May 30, 1944. H. I. MacKEN 2,350,177

TELEPHONE MEASURING SYSTEM

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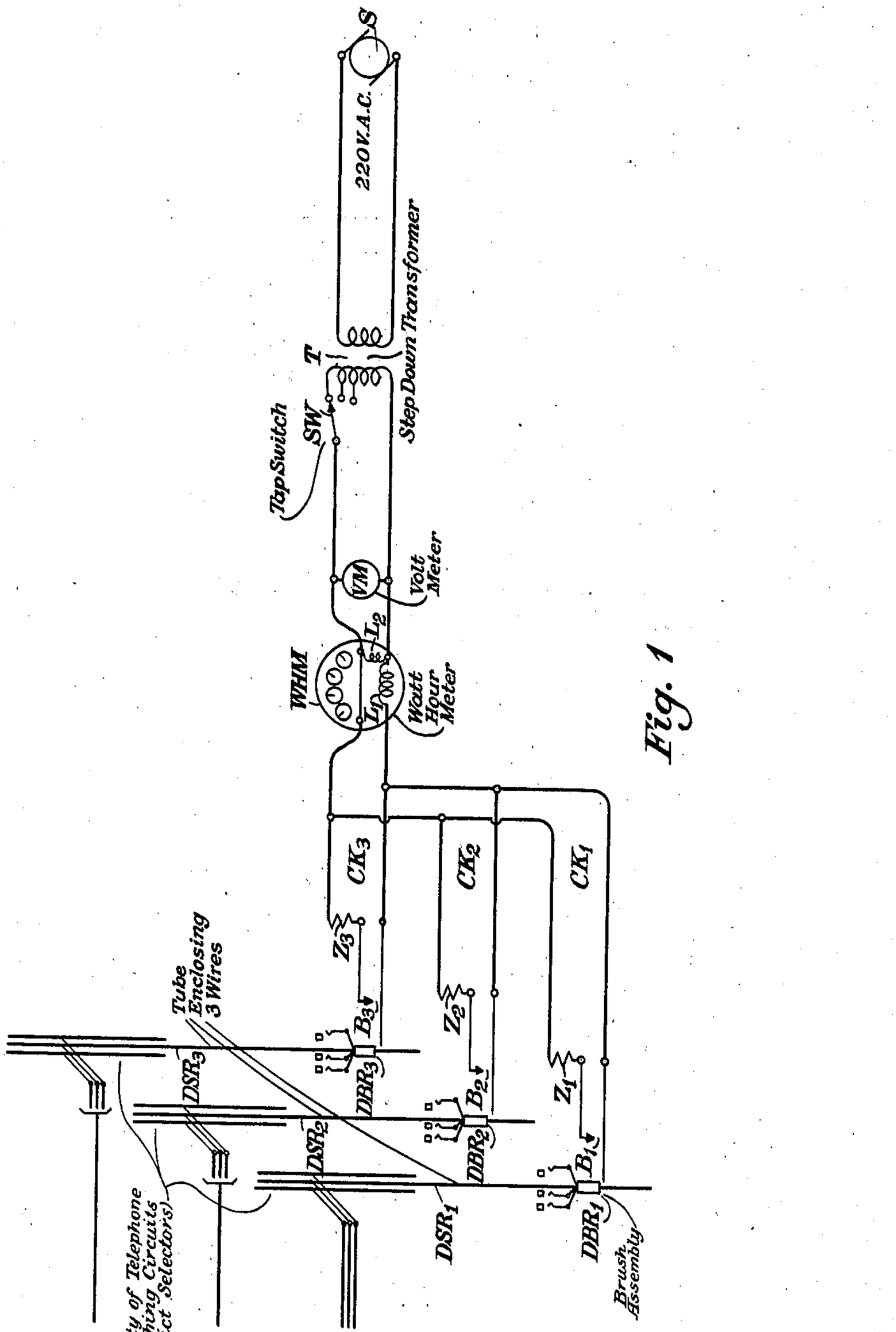

