Dec. 22, 1964 H. W. ROSENBERG ETAL 3,162,726

AUDIO SYSTEMS FOR DRIVE-IN THEATRES

Filed July 14, 1958

FIG. 2.

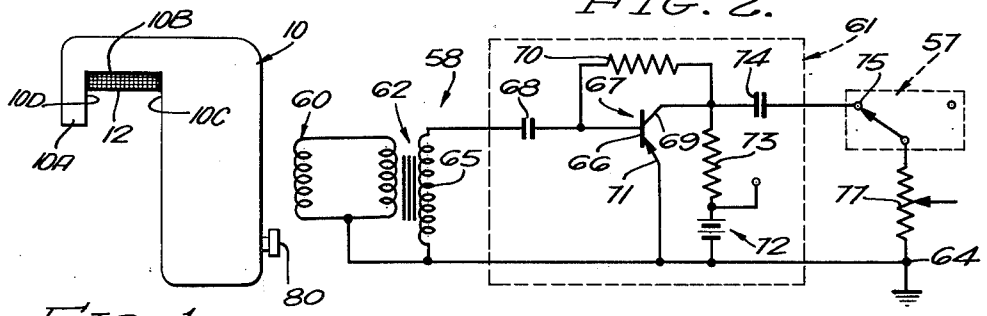


FIG. 1.

FIG. 3.

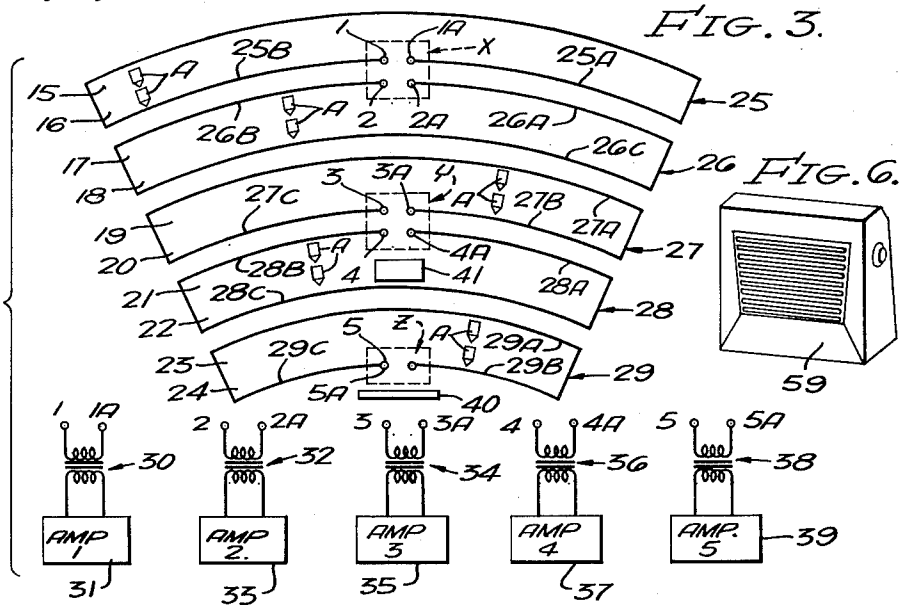


FIG. 6.

FIG. 4.

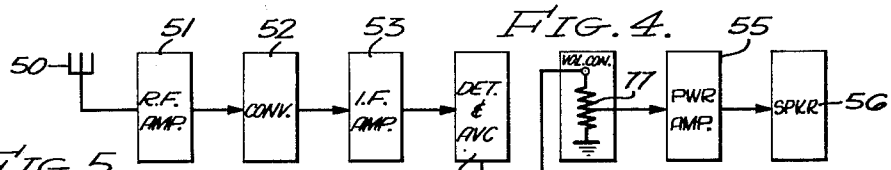


FIG. 5.

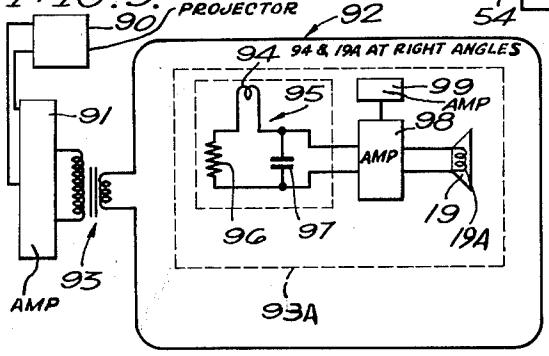
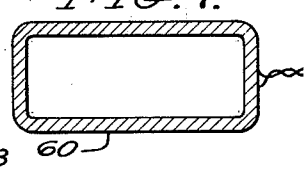


FIG. 7.



