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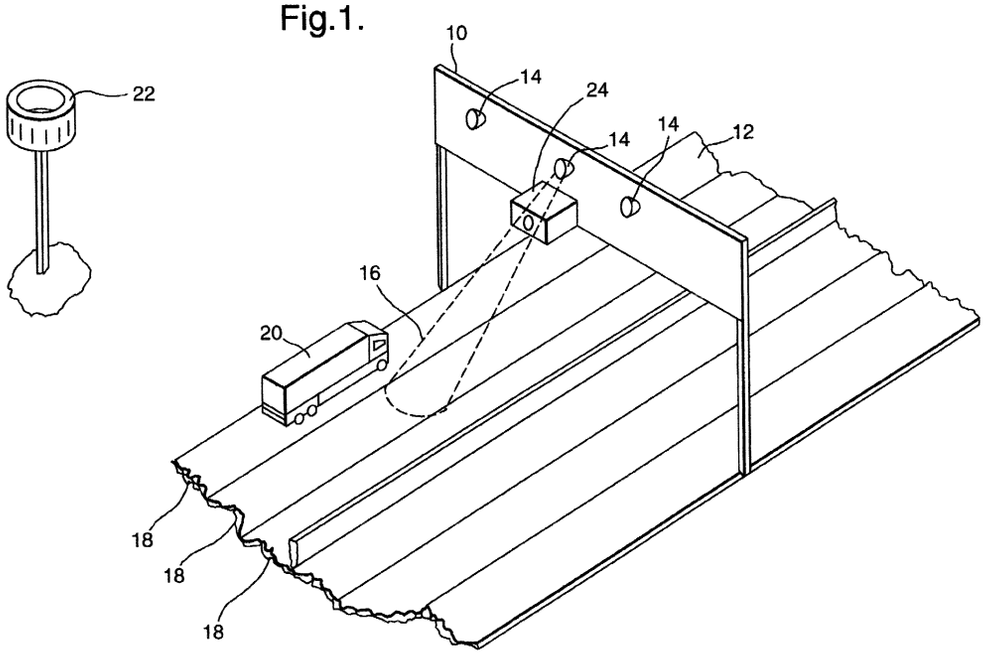
(54) Radio communications detection apparatus and method

(57) An apparatus and method is disclosed for detecting traffic violations involving use of mobile telephones and other communications apparatus in a moving vehicle 20. Directional antennae 14 are aimed at a vehicle 20 and radio emissions from the vehicle 20 are analysed to see if their type corresponds to a targeted type of radio communications activity. If there is correspondence, a camera 24 is triggered to provide an image of the vehicle 20 with appended details of communications type and time. The image can then be examined to determine if the vehicle driver was, in fact, the individual using mobile communications. Dual criteria of signal strength and communications type are used before the camera 24 is triggered. The image is communicable to another place for action, analysis or bureaucratic processing. Automatic gain control features ensure wide range signal strength handling capacity. A portable version is also disclosed.

Fig.1.



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Description

[0001] The present invention relates to apparatus and methods for detecting use of mobile communications equipment in moving vehicles. In particular, it relates to method and apparatus for detecting traffic violations associated with use of mobile communications in moving vehicles, and , in greatest particularity, is aimed at, but not exclusive to, detection of the use of mobile telephones in such circumstances.

[0002] Road traffic authorities and police forces are becoming increasingly anxious about the deleterious effects on driving standards caused by the use of communications equipment, by a vehicle driver, when the vehicle is in motion. Loss of road-related concentration, by the driver, as the driver concentrates on the content of the communication, is, if statistics are to be believed, a contributory, if not an exclusive, cause of a significant proportion of road traffic accidents. As a consequence, in many jurisdictions, it has become a moving traffic violation to be proved to be engaged in radio communications while driving a vehicle.

[0003] A particular problem arises with mobile telephones. Nearly all manufacturers provide a "hands free" kit whereby a telephone conversation can be conducted without the user requiring to hold the telephone. Even this is frowned upon by some traffic authorities because a loss of road concentration has been shown to ensue simply as a result of concentrating on the call. Anyone familiar with present road conditions will be painfully aware that a very high proportion of in-vehicle mobile telephone users do not employ a hands free kit, but simply hold the mobile telephone to their head, while driving with one free hand. This results in reduced ability to control the vehicle, should the telephone user be the driver. Worse still, some mobile telephone users cradle the telephone between their shoulder and their tilted head. If the mobile telephone user is a driver, the restriction in head mobility and hence road visibility can have catastrophic consequences.

[0004] Enforcement of restrictions on mobile telephone use is very difficult. Conclusive evidence that a mobile telephone was in use by a driver, even at the time of an accident, is hard to acquire. The present invention seeks to provide a means for establishing use, by a driver, of mobile communications equipment, in a moving vehicle, with sufficient certainty to bring a caution of conviction, should the authorities so require or desire.

[0005] An apparatus for providing evidence of use of mobile communications in a vehicle, characterised in that there is provided: a monitor (14) for monitoring emission of radio signals from the vehicle and operative to provide output indicative thereof; a controller (26,32), coupled to receive said output from said monitor and operative to determine whether or not emitted radio signals, from the vehicle, have characteristics indicative of at least one type, from a predetermined set of types, of mobile communications activity is in progress in the vehicle; and a camera, (24) operative to acquire an image of the vehicle, and coupled to be triggered by said controller (32) in the event that said controller determines that said at least one type of mobile communications activity is in progress in the vehicle.

[0006] An apparatus, according to claim 1, wherein said monitor (14) comprises a directional antenna (14) to be aimed at the vehicle, and a radio receiver (26,32,52), operative to receive signals from said antenna and to demodulate and measure the strength of signals from said antenna.

