ALARM SERVICES

DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section covers information on telecommunication channels provided for the alarm industry by the Bell System. It also provides information about the following:

- Initial alarms

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- Different types of alarm systems
- Various national organizations within the alarm industry
- Various channels offered by the Bell System
- Installation and maintenance procedures involved
- Boundaries of customer and telephone company responsibility for the alarm systems.

1.02 Whenever this section is reissued, the reason(s) for reissue will be given in this paragraph.

1.03 Initially the alarm companies either ran their own circuits to tie the protected location to the alarm monitoring office or used the telegraph or telephone facilities. The alarm transmission systems were designed to operate on the single metallic wires provided by the telegraph and telephone companies. The McCulloh Loop is the most common alarm transmission system. It is based on a patent granted on January 31, 1882, to Chauncey F. McCulloh. There are about 180,000 McCulloh circuits in operation nationwide, protecting almost 3 million locations. The system consists of a series loop which connects the protected locations with an alarm central station as shown in Fig. 1.

1.04 The market for alarm services changed as the property owner's demand for increased security produced a substantial industry growth rate. Additional services and new signaling systems were developed to handle the increased need for alarm services.

2. SERVICES OFFERED BY ALARM COMPANIES

TYPES OF ALARM SERVICES

2.01 The alarm industry offers a wide range of services to cover the protection needs of both their business and residential customers. The alarm services offered include:

- Burglar and holdup alarms
- Automatic and manual fire alarms
- Sprinkler system supervision
- Watchman supervision
- Industrial process supervision.

Each of these services uses an alarm control system responsible for performing three basic functions. They are:

- Control unit—a simple switch or control panel which turns the system on and off or changes the type of protection.
- Detection function—triggers the control unit.
- Reporting function—activates an alarm on the premises and/or transmits a signal to remote locations.

A. Local System

2.02 The local system consists of protective circuits and devices connected through control apparatus to a sounding device. This sounding device produces an alarm signal at the protected location.

B. Auxiliary System

2.03 The auxiliary system provides protection, usually limited to fire security, to a building or group of buildings. It uses municipal fire alarm facilities to transmit signals to the fire department.

C. Remote Station System

2.04 The remote station system uses a direct connection between signaling devices at a protected location and signal receiving equipment in a remote station. This system is also known as a Direct-Connect System.

D. Proprietary System

2.05 The proprietary system uses competent protection service personnel for supervisory purposes at the protected location.

E. Central Station System

2.06 The central station system signals, records, maintains, and supervises from a central station where experienced and competent operators are present at all times. These operators must react according to their operating rules when a signal is received.

3. NATIONAL ORGANIZATIONS

NATIONAL BURGLAR AND FIRE ALARM ASSOCIATION (NBFAA)

3.01 The NBFAA is the largest trade association representing the alarm industry at the national level, with headquarters located in Washington, D.C. Its membership ranges from small independent local alarm companies to the very largest national central station operators.

CENTRAL STATION ELECTRICAL PROTECTION ASSOCIATION (CSEPA)

3.02 The CSEPA is a national organization representing the majority of central station operations in the country. Some of the largest multistate central station operators are among its members.

UNDERWRITERS' LABORATORIES (U.L.)

3.03 Underwriters' Laboratories is an independent private organization which sets minimum standards for the performance, reliability, and safety of products used by alarm companies and other businesses.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

3.04 The NFPA is a nonprofit technical and educational organization that promotes the science of fire protection and prevention. The NFPA is responsible for trying to improve the method of fire protection and prevention and for establishing industrial safety standards for life and property.

4. CHANNELS OFFERED BY THE BELL SYSTEM

A. Metallic Channels

4.01 The Bell System has historically used metallic pairs to provide interoffice and interexchange facilities for the alarm industry services. Metallic facilities have become increasingly unavailable as the Bell System expands the use of carrier. In many locations metallic interoffice and interexchange facilities for these services are furnished only if available.

4.02 The Bell System has introduced alternatives for some alarm applications. Tone signaling alarm industry terminal equipment has also helped reduce the need for metallic facilities. The alarm industry, however, continues to request and have requirements for metallic interoffice and interexchange facilities. It is Bell System policy to grant alarm industry requests for metallic facilities only if pairs are available.

4.03 The phrase "only if available" in the preceding paragraph has specific connotations. Spare pairs (or binder groups) which are specifically reserved for carrier growth or other reasons are not available. They are also not available if their use would result in interference with other carrier systems or voice circuits. The Bell System will not provide a metallic channel through:

(a) The derivation of a circuit by using a good conductor from a bad pair

(b) The derivation of a circuit with reduced resistance by connecting the tip and ring wires of one pair together to form one conductor.

4.04 The Bell System intends to continue to provide metallic channels whenever appropriate facilities are available. If metallic channels are not available and the central station insists that one be provided, additional charges may be imposed for special construction or rearrangements that may be necessary to provide the channel. The telephone company is not required to maintain the dc continuity of these channels and may convert to nonmetallic at any time. Channels secured through special construction, depending on the nature of construction, may not be subject to a nonmetallic alternative.

Properties of Metallic Cable Pairs

4.05 Metallic channels are provided using available cable pairs selected at random from existing resources. Many physical and environmental factors can affect the resulting network. Examples such as foreign electromotive force (FEMF), ground leakage, induced ac voltages, and ground potential differences all exist in varying degrees. Certain combinations of cable pairs and/or the method of usage can often produce unexpected results.

4.06 A cable consists of a protective outside sheath which provides protection from environmental conditions such as moisture, rain, snow, etc. The cable may be aerial or underground. The sheath contains a number of metallic conductors separated into separate insulated pairs. Each pair is twisted in a long spiral and each pair-spiral is spiralled with other cable pairs within the protective sheath. Metallic conductors are predominately copper, and on rare occasions aluminum may be used. The cables used for local distribution or subscriber applications are generally 26 gauge in size. Cable used for interoffice applications is usually 22 or 24 gauge in size.

4.07 The major electrical characteristics that should be considered when planning a metallic network are:

- Direct current resistance
- Accumulation of FEMF and leakage to ground paths
- Possibility of induced ac voltage
- Operation of terminal equipment and its sensitivity to FEMF, ground leakage, or induced 60-Hz signals.

Direct Current Resistance

4.08 Exchange cable pairs, which are used to structure a direct wire circuit or McCulloh network, are selected at random from spare pairs in place. The Bell System does not specify any maximum resistance that may occur when a number of loops are arranged in a McCulloh or direct wire channel. When a number of local loops are configured to provide either of the mentioned channels, the electrical resistance will be the composite of the various cable pairs used to provide the channel. Exchange cables may have loops approaching or exceeding 2000 ohms. The user specifies the circuit arrangement. If the resulting network electrical resistance exceeds the user operating capabilities, it is the users responsibility to evaluate the network and reconfigure as necessary. The Bell System responsibility is to determine that the individual cable pairs are acceptable for subscriber telephone service. The Bell System will assure that electrical continuity is not broken, that the pair is clear of shorts or grounds, and that the level of FEMF and leakage does not exceed those values applied to a subscriber telephone service.

Foreign Electromotive Force and Leakage

4.09 The following discussion on foreign voltage and leakage resistance is provided solely for explanatory purposes. It should not be used for any other purpose.