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AUDIO SYSTEMS FOR DRIVE-IN THEATRES

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5 Claims. (Cl. 179—1)

The present invention relates to improved means and techniques useful in transferring sound information from a central station to a plurality of remotely located stations such as in drive-in motion picture theatres.

The present application in general relates to improvements in the type of systems described and claimed in our copending application, Serial No. 540,954, filed October 17, 1955, now United States Letters Patent No. 2,851,537, and the present application may be considered to be a continuation-in-part of said application Serial No. 540,954.

In present day drive-in motion picture theatres, electrical energy representing the sound portion of the motion picture is distributed throughout the theatre to a plurality of speakers, each of which is located at an adjacent parking area or automobile station. The speaker is connected to an elongated flexible cable to allow the patron to remove the same from a supporting post and place the same within his automobile, such speaker usually being provided with hooks to allow it to be hooked on the upper edge of an automobile window. While such arrangement is generally satisfactory, certain inconveniences and difficulties are encountered, such as those attendant upon handling and placement of the speaker and its subsequent replacement on the theatre supporting post at the time the patron wishes to leave the theatre; particularly since such operations are required to be performed usually in darkness or semi-darkness. It is not uncommon for a patron to drive away with a speaker still attached to his automobile causing damage to the supporting post, connecting cable, speaker and/or automobile.

It is, therefore, a general object of the present invention to provide improved means and techniques particularly useful in drive-in theatres whereby the aforementioned difficulties and inconveniences are minimized or obviated. For these purposes, use is made of the speaker which is already mounted in the automobile, such speaker being either a speaker of a conventional automobile radio or a speaker previously installed for these particular purposes; or the speaker may be a part of equipment which is loaned to the person when and as he enters the theatre and which is returned when leaving the theatre.

The patron is allowed theatre speakers in the manner indicated above but is encouraged to provide his own speaker by extension of some type of premium to him such as, for example, a reduction in admission price. In such instance, the patron having his automobile equipped with the speaker not only enjoys the advantage of such premium but he also enjoys a better reproduction of the sound because usually the speaker in his automobile is mounted in a better position for that purpose.

A specific object of the present invention is to provide improvements in the system described in the previously mentioned United States Letters Patent 2,851,537 and particularly improvements in a system of this type which avoids the necessity of a separate cable for each automobile.

Another specific object of the present invention is to provide improvements in an arrangement of this character in which audio frequency energy is transferred to each automobile in the theatre without conductive underground connections extending to and connected to each automobile.

Another specific object of the present invention is to provide an arrangement of this character in which audio frequency energy is inductively coupled to a pickup coil in each automobile.

Another specific object of the present invention is to provide an improved system of this character which is not easily susceptible to "jamming" or electrical disturbances produced either intentionally or unintentionally by pranksters.

A specific object of the present invention is to provide an improved arrangement of this character which eliminates the necessity for speaker supporting posts for each automobile.

Another specific object of the present invention is to provide an improved arrangement of this character which by eliminating the necessity for speaker supporting posts, permits the accommodating of an increased number of automobiles for any given area.

Another specific object of the present invention is to provide an improved audio frequency receiving means particularly adapted for the systems described herein and in United States Letters Patent 2,851,537.

Another specific object of the present invention is to provide an improved system of this character in which the underground wiring which in general forms the "primary" of the audio inductive circuit is sectionalized and disposed in predetermined patterns for more efficient sound coverage using a smaller amount of wiring and obtaining a maximum signal.

Another specific object of the present invention is to provide an improved receiver which is incorported within the confines of a conventional drive-in theater speaker housing and with the input inductive loop arranged in a unique manner on the speaker housing.

Another specific object of the present invention is to provide an improved portable-type receiver which is specifically designed for these purposes.

Another specific object of the present invention is to provide an improved sound receiver for those purposes which is admirably suited for use in conjunction with conventional portable transistorized radios.

Another specific object of the present invention is to provide an improved transistorized amplifier circuit specifically designed to combine high gain and high efficiency with very low battery power comsumption.