Fig. 1

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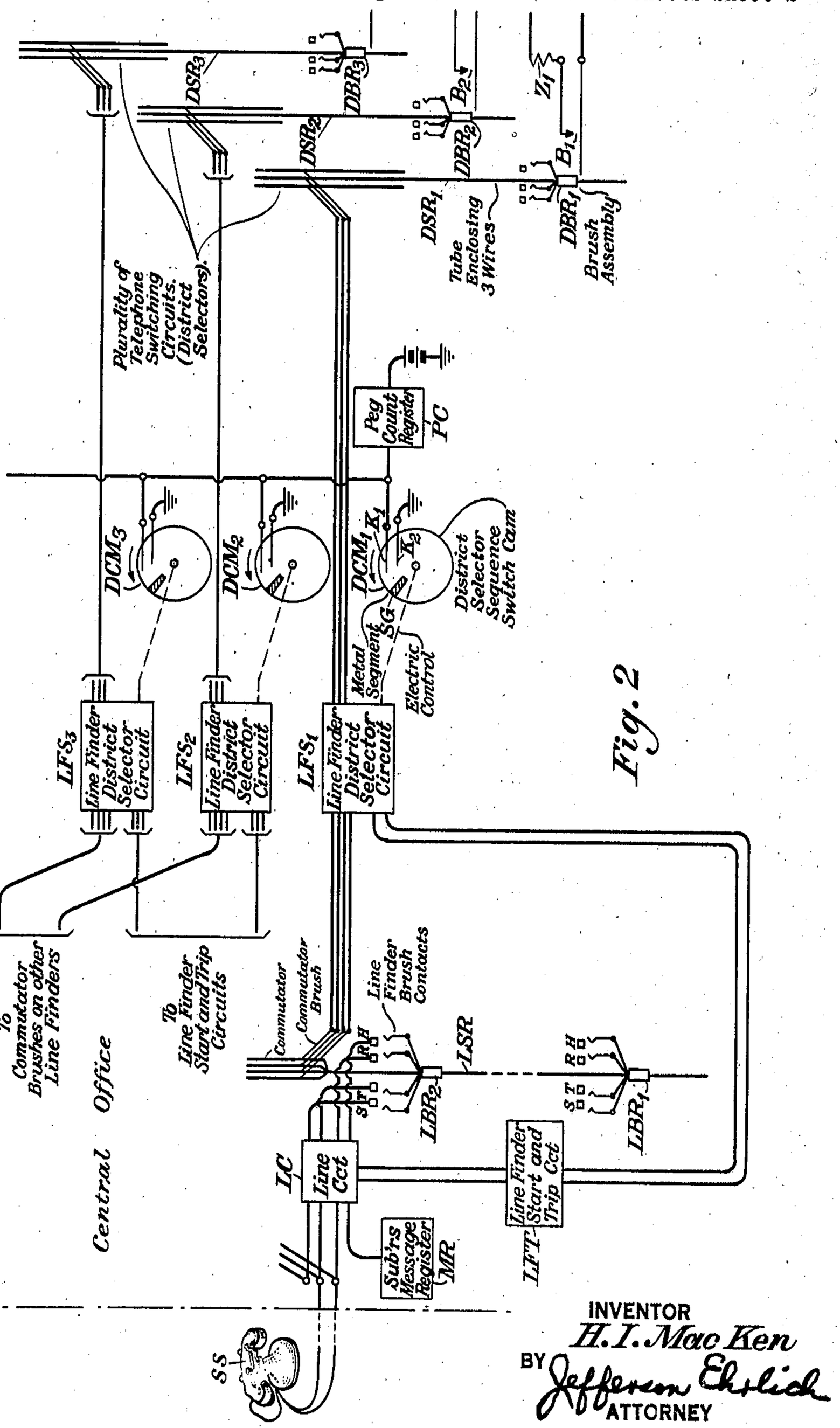

Fig. 2

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TELEPHONE MEASURING SYSTEM

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5 Claims. (Cl. 179—175.2)

This invention relates to telephone systems and to electrical systems generally. This invention also relates to timing circuits and systems. More particularly, this invention relates to systems and apparatus employed to determine the average period of time during which each of a plurality of electrical or other circuits or apparatus has been in operation.

There is at present in use in the telephone art apparatus for measuring the approximate time during which a telephone circuit is in use. This apparatus includes a relay which is operated in response to the closure of a telephone circuit, together with a pulsing device and recorder connected into a circuit controlled by the relay. The pulsing device produces successive pulses spaced apart by an interval such as six seconds and the recorder indicates the number of pulses transmitted during the closure of the telephone circuit. When such apparatus is connected to each of a plurality of telephone circuits in the telephone central office, a great many observations and computations are required to determine the average time during which each telephone circuit is operated. This prior art arrangement is unsuitable because it is time consuming, requires a large number of persons to obtain the necessary data, and utilizes a considerable amount of apparatus.