4.10 A telephone exchange plant is used to provide the loops which support McCulloh circuits. The loop used to provide the transmission media in support of a McCulloh circuit is selected, at random, from the loops available for exchange telephone service, and as such they receive the same maintenance considerations as other loops within the cable.

4.11 The normal telephone service uses cable terminals located along the transmission path. These terminals are used to make drop wire connections to various customers' premises. Binding posts are mounted on a faceplate within the terminal box. There will be a number of such sets of binding posts appearing on any cable feed. When water or condensation wets the binding posts, leakage currents will flow between the cable pairs involved (Fig. 2). If dirt or dust is present, the leakage paths may represent a relatively low resistance value. The leakage paths of primary interest to the alarm industry effectively represent an electrical connection to "foreign battery," which is normally 50 volts appearing on the ring side of other cable pairs used for telephone service within the terminal box.

4.12 For exchange telephone service, the foreign battery or ground leakage which results is of little consequence from a signaling standpoint. This is due to the loop current sensitivity requirements of the serving central office (many equipment specifications require that operation of the line equipment continue with leakage paths as low as 10,000 ohms). The Bell System uses automatic devices to test for leakage that occurs on exchange cable pairs. The sensitivity threshold setting ranges between 30k to 90k ohms for this equipment. The level of the threshold varies depending upon local conditions and climate.

4.13 When a number of exchange loops are arranged in a McCulloh configuration, any foreign voltage or leakage to ground which manifests itself on a single loop will have impact upon the entire McCulloh circuit. Additionally, multiple paths occurring on different cable pairs within the McCulloh circuit will add to produce a composite leakage resistance value which could be detrimental, although each cable pair meets its individual requirements. Table A represents the worst case leakage resistance to foreign voltage that could exist on a McCulloh circuit. The voltmeter (VM) readings indicated would result if a 100,000-ohm meter were used for the measurement. (The Bell System test meter has 100,000 ohms of resistance and a 120-volts full scale or 833 ohms per volt). The measurements would be made with the McCulloh circuit disconnected from any primary power feed. The measurements should be taken from tip or ring to a ground as indicated in Fig. 3.

4.14 Measurements taken with a voltmeter having other than 100,000 ohms total resistance will produce voltage measurements which differ from those indicated in Table A; therefore, the importance of the proper test instrument cannot be overly stressed.

4.15 A second method used to measure the amount of leakage resistance that exists on a cable pair consists of a calibrated voltage source (usually +100 volts) inserted between ground and the voltmeter. (The voltmeter is in series with the calibrated voltage source.) The voltmeter is then connected to the circuit under test. The resultant current flow (to both the high resistance battery and leakage resistance to ground path) will produce a reading on the test instrument. Measurements with the tip and ring shorted, tip only shorted, ring only shorted, or from tip to ring may be made to provide more information if necessary.

4.16 The following formula may be used to convert the obtained voltage readings to a composite leakage value.

$$R_L = \frac{\text{test battery voltage} - \text{VM reading}}{\text{VM reading}} \times \text{VM resistance}$$

A simple approximation of the leakage resistance that would occur on a multipoint McCulloh circuit may be made by dividing 43,000 by the number of loops then adding the total series loop resistance. (Example: a 5-loop McCulloh circuit having a total loop resistance of 8,000 ohms yields a leakage resistance equal to [43,000 ÷ 5] + 8,000 = 16,600 ohms. The Bell System standard voltmeter would measure 42.9 volts). This quick method of approximation will provide an order of magnitude result and is not as accurate as Table A.

Induced AC Voltages

4.17 Communication channels carrying signals having signal components down to or close to zero frequency (direct current) are particularly susceptible to influences from high strength magnetic and electric fields. Three conditions are required before induced 60 Hz and its primary odd frequency harmonics may represent a problem on a metallic channel. They are influence (character and intensity), coupling (electronic and magnetic interreaction between power and communication circuits), and susceptibility (characteristic of the communication plant and associated apparatus). A source of induced ac voltage is a telephone cable paralleling an ac power distribution system or an electically operated rail system. There is also a possibility of induced voltage on each of the cable pairs in the protective covering. The physical construction of the cable is designed to minimize the possibility of induced voltage.

4.18 Cooperative effort between the power industry and the Bell System is used to solve problems that arise when they share the same environment. Two forms of voltage measurements may be taken on a cable pair to illustrate the possibility of ground potential differences. The two forms of voltage measurements are:

(a) A measurement taken between the cable pair conductors which gives the value of metallic or differential voltage.

(b) A measurement to ground of either of the two conductors which could produce relatively high voltage readings.

4.19 The conductors making up the cable pair are twisted to form a spiral. The purpose of the twist is to equally expose each of the conductors to any outside influence. Therefore, the induced voltage will have the same magnitude and phase as that appearing on the other conductor and there will be a low differential voltage reading. However, the measurement to ground may produce a high differential voltage reading.

4.20 A limiting factor in the readings is the amount of capacitive reactance measured at the induced frequency. The commonly accepted frequency is 60 Hz plus the odd harmonics associated with that frequency. The reactance is the result of the conductor length and its relationship to the protective sheath as well as other conductors in the cable. If the remote end of the conductor under test is grounded, the result is a marked increase in the voltage magnitude. When this takes place, the conductor basically becomes a secondary winding on the transformer, the primary being the source of the inducing field. Compared to the impedance represented by the distributed capacitive reactance of the conductors, the impedance of the ground return path is normally very low.

4.21 A simple 3-point McCulloh configuration will demonstrate the situation. For the purpose of this example, assume that both subscriber loops (protected locations) are provided from the same office. The two loops have unequal lengths but are within the same cable. Crossing the cable is a larger power transmission facility as seen in Fig. 4A. As a result of the coupling between the power transmission system and the communications facilities, a voltage will be induced into each of the cable pairs. Due to the design of the communications facilities, the induced voltage will be longitudinal (common mode) and the impressed voltage will have the same magnitude and polarity. Any measurements taken across the cable pair (tip to ring) will result in a voltage reading which approaches zero (no metallic or differential voltage exists because the voltages are common mode). The same test can be made on the second loop with similar results. The first loop will not have as great an influence as the second. Therefore the induced voltage, due to the second loop, will be of a lesser magnitude.

4.22 For the purpose of this example, assume that the magnitude of the induced voltage (measured to ground) of loop one is 5 volts and loop two is 20 volts as seen in Fig. 4B. When the two loops are connected in the central office (by wiring the ring of cable pair 1 to the tip of cable pair 2), the magnitude of the impressed common mode voltages are different and the resulting signal (induced 60 Hz) can be detrimental to the service being provided. Any metallic signals that occur will be the algebraic difference of the voltages on the conductors. Depending on the equipment provided by the customer, the resulting metallic voltage may produce a nonusable circuit. The resulting voltage (15 volts) is influenced by the type of network and its environment.

4.23 The McCulloh signaling system uses ground pulsing as one of its means of communication. The possibility of induced 60-Hz signals is greatly increased during the presence of the ground signal. Prior to the presence of a ground signal, the distributed capacity in the cable pair with respect to earth ground represents a relatively high impedance to the induced 60-Hz occurring on the McCulloh channel. When the information ground is applied by the transmitter, the high impedance is replaced with a much lower value. As a result, the value of the induced 60-Hz signal impacting the McCulloh receiver at the central station location will be of a higher value than prior to ground being applied.