Another specific object of the present invention is to provide an improved sound receiver for these purposes which is admirably suited for use in conjunction with conventional automobile radios.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. This invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may be best understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIGURE 1 illustrates a side view of a conventional speaker housing on which an inductive pickup loop is uniquely mounted.

FIGURE 2 illustrates electrical circuitry for a high gain transistor pre-amplifier which is illustrated also as in block diagram form in FIGURE 4.

FIGURE 3 illustrates portions of a drive-in theatre and illustrates the underground wiring which is sectionalized and connected to separate audio power amplifiers.

FIGURE 4 illustrates the manner in which a conventional radio in an automobile is modified to selectively obtain radio reception or to obtain reception of the sound portion of the motion picture.

FIGURE 5 illustrates electrical circuitry of a complete inductively coupled sound system.

FIGURE 6 illustrates a plastic case which may be designed specifically to house a portable audio receiver complete with pickup loop, transistor amplifier, battery pack and speaker, as shown in FIGURE 5 or it may be a conventional type transistorized portable radio which has been modified for these purposes to provide dual operation as shown in FIGURE 4.

FIGURE 7 illustrates an inductive pick-up loop which mounts within the receiving unit shown in FIGURE 6. It is also shown as **60** in FIGURE 2 and **94** in FIGURE 5.

FIGURE 1 illustrates a standard type metal-cased drive-in theatre speaker housing **10** which, however, in accordance with the present invention has been modified for operation with the sound distribution system described in the aforementioned United States Letters Patent 2,851,537 or for the distribution system illustrated in FIGURES 3 and 5.

It will be observed that the speaker housing **10** in FIGURE 1 is formed with a conventional hook portion **10A** whereby, as previously indicated, the speaker housing may be supported on the window of an automobile in the conventional manner. However, in accordance with an important feature of the present invention, the inductive "secondary" pickup loop **12** is mounted on the exterior of the housing **10** and within the general confines of the hook portion **10A**. Preferably, the loop **12** is mounted against the outer surface **10B** with the plane of the loop extending parallel to such surface **10B** and with the so-called edges of the loop **12** abutting the surface **10C** and the inner surface **10D** of the hooked portion **10A**. While satisfactory reception has been obtained with the loop **12** thus mounted on a metal housing **10**, it is expected that equal or better results may be obtained when the housing **10** is of non-conducting material such as plastic. In modifying the speaker housing, the conventional single rubber covered cord was removed together with the low resistance wire wound potentiometer used conventionally as a volume control. The speaker itself was left intact within the housing **10**.

The pickup coil **12** which is about two inches square and consisting of, for example, 50 to 100 turns of small gauge enameled copper wire AWG #27 is set or encased in rubber and attached by means of an adhesive backing to the underside of the window mounting hook or bracket of speaker housing **10** as shown in FIGURE 1.

The mounting of the pickup coil **12** in this manner has the advantage of good sound signal pickup since it is outside of the metal case. It also has an additional advantage of providing a soft cushion for resting the assembly on the ledge or window of the patron's automobile.

Other modifications include the mounting within the speaker housing of a transistor amplifier, battery pack, volume control and on-off switch.

When a standard type plastic case drive-in speaker housing is used, the pickup coil, instead of being mounted outside the housing, may be mounted inside the housing and connected in like manner to a transistor audio amplifier inside the housing **10** with the input circuit of the amplifier connected to the loop and the output circuit of the amplifier connected to the speaker.

The loop in each case, be it mounted inside or outside of the speaker housing **10** is connected to a transistor audio amplifier, as shown in FIGURES 2 and 5.

In all cases, the so-called "primary" circuit of the inductive system, may further be of the form illustrated in our United States Letters Patent 2,851,537, or be in accordance with FIGURES 3 and 5 herein. FIGURE 3 illustrates a drive-in theatre with one car or automobile A shown on each one of the ramps. The ramp furthest from the projection screen **40** is represented at **15** and the closest ramp in the group shown is indicated by the numeral **24**. There are intermediate ramps **16–23**. It is observed that ramps **15** and **16** are encompassed by the

underground loop **25** and such loop **25** is connected to input terminals represented by the numerals **1**, **1A**. Terminals **1**, **1A** may be connected to the secondary winding of the transformer **30** having its primary winding connected to the output terminals of the power amplifier **31** which supplies audio frequency currents corresponding to the sound portion of the motion picture to loop **25**.