The present invention differs materially from prior time measuring circuits and systems. It includes a plurality of power consuming circuits each of which is controlled by one of the telephone circuits to be observed. The various power consuming circuits are connected in parallel relationship to a source of voltage through an integrating device such as a watt hour meter. The system is arranged so that the voltage applied to each power consuming circuit through the meter will be the same and of a predetermined value and substantially constant in voltage at that value. The readings of the meter will measure the total amount of power consumed by all of the power consuming circuits. Inasmuch as each power consuming circuit is supplied with power only while its associated telephone circuit is operated, the readings of the meter will be proportional to the total usage time of all of the telephone circuits under observation. By employing a so-called peg counter or other indicator to indicate the number of calls made over all of the telephone circuits under observation, an operator may evaluate the average usage time of each telephone circuit from the quotient of the watt hour meter reading and the peg counter reading.

This invention will be better understood from the more detailed description hereinafter following, when read in connection with the accompanying drawings, in which Figure 1 shows a circuit for carrying out the principles of this invention and Fig. 2 shows part of a telephone system which may be associated with the arrangement of Fig. 1 to carry out the invention.

Referring to Fig. 1 of the drawings, reference characters DSR_1, DSR_2 and DSR_3 represent three of a plurality of district selector rods which may be in a telephone central office of, for example, the panel type. The selector rods DSR_1, DSR_2 and DSR_3 support a plurality of brushes such as DBR_1, DBR_2 and DBR_3, respectively, only one of the brushes associated with each selector rod being shown for illustrative purposes. The brushes DBR_1, DBR_2 and DBR_3 control the closure of off-normal contacts B_1, B_2 and B_3 respectively, which in turn control power consuming circuits CK_1, CK_2 and CK_3, which are arranged in parallel relationship. These power consuming circuits include impedances Z_1, Z_2 and Z_3, which are of substantially equal magnitude so that all of the power consuming circuits will receive substantially equal amounts of power when the off-normal contacts B_1, B_2 and B_3, respectively, are closed.

The power consuming circuits CK_1, CK_2 and CK_3 are connected to the secondary winding of a transformer T through a watt hour meter WHM of any well known type. The watt hour meter may include a series coil L_1 of low impedance and a shunt coil L_2 of large impedance, together with the usual dial apparatus for indicating the amount of power transmitted through the meter to the circuits CK_1, CK_2 and CK_3. The primary winding of the transformer T is connected to a source of power S which may supply alternating voltage of, for example, 220 volts. A volt meter VM may be connected across the secondary winding of the transformer T and is used in conjunction with the tap switch SW for adjusting the voltage across the secondary of the transformer to a predetermined value. The position of the tap switch SW may be adjusted until the volt meter VM registers a predetermined voltage when a predetermined number of power consuming circuits, such as CK_1 to CK_3, are simultaneously closed. The same voltage will be applied to each of the circuits CK_1 to CK_3 and they will all receive equal amounts of current.

It will be observed that the watt hour meter interconnects the source of power S and the power consuming circuits CK_1 to CK_3 so that the meter WHM acting as an integrator, will indicate the power consumed by all the power consuming circuits. Although equal currents traverse the power consuming circuits CK_1 to CK_3, these power circuits are actually controlled by telephone circuits which usually carry variable currents.

When one of the off-normal contacts such as

B_1 becomes closed due to the operation of the district selector rod DSR_1 in response to the closure or completion of a telephone circuit (not shown in Fig. 1), current will then flow through the power consuming circuit CK_1. This flow of current will occur at a predetermined rate and the power consumed will be measured by the watt hour meter WHM. The amount of power consumed by circuit CK_1 will be proportional to the time during which the telephone circuit is in use. The circuit CK_1 will be opened when the telephone circuit controlling the selector rod DSR_1 is disconnected, whereupon no further power will be consumed by the circuit CK_1. Of course current will again flow over the circuit CK_1 when the rod DSR_1 is again operated in the usual way. Although the power consumed by circuit CK_1—which is measured by meter WHM—is proportional to the time during which the associated telephone circuit is in use, the power consumed will be affected by the number of times this same telephone has been established. The meter WHM, integrating the power consumed by all the power consuming circuits CK_1 to CK_3, is employed to obtain an indication which is proportional both to the number of telephone circuits in use over some specified period of time and to the length of time during which these various telephone circuits are in use during the period considered. If the number of times the various telephone circuits have been completed or operated can be determined, as for example by any form of peg counter or message register, the average period of use of each telephone circuit or the average holding time of the circuit may be determined by obtaining the quotient of the readings of the watt hour meter and the peg counter or message register and then multiplying this quotient by a calibration factor for the meter WHM. The calibration factor is obtained from the watt hour meter WHM reading when it is connected uninterruptedly to a predetermined number of power consuming circuits, as, for example, 60 such circuits, for a fixed period of time. Expressed arithmetically the calibration factor equals nxt/w, where w is the reading on the meter WHM, n is the number of power consuming circuits continuously connected to meter WHM and t is the time in seconds during which all of the power consuming circuits remain so connected.

