

[54] **DIRECTIONAL COMMUNICATION  
SIGNAL TAP**

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[22] Filed: **Jan. 22, 1970**

[21] Appl. No.: **4,977**

[52] U.S. CL.....333/10, 333/32, 317/101 CC,  
174/35 R

[51] Int. Cl.....H01p 5/14, H03h 7/38

[58] Field of Search .....333/10, 9, 33, 32; 317/101;  
324/95; 174/35

[56] **References Cited**

**UNITED STATES PATENTS**

|           |        |              |          |
|-----------|--------|--------------|----------|
| 2,734,169 | 2/1956 | Douma .....  | 333/10 X |
| 2,756,282 | 7/1956 | Douma .....  | 333/10 X |
| 3,048,798 | 8/1962 | Simons ..... | 333/10   |

|           |         |                       |          |
|-----------|---------|-----------------------|----------|
| 3,426,298 | 2/1969  | Sontheimer et al..... | 333/10   |
| 3,486,135 | 12/1969 | Sweeney .....         | 333/33 X |

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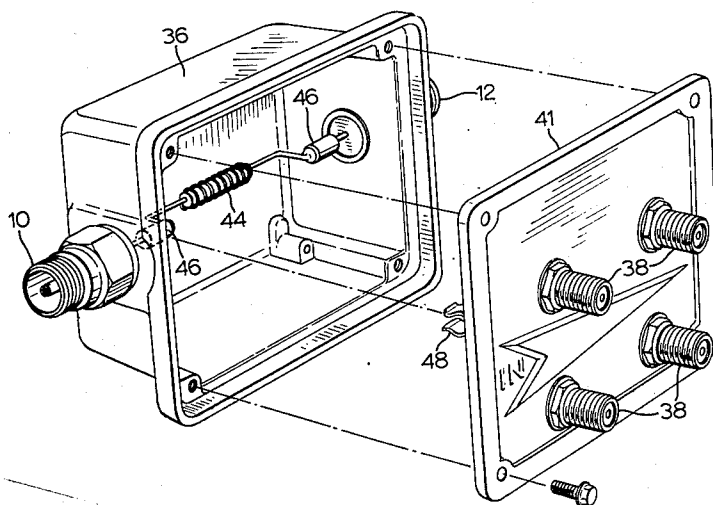
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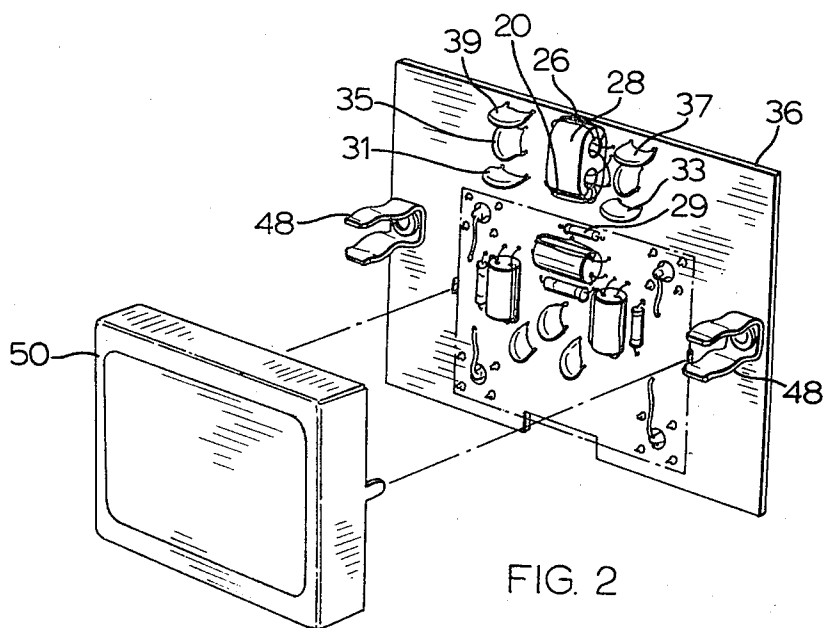
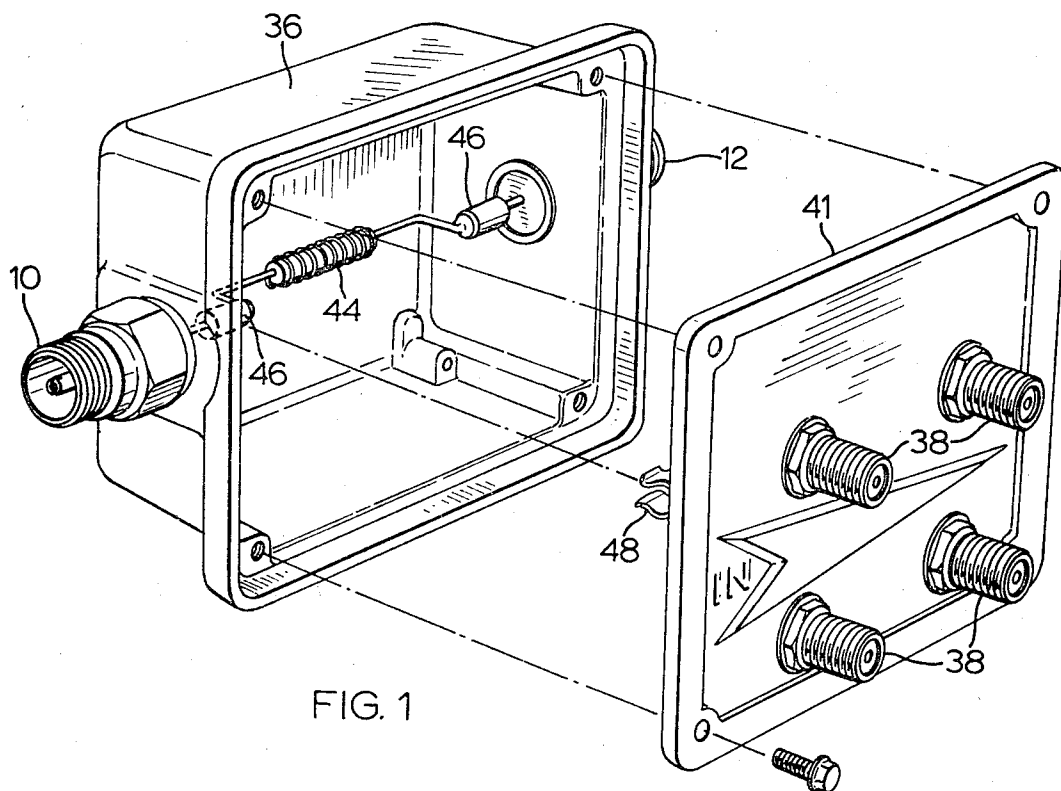
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**ABSTRACT**