It will be observed also that loops **25**, **26**, **27**, **28** and **29** are so connected that the current which flows at any particular instant of time in adjacent conductors **25A–26A**, **25B–26B**, **26C–27A**, **27B–28A**, **27C–28B**, and **28C–29A** are in the same direction. The adjacent conductors may, if desired, be buried in the same trench. It is observed also that in like manner, loop **26** embracing or encompassing respectively ramps **17**, **18** may be connected in series with the secondary winding of the output transformer **32** of the second audio power amplifier **33**. Similarly, the loops **27**, **28** and **29**, encompassing respectively the ramps **19–20**, **21–22**, **23–24** are connected in series with the secondary windings of the output transformers **34**, **36** and **38** of the audio frequency power amplifiers **31**, **33**, **35**, **37** and **39** are located in the projection booth of the theatre indicated at **41**.

It is understood that, for the purpose of obtaining proper impedance matching for each installation two or more of the loops shown in FIGURE 3 may be connected in parallel and connected to the output transformer of a single power amplifier or that two or more parallel connected loops may be connected to the output transformers of two or more parallel connected power amplifiers.

It is further understood that the loops and output transformers of the power amplifiers shown in FIGURE 3 may be connected in series or in series-parallel.

The junction boxes represented by the letters X, Y and Z in FIGURE 3 may be placed at various locations in the drive-in theatre. The boxes may be metallic or another suitable type of material and would be positioned such that each box top is flush with the parking surface of the drive-in threatre. An arrangement would be included whereby each junction box top is removable and said tops would serve as an access cover to the input loop terminals. The use of the junction boxes provide a convenient means for connecting the secondary winding at the power amplifier transformers **30**, **32**, **34**, **36** and **38** to the loop terminals and allows the loops and transformer windings to be connected in the various configurations as described above, and also aids in locating faults that may occur in the loop wiring.

FIGURE 4 illustrates a transistor battery powered portable radio which has been constructed and modified for dual operation for use in drive-in theatres of the character described herein and in United States Letters Patent 2,851,537. The radio portion of the dual purpose receiver shown in FIGURE 4 is conventional in that it includes an antenna **50**, which may be a conventional radio frequency loop antenna, a radio frequency amplifier stage **51**, a converter stage **52**, an IF amplifier stage **53**, a detector, an AVC stage **54**, an audio frequency power amplifier stage **55** and a speaker **56**, all connected in conventional manner, in cascade as illustrated in FIGURE 4. There is, however, a single pole double throw switch **57** provided for selectively connecting the power amplifier stage **55** either to the detector, AVC stage **54** or to the transistorized pre-amplifier **58** which is shown in more detail in FIGURE 2.

The radio portion of the receiving system previously described in connection with FIGURE 4, is mounted in conventional manner on a metal chassis and within a plastic case.

Within such casing, an audio frequency pickup coil **60** (FIGURES 2 and 7) is mounted between the bottom of the radio chassis and the plastic case **59**, FIGURE 6 which houses the radio. For the purpose of increasing

gain and obtaining a close impedance match, a single stage transistor amplifier 61 and subminiature transformer 62 has been used. The primary winding of the transformer 62 is connected to corresponding terminals of the loop 60. One teminal of the loop 60 and one terminal of each of the primary and secondary windings of the transformer 62 are connected to the metal chassis which is represented by the ground connection 64. The ungrounded terminal of the secondary winding 65 of the transformer 62 is coupled to the base electrode 66 of the transistor 67 by coupling condenser 68. The base electrode 66 and collector electrode 69 are interconnected by resistance 70. The emitter electrode 71 is connected to the ground connection 64. A voltage source represented by the battery 72 has its ungrounded terminal connected to the collector electrode 69 through the load resistance 73. The collector electrode 69 is coupled via condenser 74 to the contact 75 of the aforementioned switch 57 so that in the position of the switch 57 in both FIGURES 2 and 4, the amplified audio output derived from the pickup loop 60 appears across the input resistance 77 in the audio frequency power amplifier stage 55 FIGURE 4 in which case the sound pickup by the loop 60 is again amplified in the power amplifier section 55 before being applied to the speaker 56.