Ground Potential Differences

4.24 Voltage differences can exist between remote grounds. These ground potential differences are caused both by natural and man-made conditions. The degree of ground potential difference can vary with time depending upon the mechanism causing the disturbance. Periods of high solar activity produce magnetic storms on earth. During the period of a storm, ground potential differences are enhanced. A worse case approximation of the possible effect may be made by using a 1 volt per mile of cable length. The source impedance of the ground potential difference is the sum of metallic conductor resistance and ground resistance. (Approximately 10 ohms may be used for the ground resistance.)

4.25 Examples of ground potential differences which are man-made are electrically operated rail systems or an industrial complex involved in manufacturing located in an area of poor soil conductivity. In the case of the rail system, relatively short periods of ground current can flow at regular intervals. An industrial park may produce periods of ground potential differences having a much longer interval, depending upon the nature of the manufacturing or processing activities.

McCulloh Signaling System

4.26 The McCulloh Signaling System is made up of one or more transmitters, a metallic or suitable alternative transmission facility, and a receiver.

4.27 The transmitter is placed at the protected location and consists of a circular rotatable wheel having a number of removable teeth. The basic McCulloh circuit and the transmitter code wheel are shown in Fig. 5. The normal operation of the code wheel is also given. Each protected premises is assigned a unique code, and teeth are removed as required to program the wheel with the assigned code.

4.28 Once the sensing device at the protected location has been triggered, the McCulloh transmitter will activate the wheel, causing it to rotate. A set of electrical contacts will be activated by the presence or absence of the teeth, and the programmed code will be transmitted to the central station location. The normal, inactive state of a McCulloh transmitter output is a closed loop. When the transmitter is activated, interruptions in loop current are sensed by the receiver and the transmitted code is recorded.

4.29 The transmitter has two sets of contacts, one being a loop (L) and the other being ground (G). The receiver contains a loop current source and two relays. The first relay is used to receive loop information, and the second relay is arranged to receive group pulsing information. The information transmitted on the loop and ground is redundant.

4.30 The receiver is capable of detecting various line faults, such as opens, shorts, and grounds, as well as alerting the alarm central station operator. The McCulloh signaling system is designed to allow the encoded information, generated at the the protected location, to be received by the alarm central station even though the transmission facility may be open, grounded, or shorted.

4.31 The process of locating the loop with the fault requires removing the loops being tested from the McCulloh network one at a time, then testing, rewiring, and continuing until the fault is located.

4.32 These McCulloh channels permit unidirectional transmission of contact closure or voltage or current transmissions at speeds up to 15-bits per second. The maximum direct current voltages should not exceed 270 volts conductor-to-conductor or 135 volts from either conductor to ground. Alternating current voltages should be limited to a value of 50V RMS (70.7 volts peak) conductor-to-conductor or from either conductor to ground, and the shortest signaling element will not be less than 33 ms (0.033 seconds). The direct and alternating current voltage sources will limit the maximum current, conductor-to-conductor or from either conductor to ground, to a value not to exceed 20 mA (0.02 ampere).

4.33 The McCulloh channel is secured by the customer for 0 to 30 baud service and is provided using a 2-wire interface with 2-wire facilities. The interface between the customer provided equipment (CPE) and the telephone company channel facilities will be a terminal block arranged for convenient connection of the cable conductors to the CPE. The terminal block and terminating network will be provided by the telephone company, but the space must be provided by the customer. The customer is responsible for the connection of the equipment to the terminal block. The customer is also responsible for disconnecting the equipment at the interface to allow telephone company repair personnel to perform normal work operations.

Network Planning

4.34 A multipoint McCulloh network is limited to a maximum of 26 points, served from a total of no more than three different serving wire centers, and may be further limited by the transmission distance limitations of customer provided terminal equipment. A multipoint charge applies for each local channel or station terminal bridged on the same circuit in addition to all other applicable charges for the channels.

4.35 The distribution plan for any given customer circuit is to be specified by the customer, subject to the system constraints of no more than three wire centers on one circuit including the wire center serving the central station. Telephone company engineering personnel may offer alternatives to a given plan, but the customer has the ultimate responsibility for territorial coverage.

B. Direct Wire

4.36 The direct wire channel is furnished for a 2-wire interface with 2-wire facilities suitable for direct current transmission with signaling speeds not to exceed 30 baud. It is also for 2-point or 3-point service within the same or geographically adjacent exchanges. It is normally suitable for remote metering, supervisory control, and miscellaneous signaling purposes. This channel is guaranteed to be metallic and will be provided only when available.

4.37 The direct wire is particularly exposed to the effects of induced ac voltage and the associated odd harmonics. The cable pair used for the channel is often split. Each conductor is used to serve a different customer. The ground is used as an equivalent third wire providing a return communications path. This type of operation is not only exposed to the effect of induced ac voltage but can also suffer from ground potential differences. In addition to the possibility of induced ac voltage and ground potential differences, the direct wire circuit is also sensitive to FEMF and leakage to ground.

4.38 There are several limits placed on the direct wire channel. It can handle a maximum of 270 volts tip to ring and 135 volts from tip and ring to ground. The current is limited to 50 mA. The ac voltage is limited to 70.7 volts peak-to-peak and 50 volts RMS. The channel is tariffed to serve 2 or 3 points and is guaranteed metallic only where available.

5. TELEMETRY/ALARM BRIDGING SERVICE (TABS)

5.01 The TABS is a multistation voice-frequency private line service designed to provide connections between a master station and a number of remote stations simultaneously. Direct transmission between remote stations is not intended. This service is intended for application in multipoint voice-frequency data or tone signaling arrangements, with transmission at rates up to 400 baud. For further information see Section 314-410-560. The TABS is provided in the following arrangements. Tables B and C reflect TABS and DATAPHONE Select-A-Station (DSAS) offerings as well as their associated channels.

A. Split-Band, Active Bridging

5.02 A split-band, active bridging arrangement provides for a 4-wire (master station or midlink channel) split frequency bridge and multiple 2-wire (remote station) ports. The TABS is intended for application in multipoint voice-frequency data or tone signaling arrangements. Two-way (polling) communication between the master station and each remote station is intended. The split-band bridging system can accommodate 128 2-wire ports. The end-to-end loss is 16 dB. The signal-to-noise (S/N) ratio is 24 dB. The frequency response is 500 to 2800 Hz and −4 to +14 dB. Full-voice bandwidth is not provided for the arrangement. Figure 6 shows the split-band bridging service.

B. Passive Bridging

5.03 A passive bridging arrangement provides for a 2-wire (master station or interconnection station channel) common port and multiple 2-wire (remote station) ports and is intended for data or tone signaling arrangements. Two-way (polling) communication between the master station and each remote station is intended. The passive band bridging service is a 10-point service. There is a loss of 37 dB. The signal-to-noise ratio is 24 dB. The frequency response is 500 to 2800 Hz and −4 to +14 dB. Full bandwidth is provided for this arrangement. The customer is responsible for networking. Figure 7 shows the passive bridging service.

C. Summation, Active Bridging

5.04 A summation, active bridging arrangement provides for a 2-wire (master station or midlink channel) common port and multiple 2-wire (remote station) ports and is intended for data or tone signaling arrangements. One-way communication from each remote station to the master station is intended. The summation bridging service is a 128 point service. There is a loss of 16 dB. The signal-to-noise ratio is 24 dB. The frequency response is 500 to 2800 Hz and −4 to +14 dB. Full bandwidth is provided for this arrangement. Figure 8 shows the summation bridging service.

