

## BRIDGE LIFTERS

### CHARACTERISTICS AND APPLICATIONS

#### 1. GENERAL

1.01 This practice is written to outline the characteristics and application of bridge lifters. Bridge lifters are defined as devices which remove, either electrically or physically, bridged telephone pairs. The reason for isolating bridged pairs is to control transmission losses and is discussed in detail in later sections. Relays, saturable inductors and semiconductors are the more common devices used in the design of bridge lifters.

1.02 The design and application of bridge lifter principles will be discussed in this section. Operating characteristics, design parameters and limitations of specific bridge

lifters will be listed in separate sections in this series which will be supplemented as new devices are introduced.

1.03 An understanding of the losses caused by bridge taps is necessary to design outside plant in accordance with transmission objectives. Fig. 1 shows typical bridging losses of nonloaded cable. This shows that the loss caused by 6000 feet of bridged tap is in the order of 1.5 db at 1000 cycles. The average 1000-cycle loss of all loops in the Bell System is 3.4 db, so it is obvious that bridged tap can be a substantial part of the overall loss. At frequencies above 1000 cycles, bridge taps cause even greater losses.

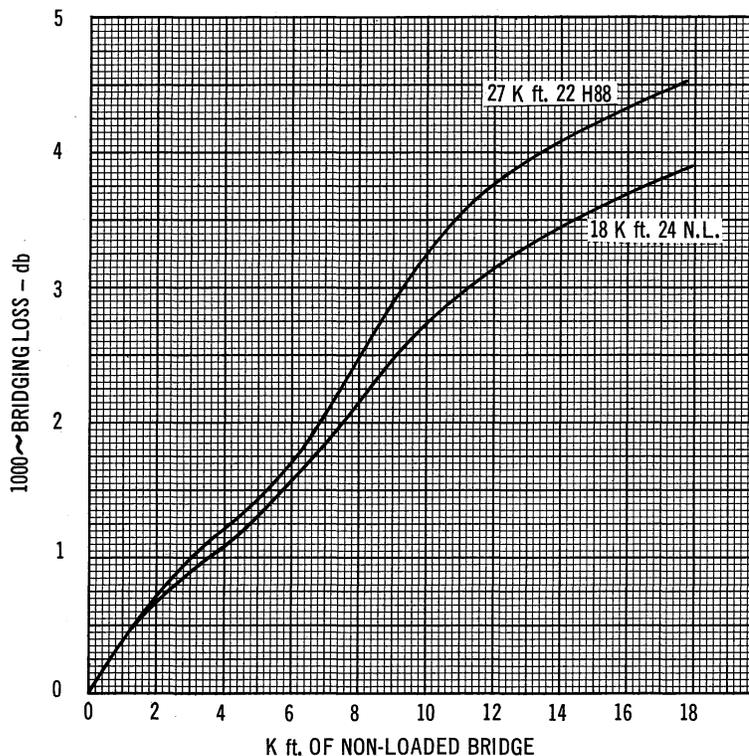


Fig. 1 - Bridging Loss of Non-Loaded Loop (on Hook) on Non-Loaded and Loaded Subscriber Loops

1.04 While some bridge tap may be necessary in the design of the loop plant, it should be kept at a low value and should in no case exceed 6000 feet. Where bridge taps in excess of 6000 feet would result from various causes such as secretarial service, area and C.O. cutovers, obtaining party line fills etc, bridge lifters should be used to keep within the 6000 foot limit.

1.05 Loaded bridged tap presents an even greater transmission penalty. In addition to the losses mentioned in the previous paragraph loaded bridged tap introduces severe and irregular losses depending upon the location of the bridge tap with respect to the loading. This

is illustrated in Fig. 2. Loaded bridge tap, even of minor length, must not exist.

1.06 In the design of long loops in the rural areas, proper loading for all parties on a multi-party line can be obtained without loaded bridge taps through use of bridge lifters. More complete information concerning insertion losses of bridged cable pairs is available in Section AB22.090.11.

