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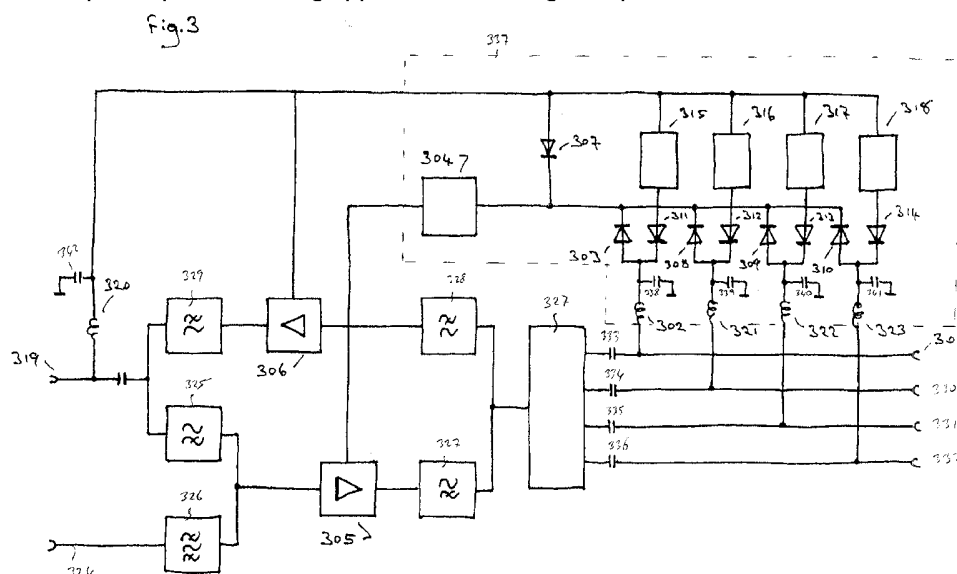
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UK CL (Edition X) **H4R**
INT CL **H03H, H04N**
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(54) Abstract Title: **Television broadcast signal distribution amplifiers**

(57) A broadcast radio frequency amplifier for receiving and distributing broadcast radio frequency signals comprises: one or a plurality of signal inputs (319, 324); one or a plurality of signal outputs (301, 330 - 332); a forward path amplifier (305) for amplifying broadcast radio frequency signals received at said one or plurality of signal inputs, and supplying an amplified said broadcast radio frequency signal to said one or a plurality of signal outputs; a return path amplifier (306) for amplifying a control signal and supplying an amplified control signal to a said signal input; a power steering circuit (337) capable of feeding power applied to a said output to said forward path amplifier (305) in a first mode of operation, and said power steering circuit being capable of providing power to said forward path amplifier when power is applied to a said input, in a second mode of operation. The power steering circuit operates such that (i) power applied to a TV input is fed to the return path amplifier, whereas power applied to one or more outputs does not reach the return path amplifier, and (ii) power for infrared receivers is only provided to unpowered outputs if power is being applied to the TV signal input.