D. Customer/Company Responsibilities

5.05 The selection of the bridging service is the responsibility of the customer. The customer must also select the bridge capacities and deployment pattern compatible with current needs and planned growth. The Bell System is responsible for advising the customer on appropriate network configurations based on the following:

(a) Split-Band, Active Bridging—Only one bridge per tandem (star) arrangement. No double-tandem operation is permitted.

(b) Passive Bridging—Each 10-port bridge has the capacity of ten 2-wire ports which may be used for connecting remote stations. The backbone to the master station or regeneration point is comprised of one 2-wire port.

(c) Summation and Split-Band Active Bridging—The telephone company has transmission and maintenance responsibility for the entire network exclusive of the customer provided terminal equipment.

5.06 Voice-frequency telemetry/alarm bridging services have several distinct advantages over subvoice grade telemetry services. These advantages are:

(a) They do not rely on interoffice metallic facilities which are in short supply in some areas.

(b) Larger geographic areas can be served by a single circuit and also by a single customer master station.

(c) Station outages are more easily identified and isolated.

(d) Up to 128 remote stations may be connected to a master station over an individual split-band, active bridging or summation, active bridging system.

(e) If passive bridging is used, customers may choose to use tandem passive bridges if they provide the regenerators and interconnection station channels. The regenerators provide intercommunications between bridges. However, the telephone company considers each passive bridge and the associated channels as an independent multipoint system. The telephone company assures transmission only within each passive bridge system.

(f) In split-band, active and summation, active bridging arrangements, secondary bridges must be directly connected to the primary bridge via midlink channels. Secondary bridges cannot be connected through other secondary bridges to allow additional layers of tandeming.

6. "DATAPHONE" DATA COMMUNICATIONS SERVICE SELECT-A-STATION

6.01 The DATAPHONE Select-A-Station service is a private line data service that is designed for applications in which a master station exchanges voiceband data information with a number of remote stations, one at a time, usually in a rapid sequence. Point-to-point voiceband connections are set up between the master station and each remote station to allow this exchange of information. Alternate voice service and dc continuity are not available. Two-way transmission between the master station and the remote stations is possible, but no direct transmission is available between remote stations. Simultaneous communication from the master station to all remote stations is not possible. Control signaling is accomplished by frequency division of the channel, making a separately ordered channel unnecessary. Connection control can be achieved only from the master station.

6.02 Connection control comes from the master station. All remote stations other than the one connected at a particular time are isolated from the connected path and from each other. Therefore, no trouble on one remote leg can affect proper operation of the remainder of the circuit. This isolation of each point-to-point connection also ensures the privacy of communications between the master station and each remote station.

6.03 Data station selectors (DSSs) are located at the master station in telephone company central offices to make connections between the master station and the various remote stations. A multilead interface between the selector control unit (SCU) and the master station terminal allows various degrees of control over the duration and order of the connections. The SCU generates the necessary control signals. After the connection to a particular remote station is made, the customer has full responsibility for end-to-end transmission. The customer provides the necessary equipment at both the master and remote sites. The end-to-end channel has a 4-wire voiceband termination from the SCU at the master station and a 2-wire or 4-wire voiceband termination from a channel service unit (CSU) at the remote station. The transmission equipment connected to the SCU at the master station must be true 4-wire for proper operation. End-to-end transmission may be duplex (simultaneous transmission in both directions) or half duplex (provides transmission alternately in either direction or in one direction only). When 2-wire remote terminations are used, each connection will contain a 2-wire section, and 2-wire transmission methods must be used. Echoes must be taken into account when the remote termination is 2-wire.

6.04 Tandem connection of DSS is allowable. Geographic and economic conditions make this type of connection desirable. A maximum of two DSSs, denoted as primary and secondary, may be placed in tandem. The number of secondaries that may be placed on a single primary is limited only by the number of output ports available on that primary. The maximum number of output ports available per DSS is 128 in the sequential offering and 125 in the addressable offering. Each output port connects to a remote station, or if the port is on a primary DSS, it may connect to a secondary DSS. A number of these circuits can be controlled from a master site; therefore the customer control equipment must provide control information to several SCUs.

A. Sequential

6.05 When using the sequential offering, the connection sequence is fixed by the initial assignment of stations to DSS output ports. There is no control over the order of stations polled on an in-service basis unless the reset option is provided. The sequential offering has three DSS options: automatic step, automatic step with reset, and controlled step. The first two DSS options further restrict control in that the time duration of all connections made by a particular DSS is fixed at one value when that DSS is installed, so that DSS thereafter moves automatically to the next station in sequence at the end of the fixed connection time. Thus, the message length from each remote station must be known and must be reasonably constant to make efficient use of these options. However, the second option, automatic step with reset, allows some control over the order of connections in that the DSS will return to the beginning of the cycle in response to a signal from the master station. However, connection duration is still fixed at installation. The third option, controlled step, allows continuous in-service control of the connection time to each station by means of a signal sent from the master station, which causes the DSS to step. In this case, the duration of each connection need not be known before the connection is established and a wide variety of connection times for all the remote stations can be handled efficiently.

B. Addressable

6.06 The addressable offering allows random station access as well as in-service control of the connection time. With addressing, the connection routine can be continuously varied to suit user needs. In addition, the addressable offering has a sequential mode that can be placed into operation on an in-service basis to reduce the overhead time. Table B gives the system characteristics of the TABS/DSAS channels, and Table C gives the channel characteristics.

7. INSTALLATION

A. Circuit Continuity

7.01 The telephone company will terminate its channels within the buildings involved at a point agreed to by both parties. The telephone company will wire to the point of termination of the circuit on the premises of the subscriber or authorized user. The types of facilities furnished are those regularly provided in telephone company plant.

7.02 The telephone company will furnish and install any station protectors required per Bell System Practices in connection with drop and block wires installed by the telephone company.

7.03 The first point of connection of telephone company facilities with wires or terminal apparatus of the alarm company will be considered as the point of termination normally used by the telephone company. The alarm company will furnish any station wiring required beyond this point of termination in order to extend the circuit to the location of its terminal apparatus or station equipment.

B. Special Services Protection (SSP)

7.04 Special services protection is provided for burglar and fire alarm circuits which are classed as special service lines. A marking device placed in the central office or outside plant serves as a warning to anyone in the vicinity of the circuit to use caution. Terminal punchings and binding posts will be marked by red plastic rings, binding post caps, and binding post insulators.

7.05 In order to avoid exposing these types of circuits to unauthorized persons, the alarm companies may request the telephone company to eliminate SSP treatment on the alarm circuits. It may be requested that SSP be omitted at all outside plant appearances of the channel or only at the serving terminal location(s). Such requests should be confirmed in a letter from the alarm company.

C. Certified Circuit (Double Drop)

7.06 When orders for signal circuits are placed, alarm companies request that one or more of the circuit locations be served by a "Certified Circuit." These requests are only made when it is known that the circuit locations are to be served from a pole or wall-mounted distribution terminal. When so specified the telephone company will install "parallel" (double) drop wires between the pole or wall-mounted distribution terminal and the protected premises. The rate and charge for an additional channel terminal applies when a "Certified Circuit" is associated with an interexchange channel. The rate and charge for an additonal termination in the same building applies when a "Certified Circuit" is associated with local service.