This invention relates to a directive tap for tapping off a portion of a signal strength such as a television signal from a main cable transmission line. The tap of the invention has an improved directivity over a substantial bandwidth which is achieved by providing an electrostatic shield between the input and output levels of the tap on a tap circuit that has a directivity of at least 15 decibels over a range of at least 150 megahertz. The improved directivity is preferably achieved by constructional features of the current and voltage sensing transformers of the unit which includes a winding hole in the core of at least one-hundred-twenty-five thousandths of an inch to provide extra spacing for the windings and the use of a single turn winding on each core that is tightly pulled through the core to accurately and predictably locate the winding with respect to the core.

**5 Claims, 7 Drawing Figures**





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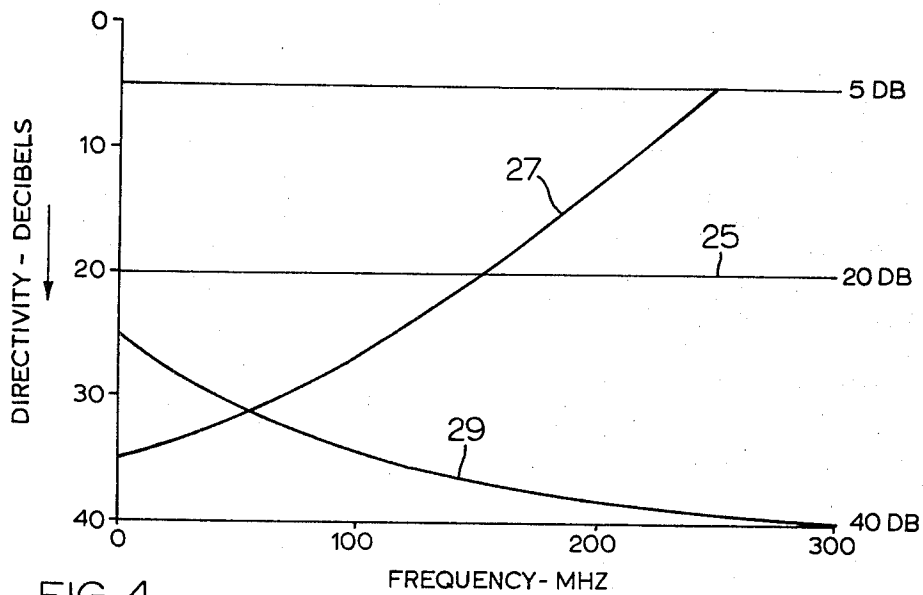


