle resting position, means for registering a unit toll charge on the call register for the connection responsive to a predetermined portion of the cyclic movement of the timing mechanism, automatic means for causing the timing mechanism to move over said predetermined portion in varied time duration, and automatic means governed by said timing mechanism for applying two spaced signals wherein a first one of said signals indicates a substantially predetermined amount of said predetermined time duration remains and the second one of said signals indicates that this latter time duration has substantially elapsed, the latter said time between signals being spaced substantially constant

with respect to each other and also counting back from the termination of said predetermined duration periods, regardless of the lengths of the predetermined duration periods.

40. In a toll telephone system, means for establishing connection between a calling line and a desired called line, a call toll register, a cyclically operative timing mechanism for the connection, means controlled over the called line for initiating the operation of the timing mechanism from idle resting position, means for registering a unit toll charge on the call register for the connection responsive to a predetermined portion of the cyclic movement of the timing mechanism, automatic means for causing the timing mechanism to move over said predetermined portion in varied time duration, and automatic means governed by said timing mechanism for applying a signal to indicate that a substantially predetermined amount of said predetermined duration period remains, regardless of the length of the predetermined duration period.

In witness whereof, I hereunto subscribe my name this twelfth day of May, 1927.

HERBERT M. FRIENDLY.