2. PRINCIPLE OF OPERATION

2.01 Bridge lifters are designed to isolate one or more lines that are bridged together at a common point. In order to retain the trans-

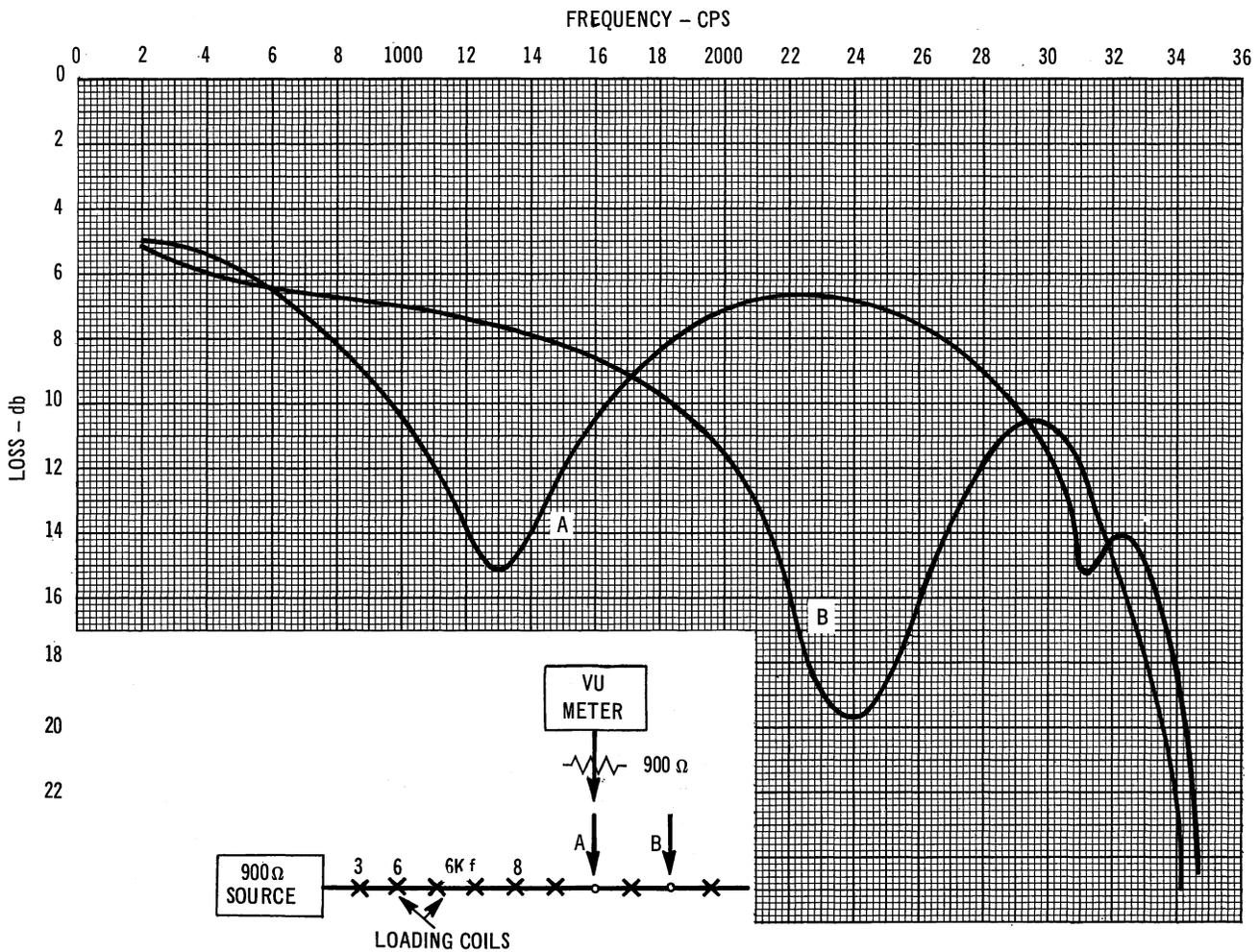


Fig. 2 - Loss-Frequency Characteristics of Loaded Bridge Taps

mission characteristics of individual lines an ideal bridge lifter should have the following parameters: zero insertion loss when activated and zero bridging loss when idle. If such a bridge lifter were used as illustrated in Fig. 3, then line No. 2 going off-hook would cause its bridge lifter to be transparent while the bridge lifter on line No. 1 would present an infinite impedance over the voice frequency band. It is a further requirement that the bridge lifter pass ringing current and DC supervisory signals while in the idle condition.

**2.02** Some means of control is required to transform the bridge lifter from an active to an idle state and vice versa. This can either be from sensing a change in the condition of the line or from an external source. Present bridge lifter designs are series elements inserted in the line which detect changes in DC line current to change their mode of operation.

**2.03** Any bridge lifter design that uses the DC line current to establish its mode has to cope with the problem of where to establish the transition current. In other words, at what line current should the device go from a high impedance to a low loss condition?