FIG. 4

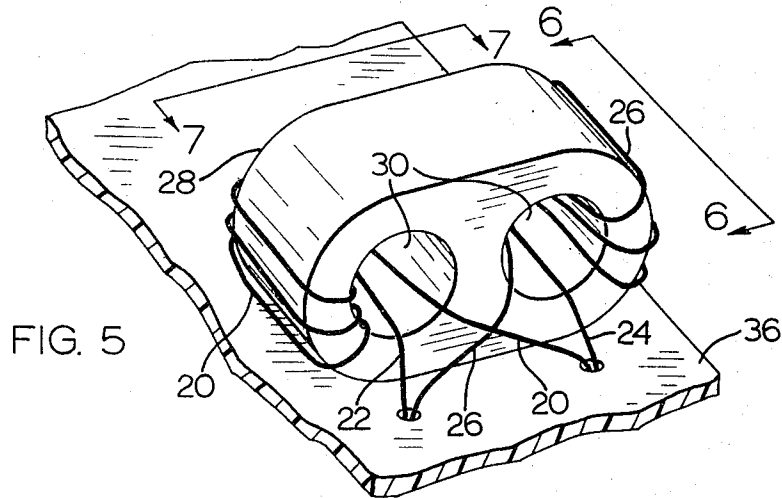


FIG. 5

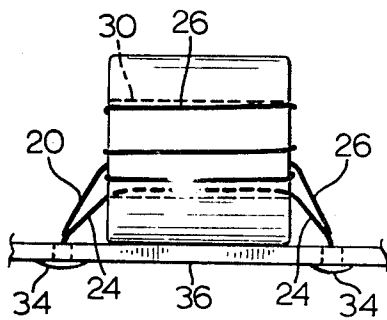


FIG. 6

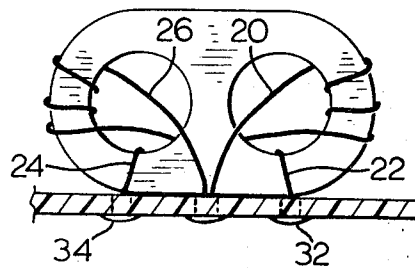


FIG. 7

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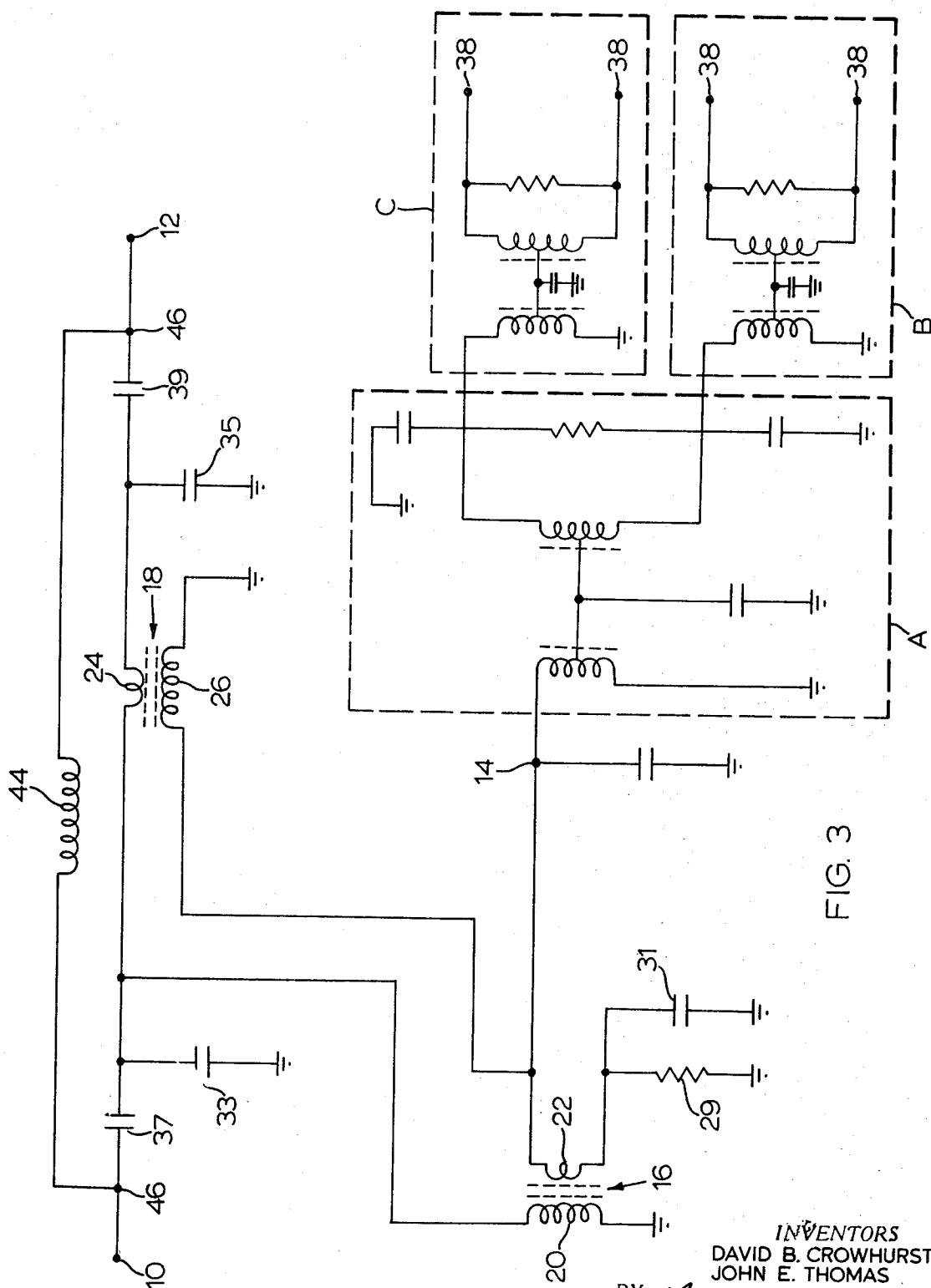