D. Notification of Work Completion

7.07 Immediately following the completion of a work order, the telephone company representative should call the alarm company involved and advise that the work has been completed.

8. MAINTENANCE

A. General

8.01 The telephone company will maintain all drop pair, block, and inside wiring installed by its employees and will cooperate with alarm companies in correcting the problem. The alarm companies are responsible for the maintenance of all station wiring installed by their personnel beyond the point of the telephone company termination. They are also responsible for extending the circuit to the terminal apparatus or station equipment.

B. Trouble Clearing Procedures

8.02 When trouble occurs, the alarm company will make initial tests in an effort to isolate the trouble location. The alarm company will request the assistance of the local telephone company testboard in sectionalizing the trouble in cases involving multipoint series circuits. Channels provided for direct current alarm services will be tested to assure that they are clear of shorts, opens, and grounds and that the presence of FEMF or leakage is within limits for telephone service provided in the same cable. The alarm company should be informed if the trouble is in a leg and not between telephone offices. The alarm company will do one of two things:

(a) Dispatch their maintenance personnel to open the circuit at the point of connection between telephone company (TELCO) and alarm company facilities and make tests directly with the TELCO test desk. If the trouble is in the alarm company portion of the circuit or equipment, the alarm company will close the circuit at the connecting block and notify TELCO, who will then close out the trouble report.

(b) Request a TELCO dispatch instead of dispatching alarm company maintenance personnel. The alarm company is responsible for providing access for the TELCO employee at the point of separation. If the trouble proves to be in the alarm company equipment or their portion of the circuit, a maintenance service charge (MSC) will be applied. The TELCO personnel are not permitted to work on equipment or facilities installed by alarm companies, nor are alarm company personnel allowed to work on TELCO equipment or facilities.

No circuit will be opened or worked on by telephone company personnel unless the alarm company reports a case of trouble to the control office or specifically releases the circuit.

9. CUSTOMER RESPONSIBILITY

9.01 The operating characteristics of the terminal equipment provided by the user should not interfere with any of the other services offered by the telephone company. This equipment cannot endanger the safety of telephone company employees or the public. It must not cause damage or require change in or alteration of the equipment or facilities of the telephone company. If the equipment does present a hazard or cause interference, the telephone company will present a notice to the customer regarding the removal of the equipment or steps to take to prevent interference or hazards. The customer must agree to release the facilities to the telephone company when maintenance is necessary. The time and interval of release will be negotiated by both parties.

10. TELEPHONE COMPANY RESPONSIBILITY

10.01 The telephone companies are responsible for furnishing and maintaining private line channels. The telephone company is not responsible for the installation, operation, and maintenance of any terminal equipment provided by the user. The telephone company is not responsible for the overall performance of CPE over channels provided by the telephone company. The telephone company does not guarantee that these channels will be compatible with or adaptable to any particular type of customer provided control or indicating equipment. The telephone company will provide a suitable McCulloh termination unit, located at the protected location interface, on all new channel terminations providing McCulloh service.

TABLE A

LEAKAGE RESISTANCE VERSUS FOREIGN VOLTAGE (NOTE)

NUMBER OF LOOPS	EFFECTIVE LEAKAGE OHMS	VM READING (TO GROUND)
2	21,980	41.0
5	9,860	45.5
10	6,619	46.9
15	5,979	47.2
20	5,822	47.2

Note: For the purpose of calculation, it has been assumed that all loops have 770 ohms of resistance and that an equivalent 43,000-ohm battery of 50 volts appears at each customer location. This table is not to be used for maintenance purposes. It is only for explanatory purposes.

TABLE B

SYSTEM CHARACTERISTICS

SYSTEM	MAXIMUM PROTECTED LOCATION	END-TO-END LOSS	CHANNELS AND LOSS			
			4W 8 DB	4W 0 DB	2W 8 DB	2W 0 DB (SIMPLEX)
DSAS	16,384	30 dB	X	X	(*)	
Split Band	128	16 dB	X	X	X	
Passive†	10	37 dB			X	
Summation	128	16 dB			X	X

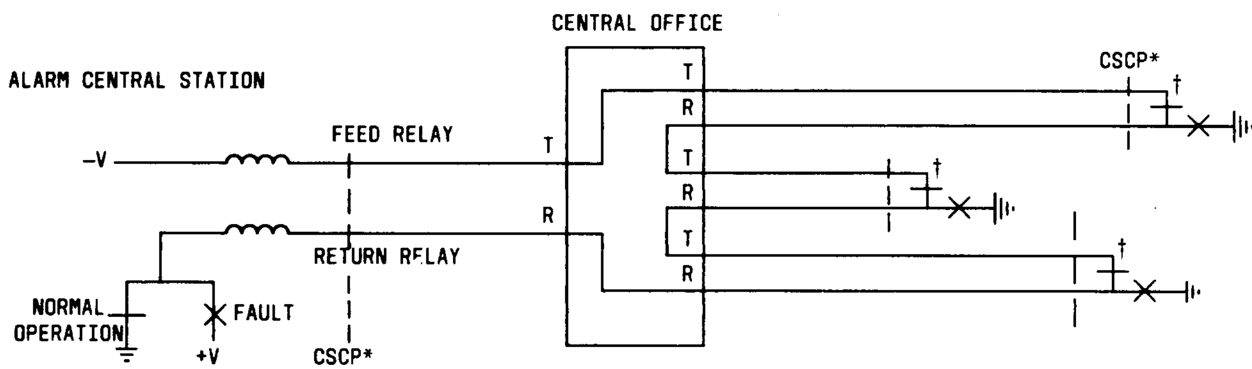
* DSAS 2-wire local channel designed for 12 dB.
† Totally passive design.