**2.04** The upper limit is set by the environment in which the bridge lifter is to be used.

For administrative reasons it is desirable to have a means for bridging any two lines within an office up to 1300 ohms. A 1300-ohm line will draw about 25 ma but if a short line of zero ohms is bridged at the central office to a 1300-ohm line when both are active (a necessary requirement), the current in the 1300-ohm loop will be reduced to about 7 ma. The bridge lifter then should be designed to change its mode at all currents down to at least 7 ma. While it may not be necessary to meet transmission objectives at 7 ma, it is necessary that sufficient transmission be provided at this minimum current in order that the customer on the long loop can break in during an emergency.

**2.05** The lower limit is set by the line leakage current. If an insulation resistance of 10,000 ohms is assumed with a 50-volt central office battery, the leakage current will be 5 ma. This then determines the minimum and leaves us with the ideal switching current between 5 and 7 ma.

**2.06** Fig. 4 graphically represents two performance characteristics of bridge lifters. Characteristic A is ideal and is of the type exhibited by a relay. If it operates at a line current

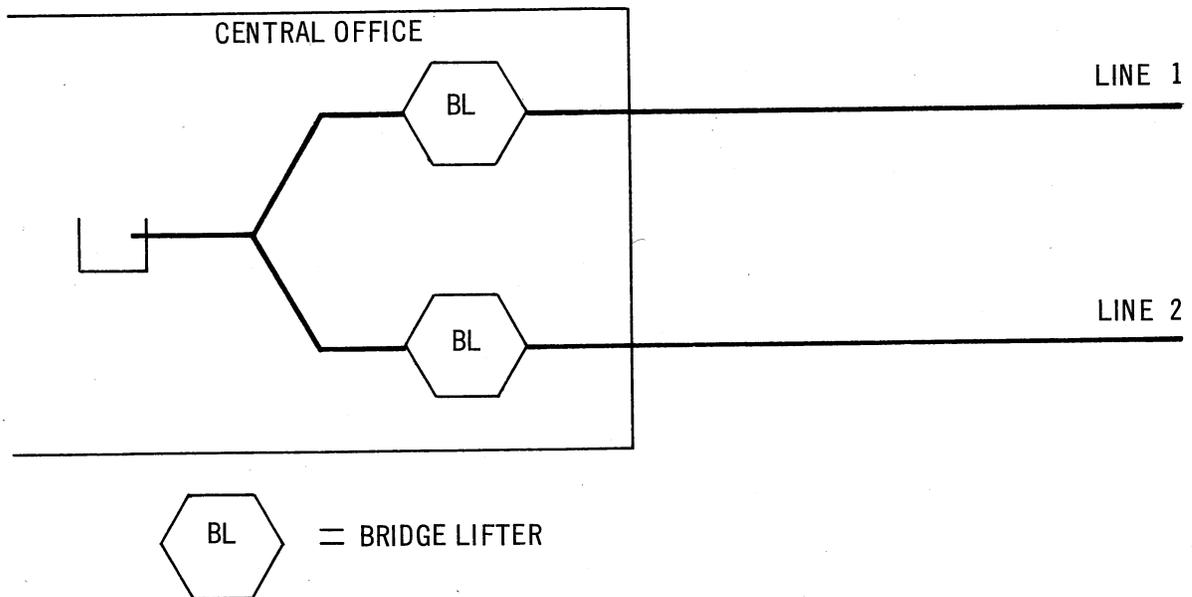


Fig. 3 - Central Office Bridging

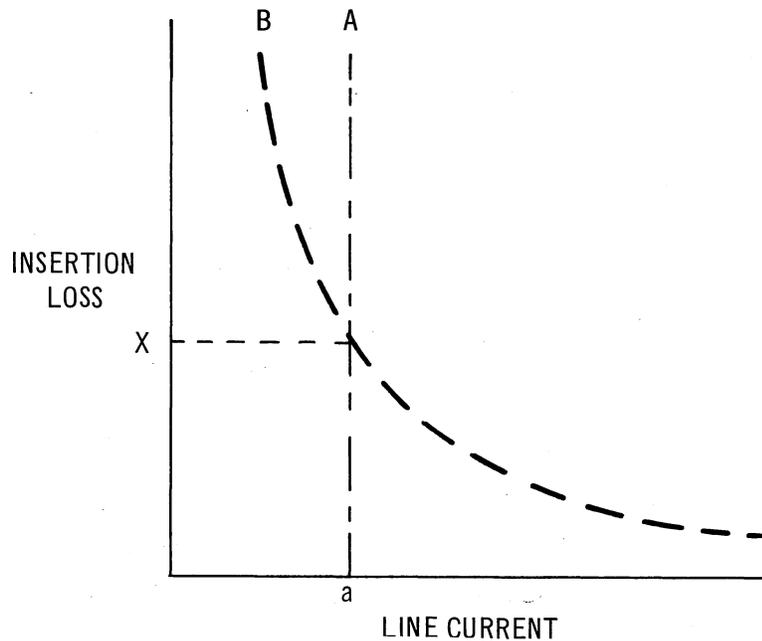


Fig. 4 - Operating Characteristics of Bridge Lifters

"a" between 5 and 7 ma, it would exhibit the ideal characteristics of Paragraph 2.01.