By acquiring an image of the vehicle, at the moment of communications use, the present invention seeks to provide visual evidence which can be used to establish if the driver was the sole occupant of the vehicle, if the driver, if sole, was employing a hands free method of communication, if the driver was not the sole vehicle occupant but was nonetheless visibly engaged in mobile communications, or if there was a certainty or high probability that another person, in the vehicle, was in fact the communications user.

[0007] The various aspects provide, for preference, for use of a directional antenna to be aimed at the vehicle, and a radio receiver, to receive signals from the antenna and to demodulate and measure the strength of signals from the antenna.

[0008] In this manner, invention seeks to provide, for strong forensic proof, that the individual vehicle, and no other, is the sole target for monitoring.

[0009] The various aspects further provide for responding to the indication of measured strength of the signal from the antenna to determine, in a first stage, by a first criterion, if a predetermined signal strength has been exceeded; and, if the predetermined signal strength has been exceeded, in a second stage, analysing the demodulated signal to determine the nature of the signal and to determine, by a second criterion, if the signal belongs to at least one type of the predetermined set of types of mobile communications activity , the image being acquired or the camera being triggered if the first and second criteria are fulfilled. In this manner, a picture is taken of the vehicle if and only if a targeted type of mobile communications activity is sure to be taking place in the vehicle.

[0010] In this manner, the invention seeks to provide that a very high probability, or certainty, of use of mobile communications equipment exists before any action is initiated. Further, by analysing the type of communications activity, the invention seeks to provide further forensic certainty through the signal style being identified and matched, if required, against the type of communications equipment in the vehicle.

[0011] The range of signal strengths can be very large. A mobile telephone, close to a receiver and generating full power, can easily overload the receiver. On the other hand, even weak signals require to be monitored on occasions. The range of signal strengths is enormous. Forensic certainty requires that the invention

always functions in a correct manner, and cannot be overloaded.

[0012] To this end, the various aspects of the invention provide that the receiver comprises plural automatic gain control amplifier stages for accommodating the wide range of signal strengths from the antenna, and further provides that the analysis of the type of radio communications activity involves feedback to control the gain of at least one of the stages. In this manner the invention seeks to ensure proper linearity of the analysis by keeping signal levels within acceptable ranges of amplitude.

[0013] Band planning ensures that mobile communications occur on a limited number of frequency band allocations. For example, at the present time most mobile telephones are to be found, in the United Kingdom, around 900 MHz and 1800 MHz, while PMR (private mobile radio) and amateur radio is to be found on a scattering of bands in the VHF and UHF allocations. It would result in a degradation of the quality of evidence due to unwanted radio interference, and possible "false detection", if a wide band approach were adopted.

[0014] The various aspects of the present invention seek to overcome this objection by providing that the receiver is band limited to receive only that band or those bands of radio signals wherein the predetermined set of types of mobile communications activity are expected to occur.

[0015] For further forensic benefit, the various aspects of the invention provide that, when triggering the camera or acquiring the image, details are appended to the acquired image, indicative of the type and time of detected radio communications activity. This seeks to strengthen the evidential value of any image, later relied upon for proof.

[0016] In one preferred embodiment of the invention, the various aspects of the invention provide for incorporation in a portable apparatus where the antenna can be pointed into the path of an oncoming vehicle. In this manner, the invention seeks to provide means, much like the "speed guns", employed to detect speeding drivers, but directed to the purpose of the invention.

[0017] In another preferred embodiment of the invention, the various aspects provide that the antenna is suspended above a road surface. This permits the invention to be installed on existing structures, such as highway bridges or gantries, and existing power sources and resources where present.

[0018] In another preferred embodiment of the invention, the various aspects provide that image acquisition is achieved by a camera, which provides a secondary function as a roadway speed detection camera. In this manner the present invention seeks two advantages. Firstly, since speed detection cameras automatically append time and vehicle speed indication to an acquired image, and show vehicle registration plates, evidence is provided that the vehicle was actually in motion at the time of mobile communications use and substantiate identification. Secondly, since many speed detection cameras already exist on roads and highways, there is the economic possibility of installing the invention in association with already present cameras and simply giving a secondary source of triggering to the speed detection camera.

[0019] The various aspects of the invention further provide that the predetermined set of types of radio communications activity includes the use of one or more types of mobile telephone, in which case the one or more types of mobile telephone include one or more of types using TDMA, CDMA, or GSM. In this manner, the invention seeks to target the main cause of concern over mobile communications from moving vehicles.

[0020] Where targeted types of mobile communications activity exist on separate bands of frequencies, it is again a source of detection error if the signals from two or more bands are allowed to interfere with each other. To overcome this problem the various aspects of the present invention provide that, where the predetermined set of bands whereon the predetermined set of types of radio communications activity are expected to occur comprises a plurality of bands, the receiver switches from one to another of the plurality of bands. In this manner, the present invention seeks to provide accurate and proper analysis of radio emissions in each band in turn..

[0021] While the various aspects and features of the invention, as so far described, allow for the forensically sound acquisition of an image of a vehicle wherein targeted mobile communications activity is in progress, the invention further seeks to provide utility by enabling improved administrative process, or instant or rapid action to be taken on the basis of the acquired image.

[0022] To this end, the various aspects of the invention provide that the acquired image can be transmitted to another location.

[0023] By this means, the image can be sent to a waiting enforcement vehicle, which can catch the violator in the act and, if required, levy an instant penalty. Equally, the image can be sent ahead to a highway toll station, where a ticket of instant penalty can be imposed. In a similar vein, the image can be sent directly to an administrative centre where data processing can be used to commence any penalty procedure.