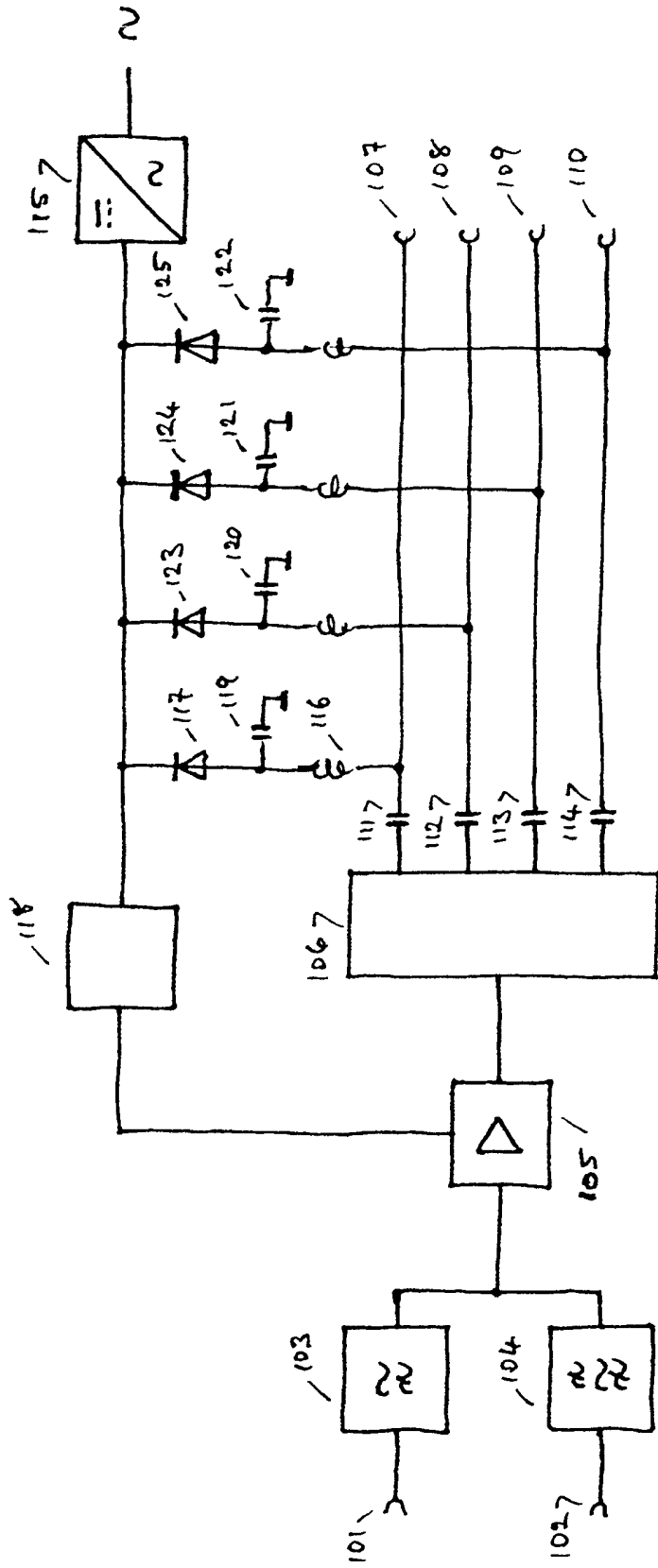


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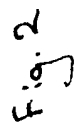
This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