**2.07** Characteristic B represents a device that has a more gradual transition from the high to low loss condition. In this case the design and line current "a" are chosen somewhat arbitrarily based upon judgment and anticipated usage.

**2.08** It is easy to see that type A has a much more critical operating characteristic. Small variations in line current "a" will have a significant effect on the performance of the circuit in which the bridge lifter is connected.

### 3. APPLICATIONS

#### Party Line Association

**3.01** The most common application of bridge lifters is that of party line association in the Dedicated Plant Program. In this case up to 4 customers whose loops do not exceed 1300 ohms may be bridged in the central office as in Fig. 5. Section M24.54 prescribes the methods for administering this program.

#### Secretarial Service

**3.02** In this application, the secretarial service (SS) is generally located close to its home telephone office for rate reasons. The customers served by the same office are generally connected by direct lines to the SS equipment. Customers served by another office are sometimes connected to the service through individual trunk pairs but often concentrator-identifiers (C-I) are used. Where the SS is located at a distance from its home office, a C-I may also be employed between the home office and the SS. C-I's are available for concentrating a maximum of 40, 60, 80 and 100 lines down to 2, 3, or 4 trunks. Operation of these units is such that a C-I trunk cannot become bridged across a connection except during the period when ringing is being applied. The C-I trunk will remain bridged for the duration of the call only if the SS operator answers while ringing is being applied, otherwise, it will release until the next application of ringing.

**3.03** Hence, where a C-I is used, inductors should be added only to the customer's loops. When a C-I is not used, inductors should be added to the customer's loop and the SS loop or interoffice trunk pair in accordance with the

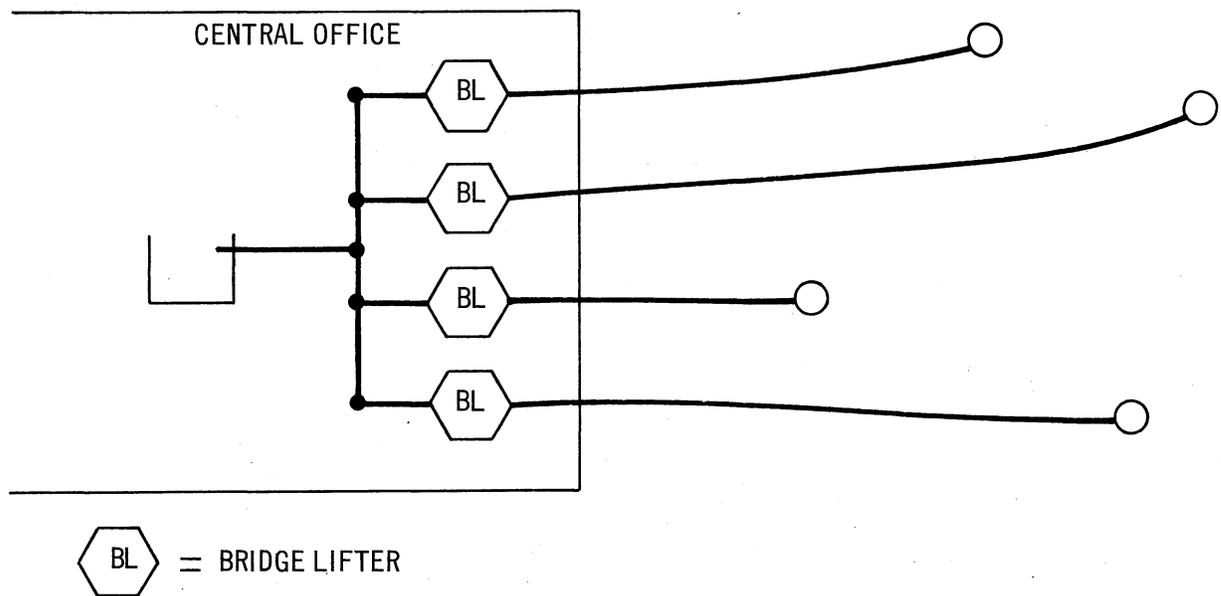


Fig. 5 - Party Line Association in Central Office

rules outlined under "Off Premise Extensions." These Conditions are illustrated in Fig. 6.