[0024] The invention is further described, by way of example, by the following description, taken in association with the appended drawings, in which:

[0025] Figure 1 is a projected view of one embodiment of the invention, installed on a highway gantry and illustrating various aspects thereof.

[0026] Figure 2 is a schematic diagram of the various parts of a first illustrative form of the invention, functioning according to a plural band requirement.

[0027] Figure 3 is a schematic diagram of a second illustrative form of the invention, functioning according to a simplified, lower cost and lower performance single band requirement.

[0028] Figure 4 is a flow chart giving an example of the control activities, which take place within the embodiments of figures 2 and 3.
and
[0029] Figure 5 is a projected view of one manner in which the invention can be incorporated into a portable apparatus.
[0030] Referring to Figure 1, a gantry 10, across a highway 12, supports a plurality of radio antennas 14, for monitoring radio signals from vehicles passing the gantry each antenna 14 having a directional cone of coverage 16 restricted to a part (in this case a lane 18) of the highway 12 and facing oncoming traffic 20 . The antennas 14 can comprise directional reflectors, absorbent beam-limiting baffles, phased active or parasitic arrays, or any combination of any known technique. All that is required of the antennas 14, within the present invention, is that the cone 16 of coverage should be directional. In particular, it is desirable that the directionality of the cone 16 should provide significant attenuation to any competing fixed sources of potentially interfering radio signals, such as a mobile telephone base station 22, which has the potential to generate blocking and radio super heterodyne image interference (not to be confused with the visual image, hereafter described)
[0031] Also mounted on the gantry 10 is a camera 24, facing the oncoming traffic 20. In one preferred embodiment, the camera 24 is simply an already existing speed detection camera, which is further triggered by detection of mobile phone activity in the oncoming traffic 20. In a second preferred embodiment, the camera 24 is a dedicated part of the invention, similarly triggered. The manner of triggering the camera is described below. When triggered, the camera 24 acquires an image of the front of the oncoming vehicle 20 where the potential exists to record the identity of the vehicle 20 and the identity and activity of the driver.
[0032] The camera 10 can be a simple photographic film camera, or a video camera, or a digital stills picture camera. According to the present invention, all that is required of the camera 24 is that it can acquire an image which is capable of storage and, for preference, can be transmitted to another location. For preference again, the acquired image should be capable of having evidential data added or appended thereto.
[0033] Attention is next drawn to Figure 2, showing a schematic diagram of the functional elements of a plural band embodiment of the invention.
[0034] A first radio frequency front end 26A receives signals in the range 1800 MHz to 1900 MHz, corresponding to current transmission frequency allocations for one group of subscriber units (mobile telephones). Equally, a second radio frequency front end 26B receives signals in the range 800 MHz to 900 MHz, corresponding to a second current transmission frequency allocation for another group of subscriber units. While only two front ends 26A 26B are shown in Figure 2, the present invention also encompasses the presence of three or more front ends 26. The invention, described in Figures 2, shows the front ends 26A 26B being switched at an intermediate frequency. It is to be understood that the front ends 26A 26B can also be switched at radio frequency. One beneficial embodiment includes front ends 26 having frequency ranges of 2400 MHz to 2500 MHz and 5725 MHz to 5875 MHz.
[0035] Each front end 26A 26B comprises a respective mechanical or passive electrical first band pass filter 28A 28B which limits unwanted signals presented to a respective low noise amplifier (LNA) 30A 30B which receives an automatic gain control signal (LNA GAIN CNTL) from a processor 32, whose function is further described below. After the respective low noise amplifiers 30A 30B, the respective signals are provided to a second respective band pass filter 34A 34B and then to a respective radio frequency mixer 36A 36B which is provided with a respective beat frequency oscillation from a respective radio frequency variable frequency oscillator (RF VCO) 38A 38B, each controlled by a respective synthesiser 40A 40B which, in turn, derives its frequency reference from a respective crystal oscillator (TCXO) 42A 42B. The respective radio frequency mixers 36A 36 B each generate an intermediate frequency centred on 280MHz which is filtered by respective third band pass filters 44A 44B. This choice of intermediate frequency ensures acceptable radio super heterodyne image rejection.
[0036] Each front end 26A 26B further comprises a respective intermediate frequency variable frequency oscillator (IF VCO) 46A 46B, used, as later described, to beat the intermediate frequency signal down to base band, and locked in sympathy with their respective radio frequency variable frequency oscillators 38A 38B at twice the intermediate frequency for phase and quadrate demodulation, as described below.
[0037] The outputs of the respective third band pass filters 44A 44B are coupled as respective first and second inputs to a first intermediate frequency switch 48, operated by the controller 32 (via signal X) to select either the output of the first front end 26A, or the output of the second front end 26B, for provision to a fourth band pass filter 50 whose output provides input to an intermediate frequency stage 52 at a second gain controlled amplifier 54 which in turn provides input to a phase demodulator 56 and a quadrate demodulator 58. Phase and quadrate demodulation are here used together to improve the signal to noise ratio and resolution over that which would be obtained using a single demodulator,
[0038] The output of the first front end intermediate frequency variable frequency oscillator 46A is coupled as a first input to a second intermediate frequency switch 60. The output of the second front end intermediate frequency variable frequency oscillator 46B is coupled as a second input to the second intermediate frequency switch 60. The second intermediate frequency switch 60 is controlled by the processor 32 (via signal

X) in sympathy with the first intermediate frequency switch 48 such that, when the output from the first front end 26A is coupled as the input to the fourth band pass filter 50, the output from the first front end intermediate frequency variable frequency oscillator 46A is coupled as the output of the second intermediate frequency switch 60, and when the output of the second front end 26B is coupled as the input to the fourth band pass filter 50, the output of the second front end intermediate frequency variable frequency oscillator 46B is coupled as the output of the second intermediate frequency switch 60. The front ends 26A 26B thus provide their respective outputs, together with the outputs of their respective intermediate frequency variable frequency oscillators 46A 46B, in turn, to the intermediate frequency stage as the controller 32 causes switching between them (via signal X).