Original Printed on Recycled Paper

Fig 1

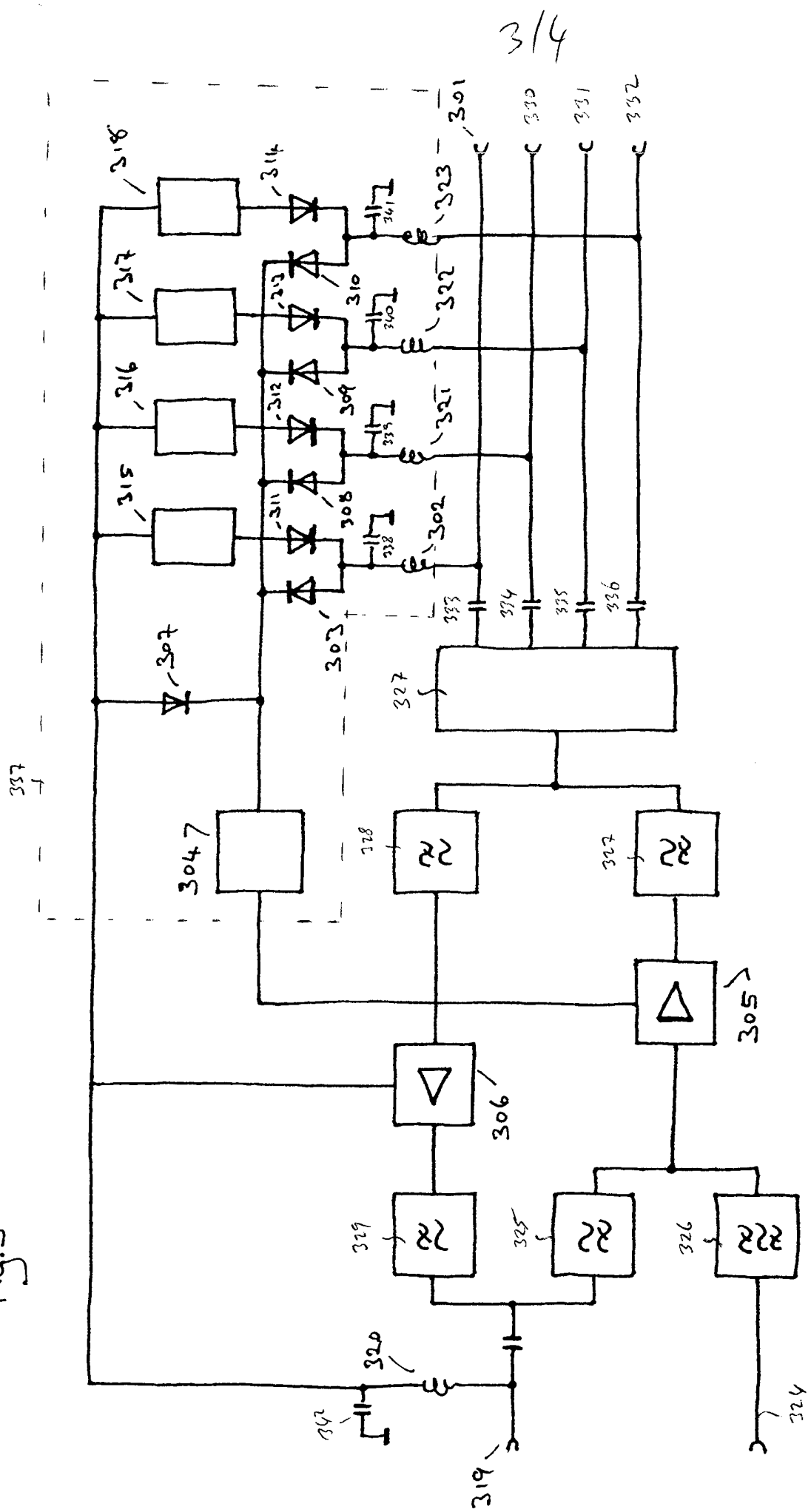


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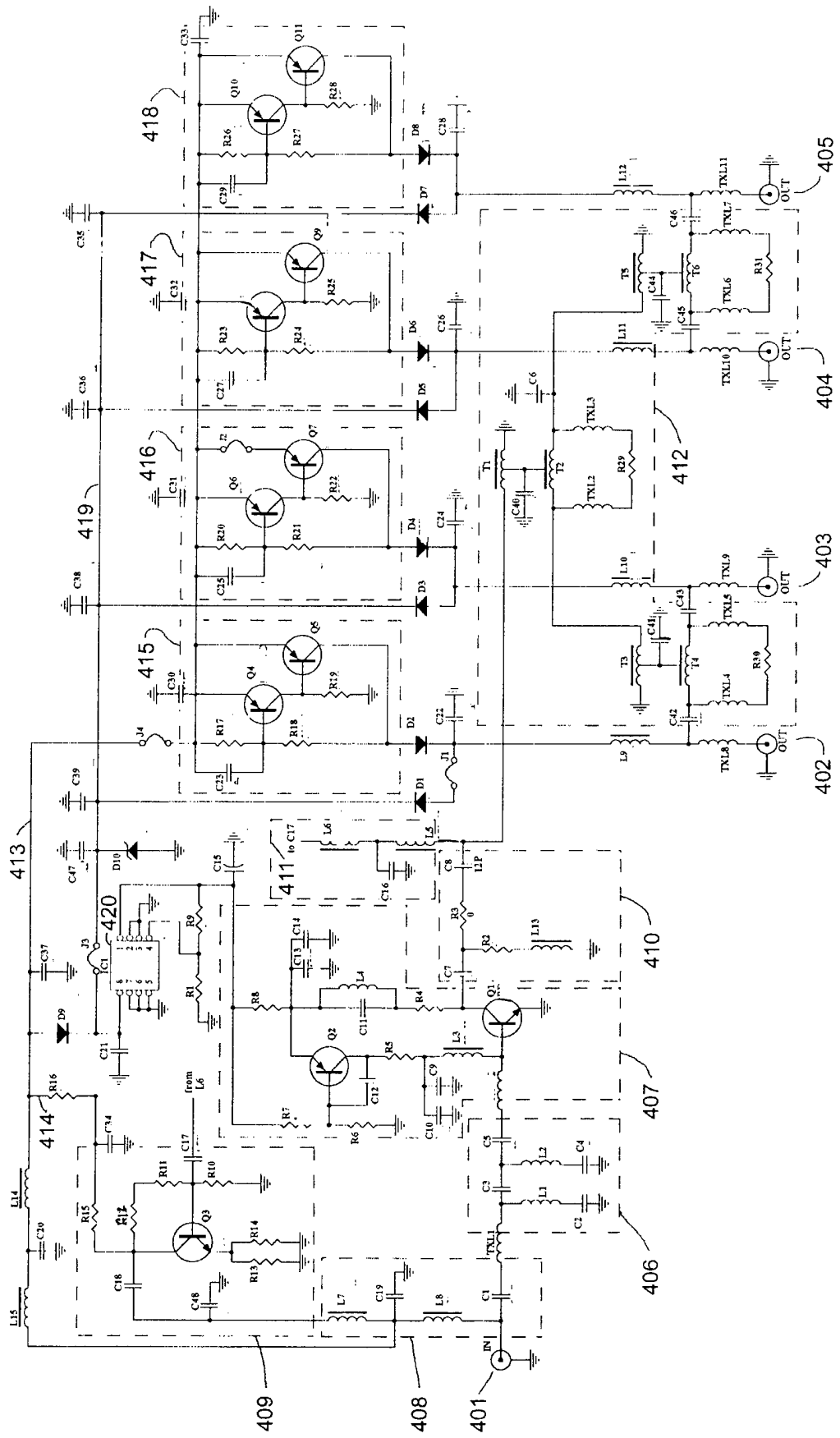
Fig. 3



300 301 302 303

4/4

Fig. 4



Improvements to Television (etc.) Broadcast Signal Distribution Amplifiers

Field of the Invention

The present invention relates to amplifiers, particularly although not
 5 exclusively amplifiers used for distribution of received broadcast television,
 radio and data signals, particularly although not exclusively in the VHF and UHF
 frequency bands.