Although the off-normal contacts B_1 to B_3 (which control circuits CK_1 to CK_3, respectively) are shown controlled by the selector rods DSR_1 to DSR_3 for illustrative purposes, the contacts B_1 to B_3 may be controlled in any other manner which will be apparent to those skilled in the art. The movable members of contacts B_1 to B_3 may be, for example, the armatures of ordinary electromagnetic relays having their windings connected to current-carrying circuits and the latter circuits may or may not be independent of each other.

Moreover, the power consuming circuits CK_1 to CK_3 may be replaced by any well known power consuming devices, or by other circuits or devices which carry equal or substantially equal currents. According to this invention an integrating device is employed to measure the power consumed by all of the various power consuming devices or circuits to determine the average usage time of the circuits or apparatus which control the power consuming devices or circuits.

Fig. 2 shows some of the apparatus of a panel type of telephone system that may be used to control the power consuming circuits of Fig. 1. Fig. 2 shows only some of the equipment of the central office which may be controlled by one of a plurality of subscribers' sets such as SS. The central office equipment may include a so-called line circuit LC, a line finder start and trip circuit LFT, and a line finder selector rod LSR, only one of which is shown for illustrative purposes, all of this equipment being of well known type. The line finder selector rod LSR may support a plurality of brushes such as LBR_1 and LBR_2, only two of which are shown for illustrative purposes. The central office may also include a plurality of line finder district selector circuits such as LFS_1, LFS_2 and LFS_3, although the line finder selector circuit LFS_1 is shown associated with the line finder selector rod LSR. Each line finder selector circuit such as LFS_1 may control a district selector sequence switch such as DCM_1. Each such sequence switch includes, among other things, two stationary contacts K_1 and K_2 and a rotary metal segment SG which, during part of its rotation in a counter-clockwise direction, may close a circuit between the two contacts K_1 and K_2. When contacts K_1 and K_2 are closed by the metal segment SG, they will operate a peg counter PC which may be of well known type, the peg counter PC being employed to register one individual operation of the telephone circuit. It will be understood, however, that each registration by the peg counter PC will be completed only after the associated district selector rod DSR_1, has risen from its normal position in response to current from the district selector circuit LFS_1 to close the associated off-normal contacts B_1. Other similar office equipment (not shown) will control any one of a plurality of other district selector rods such as DSR_2 or DSR_3. All of the equipment shown in Fig. 2 is of well known type and is arranged in a well-known manner.

When the subscriber at station SS removes his instrument from its cradle, the line circuit LC, which includes a plurality of relays (not shown), will be so actuated as to energize the line finder trip circuit LFT. This will cause one of the brushes such as LBR_1 of the line finder selector rod LSR to be tripped, whereupon the line finder selector rod LSR will start to ascend from its normal position. The line finder selector rod will come to rest in an elevated position when its contact H reaches a grounded terminal, as is well known in the art. The terminal H is one of four terminals which are designated S, T, R and H, corresponding to four conductors which are enclosed within the line selector rod LSR. All of the selector rods such as LSR, DSR, etc., embody tubes which enclose a plurality of conductors. The line finder selector LSR will remain in its elevated position until the call from the subscriber's set SS is completed, whereupon the rod LSR will return to its lowermost or normal position.

While the line finder selector rod LSR remains elevated and in a stationary position, the line finder district selector circuit LFS_1 will then operate other equipment such as a sender (not shown) of well known type, which returns dial tone to the subscriber's set SS. The sender will also record the subsequent dial pulses emanating from the subscriber's set SS. The sender will also control the operation of a district circuit selector rod DSR_1 which is associated therewith, tripping one of its brushes such as DBR_1. The selector rod DSR_1 is then moved upwardly until its three contacts—which are connected to three

conductors enclosed within the selector rod DSR_1—reach the terminals of an idle trunk or circuit leading to the called party. The conductors enclosed by the selector rod DSR_1 are attached to the usual brush contacts of a brush assembly of well known type. These three brush contacts engage three corresponding flat metal strips in a well known manner.