[0039] The output of the second intermediate frequency switch 60 is first divided by two at 62 to bring it down to the intermediate frequency and reduce oscillator phase noise and then provided directly as input to the phase demodulator 56, and, after a ninety degree phase shift 64, as input to the quadrate demodulator 58. The phase and quadrate demodulators each beat the intermediate frequency down to base band with a spectrum stretching from DC to 8.8 MHz. The outputs of the phase 56 and quadrate 58 demodulators are provided as input to respective low pass filters 66A 66B each with cut off frequency of 8.8 MHz, and thence as input to respective phase 68A and quadrate 68B analogue to digital converters whose outputs, a sequence of digital representations of the instant amplitude of their analogue inputs, are coupled as selectable inputs to the bus of the processor 32.

[0040] An analogue indication of the coarse received signal strength (RSSI), as determined by the measurement of current passing through the second gain control amplifier 54, is converted by a signal strength analogue to digital converter 70 into digital form, in turn coupled as a selectable input to the bus of the controller 32.

[0041] Bus buffers 72 receive and hold instructions from the bus of the controller 32, in particular the gain control signal (LNA GAIN CTRL) for the respective low noise amplifiers 30A 30B in the front ends 26A 26B, and the control signal (X) for the first 48 and second 60 intermediate frequency switches. The buffers 72 also allow the processor 32 to control the camera 24 to trigger image acquisition, to add information to the image, and to receive a representation of the acquired image, from the camera 24, for onward transmission, by a communications interface 74, also on the buffers of the processor 32 to another location. It is to be understood, in the description of Figure 2, of Figure 3, and in the following claims, that the invention encompasses the processor 32 comprising a second processor, whose specified functions include image acquisition from the camera 24 and/or onward transmission of the image.The communications interface 74 can be for radio, landline or cable use, dependently upon the permanency and/or disposition of the site of use of the invention.

[0042] A gain control digital to analogue converter 76 receives a gain control digital signal from the bus of the controller 32 to control the gain of the second gain control amplifier 54. Finally, non-volatile read only memory (EPROM) and random access memory (NVRAM) are coupled to the processor 32 to provide the program and operational memory for the processor 32.

[0043] The action of automatic gain control from the processor 32 is best illustrated by an example of how the embodiment of Figure 2 can be made to perform. At a minimum input signal level of -110dBm, the system is "wide open" and maximum gain applied (around 80dB) between the antenna 14 and the processor. At -40dBm input, all intermediate frequency (IF) analogue gain control (in 54) is applied to minimise the gain of the second gain control amplifier 54. At -20dBm input, the low noise amplifier 30A 30B is bypassed (Odb gain). At -10dBm input, the second gain control amplifier 54 is bypassed to give an overall system gain of -10dB, which is still within the limit that the controller 32 can accept, and with acceptable signal to noise ratios at all levels to ensure linearity of processor 32 operation. By use of multiple gain control strategies, the system can operate over a very wide range of inputs, in this example, theoretically 100dB (and practically around 90dB). Put simply, this represents a power range of received signals having a ratio of ten billions to one over which the embodiment will operate.

[0044] While only two front ends 26A 26B have been shown in this example, it is to be appreciated that more than two front ends 26A 26B can be switched in the same manner for their received signals to be examined in turn. It is also to be appreciated that a front end 26A 26B can be switched between different antennae to scan different target areas in turn.

[0045] Attention is next drawn to Figure 3, showing a schematic diagram of the functional parts of a simplified, single band embodiment of the invention. Like numbers denote like elements, with any slight differences explained.

[0046] A third radio frequency front end 26C, the sole front end in this embodiment, has its first band pass filter 28C covering the range 800 MHz to 2700 MHz, thereby spanning the range of mobile telephone coverage, and other styles of service, mentioned in relation to Figure 2. Apart from the change in frequency range, all is as in the first and second front ends 26A 26B, with the exception that a simple diode detector 80, for preference a Schottky diode detector, in view of the high frequencies involved, acts as a direct demodulator. The receiver, in this instance, is not a super heterodyne receiver but a wide band "Tuned Radio Frequency" (TRF) receiver. The expense of variable frequency oscillators 46A 46B 38A 38B, radio frequency mixers 36A 36B, phase locked loop components 40A 40B 42A 42B and demodulator components 62 64 56 58 is avoided. The signal

strength digital to analogue converter 70A derives its analogue input, in this instance, directly from the diode detector 80, and only a single signal digital to analogue converter 68C provides input to the processor 32 bus, after an analogue processing stage 82 has modified the output from the diode detector 80. The receiver of Figure 3 needs no alignment and can be accommodated on a single, compact circuit card.

[0047] The analogue processing stage 82 comprises base band filters, which limit noise, and can comprise autonomous automatic gain control stages to control the level of signal presented to the input of the signal analogue to digital converter 68C. The processor 32 is a digital signal processor and, when the Received signal strength indication (RSSI) from the signal strength digital to analogue converter 70A exceeds a predetermined limit, the processor 32 performs a Fast Fourier Transform (FFT) on the output data stream from the signal analogue to digital converter 68C to establish the spectrum of the signal arriving at the antenna 14, The processor 32 then compares the spectrum with different types of spectrum which belong to a set of spectral types which would cause the camera 24 to trigger. If a match is found, the camera 24 is triggered. The processor 32, in Figure 2, can operate in the same manner, though it is to be appreciated that any system of operation for the processor 32 which permits identification of at least one type, or of several types, of signal , can be applied in the present invention. For example, it may be sufficient to identify TDMA (Time Division Multiple Access) transmission slots to establish the use of a GSM style mobile telephone.