It is understood that the resistor 77 may be of the potentiometer type and serve as a volume control when either radio reception or sound reception is being achieved depending upon the position of the two-position switch 57.

For purposes of avoiding duplication of description, it is understood that the audio amplifier mounted within the casings 10 FIGURE 1 and 59 FIGURE 6 is considered to be the same audio frequency amplifying system described in connection with FIGURES 2 and 4, in which case the loop 12 of FIGURE 1 performs the same function as loop 60 in FIGURES 2 and 7 and is connected in like manner to the transformer winding 62, FIGURE 2.

An on-off switch 80, mounted together with the volume control on the speaker housing 10, FIGURE 1 in such case, is connected in series with the voltage source 72, FIGURE 2 which comprises simply a low voltage battery pack since it is understood, of course, that transistors are used in amplifying stages 67, FIGURE 2, and 55, FIGURE 4. Also, in such case a volume control knob 80 is mounted on the housing 10 for changing the position of the tap on the volume control which is considered in this case to be the resistance 77, FIGURE 4.

Thus, a patron in a drive-in theatre and having the systems shown in FIGURE 4, may either select radio reception during intermissions by use of switch 57 or during the showing of the moving picture, may pick up the sound portion of the picture by moving the switch 57 to its other position.

It is understood that the switch 57 may be a phone jack mounted on the receiver and that unit 58 may be an accessory which is loaned to a patron entering the theatre. In the latter case, the unit 58 is provided with a cord having a phone plug on the end thereof which is insertable in the phone jack on his radio receiver. Normally, the patron's radio in such case is conditioned for radio reception. When the phone plug is inserted into the jack, the front portion of his radio receiver is displayed and the pickup unit 58 is connected to the amplifier 55 as indicated in FIGURE 4. Further, it is understood that while the various units may in some cases contain its own battery pack, in other cases the transistor apparatus may be powered from the storage battery of the automobile through a cord which terminates in a cigarette lighter plug that is insertable in the conventional cigarette lighter socket on the dashboard of the automobile.

FIGURE 5 serves to illustrate a complete system in which a portion of the motion picture projector is indicated at 90 and the audio power amplifier is indicated at 91. The output of the audio amplifier 91 is applied to one or more loops buried in the ground as described in our copending application or as described herein and such one or more loops are represented by the loop 92 and are coupled to the amplifier 91 through a suitable step down audio transformer 93.

It is understood that the loop 92 represents one or more loops buried in the ground or represents loops above the surface of the ground and indeed, the loop 92 represents also a loop which is mounted to surround an elevated concrete parking area which may or may not be provided with ramps. In the latter case, the loop may further be within the concrete structure or may be above the surface of the concrete structure which supports the automobiles or may be below the concrete structure which supports the automobile. In either case, the audio receiving system mounted within the automobile is represented by the apparatus shown within the dotted rectangle 93A. This includes the pickup loop 94, which may be the loop represented at 12 in FIGURE 1 or the loop represented at 60 in FIGURES 2 and 7. Instead of coupling the loop 94 to the first stage of the transistor amplifier as shown in FIGURE 2, the loop 94 may in this case be coupled to such input circuit through a low-pass filter 95 which includes the resistance 96 and condenser 97. One terminal of the loop 94 is connected to one input terminal of the audio amplifier 98 and the other terminal of the loop 94 is connected to the other input terminal through resistance 96. The condenser 97 shunts the series-connected pickup coil 94 and resistance 96. The output of the audio amplifier 98 is applied to speaker coil 19A of speaker 19 and the power source for the audio amplifier is represented at 99. This power source 99, as previously indicated, may be self-contained battery power pack or may be the storage battery of the automobile connectable to the apparatus through a conventional cigarette lighter plug which is insertable in the cigarette lighter socket on the dashboard of the automobile.

Or, the apparatus shown as 58, FIGURE 4 may be permanently mounted within the automobile in which case it would be powered by the automobile storage battery and dual operation of both the automobile radio or the audio receiver achieved by the selector switch 57, FIGURE 4.

FIGURE 6 illustrates a plastic case which may be especially designed to house a portable type audio receiver unit complete with pick-up loop, transistor amplifier, battery pack and speaker which is the entire apparatus shown enclosed by the dotted line 93, FIGURE 5 or it may be a conventional type transistorized portable radio which has been modified for dual operation first as a conventional radio and second as an audio receiving unit for drive-in theatres. In the latter case it contains all of the apparatus represented in block form in FIGURE 4.