FIG. 3

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## DIRECTIONAL COMMUNICATION SIGNAL TAP

This invention relates to a tap for tapping off a portion of a communication signal from a main line to a tap line or to a plurality of tap lines.

It is common practice to transmit television signals through a residential area on a main line coaxial cable and to tap off portions of the signal strength at spaced apart points along the cable for receiver sets. A device known as a directional tap is used at these tap off points and this invention relates to improvements in such taps that are designed to improve its directivity.

Devices of this type must be directive in the sense that they transfer the required portion of the signal that enters the main input to the tap output but reject a signal that is reflected back along the line to enter the device at the main line output. Signals reflected in this way which appear at the tap output appear in the case of television signals as ghosts on the television screen. The ability of a signal tap to exclude reflected signals from the tap output is referred to by the term "directivity." A tap device with good directivity is efficient at rejecting unwanted reflected signals from the tap output. Most tap designs have a directivity that varies with the frequency of the signal being tapped off. Thus, in the case of a tap used for television reception, it is often found that the directivity will be satisfactory over a portion of the television transmitting band but not as satisfactory over other portions of the television transmitting band.

It is an object of this invention to provide a directional tap that has good directivity over a wide signal band, especially over the normal television transmitting band.

The invention then relates to a directional signal tap having a main line input, a main line output, and a tap output, of the type having a main line voltage sensing transformer and a main line current sensing transformer, the said main line voltage sensing transformer having a primary winding and a secondary winding, and the said main line current sensing transformer having a primary winding and a secondary winding, the secondary winding of the said voltage sensing transformer and the said secondary winding of the said current sensing transformer being connected to said tap output, the winding ratio of the primary winding and the second winding of the current sensing transformer being related to the winding ratio of the primary winding and the secondary winding of the voltage sensing transformer to achieve substantially equal voltages on the secondary winding of the said current sensing transformer and the secondary winding of the said voltage sensing transformer in use, the polarities of the said current sensing transformer and the said voltage sensing transformer being connected so that the signals on the secondary winding of the current sensing transformer and on the secondary winding of the voltage sensing transformer are additive at said tap output for a signal entering at said main line input and cancel at said tap output for reflected signals entering at said main line output, said current sensing transformer and said voltage sensing transformer being mounted on a circuit panel, the improvement of forming the core of each of said current sensing transformer and said voltage sensing transformer from a core material by making a through hole therein, forming each of said primary winding of said current sensing transformer and said secondary winding of said voltage sensing transformer from a single turn through its respective through hole, the free ends of the single turn of each of said turns overlying said board, said turns being taut through their respective holes against the wall of their respective holes that is most adjacent the board, the secondary winding of said current sensing transformer and the primary winding of said voltage sensing transformer being wound through their respective holes and spaced from their respective primary windings, an electrostatic shielding plate shielding the main line and the tap output, comprising a condenser plate between the main line and the tap output.

The invention will be clearly understood after reference to the following detailed specification read in conjunction with the drawings.

In the drawings,

FIG. 1 is a perspective view of a directional tap according to this invention with the cover removed from the body of the casing and having the output at the tap output thereof split into four parallel paths;

FIG. 2 is a view of the printed circuit panel removed from the cover and with the electrostatic shield removed to show the components;

FIG. 3 is a circuit diagram of an embodiment of the invention.

FIG. 4 is a graph illustrating changes in directivity with frequency;

FIG. 5 is a perspective view of the transformer assembly used in the circuit;

FIG. 6 is a view in the direction of 6—6 of FIG. 5; and

FIG. 7 is a view in the direction of 7—7 of FIG. 5.

FIG. 3 shows a basic circuit diagram for a conventional directional signal tap. It has a main line input terminal 10, a main line output terminal 12, and a tap output terminal 14. In practice, a coaxial cable along which a signal is being transmitted is broken and connected to the main line input terminal and the main line output terminal so that the signal passes through the device. Portions of the signal are tapped off for use at the tap output terminal. As indicated above, devices of this nature are used extensively in cable television, where a coaxial cable is extended through a residential district and television signals transmitted thereover. Portions of the signal strength are tapped off at the tap outlets and taken into individual residences along the line.