Background to the Invention

The embodiments herein are concerned with certain classes of amplifier
 10 used for the distribution of received broadcast television, radio and data signals,
 usually in the VHF and UHF frequency bands. Such amplifiers are typically used
 where the signals from a single antenna installation are to be distributed to a
 small number of outlet 'points' located within a building. "Small number" here
 means a number sufficiently small that each outlet point can be fed from a
 15 dedicated output on the amplifier – in practice this typically means up to about ten
 or twelve outputs.

Known amplifiers conventionally used in small distribution systems
 typically fall into one of two classes, as follows.

20 **Aerial amplifier**

Referring to fig 1 herein, one known class of distribution amplifier unit is
 illustrated in block and circuit diagram form. The figure shows an amplifier with
 two inputs and four outputs, but these numbers are by way of example only. A
 distribution amplifier has one or more inputs (101, 102) for particular frequency
 25 bands. The input signals are fed through individual band filter circuits (103, 104)
 before being combined and fed to an amplifier circuit (105). The output of the
 amplifier circuit is fed to a radio-frequency splitter circuit (106), the latter
 providing the required number of outputs (107–110) via DC blocking capacitors
 (111–114). (Four outputs are shown throughout this specification, by way of

example only. The principles described can be applied generally to any number of outputs.)

This type of amplifier may have a local mains power supply (115), or may be line-powered, (powered by superposition of a DC voltage on a coaxial cable) from a separate power unit via any one of the output connections. In the latter case power arriving at an output connector (e.g. 107) is conducted via a radio-frequency choke or inductor (116) and diode (117) to the amplifier circuit, typically via a voltage regulator circuit (118). Decoupling capacitors (119–122) help prevent unwanted radio-frequency energy reaching the power circuitry, and further diodes (123–125) prevent power being back-fed to the other (unpowered) outputs.

This class of amplifier is typically described as an "aerial amplifier," "distribution amplifier" or "multi-way amplifier" and would typically be used in a system where the all input signals are derived directly from relevant receiving antennas .

Return-path amplifiers

A second known class of amplifier unit is typically used in order to distribute the radio-frequency output channel from certain types of satellite TV receiver [for example known "Sky"^(RTM) set-top boxes] in addition to the off-air antenna signals. In this case the TV antenna signal is looped-through a satellite receiver before being connected to the TV input of a distribution amplifier, so that the input to the amplifier includes the satellite receiver's output programme channel, modulated on to a carrier at an appropriate frequency. This class of amplifier incorporates a 'return-path' facility in order to allow viewers to control the satellite receiver from one or more remote locations. Remote control is achieved by using infrared receiver devices at remote locations (such locations being system outlet points fed from the distribution amplifier). A remote infrared receiver device (actually an infrared receiver coupled with an RF oscillator, so as to operate as a sort of transponder) communicates with the satellite receiver using a modulated radio-frequency signal in an HF band (typically between 5

and 10 MHz) sent via the amplifier in the reverse direction, i.e. from the system outlet point toward the satellite receiver. This class of amplifier is typically described as a "return-path amplifier," or "remote control bypass amplifier" because of the presence of a reverse radio-frequency path in addition to the forward path of the aerial amplifier described above.

Fig. 2 herein illustrates a typical known return-path amplifier in block and circuit diagram form. This is similar to the 'aerial amplifier' described above, except for the addition of a return-path amplifier circuit (201) with associated diplexing filters (202, 203, 204). Power for the amplifier circuits is supplied either as DC line-power from the satellite receiver via a radio-frequency choke or inductor (205) or by a local mains power unit (206). In addition power for the remote infrared receivers is supplied as DC line-power via the amplifier outputs (207–210). Current limiting circuitry (211–214), typically of the fold-back type, is included at each output so that the power supply to the amplifier circuitry and other outputs is not affected if any output or outputs are short-circuited at DC. (A DC short-circuit is a valid load condition when no infrared receiver is connected, since items of receiving equipment may incorporate inductors connected to ground at their antenna inputs.)