The message register MR at the central office will record the number of calls made from the subscriber's set SS is a well known manner. The peg counter PC is shown common to a plurality of line finder district selector circuits such as LFS_1 to LFS_3 and their associated district selector sequence switch cams such as DCM_1 to DCM_3, and district selector rods DSR_1 to DSR_3. As already noted, the peg counter PC will register once for each complete rotation of the district sequence switch cam DCM_1. The peg counter PC will actually indicate the total number of calls in which subscribers having sets such as SS have dialed at least three digits of the various dial codes and have thereby established telephone circuits. The peg counter readings will thus indicate the total number of telephone circuits which are established for a predetermined number of subscribers' stations, as, for example, one hundred (or more) subscribers' stations.

The details of the various pieces of equipment at the central office for the panel type of telephone system has not been described in detail as this equipment is of well known type and the operation of the equipment has been in no wise changed for the practice of the present invention. It is to be remembered, however, that the peg counter PC is employed to provide an indication of the number of times telephone circuits have been completed from a predetermined number of subscribers' stations. It is the numerical indication of the peg counter PC which, together with the indication of the watt hour meter WHM or other integrating device, supplies sufficient information from which may be determined the average usage time of any one of the various telephone circuits controlled by a predetermined number of subscribers' stations.

It will be noted that the various telephone circuits carry variable currents and at the same time control the operation of a plurality of power consuming circuits such as CK_1 to CK_3. These power consuming circuits CK_1 to CK_3 are arranged to receive equal amounts of power when these circuits are energized. It will be understood that the various telephone circuits, whether in a panel type of telephone system or in any other type of telephone system, may be used to control any other devices or apparatus which, when actuated, receive equal amounts of power. The watt hour meter WHM merely represents one form of integrating apparatus for integrating the power consumed by the power consuming devices, and any other integrating device or devices may well be substituted therefor within the scope of this invention.

While this invention has been disclosed in certain specific arrangements which are deemed desirable, it will be obvious that the general principles herein disclosed may be embodied in many other organizations, widely different from those illustrated, without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. In apparatus for measuring the operating time of a plurality of telephone circuits, the combination of a plurality of selectors each controlled by one of said telephone circuits, each selector having an off-normal contact, a plurality of equal power consuming circuits connected in parallel relationship to each other, each power consuming circuit being controlled by the off-normal contact of one of said selectors, a source of alternating current power, and a power integrating device interconnecting said source of power and said power consuming circuits.

2. In apparatus for measuring the operating time of each of a plurality of telephone circuits, the combination of a plurality of selectors each controlled by one of said telephone circuits, each selector having a contact which is closed when the selector is displaced from its normal position, a plurality of power consuming devices each corresponding to one of said selectors and being controlled by the contact of said selector, said devices being arranged in parallel relationship with each other, a source of alternating current power, and a power integrating and measuring device interconnecting the source of power with said power consuming devices.

3. In apparatus for measuring the operating time of each of a plurality of circuits carrying variable currents, the combination of a plurality of selectors each controlled by one of said circuits, each selector having an off-normal contact, a plurality of power consuming circuits which receive equal amounts of current, means responsive to the closure of said off-normal contacts to energize the associated power consuming circuits, said power consuming circuits being interconnected in parallel relationship with each other, and means for determining the amount of current consumed by all of said power consuming circuits.

4. In a telephone system, the combination of a plurality of telephone trunk circuits, apparatus for indicating the number of times said telephone trunk circuits have been operated, a plurality of power consuming circuits connected in parallel relationship, each power consuming circuit being associated with and controlled by one of said telephone trunk circuits, means responsive to the operation of any one of said telephone trunk circuits for energizing the corresponding power consuming circuit, power integrating apparatus connected to all of said power consuming circuits to indicate the amount of power consumed by said power consuming circuits, and means to prevent the voltage applied to said power consuming circuits from reaching said telephone trunk circuits.

5. Apparatus for measuring the usage of time of each of a plurality of telephone circuits, comprising a device connected to all of said telephone circuits to indicate the number of times said telephone circuits have been operated, a plurality of selectors each controlled by one of said telephone circuits, each selector having an off-normal contact, a plurality of power consuming devices each of which is associated with one of said telephone circuits, means controlled by the off-normal contacts of said selectors to operate the corresponding power consuming circuits, said power consuming circuits being arranged to receive equal amounts of power when they are operated, and means for indicating the amount of power consumed by all the said power consuming circuits.

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