As discussed above, a problem with taps of this nature is that the signal that is transmitted along the main line is reflected back and a reflected signal enters the device at the main line output 12. The reflected signal can appear at the tap output as a ghost on a television screen or as some kind of an unwanted distortion in other types of cable signal transmissions, such as radio, teletype and facsimile. The tap output is designed to eliminate distortion in the tap output from reflected signals and it is essentially designed with a voltage sensing transformer generally indicated by numeral 16 and a current sensing transformer, generally indicated by numeral 18. The voltage sensing transformer 16 has a relatively large primary winding 20 and small secondary winding 22. The current sensing transformer 18, on the other hand, has a relatively small primary winding 24 and large secondary winding 26. The transformers 16 and 18 are designed such that the voltage on the secondary windings of each of them is about the same. The polarities of the terminals of the transformers 16 and 18 are connected such that the voltages appearing across the secondary windings of the two transformers for a main line input signal are in phase and additive at the tap output. At the same time, voltages appearing across the secondary windings of the two transformers due to a reflected signal entering the device at the main line output are 180° out of phase at the tap output and therefore cancel each other. Thus, the device is theoretically designed to obviate the effect of reflected signals at the tap output and this is essentially the manner in which the reflected signal is prevented from reaching the tap output.

Devices of this type are by usage custom designed to match the circuit into which the tap output 14 feeds. In this connection, the impedance looking back from the tap output by custom in the television industry should be about 75 ohms. This is achieved by means of the terminating resistor condenser arrangement that includes resistor 29 and condenser 31. Resistor 29 is about 79 ohms. It will be apparent that if the secondary winding 22 of transformer 16 connected directly to ground, there would be very low impedance looking back from the tap output 14. Resistor 29 is included primarily for this purpose. Condenser 31 is included to improve an inherent phase shift that takes place with varying frequency as a result of the interaction of the two transformers 16 and 18. Condensers 33 and 35 are adapted to correct undesired impedance variations on the main line due to transformers 16 and 18. The design considerations for designing the resistor 29 and condenser 31 arrangement are well known and not dwelt upon in this specification.

It will be noted that when the signals of the transformers 16 and 18 are additive to the tap output, they would tend to produce a voltage twice the expected voltage from a particular turns ratio. Half of this voltage is dissipated across the 75 ohms resistor 29 and the other half across the circuitry beyond the tap output, so that in result the tap output voltage is designed to depend almost entirely on the transformer ratio.

It will be understood that the terminating resistor 29 is chosen to be 75 ohms, but that this is a matter of choice and that other values could be selected.

It will also be appreciated that the basic design of the tap circuit as described above is not broadly new. Moreover, there are other transformer arrangements and designs that achieve the same effect. The basic idea, though, of all directive taps of this type is that they employ a current sensing transformer and a voltage sensing transformer with secondaries arranged to be additive for a main line input signal and subtractive for a reflected signal that enters the device at the main line output.

Theoretically, these circuits should have perfect directivity. In practice, however, they are very difficult to build with directivity over a wide signal band because they are sensitive to changes in frequency. There are stray capacitances including capacitances between the turns of the transformers, between windings of the transformers and the ferrite cores of the transformers, which vary with frequency, with the result that the characteristics of the unit change with frequency. In some cases, these factors may prevent the device from working well at any frequency.

As indicated above, a directional tap device is designed to tap off a portion of a main line signal that enters a main line input, and the devices are designed to have a predetermined signal power loss between the main line input 10 and the tap output 14. It is desired that the reflected signal entering the device at the main line output should not appear at the tap output, and it is thus desired that the power loss between the main line output 12 and the tap output 14 of reflected signals entering the main line output terminal 12 should be as large as possible. Directivity is the critical thing, and directivity may be defined as the difference between the loss of the signal between the main line output 12 and the tap output less the loss of signal between the main line input 10 and the tap output 14. Tap isolation is defined as the total signal loss for signals entering the main line output to the tap output. A large isolation loss with respect to loss in the desired path indicates good directivity.

FIG. 4 is a typical graph showing increasing directivity in the downward direction and increasing signal frequency from left to right for tap devices designed for television band of transmission. Directivity is indicated in decibels and the requirement is to be above 20 decibels for the signal band concerned, i.e., below the line 25 on the graph. Line 27 is a characteristic curve for tap devices prior to this invention. Line 29 is a characteristic line for a device according to this invention. The general improvement reflected in a characteristic curve of the general shape of the curve 29 is achieved by control and reduction of parasitic capacitances through the control of the shape of the windings, the disposition of the windings, the design of core materials of the transformers in combination with shielding devices for shielding the main line from the tap output. The frequency range of up to 300 megahertz is the usual television frequency range in North America.