Summary of the Invention

According to one aspect there is provided a radio frequency amplifier unit for receiving and distributing broadcast radio frequency signals, said amplifier circuit comprising:

one or a plurality of signal inputs (319, 324);

one or a plurality of signal outputs (301, 330 – 332);

a forward path amplifier circuit (305) for amplifying a broadcast radio frequency signal received at said one or plurality of signal inputs, and supplying

an amplified said broadcast radio frequency signal to said one or a plurality of signal outputs;

5 a return path amplifier (306) circuit for amplifying a control signal and supplying an amplified control signal to a said signal input;

characterised by comprising:

10 a power steering circuit (337) capable of feeding power applied to a said signal output to said forward path amplifier (305), but not feeding power to said return path amplifier circuit (306), nor to any other signal outputs, in a first mode of operation, and

15 said power steering circuit being capable of providing power to said forward path amplifier circuit and to said return path amplifier circuit when power is applied to a said signal input (319), in a second mode of operation.

20 Preferably, said power steering circuit is also capable of providing power for infrared receivers to un-powered said signal outputs, only if power is applied to a said signal input, in said second mode of operation.

25 Preferably, when line-power is applied to any one of the amplifier unit's signal outputs but not to any said signal input, said return path amplifier circuit is disabled.

Preferably, if line-power is applied to a said signal input, said return path amplifier is enabled for supplying a radio frequency control signal to a said signal input.

30 Preferably said power steering circuit comprises:

a first DC common power rail (344) connected to a said TV signal input via a radio frequency choke or inductor;

5 a DC power connection from the said first common DC power rail to provide power for the said return path amplifier circuit (306);

one or a plurality of current limiting circuits (315 – 318) each having its input connected to the said first common DC power rail;

10 one or a plurality of diodes, forming a first set of diodes (311 – 314), each with its anode connected to the output of a said current limiting circuit;

one or a plurality of radio frequency chokes or inductors (302, 321 – 323), each connected between the cathode of a diode belonging to the said first set of
15 diodes and a said signal output (301, 330 – 332);

one or a plurality of diodes, forming a second set of diodes (303, 308 – 310), each with its anode connected to the junction between the cathode of a diode belonging to the said first set of diodes and a said radio frequency choke or
20 inductor;

a second common DC power rail (345) connected to the cathodes of all the diodes belonging to the said second set of diodes;

25 a further single diode (307) connected between the said first and second common DC power rails, with its anode connected to the said first common DC power rail and its cathode connected to the said second common DC power rail;

30 a DC power connection from the said second common DC power rail to provide power for the said forward path amplifier circuit (305), optionally via a voltage regulator circuit (304); and

a plurality of radio frequency de-coupling capacitors (338 – 342), as required, to prevent radio frequency energy from entering the power circuitry.

5 Said return path amplifier (306) preferably receives power from a TV band signal input (319) where DC line-power is applied to the amplifier's TV band signal input.

10 Preferably, DC line-power applied to at least one of said signal outputs is isolated from said return path amplifier circuit (306) by said power steering circuit.

15 Preferably, if DC line-power is applied to any one or more of the amplifier's signal outputs, the amplifier circuit will operate as an "aerial amplifier" as described herein, and the return-path amplifier section will be disabled.

20 Preferably, if DC line-power is applied to any one or more of the amplifier's signal outputs, no power for remote infrared receivers will be fed to any other signal output.

25 Preferably, if DC line-power is applied to the said TV band signal input of said amplifier unit, said amplifier unit will operate as a "return-path amplifier", as described herein , and a return-path section of said amplifier unit will be active, and DC power for remote infrared receivers will be present at each said signal output.

30 Preferably, if DC line-power is applied to the said TV band signal input of said amplifier unit, DC power for powering one or more remote infrared receivers will be present at each said signal output.

Other aspects are as recited in the claims herein.

Brief Description of the Drawings

For a better understanding of the invention and to show how the same may be carried into effect, there will now be described by way of example only, specific embodiments, methods and processes according to the present
5 invention with reference to the accompanying drawings in which:

Figure 1 herein illustrates schematically one example of an amplifier of a known class known as "aerial amplifiers" or "distribution amplifiers" or "multi-way amplifiers" suitable for use in a system where all input signals are derived directly
10 from their relevant receiving antennas;

Figure 2 illustrates schematically one example of a known "return path" type amplifier, suitable for distributing radio frequency output channels from a satellite television receiver or other auxiliary signal source, in addition to off-air antenna
15 signals and which is also known as a "remote control bypass amplifier";

Figure 3 illustrates schematically in block and circuit diagram form an amplifier circuit according to a first specific embodiment of the invention, capable of operating in an "aerial amplifier" mode, and in a "return path amplifier" mode;
20 and

Figure 4 illustrates schematically in more detail a novel amplifier circuit of the type referred to in fig 3 herein, according to a second specific embodiment of the invention.