FIGURE 7 illustrates an inductive pick-up coil which is designed to mount within the receiver unit case shown in FIGURE 6. The pick-up coil is an air-core parallel wound multi-turn type. It may consist of, for example, 50 to 100 turns of AWG #27 enameled copper wire and rectangular in shape with approximate dimensions of 4" x 6" but not too large so that it would not fit in the receiver unit case shown in FIGURE 6.

In those cases where interference is not encountered from power lines, it is preferred that the loop 94 be coupled to the input stage of the first amplifier through a transformer as shown in FIGURE 2 without a filter since in such case, higher gain is realized.

Preferably in order to avoid interference from neighboring power lines, the power lines entering the drive-in theatre extend through metal conduits which are buried in the ground.

While FIGURE 3 shows a ten ramp system, it is, of course, within the province of the present invention to apply the same to any number of ramps.

The use of separate loops in each case, as illustrated in FIGURE 3, with separate power amplifiers is preferred because of flexibility imparted to the system. By thus being flexible, i.e., gains in the individual amplifiers 31, 33, 35, 37 and 39 may be adjusted independently, less trench digging is required and wire may be used more economically; also, the entire area of the drive-in theatre may be covered more effectively. In a practical installation, an audio field strength meter is found quite useful. Such field strength meter may comprise simply an untuned loop having its output amplified, then rectified and then applied to a meter having a full scale deflection of approximately one milliampere. By observing the readings of the meter and adjusting the individual amplifiers, full and uniform coverage is achieved with attendant economy.

In each case the loop is mounted with its plane extending horizontally when the receiving apparatus is mounted for operation in a drive-in theatre. Also, precautions are taken to isolate the pick-up loop from the speaker or other parts of the circuit which may introduce feedback. Such isolation may be accomplished by physical spacing. Indeed it has been found to be either highly desirable or necessary that the planes of the pick-up coil 94 (FIGURE 5) and the speaker voice coil 19A be at right angles to each other to minimize or eliminate feedback which might produce oscillations.

While the particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

We claim:

1. In a drive-in theatre in which a plurality of automobiles is parked on an extended surface area, the combination comprising a plurality of extended audio frequency inductive loops which are disposed below and encompass different portions of said surface area to encompass said plurality of automobiles in said theatre, a source of audio frequency only connected to each one of said loops to produce current of audio frequency therein, audio signal receiving means on each automobile in said theatre comprising an audio frequency inductive loop cooperating magnetically with a corresponding one of said audio frequency loops to transfer signals of audio frequency therebetween.

2. In a drive-in theatre in which a plurality of automobiles is parked on an extended area and in which inductive means is disposed below said surface area, and in which a source of audio frequency only is connected to said inductive means to produce currents of audio frequency therein, and in which audio signal receiving means on each automobile in said theatre comprises an audio frequency inductive loop cooperating magnetically with said inductive means to transfer signals of audio frequency therebetween, characterized by the fact that said inductive means is in the form of a plurality of inductive loops each encompassing different sections of said extended area and individual wires of audio frequency are connected to corresponding ones of the last mentioned loops.

3. A drive-in theatre as set forth in claim 2 in which each loop encompasses different ramps on which the automobiles are parked in the theatre.

4. In a drive-in theatre in which a plurality of automobiles is parked on an extended surface area and in which extended audio frequency inductive means is disposed below and encompasses said surface area to encompass said plurality of automobiles in said theatre, audio frequency source means connected to said inductive means to produce currents of audio frequency therein, and in which audio signal receiving means on each automobile in said theatre comprises an audio frequency conductive loop cooperating magnetically with said inductive means to transfer signals of audio frequency therebetween, characterized by the fact that said audio signal receiving means is within a housing having a hooked portion adapting same for support on a portion of the automobile, with said loop being within the confines of said hooked portion, such that when said housing is mounted on said automobile by said hooked portion, the plane of said loop on said housing extends generally horizontal.

5. In a drive-in theatre, audio signal receiving means for mounting on an automobile, said means being mounted in a housing which is readily adapted for support on a portion of the automobile, said housing having a hooked portion serving as a support for the housing on the automobile, and an inductive loop mounted generally within the confines of said hooked portion.

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