**Off Premise Extensions**

**3.04** When extension stations are located off the premise of the main station it is seldom possible to extend the loop to the extension station directly from the main station. The off-premise extension station loop is generally bridged to the main station loop at the central office.

**3.05** To control transmission losses at either the extension or the main station, bridge lifters should be installed at the central office in accordance with the following:

- (1) When the length of the bridged tap on the active loop combined with the length of the inactive loop and its bridged tap exceeds 6000 ft. of nonloaded cable.
- (2) When either the extension or the main station loop is loaded.
- (3) When the extension is located in a remote exchange area, dial long line or other equipment should be located so that the line current is within the operating limits of the bridge lifter.

**Bridging Remote from the Office**

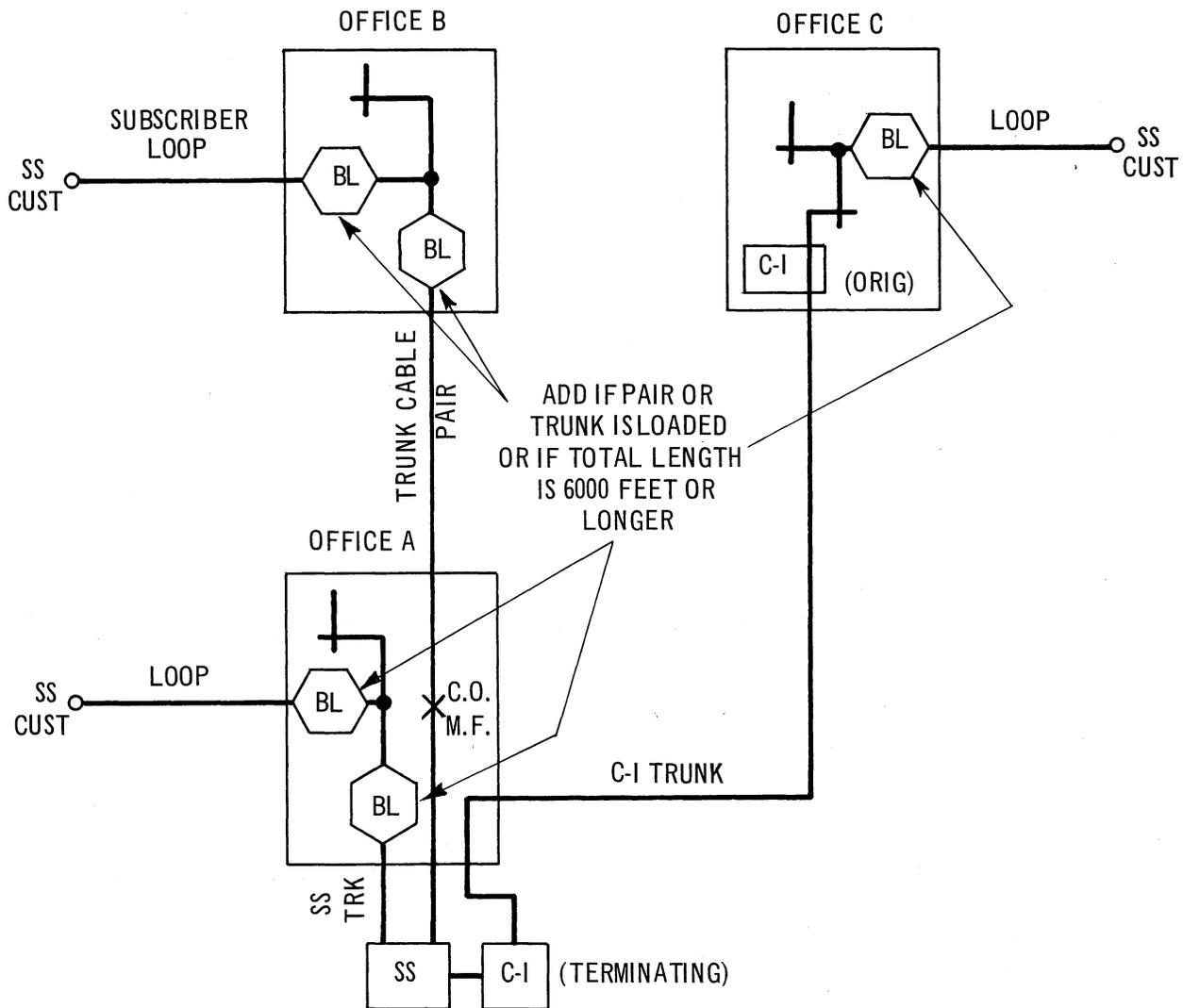
**3.06** The use of bridge lifters in the cable plant presents serious administrative and record-keeping problems to the Plant and Engineering Departments. For this reason remote bridging should be discouraged and only used where a satisfactory recording system has been adopted.