25

Detailed Description

There will now be described by way of example a specific mode contemplated by the inventor. In the following description numerous specific details are set forth in order to provide a thorough understanding. It will be
30 apparent however, to one skilled in the art, that the present invention may be practiced without limitation to these specific details. In other instances, well

known methods and structures have not been described in detail so as not to unnecessarily obscure the description.

In this specification, the term “amplified” is used to mean a signal which has
5 been through an amplifier stage and, optionally, through a radio frequency
splitter, so that the complete amplifier unit may increase or decrease the strength
of the signal. The term includes signals which have been increased in amplitude
by an amplifier device, so as to give a stronger signal, as well as signals which
may have been decreased in amplitude as a result of the attenuation introduced
10 by the splitter, so as to produce a weaker signal.

Figs 3 and 4 herein describe embodiments of a new class of amplifier
which may be used for either of the applications described in the foregoing
sections. The new class of amplifier has two operating modes, corresponding to
15 the aerial amplifier and return-path amplifier described above. Mode selection is
automatic, depending on the way in which the amplifier is powered.

Fig. 3 shows in block and circuit diagram form one embodiment of the
invention.

The amplifier circuit comprises one or a plurality of signal inputs 319, 324,
20 two of which are shown, but which, in various embodiments are not limited to
only two inputs, each input configured to a particular selected frequency band;
a plurality of band filter circuits (325, 326); a forward amplifier circuit (305); an
output of the forward amplifier circuit being fed to a radio frequency splitter
circuit 343; a return path amplifier 306 with a plurality of associated diplexing
25 filters (327 - 329); a plurality of signal outputs (301, 330 - 332) each output
circuit being connected to an output of the RF splitter circuit 343 by a
corresponding respective DC blocking capacitor (333 - 336); and a power
steering circuit (337, shown dashed line). In principle, the overall signal gain
through the amplifying stage(s) and the RF splitter could be either greater than
30 or less than unity.

The power steering circuit comprises a plurality of current limiting circuits (315 - 318), each current limiting circuit connected to a corresponding respective signal output (301, 330 - 332); a plurality of radio frequency chokes, or inductors (302, 321 - 323), each said choke/inductor connected to a corresponding respective signal output (301, 330 - 332); each choke/inductor being connected between a corresponding signal output and a current limiting circuit via a respective diode (311 - 314), and being connected to earth via a corresponding respective de-coupling capacitor (338 - 341); an optional input voltage regulator (304) for regulating a power supply to the forward amplifier; connecting each RF choke or inductor (302, 321 - 323) to the input of the voltage regulator (304) is a corresponding respective diode (303, 311 - 308 - 310); a further diode (307) connecting the plurality of current limiting circuits (315 - 318) to the input of the voltage regulator (304); a radio frequency choke or inductor (320) connected to a signal input 319, and a capacitor 342, de-coupling one end of said RF choke or inductor 320 to earth.

Voltage regulator (304) is not an essential feature, since 'output' power from diodes (303, 308-310) could go directly to the forward amplifier circuit (305), in other embodiments.

In summary, two modes of operation are as follows:

- (i) Firstly, if DC line-power is applied to any one or more of the amplifier's signal outputs, the amplifier unit will operate as an aerial amplifier, as described above. Specifically, the return-path amplifier section will be disabled and no power for remote infrared receivers will be fed to any signal output;
- (ii) Secondly, if DC line-power is applied to a TV band input of the amplifier unit, the amplifier unit will operate as a return-path amplifier as described above, i.e. the return-path section will be

active and power for remote infrared receivers will be present at each signal output.

This means, that in the second mode of operation, where, for example 9 volt DC line-power is applied to the amplifier's TV band input, for example from a digital satellite receiver box, then the amplifier will function correctly for the RF TV band signals, and additionally will pass via the return path TV satellite box control signals, for example as received from an infrared receiver, for example at approximately 7 MHz, the control signal being available in a return direction at the signal input of the amplifier so that the satellite receiver box can use those signals in order to control, for example, channel changes.

Referring to Fig. 3 it will be seen that the radio-frequency configuration of the amplifier is identical to that of the return-path amplifier described above. Novelty is in the power steering circuitry. Firstly consider case (i) above where power is applied via one of the signal outputs (e.g. 301). Power is conducted via radio-frequency choke or inductor (302) and diode (303) to the input of voltage regulator (304). The output of the voltage regulator feeds the forward-path amplifier circuitry (305). (The voltage regulator is optional and may be omitted in some embodiments.) Note, however, that power does not reach the return-path amplifier circuitry (306), nor does it reach any other signal outputs since it is blocked by diodes (307–310) which are reverse-biased in this mode. Further diodes (311–314) also prevent power from passing backwards into the current-limiting circuits (315–318). Thus the return-path functions of the amplifier are inactive when power is applied via an output.