This invention provides a transformer core construction that permits the windings of the transformers 16 and 18 to be wound thereon with good spacing therebetween to reduce the intercoil capacitance and with a manufacturing predictability as to location of the core windings to achieve control of electrical parameters. One of the basic reasons for the poor directivity of coupling devices in the past has been that the construction did not provide for control of the stray capacitances. This invention improves the design in this respect and, in addition, provides a physical shield between the main line and the tap output lines which is effective by reason of the improvement in the transformer design. It is the

two concepts in combination that provide the desirable directivity of this invention.

The transformers 16 and 18 in the embodiment of the invention shown are wound on a common core element 28 that is formed with two through holes 30 around which the coils 20, 22 24 and 26 are wound. Although wound on a common core, the transformers do not interact because the magnetic field in the core in the case of each hole is very close to the hole. A minimum hole spacing to achieve this is used. This is common transformer practice. They could be wound on separate cores if desired with the same result.

Concerning stray capacitance, the stray capacitance between turns, stray capacitance between coils and core, and stray capacitance between primary and secondary windings of the transformers are the most significant ones. Capacitance varies inversely as the square of the distance between the windings or capacitive plates. The transformer core in the case of this invention is designed with a large opening for each transformer so that the primary and secondary windings can be spaced apart. The windings 24 and 22 are a single wire. The free ends of the windings 22 and 24 are secured to the rigid board 36 for a printed circuit as at 32 and 34. They are pulled taut so as to hold the transformer core 28 in firm abutting relationship with the board 36. By pulling the wire of coils 22 and 24 in this way, the coil portion that extends through the core 28 is forced to assume a limiting position in the trough of the wall of the hole and against the portion of the wall of the holes 30 that is most adjacent the board. They are in a limiting position as a result of the tautness of the connection and by this means, the location of the coils 22 and 24 is predictable in relation to the cord and board.

As indicated, the holes 30 are relatively large and the large windings 20 and 26 of the two transformers are wound on the cores in a fashion that they do not cross the small turns and they are, by reason of the size of the hole, spaced substantially from the other wire of all other coils. There is, thus, achieved a wide separation and predictability of location of the windings of the transformers. The distance between windings is large and positively controlled.

The coils 22 and 24 consist of a single wire passed through the cores which, when constructed as described, is predictably located and which is also spaced from the wires of the other coils. The important thing is that the coils be wound with a tautness and the free ends thereof be secured to the panel board with a tautness that positively locates the coils in the limiting and predictable positions in the manufacturing operation.

It will also be noted that the small turns coils 22 and 24 or their leads do not cross a large turns coil 26 or 20 or their leads. The leads of the large turns coils preferably cross at the center of the holes 30 through the coil. This is spaced from the small turns coils. Here, again, the leads of the large turns coils may cross at locations in the holes 30 at points other than the center, but in each case, the object should be to have the leads of the large turns coils at locations as remote as possible from the wires and leads of the small turns coils to reduce stray capacitance between the windings.

Capacitance is also affected by other factors, such as wire size. In practice, one selects the smallest wire according to known practice in this field that is practically workable in a particular situation with a view to reducing capacitance.

As indicated above, the size of the holes 30 is a factor in the spacing to reduce inter coil stray capacitance. Previously, it appears that the criteria of design was to have a core hole sufficient in size to admit the wire turns. With this invention, one makes the hole larger than is sufficient for this purpose and with the objective of achieving a separation and to be able to positively locate at least the turns of the small turns coils. Common sizes for the diameter of the holes 30 in the past have been between thirty to sixty one-thousandths of an inch, whereas this invention contemplates a hole having a diameter of at least one hundred twenty-five one-thousandths of an inch, preferably in the order of one hundred seventy one-

thousandths of an inch. Larger sizes may be better but not necessary for a good practical result.

This invention permits one to design couplers with greater turns ratios than previously and still maintain directivity.

In actual construction of a device according to this invention, large turn windings are manually adjusted in their position on the core to achieve the desired intercoil capacitance. This is done by manually moving the coils a small amount after they have been wound on the cores in the test procedure. This adjustment is something that is facilitated by the relatively large size of the holes 30. It must be done after the unit is fully assembled and tested for directivity after the electrostatic shield to be referred to later has been applied. However, with the large hole and positively located small coil about 90 percent of the production line assembly passes without adjustment. Adjustment, if required, is very simple.

Careful consideration to the foregoing things will achieve a directional coupler with a high isolation of low leakage from main line output to tap output. In an actual circuit, the benefit of this high isolation can be lost by other dominating leakage paths. These are external leakage paths which may interfere in parallel with the low leakages through the coupler. Therefore, to achieve the benefit of the foregoing described features of coupler designs, one must simultaneously control the external leakage paths. It is not enough to control the internal capacitances. The two in combination are necessary.