[0048] Attention is now drawn to figure 4, which shows a flow chart of the activity of the processor 32, applicable to both Figures 2 and 3.

[0049] In a first activity 84, the receiver simply scans the band or bands for signals. In the case of the Figure 2 embodiment, the controller 32 operates the intermediate frequency switches 48 60 to look at the signals from each front end 26A 26B in turn. In the case of the Figure 3 embodiment, the processor 32 can scan the output of the analogue processor stage 82, or simply wait for activation. A first test 86 has the processor 32 examine the output from the signal strength analogue to digital converter 70 70A. If a predetermined amplitude limit has not been exceeded, control passes back to the first activity. If the predetermined limit if received signal strength indication (RSSI) has been exceeded, control passes to a second activity 88 where the controller 32 examines the base band signal presented to its bus to determine the nature of the signal being received. In the case of the Figure 2 embodiment, the processor 32 created the vector sum of the outputs of the phase demodulator 56 and the quadrate demodulator 58 to give an enhanced signal to noise ration, and examines the result. In the case of the Figure 3 embodiment, the processor 32 examines only the output of the analogue processing stage 82. A second test 90 then checks to see if a match can be found between the type of signal being received and any targeted type of signal for which the camera 24 should be activated. If no match is found, control returns to the first activity 84. If a match is found, control passes to a third activity 92 where the processor 32 triggers the camera 24, appends any details to the image, and subsequently transmits the image to another place, while, for preference, retaining a permanent record of the image. Control then passes back to the first activity 84.

[0050] During the third activity 92, the nature of the image can take many forms. If the camera 24 is a speed detection camera, details of the vehicle velocity will automatically be appended without intervention by the processor 32, thereby showing that the vehicle was in motion. If the camera 24 is not a speed detection camera, the image can comprise two or more frames taken at known intervals to demonstrate that the vehicle was in motion against a fixed background. In the final instance, the image can comprise a series of frames, in the form of a video image. When linked to a video camera in an enforcement vehicle, or on a video surveillance camera, the triggering of the camera can take the form of marking frames of video footage, if the camera is running, to show that mobile communications are in progress, together with starting the camera if it happens not to be running at the time.

[0051] Attention is next drawn to Figure 5, showing one way in which a portable version of the invention can be implemented.

[0052] A housing 94, comprising a pistol grip 96 for an operator to hold and aim the device and having a trigger 98 for the operator to activate the device, serves as a mounting for a directional antenna 14 and a camera 24, looking past but in the same direction as the directional antenna 14. The housing also incorporates one or other of the embodiments of Figure 2 or Figure 3. In use, the operator simply points the directional antenna 14 into the path of an oncoming vehicle and, if mobile communications activity is detected, the camera 24 is activated. The image can then be sent to another place via a radio link antenna 100.

[0053] For the purpose of clarity and completeness, the items indicated AL in Figure 2 and 3 are amplitude limiters, whose function is solely to protect against excessive signals or transients damaging the receiver (s).

[0054] The invention is further clarified by the following claims.

Claims

1. An apparatus for providing evidence of use of mobile communications in a vehicle, **characterised in that** there is provided: a monitor (14) for monitoring emission of radio signals from the vehicle and operative to provide output indicative thereof; a controller (26,32), coupled to receive said output from

said monitor and operative to determine whether or not emitted radio signals, from the vehicle, have characteristics indicative of at least one type, from a predetermined set of types, of mobile communications activity is in progress in the vehicle; and a camera, (24) operative to acquire an image of the vehicle, and coupled to be triggered by said controller (32) in the event that said controller determines that said at least one type of mobile communications activity is in progress in the vehicle.

2. An apparatus, according to claim 1, wherein said monitor (14) comprises a directional antenna (14) to be aimed at the vehicle, and a radio receiver (26,32,52), operative to receive signals from said antenna and to demodulate and measure the strength of signals from said antenna.

3. An apparatus, according to claim 2, wherein said controller (32) is operative to respond to the indication of measured strength of the signal from said antenna (14) to determine, in a first stage (84,86), by a first criterion, if a predetermined signal strength has been exceeded (86); and, if said predetermined signal strength has been exceeded, is operative, in a second stage (88), to analyse the demodulated signal to determine the nature of the signal and to determine, by a second criterion, if the signal belongs to said at least one type of said predetermined set of types of mobile communications activity , said controller (32) triggering said camera (24) if said first and second criteria are fulfilled.

4. An apparatus, according to claim 2 or claim 3 wherein said receiver (26,32,52) comprises plural automatic gain control amplifier stages (30) for accommodating a wide range of signal strengths from said antenna (14).

5. An apparatus, according to claim 4, wherein said controller (32,72) is operative to control the gain of at least one of said stages.

6. An apparatus, according to claim 2, 3 or 4 wherein said receiver is band limited (26c) to receive only that band or those bands of radio signals wherein said predetermined set of types of mobile communications activity are expected to occur.

7. An apparatus, according to claim 1, 2, 3, 4, 5 or 6, wherein said controller (32), when triggering said camera (24), is operative (72,74) to append details to the acquired image, indicative of the type and time of detected radio communications activity.

8. An apparatus, according to claim 1, 2, 3, 4, 5, 6, or 7 wherein said apparatus is portable (94) and wherein said antenna (14) can be pointed into the path of an oncoming vehicle.