**Removal of Bridge Tap**

**3.07** It is frequently desirable to limit the amount of bridged tap on a line for transmission reasons. In those cases where it is not practicable to physically remove the excess tap, bridge lifters may be used to isolate the line.

**Bridging Between Load Coils**

**3.08** Bridging between load coils and loaded bridged tap are two conditions that must not exist in the cable plant unless isolated by bridge lifters. It sometimes becomes necessary to do this to achieve adequate party line fills on rural lines. Fig. 7 illustrates the different uses of bridge lifters on loaded plant. It is important to note that it is necessary to place bridge lifters in both the tap and the line to satisfy both conditions (no bridging between load coils and no loaded bridge tap). Also note that when possible the bridge lifter on the line is located at the load



 = BRIDGE LIFTER  
 SS = SECRETARIAL SERVICE  
 C-I = CONCENTRATOR-IDENTIFIER

**Fig. 6 – Concentrator-Identifier Application of Bridge Lifters**

coil to permit more than one tap within the load section.

**Bridging at Remote Concentrators**

**3.09** All lines bridged at the remote concentrators should have a bridge lifter in the line similar to central office bridging as shown in

**Fig. 5.** Due to the high probability of reverte calling, it will be necessary to determine that adequate line current is furnished to the longest and shortest lines in the reverte call condition. This is discussed further in Paragraph 4.03. Do not bridge a regular party line in the C.O. with another party line that is assigned to a concen-

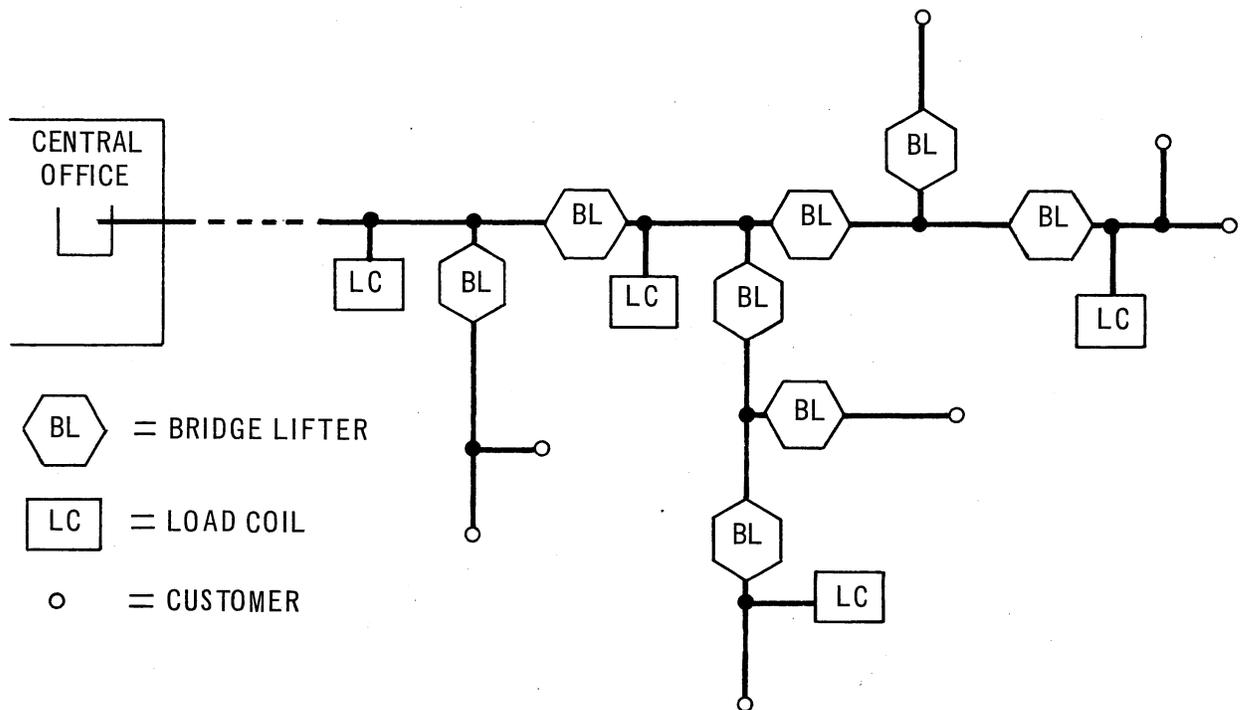


Fig. 7 - Remote Line Applications of Bridge Lifters

trator as this can cause false operations of the concentrator under certain conditions.