TABLE C

CHANNEL CHARACTERISTICS

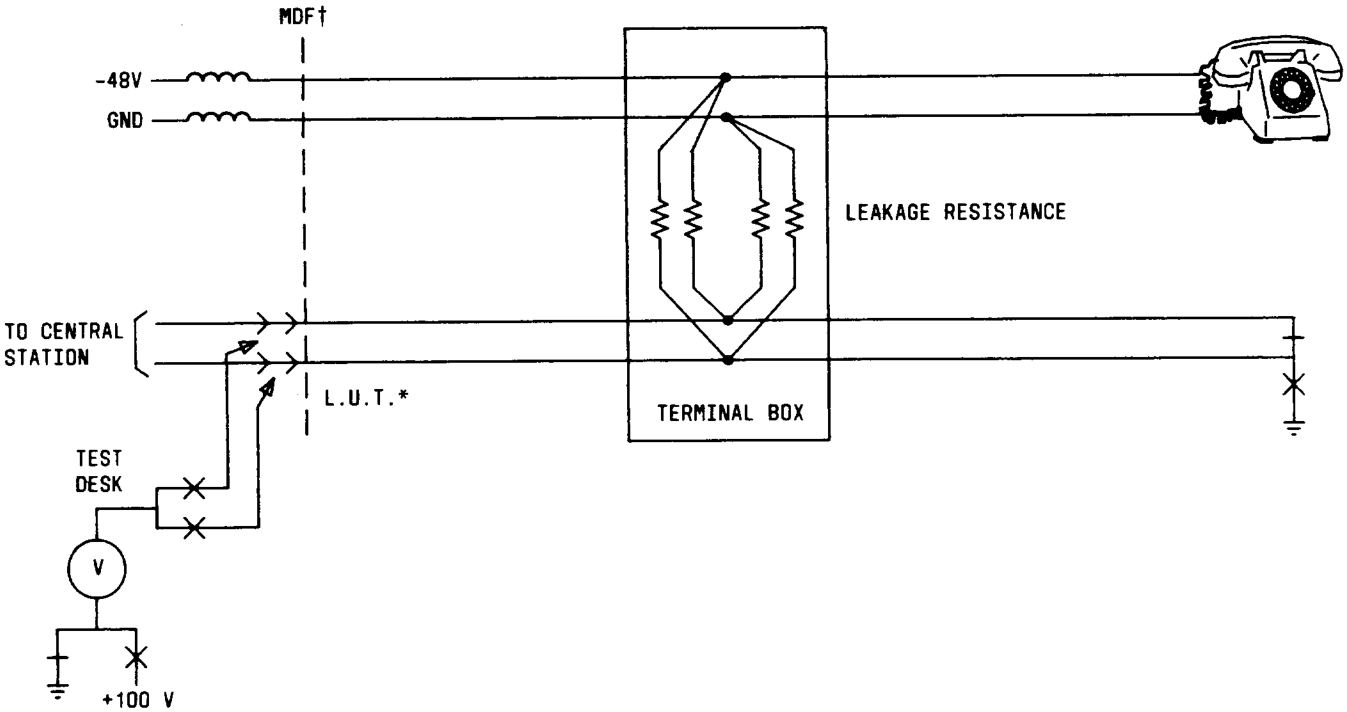
CHANNEL (NOTE)	USE	FREQUENCY	RESPONSE (DB)
4W 8 dB	Master Feed	500 to 2800	−1 to +3
4W 0 dB	Interoffice Trunk	300 to 3000	−2 to +6
2W 0 dB	Interoffice Trunk		
2W 8 dB	Protected Loc. Loop	500 to 2800	−2 to +8

Note: All above channels based upon 40 series channels developed for DSAS.