9. An apparatus, according to claim 2, 3, 4, 5, 6, 7 or 8 wherein said antenna (14) is adapted for suspension above a road surface.

10. An apparatus, according to claim 1, 2, 3, 4, 5, 6, 7, 8 or 9 wherein said camera (24) provides a secondary function as a roadway speed detection camera.

11. An apparatus, according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 wherein said predetermined set of types of radio communications activity includes the use of one or more types of mobile telephone.

12. An apparatus, according to claim 11, wherein said one or more types of mobile telephone include one or more of those operating with TDMA, CDMA, GSM, DCS, PCS, NADC, AMPS, TACS, CDPD, DECT or ISM..

13. An apparatus, according to claim 6, or according to claim 7, 8, 9, 10, 11 or 12 when dependent upon claim 6, wherein said predetermined band or set of bands whereon said predetermined set of types of radio communications activity are expected to occur comprises a plurality of bands, and wherein said receiver is operative to switch (48,60) from one to another of said plurality of bands.

14. An apparatus, according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 or 13 wherein said controller (32) is operative to transmit the acquired image to a another location.

15. An method for providing evidence of use of mobile communications in a vehicle, characterised by the steps of: monitoring emission of radio signals from the vehicle (14,84) and providing output indicative thereof; examining (26,32,52,84,86) said output, indicative of radio emission from the vehicle and determining whether or not emitted radio signals, from the vehicle, have characteristics indicative of at least one type, from a predetermined set of types, of mobile communications activity being in progress in the vehicle; and acquiring an image (24,92) of the vehicle in the event that said at least one type of mobile communications activity is in progress in the vehicle.

16. An method, according to claim 15, wherein said step (16) of monitoring the vehicle includes the use a directional antenna (14) to be aimed at the vehicle, and the use of a radio receiver (26,32,52) to receive signals from said antenna (14) and to demodulate and to measure the strength of signals from said antenna

17. An method, according to claim 16, wherein said step of examining said output indicative of radio emissions includes the steps of: examining an indication of measured strength of the signal from said antenna and determining, in a first stage (84,86), by a first criterion, if a predetermined signal strength has been exceeded; if said predetermined signal strength has been exceeded, in a second stage (88,90), analysing the demodulated signal to determine the nature of the signal and to determine, by a second criterion, if the signal belongs to said at least one type of said predetermined set of types of mobile communications activity; and acquiring (92,24) said image if said first and second criteria are fulfilled.

18. A method, according to claim 16 or claim 17, for use where said receiver (26,32,52) comprises plural automatic gain control amplifier stages (30) for accommodating a wide range of signal strengths from said antenna (14).

19. A method, according to claim 18, wherein said step of examining said outputs includes employing an analysis of said outputs to control the gain of at least one of said stages.

20. A method, according to any one of claims 16, 17 or 19, for use where said receiver is band limited (26c) to receive only that band or those bands of radio signals wherein said predetermined set of types of mobile communications activity are expected to occur.

21. A method, according to any one of claims 15 to 20, including the step (72,74) of appending details to the acquired image, indicative of the type and time of detected radio communications activity.

22. A method, according to any one of claims 15 to 21, for use in a portable apparatus (Figure 5) and wherein said antenna (14) can be pointed into the path of an oncoming vehicle.

23. A method, according to any one of claim 15 to 22, including the step of suspending said antenna above a road surface.

24. A method, according to any one of claims 15 to 23, wherein said step of acquiring said image includes use of a camera (24), where said camera provides a secondary function as a roadway speed detection camera.

25. A method, according to any one of claims 15 to 24, wherein said predetermined set of types of radio communications activity includes the signals emitted by of one or more types of mobile telephone.

26. A method, according to claim 25, wherein said one or more types of mobile telephone include one or more of those operating with : TDMA, CDMA, GSM, DCS, PCS, NADC, AMPS, TACS, CDPD, DECT or ISM..

27. A method, according to claim 20, or any one of claims 21 to 26 when dependent upon claim 20, wherein said predetermined band or set of bands (25A, 26B, 26C) whereon said predetermined set of types of radio communications activity are expected to occur comprises a plurality of bands, and wherein said step of monitoring emission of radio signals includes causing said receiver (48, 60) to switch from one to another of said plurality of bands.

28. A method, according to any one of claims 15 to 27, including the step (72,74) of transmitting the acquired image to a another location.