**Central Office Cutover — Area Transfers — PBX Moves**

3.10 The application of bridge lifters to central office cutovers, area transfers and PBX moves, will reduce the need for overtime work. In these cases it will not be necessary to add or remove half taps (bridged taps) immediately before or after the operation.

3.11 Central office cutovers can take several forms where an office is to be replaced by another located nearby. Cables may be run from the new office to the main entrance cables of the old office and pairs from it multiplied (half tapped) to the customer's loops. The relatively short multiplied pairs should result in small transmission impairment and no inductors need be added.

3.12 Where the new office is relatively distant as illustrated in Fig. 8 it may be advisable to use bridge lifters to control the bridging

losses. In some instances the distance "A" in Fig. 8 must be kept short to keep within the signaling and supervision limits of the new office. In any case the decision to use bridge lifters should be decided upon the basis of the transmission penalties, length of time the penalty will be incurred, and the additional cost of the bridge lifters. Transmission bridging losses are discussed in Paragraph 1.03.

3.13 Loaded loops and central office trunks to be transferred must have bridge lifters or cutover devices to control the frequency distortions outlined in Paragraph 1.03. Concepts similar to those described above should be used for area transfers (see Fig. 9) and large PBX moves.

**4. LIMITATIONS**

4.01 Specific limitations for each type of bridge lifters are listed in the accompanying point sections. See 1.02.

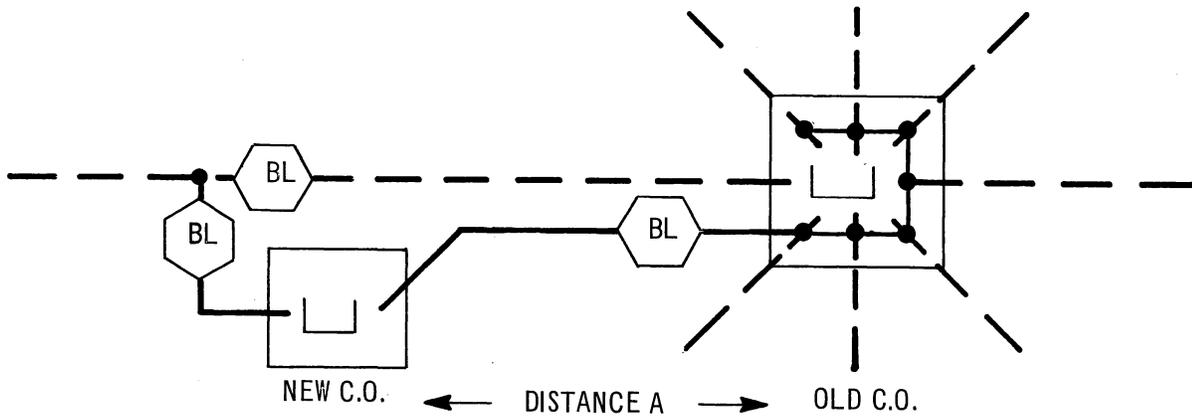


Fig. 8 – Central Office Cutover Application of Bridge Lifters

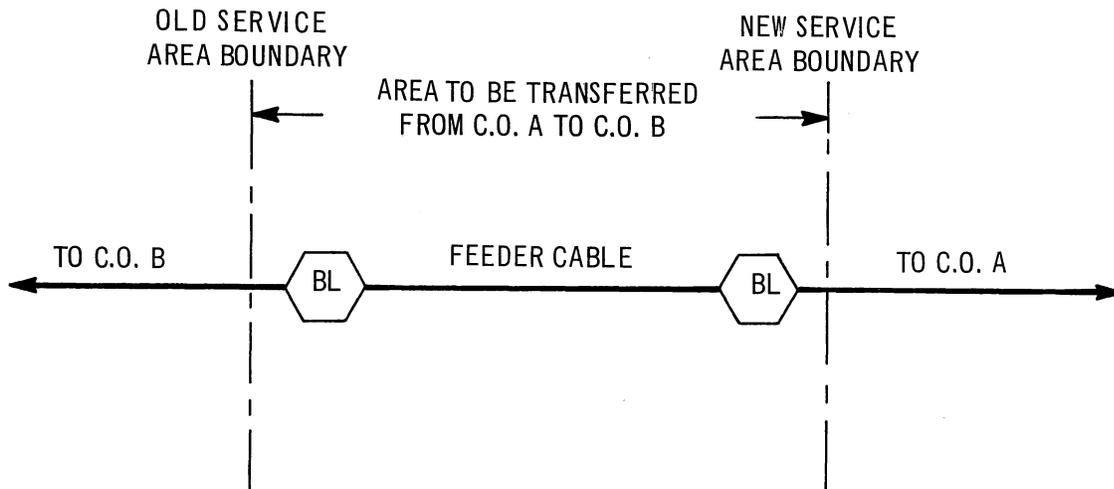


Fig. 9 – Area Transfer Application of Bridge Lifters