The principal stray external capacitances with which one must be concerned are the capacitances between the high-level main line section and the lower level output section. There are two principal stray capacity paths; one is from the main line input to the tap output; the other is from the main line output to the tap output. It will be appreciated that the capacitance is from any point on the main line input, which would include all points from the main line connector to the device through the primary of the transformer 18 and to any point on the tap output, which would include any point from the coaxial connector of the unit back to the output of the transformer 16. This latter section could include a splitter, not yet described, and associated elements. Similarly, the main line output would include all points from the transformer 18 to the connector at the cable at the other end of the box.

According to this invention, one electrostatically shields these points by means of a metallic electricity conducting plate physically located between the two and grounding the plate so that the capacitance of each of the respective points is a capacitance from the point to ground.

The form of the shield is a metal box that fits over these coupler elements on the printed circuit.

In this connection, reference will be made to FIGS. 1 and 2, which illustrate the physical nature of the device.

In FIG. 1, there is illustrated a directional tap according to this invention. It consists of a housing box having a body 36 and a cover 41 with a coaxial cable connector 10, which is the main line input, and a similar coaxial cable connector 12, which is the main line output. Parts on FIGS. 1 and 2 will be numbered with numbers corresponding to their counterparts in FIG. 3 where possible.

There are four connectors 38 which are split off from the tap output 14 of FIG. 3. The tap output 14 is split four ways by means of 3 standard hybrid splitters so that one can tap off four separate but identical, signals from the connectors 38 each with a 75 ohm impedance. The splitting of the tap output into four similar signals has been indicated on FIG. 3, wherein numerals 38 have been applied to indicate the physical connectors 38 on FIG. 1.

The object of the splitter circuit illustrated in FIG. 3 is to split the tap output from the terminal 14 into four outputs, each with an impedance of 75 ohms. It will be recalled that the impedance looking back into the circuit from the point 14 has been designed to be 75 ohms. To achieve a four-way split of the signal, one first splits the signal into two signals by means of a conventional hybrid splitter enclosed within the block, and generally indicated by the letter A, and then taking the

dual output from this splitter and passing through two similar splitters, generally indicated by the letters B and C.

It will be appreciated that the splitter need not be a four-way split; in fact, the signal could be taken off from the single tap 14. A four-way splitter is a practical device that is in commercial demand at the present time, but the demand may change with requirements. The term "output" used in this specification is intended to include terminals, such as those 38 or such as the one 14.

With a coupler circuit according to this invention, it is not difficult to achieve a directivity of at least 20 db. across the full television transmitting band (that is, the attenuation of signals that are reflected back into the coupler circuit is 20 decibels greater than the attenuation of signals entering the input of the coupler). The electrostatic shield is a very important factor in achieving directivity of this order, but it operates to achieve this effect in combination with a coupler that has inherently good directivity. The mere addition of an electrostatic shield to a coupler with poor inherent directivity would not achieve a significant improvement in overall directivity. Previous to this invention, in practice, shields have not been used because of the basic coupler circuit was not of a standard that could be improved by the use of shield.

An important feature of this invention is the realization that a substantial advantage can be achieved by using a shield if the coupler circuit meets a certain requirement, and it may well be that coupler circuits other than the one illustrated can be achieved that will combine with a shield to achieve an overall directivity that is comparable with this invention.

Therefore, the essence of the invention in its broad aspect is the use of a shield in combination with a coupler circuit of improved characteristic so that the shield is of value.

The requirements of the device, of course, are that it have a directivity of, say, less than 20 decibels over the entire transmitting range with which the invention is to be used. This invention is concerned with a directivity for a transmitting range of between from 5 to 1,000 megahertz. These are the ranges that will likely be used for cable television transmission, although, at the present time, the most common range is between 54 to 216 megahertz, i.e., a range of 162 megahertz. A device having an inherent directivity of at least 15 decibels over a range of 150 megahertz in contrast with an electrostatic shield is thought to be patentably novel.

Standard couplers commonly have a directivity of about 10 decibels. They do not use electrostatic shields on these couplers because a shield would not significantly increase the directivity. Overall directivity can only be improved by using a shield if the inherent directivity of the coupler circuit is over 15. Many devices have a good directivity at one frequency but are not useful because they do not maintain this over the entire transmitting range of the device.

The essence of the invention, then, in its broad aspect is the use of an electrostatic shield on a coupler circuit having a directivity of at least 15 decibels over the useful range of the device.

The applicant has disclosed a preferred construction for manufacturing a basic coupler having a good directivity which includes the concept of spacing the coils by using an oversized hole for the core and by drawing the single turn of the low turns winding taut against the printed circuit board so that the location of the windings are predictable as the result of the manufacturing operation. Other basic circuit designs having good directivity may be achieved and it is intended that, if so, the use of these improved directivity circuits, in combination with an electrostatic shield, should be included within the scope of this invention. The applicant has pointed the way to how to get advantage out of an electrostatic shield in a construction of this type. It is only when a unit having a predetermined directivity is constructed that it is valuable.