* CSCP – CHANNEL SERVICE CONNECTION POINT
† CODE WHEEL

Fig. 1—Basic McCulloh Circuit Configuration



* LINE UNDER TEST

† MAIN DISTRIBUTING FRAME

Fig. 2—Measuring Leakage Resistance

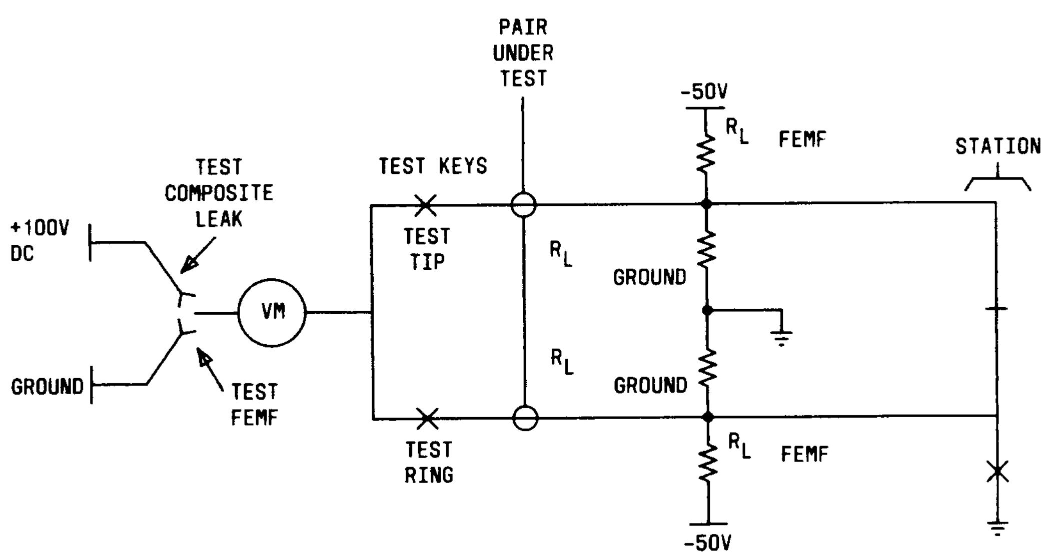


Fig. 3—Measurements for Foreign Voltage or Leakage to Ground

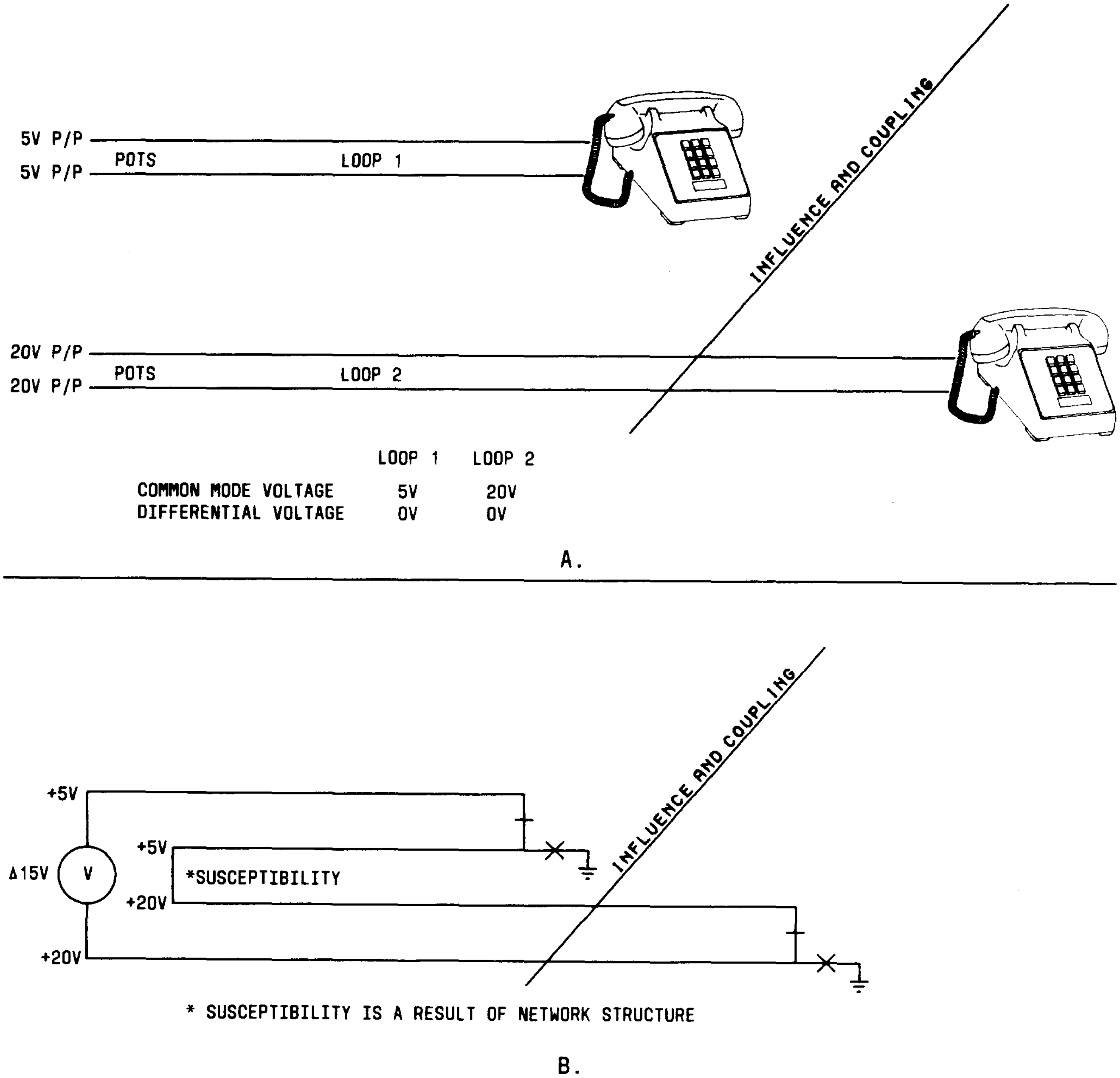


Fig. 4—Effects on McCulloh Network from Induced AC Voltage

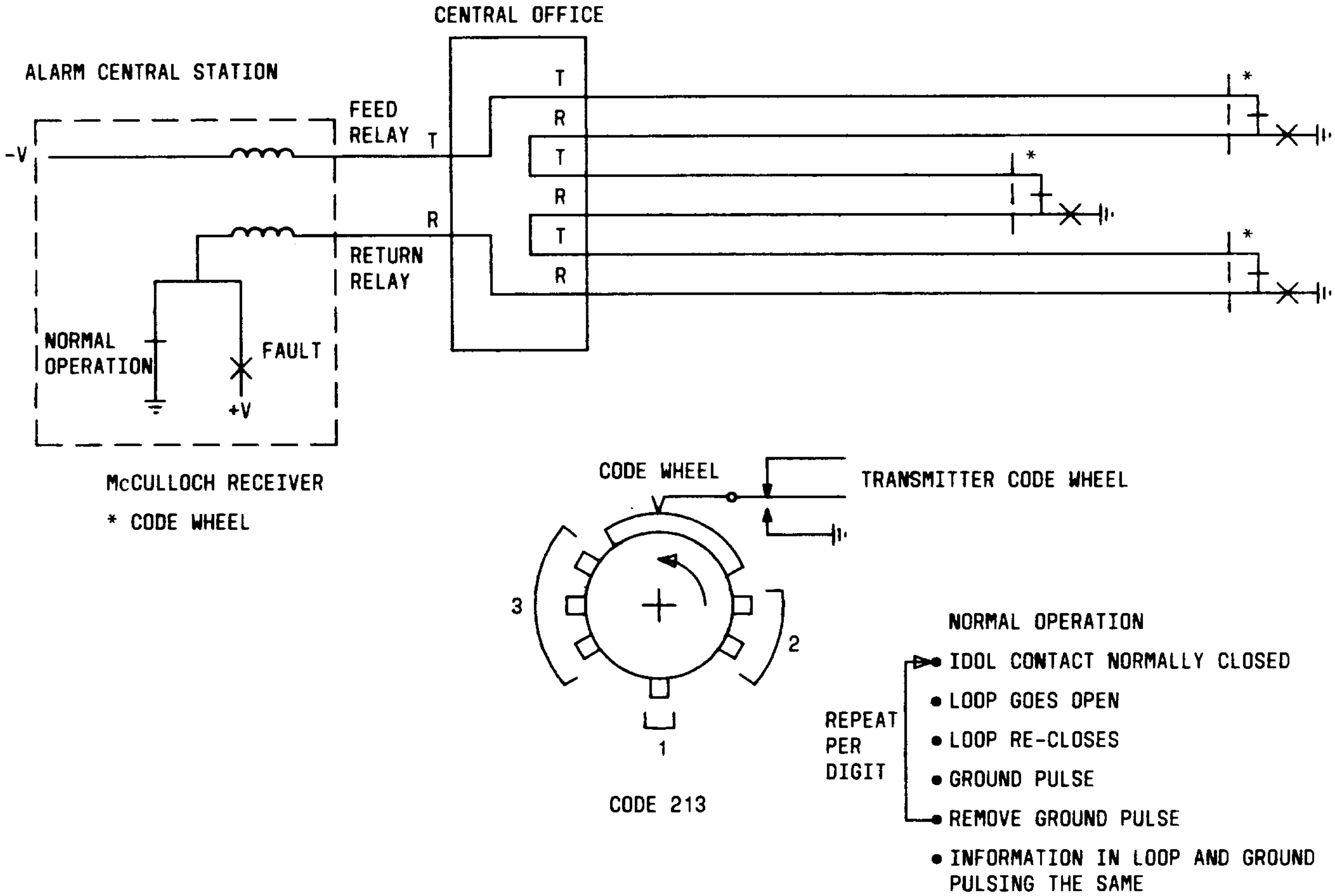
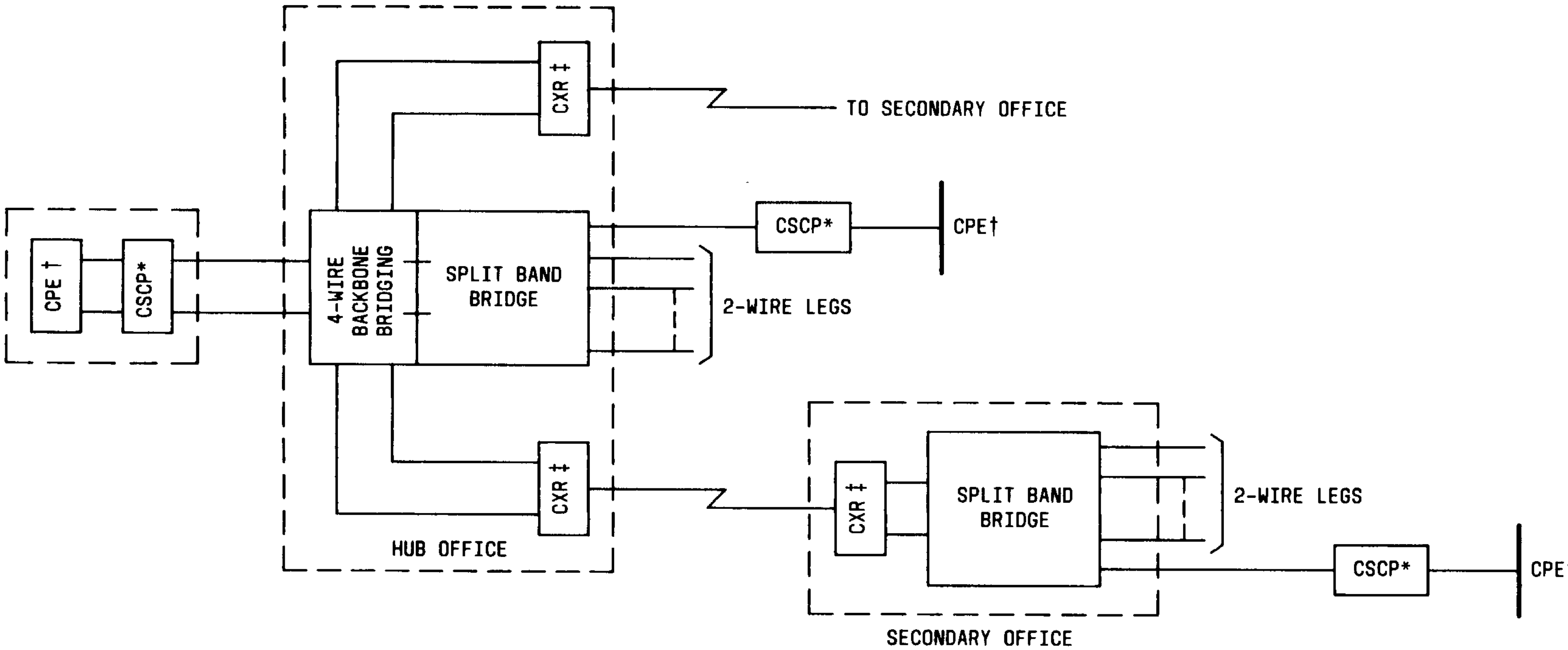