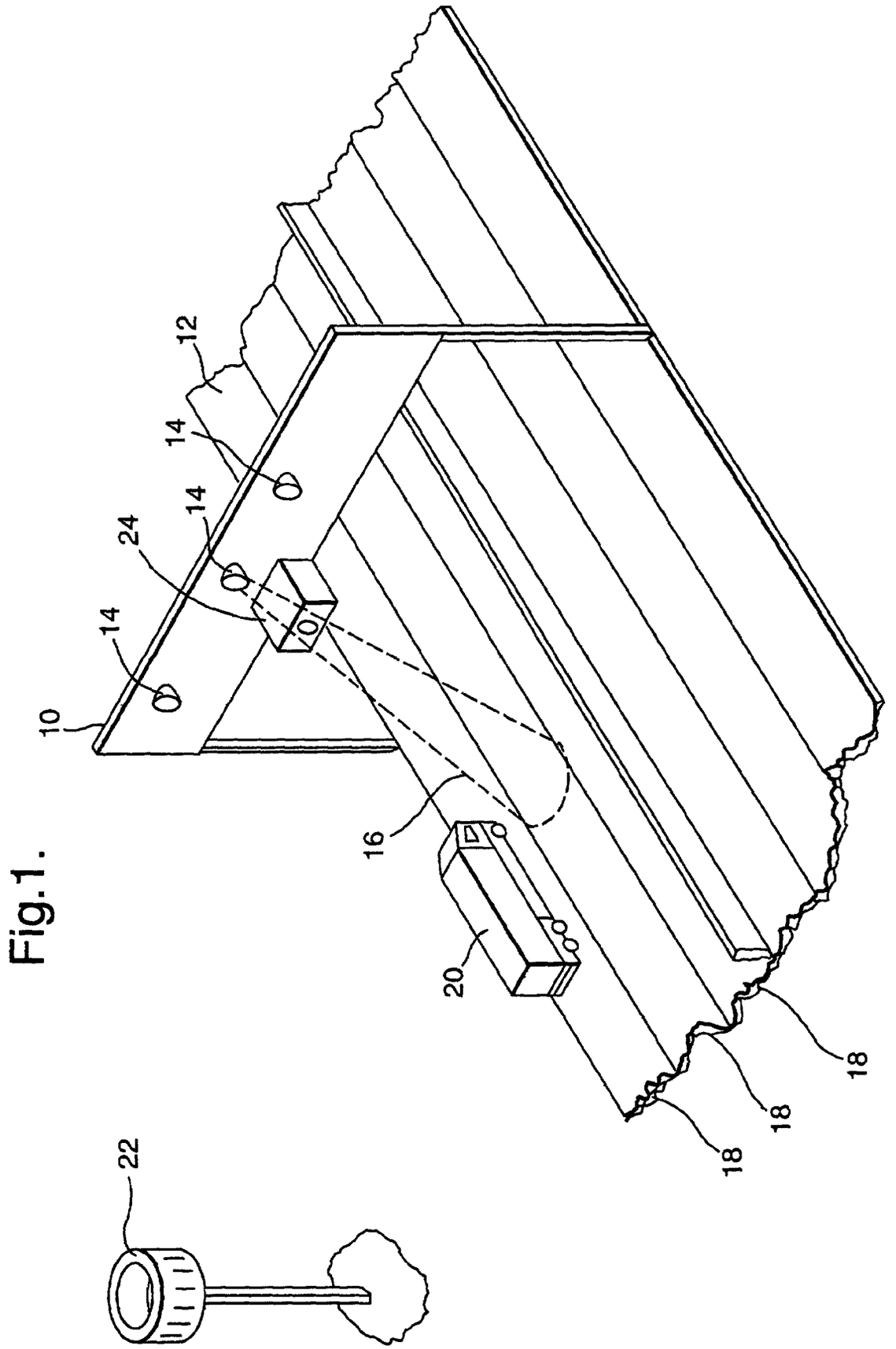

Fig.1.

Fig.2.

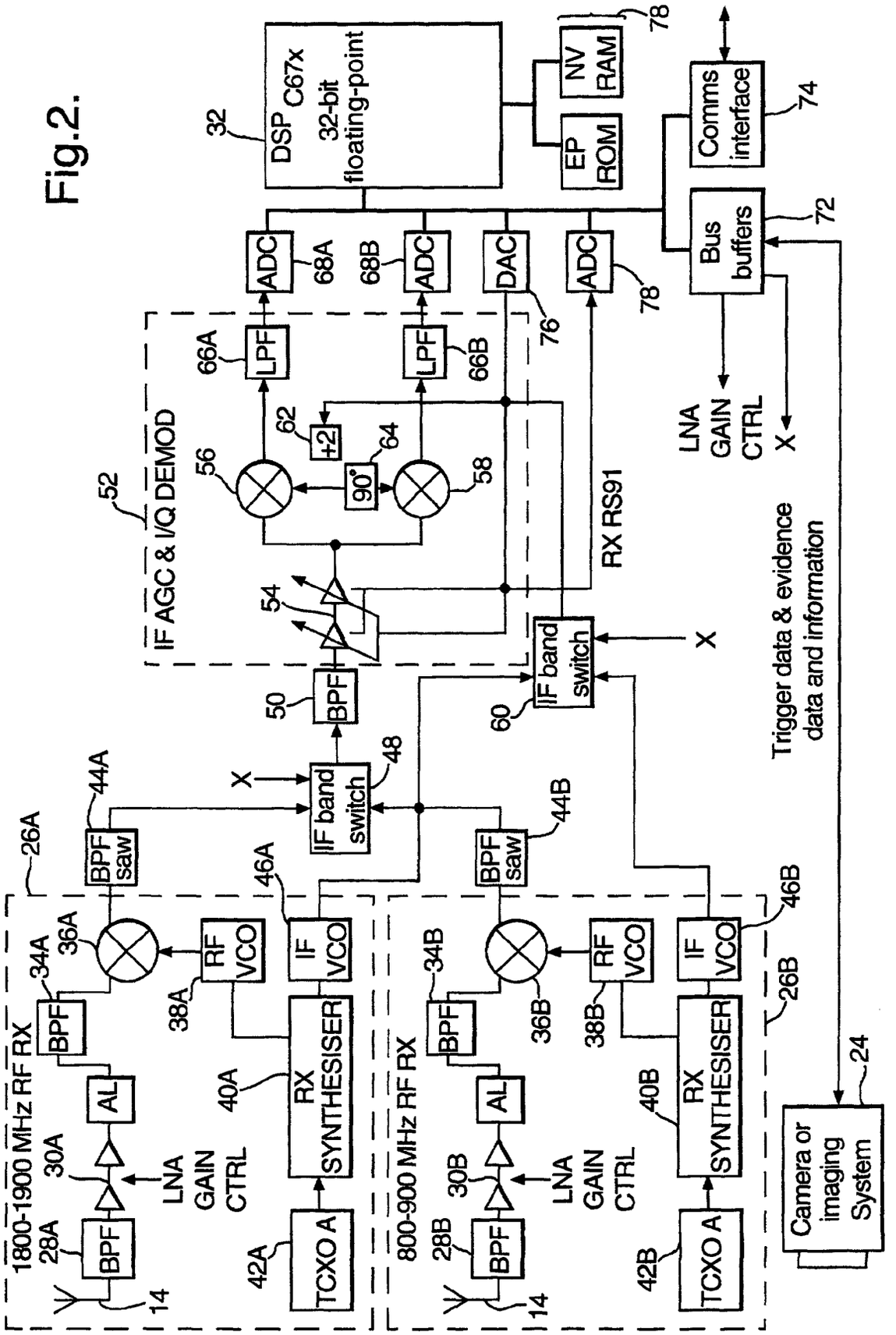
1800-1900 MHz RF RX
800-900 MHz RF RX
IF AGC & I/Q DEMOD
DSP C67x 32-bit floating-point
EP ROM
NV RAM
Comms interface
Bus buffers
ADC
DAC
LPF
BPF
BPF saw
AL
RF VCO
IF VCO
RX SYNTHESISER
TCXO A
IF band switch
LNA GAIN CTRL
RX RS91
Trigger data & evidence data and information
Camera or imaging System
90°
±2