On the other hand, one might use the applicant's basic circuit with good success and achieve the similar effect to the electrostatic shield by spacing the high-level side of the circuit from the low-level signal side of the circuit a sufficient amount

to avoid the necessity of an electrostatic shield. It is contemplated that this also should be within the scope of the applicant's invention.

The circuitry of the tap connector can be pulled from the box 36 to leave the power passing coil 44 in the box. It will be noted that there are posts 46 at each end of the box, and these posts connect with clip-on-type connectors 48 on the printed circuit portion of the device. The power passing coil 44 is adapted to pass the low-frequency power that is also on the main line for the purpose of supplying power to spaced-apart communication signal amplifiers in use. This is a known expedient and the coil 44 has been indicated by a similar numeral on FIG. 1. Condensers 37 and 39 are designed as power blocks for the power components on the line but will pass the signal frequencies.

The shield for shielding the high-signal level side of the circuit from the lower signal level or tap output section consists of a metallic box 50, which is electrically connected to a ground terminal on the opposite side of the printed circuit board 36 and which physically separates the high-power side from the low-power side of the unit. The elements on circuit diagram FIG. 3 are indicated by the same numerals on the circuit panel 36. It will be appreciated that the shield could take many forms. It need not be a metallic box. The requirements of the shield are that it be electrically conducting surface that is grounded and that physically is located between the input terminal and the output terminal.

Printed circuit panel has electricity conducting paths on the opposite side to that visible in FIG. 2 to achieve the electrical connections indicated in the circuit diagram. Splitter connectors 38 also extend from said opposite side of the panel to extend through holes formed in the cover 41, as shown. The panel 36 is mounted on the back of cover 41.

IN use, the unit is connected to a coaxial cable and splits off portions of the signal as described above and as is common in the trade but with greater directivity because of the novel feature of construction described above.

What we claim is:

1. A directional signal tap comprising a high-signal level side connecting a main line input with a main line output; a low-level signal side including multiple tap outputs and splitter circuitry connected therewith; directional coupler means connecting the high- and the low-level sides and including a main line voltage sensing transformer having a primary winding and a secondary winding and including a main line current sensing transformer having a primary winding and a secondary winding, wherein said secondary winding of said voltage sensing transformer and said secondary winding of said current sensing transformer are connected to said tap output with polarities to cause voltages on each of said secondary windings to be additive for signals entering at said main line input and to be subtractive for signals entering said main line output, said primary winding and secondary winding of said voltage sensing transformer and said primary winding and said secondary winding of said current sensing transformer being related to achieve substantially equal voltages on the secondaries of each of said transformers in use, the inherent directivity of

said coupler means being at least 15 decibels over a signal transmitting band width of at least 150 megahertz and said circuitry being mounted on a panel of a printed circuit type; and electrostatic shielding means between the high-level signal side of the directional signal tap and the low-level side of the directional signal tap.

2. In a directional signal tap having a main line input, a main line output, a tap output, a main line voltage sensing transformer having a primary winding and a secondary winding, a main line current sensing transformer having a primary winding and a secondary winding, wherein said secondary winding of said voltage sensing transformer and said secondary winding of said current sensing transformer are connected to said tap output with polarities to cause voltages on each of said secondary windings to be additive for signals entering at said main line input and to be subtractive for signals entering at said main line output, said primary winding and secondary winding of said voltage sensing transformer and said primary winding and said secondary winding of said current sensing transformer being related to achieve substantially equal voltages on the secondaries of each of said transformers in use, the component parts of the circuit of said signal tap being mounted on a panel of a printed-type circuit, the improvement of forming the core of said voltage sensing transformer and the core of said current sensing transformer with a through hole having a diameter of at least one hundred twenty-five one-thousandths of an inch, winding the primary and secondary windings of said voltage sensing transformer and said current sensing transformer about their respective cords through their respective through holes, the secondary winding of said voltage sensing transformer and the primary winding of said current sensing transformer each being a single wire through said through hole at their respective cores and each having their free ends connected to the panel of the printed circuit, said single wires being taut whereby to assume a limiting position in their respective through holes and to locate them in a limiting position with respect to their respective cores and to the other windings of the core and an electrostatic shield between the high-level signal side of said directional signal tap and the lower level signal side of said directional signal tap.

3. In a directional signal tap device as claimed in claim 2, wherein the core of said voltage sensing transformer and the cord of said current sensing transformer are formed from a common piece of core material.

4. A directional signal tap as claimed in claim 2, having electrostatic shielding means between the high-level signal side of the directional signal tap and the low-level signal side of the directional signal tap, said signal tap having an inherent directivity of at least 17 decibels over a range of at least 150 megahertz.

5. A directional signal tap as claimed in claim 3, having electrostatic shielding means between the high-level signal side of the directional signal tap and the low-level signal side of the directional signal tap, said signal tap having an inherent directivity of at least 15 decibels over a range of at least 150 megahertz.

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