Fig. 5—Basic McCulloh Circuit Operation



*CSCP – CHANNEL SERVICE CONNECTION POINT
†CPE – CUSTOMER-PROVIDED EQUIPMENT
‡CXR – CARRIER

Fig. 6—Telemetry/Alarm Bridging Service, Split Band

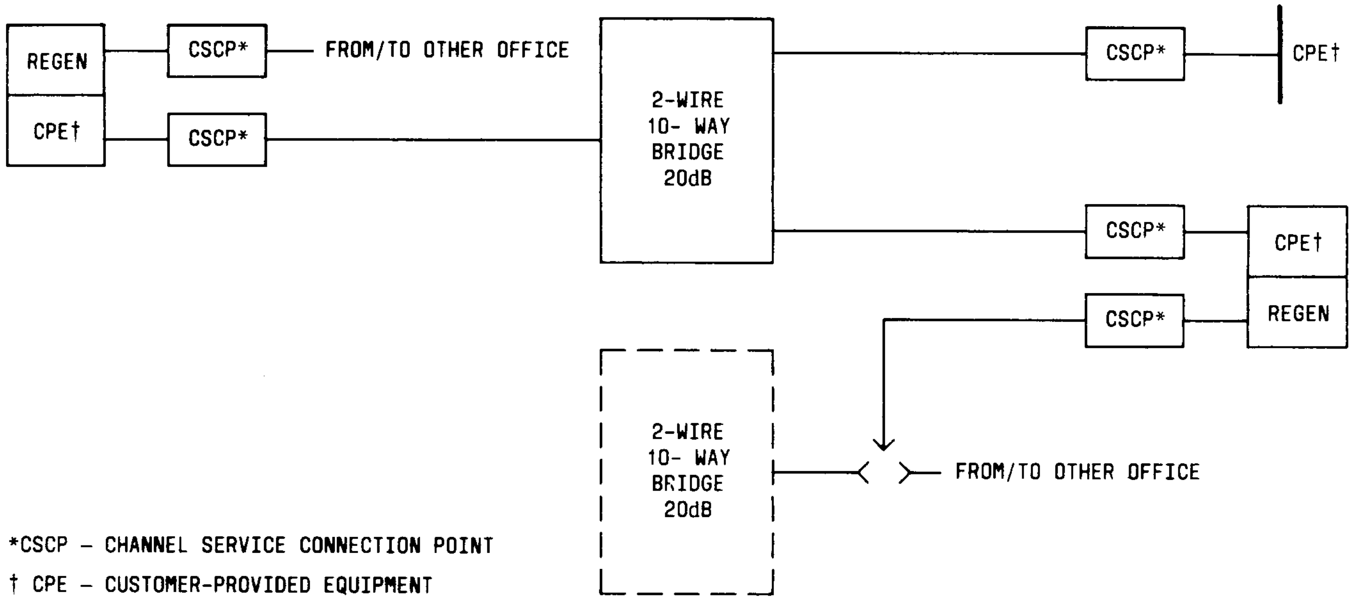


Fig. 7—Telemetry/Alarm Bridging Service, Passive

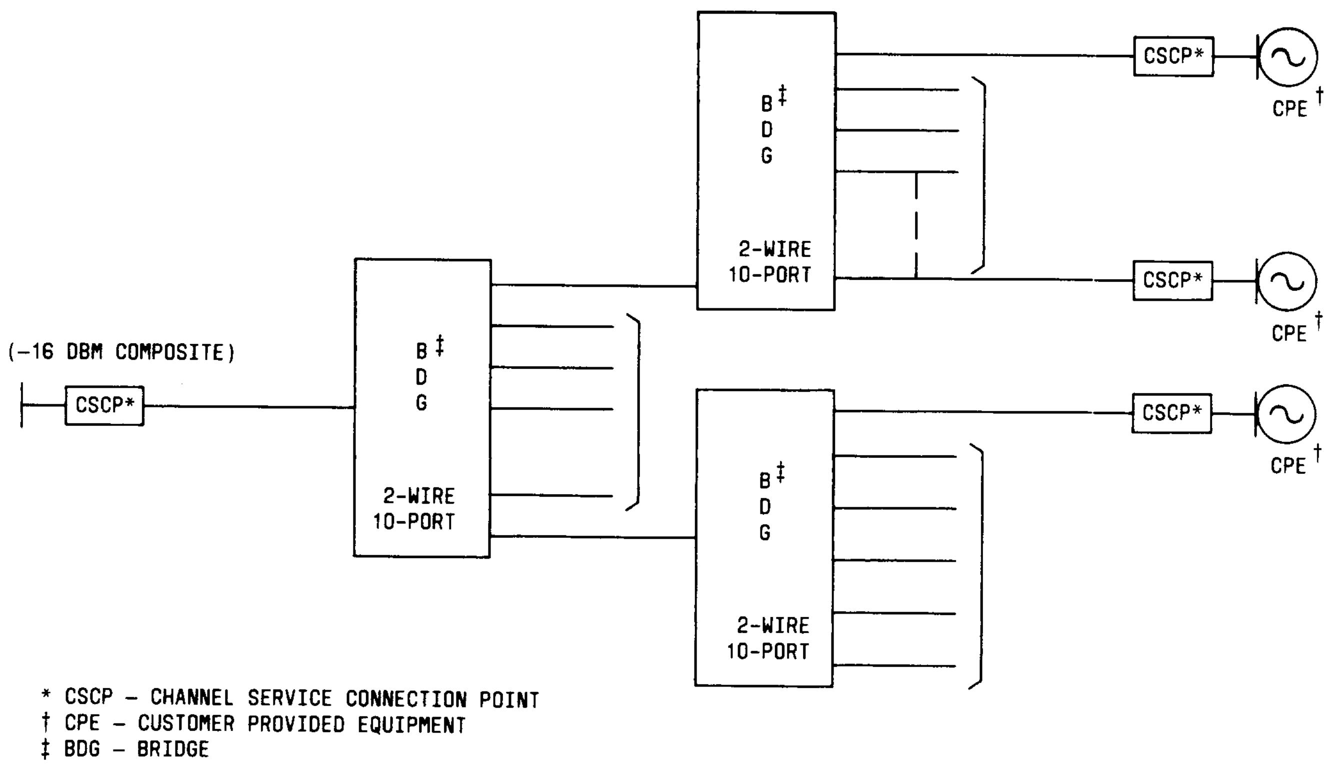


Fig. 8—Telemetry/Alarm Bridging Service, Summation