Now consider case (ii) above where power is applied via the TV band input (319). Power passes via radio-frequency choke or inductor (320) directly to the return-path amplifier circuitry (306), and via the current limiting circuits (315–318), diodes (311–314) and radio-frequency chokes or inductors (302, 321–323) to the signal outputs. Power also passes via diode (307) and the optional voltage regulator (304) to the forward-path amplifier circuitry (305).

Thus the return-path functions of the amplifier are active when power is applied via the TV signal input.

In return path mode, diode (307) is forward biased and provides a means by which input power is passed to the forward path amplifier (305), via the
5 voltage regulator (304) if fitted.

Referring to figure 4 herein, there is illustrated schematically, by way of example only, a full circuit diagram of a particular practical embodiment.

This particular embodiment has a single TV signal input (401) and four
10 signal outputs (402 – 405). The radio frequency structures of the amplifier unit are identified by dashed lines, thus:

an input band filter (406), being in this example a UHF high-pass filter;

15 a forward path amplifier circuit (407), consisting in this example of a single bipolar junction transistor amplifying stage (Q1) with an active bias circuit (Q2);

a low-pass diplexing filter (408) for combining the output from the return path amplifier circuit at the signal input of the amplifier unit;

20

a return path amplifier circuit (409), consisting in this example of a single bipolar junction transistor amplifying stage (Q3);

a second diplexing filter structure consisting of a high-pass section (410) passing
25 the output of the said forward path amplifier circuit to the four-way splitter, and a low-pass section (411) passing the control signal from the said four-way splitter to the input of the said return path amplifier circuit;

a four-way splitter circuit (412) feeding the said four signal outputs.

30

The elements of the power steering circuitry are identified thus:

a first common DC power rail (413) connected to the said TV signal input via radio frequency chokes (L14, L15) and inductor (L8);

5

a DC power connection from the said first common DC power rail to provide power for the said return path amplifier circuit (414), in this example via resistor (R16);

10 four current limiting circuits (415 – 418) each having its input connected to the said first common DC power rail;

four diodes, forming a first set of diodes (D2, D4, D6, D8), each with its anode connected to the output of a said current limiting circuit;

15

four radio frequency chokes or inductors (L9 – L12), each connected between the cathode of a diode belonging to the said first set of diodes and a said signal output (301, 330 – 332);

20 four diodes, forming a second set of diodes (D1, D3, D5, D7), each with its anode connected to the junction between the cathode of a diode belonging to the said first set of diodes and a said radio frequency choke or inductor;

a second common DC power rail (419) connected to the cathodes of all
25 the diodes belonging to the said second set of diodes;

a further single diode (D9) connected between the said first and second common DC power rails, with its anode connected to the said first common DC power rail and its cathode connected to the said second common DC power rail;

30

a DC power connection from the said second common DC power rail to provide power for the said forward path amplifier circuit (407), in this example via an integrated circuit voltage regulator (420); and

- 5 a plurality of radio frequency de-coupling capacitors (C20, C22, C24, C26, C28), required to prevent radio frequency energy from entering the power circuitry.

10 In this example, additional radio frequency de-coupling capacitors (C30 – C33, C35 – C39, C47) are used to de-couple the said common DC power rails in accordance with known normal good radio frequency design practice.

15 In this example a surge protection diode (D10) is used as a voltage clamping device on the second said common DC power rail to protect the circuitry from damage in the event of any voltage surge occurring on the line-power feed connected to the signal input or a signal output, for a example a surge induced by lightning discharge. This is a well known method of protection.

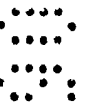
20 Each of the elements of the power steering circuit is a well known circuit structure or component.

Advantages of the Embodiments

25 One class of amplifier unit is able to be used in applications previously requiring two classes, thus achieving economies in manufacturing and stock holding, etc.

30 Automatic selection of the required mode, depending on the way in which power is applied to the amplifier is simple for the installer to understand. Even if power is applied to the TV signal input and one or more signal outputs, the amplifier circuit will be in return path mode, so the system would still work even if the system is installed in such a mis-configuration.

Replacement or reconfiguration of the amplifier is not required if the distribution system configuration is changed by addition or removal of a TV signal loop-through a satellite receiver.