4.02 In general it is desirable to limit the usage of bridge lifters so that they do not contribute more than 0.5 db insertion loss (1000 cycle). It is also desirable that the total bridging losses contributed by the taps equipped with bridge lifters do not exceed 0.5 db.

4.03 Revertive calls between lines of widely different lengths will not have satisfactory transmission when bridged in the central office such as in the Dedicated Plant Program. This is because a large amount of the C.O. battery current will go to the short low resistance

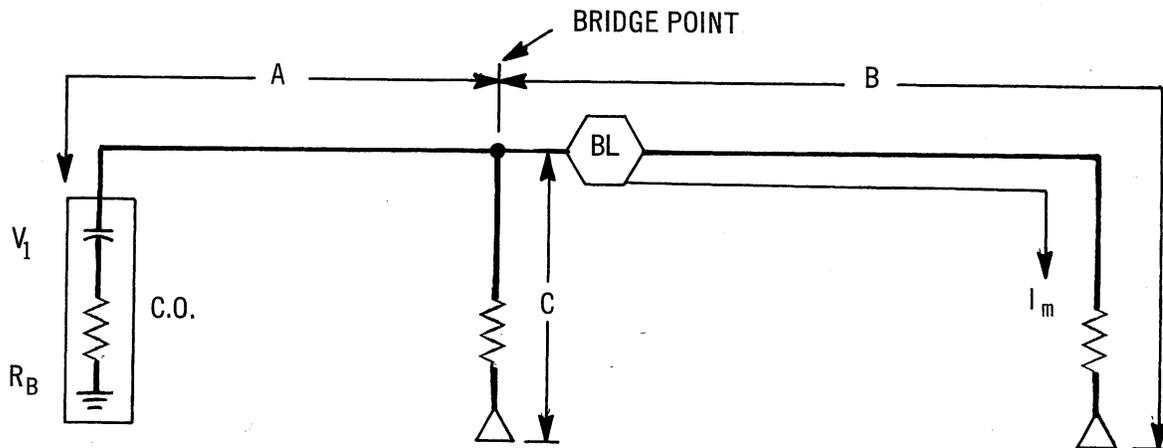
loop and a low and insufficient current will go to the longer loop. Consequently revertive calling should not be permitted between parties bridged at the central office. In those cases where this problem arises it will be necessary to reassign the conflicting customers to new party line groupings. Such cases will be remote when the central office bridging is done on a random basis.

4.04 Revertive calling on a rural line where the bridging is accomplished at the subscribers end of the feeder cable will require

careful calculations to determine that when the highest and lowest resistance customers are bridged together there is sufficient line current to operate the bridge lifters and telephone transmitters. Fig. 10 will be of assistance in computing currents and resistance of bridged lines to determine if current requirements have been sat-

isfied. There is a high probability of revertive calling on rural lines.

4.05 Loops over 1300 ohms or equipped with long line equipment should not be bridged in the central office for reasons given in Paragraph 4.03.



- A = C.O. TO BRIDGE POINT = \* LOOP RESISTANCE
- B = HIGH RESISTANCE BRANCH = " + SET RESISTANCE 200Ω
- C = LOW " " = " + SET RESISTANCE 100Ω
- $V_1$  = C.O. BATTERY VOLTAGE = 48V
- $R_B$  = C.O. BATTERY RESISTANCE = 400Ω
- $I_M$  = MINIMUM CURRENT THROUGH HIGH RESISTANCE BRANCH

$$C = \frac{I_M B (A + R_B)}{V_1 - I_M (A + B + R_B)}$$

Fig. 10 - Computation of Line Currents in Remote Branches