Claims:

1. A radio frequency amplifier unit for receiving and distributing broadcast radio frequency signals, said amplifier circuit comprising:

5

one or a plurality of signal inputs (319, 324);

one or a plurality of signal outputs (301, 330 – 332);

10

a forward path amplifier circuit (305) for amplifying a broadcast radio frequency signal received at said one or plurality of signal inputs, and supplying an amplified said broadcast radio frequency signal to said one or a plurality of signal outputs;

15

a return path amplifier (306) circuit for amplifying a control signal and supplying an amplified control signal to a said signal input;

characterised by comprising:

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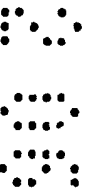
a power steering circuit (337) capable of feeding power applied to a said signal output to said forward path amplifier (305), but not feeding power to said return path amplifier circuit (306), nor to any other signal outputs, in a first mode of operation, and

25

said power steering circuit being capable of providing power to said forward path amplifier circuit and to said return path amplifier circuit when power is applied to a said signal input (319), in a second mode of operation.

30

2. The amplifier unit as claimed in claim 1 wherein, the power steering circuit is also capable of providing power for infrared receivers to un-powered said signal outputs, only if power is applied to a said signal input, in said second mode of operation.



3. The amplifier unit as claimed in claim 1, wherein if line-power is applied to any one of the amplifier's signal outputs but not to any said signal input, said return path amplifier is disabled.

4. The amplifier unit as claimed in any one of the preceding claims, wherein if line-power is applied to a said signal input, said return path amplifier is enabled for supplying a radio frequency control signal to a said signal input.

10

5. The amplifier unit as claimed in any one of the preceding claims, wherein said power steering circuit comprises:

one or a plurality of current limiting circuits (315 - 318);

15

one or a plurality of choke/inductor and capacitor circuits (302, 321 - 323; 338 - 341), each connected in series between a corresponding respective current limiting circuit and a said signal output;

20 one or a plurality of first diodes (303, 308 - 310), each said diode connected between a corresponding respective choke/inductor - capacitor circuit, said forward amplifier circuit (305)]; and

25 one or a plurality of second diodes (311 - 314), each connected between a corresponding said current limiting circuit, and a corresponding said choke/inductor - capacitor circuit.

6. The amplifier unit as claimed in claim 5, further comprising at least one voltage regulator (304) connected to said forward amplifier circuit (305) for regulating a power supply to said forward amplifier circuit (305).

30

7. The amplifier unit as claimed in claim 6, further comprising a further diode, connected between an opposite end of said one or a plurality of current limiting circuits and an input of said at least one voltage regulator (304).

5 8. The amplifier unit as claimed in claim 5, wherein said one or a plurality of choke/inductor and capacitor circuits (302, 321 - 323; 338 - 341), are each connected in series between a corresponding respective current limiting circuit and a corresponding respective said signal output, via a diode (311-314).

10 9. The amplifier unit as claimed in claim 5, further comprising a further diode, connected between an opposite end of said one or a plurality of current limiting circuits said forward amplifier circuit (305).

15 10. The amplifier unit as claimed in any one of the preceding claims, wherein said return path amplifier (306) receives power from a TV band signal input (319) where DC line-power is applied to the amplifier's TV band input.

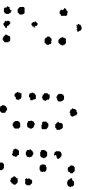
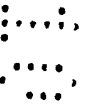
20 11. The amplifier unit as claimed in any one of the preceding claims , wherein power applied to at least one of said outputs is isolated from said return path amplifier circuit (306) by said power steering circuit.

25 12. The amplifier unit as claimed in any one of the preceding claims, wherein if DC line-power is applied to any one or more of the amplifier's signal outputs, the amplifier circuit will operate as an aerial amplifier as described herein, and the return-path amplifier section will be disabled.

30 13. The amplifier unit as claimed in any one of the preceding claims wherein if DC line-power is applied to any one or more of the amplifier's signal outputs, no power for remote infrared receivers will be fed to any other signal output.

14. The amplifier unit as claimed in any one of the preceding claims,
wherein, if DC line-power is applied to a TV band input of said amplifier unit, said
amplifier unit will operate as a return-path amplifier, as described herein, and a
return-path section of said amplifier unit will be active, and DC power for remote
5 infrared receivers will be present at each said signal output.

15. The amplifier unit as claimed in any one of the preceding claims,
wherein, if DC line-power is applied to a TV band input of said amplifier unit, DC
power for powering one or more remote infrared receivers will be present at each
10 said signal output.





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Examiner: Steve Evans

Claims searched: All

Date of search: 26 June 2006

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	US 2002/0093596 A1 (GRASTY) - Whole document

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

H4R

Worldwide search of patent documents classified in the following areas of the IPC

H03H; H04N

The following online and other databases have been used in the preparation of this search report

Online: WPI, EPODOC