Fig.3.

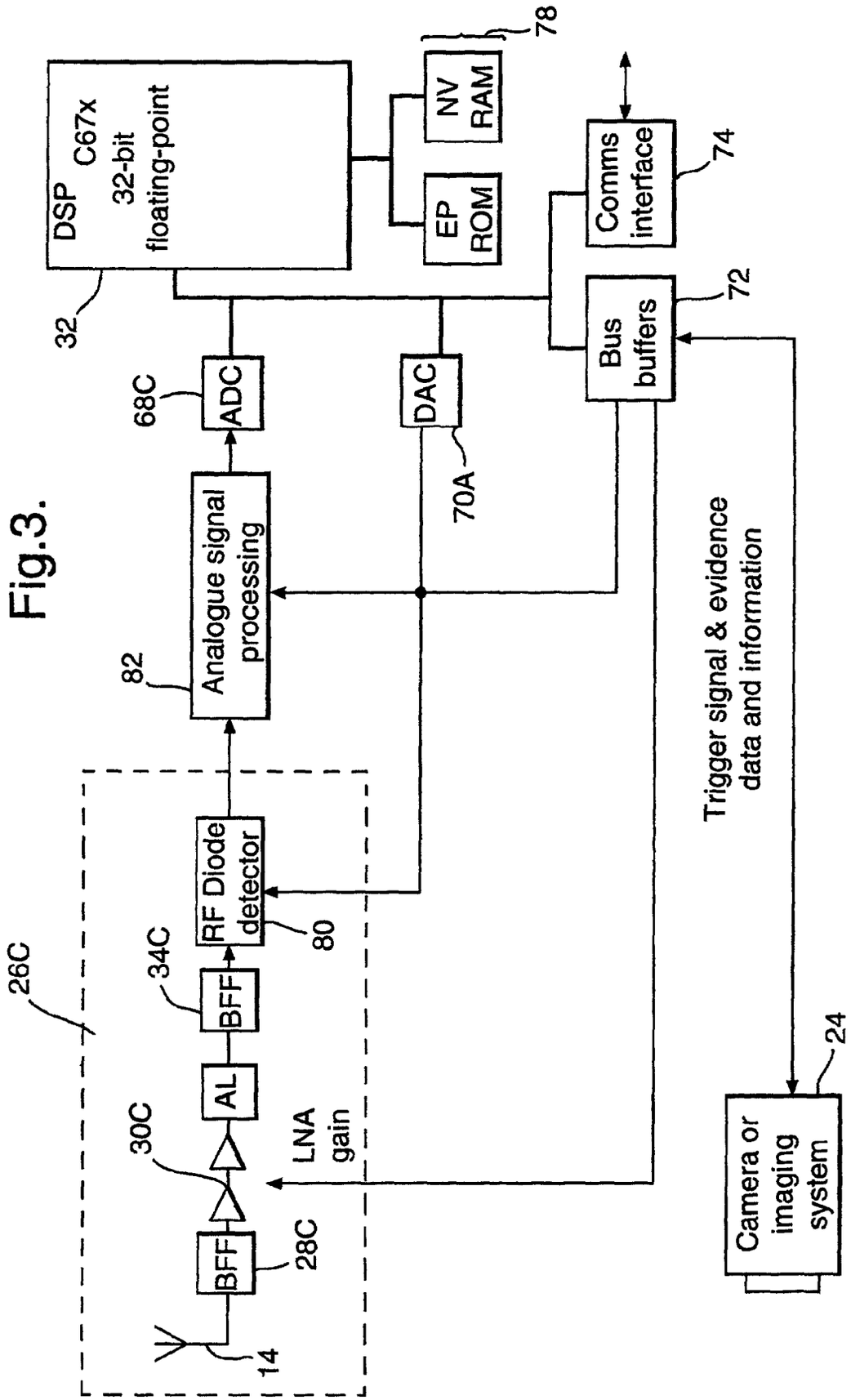
DSP C67x 32-bit floating-point
32
NV RAM
EP ROM
78
Comms interface
74
Bus buffers
72
ADC
68C
DAC
70A
Analogue signal processing
82
RF Diode detector
80
BFF
34C
AL
BFF
30C
28C
LNA gain
14
26C
Trigger signal & evidence data and information
Camera or imaging system
24

Fig.4.

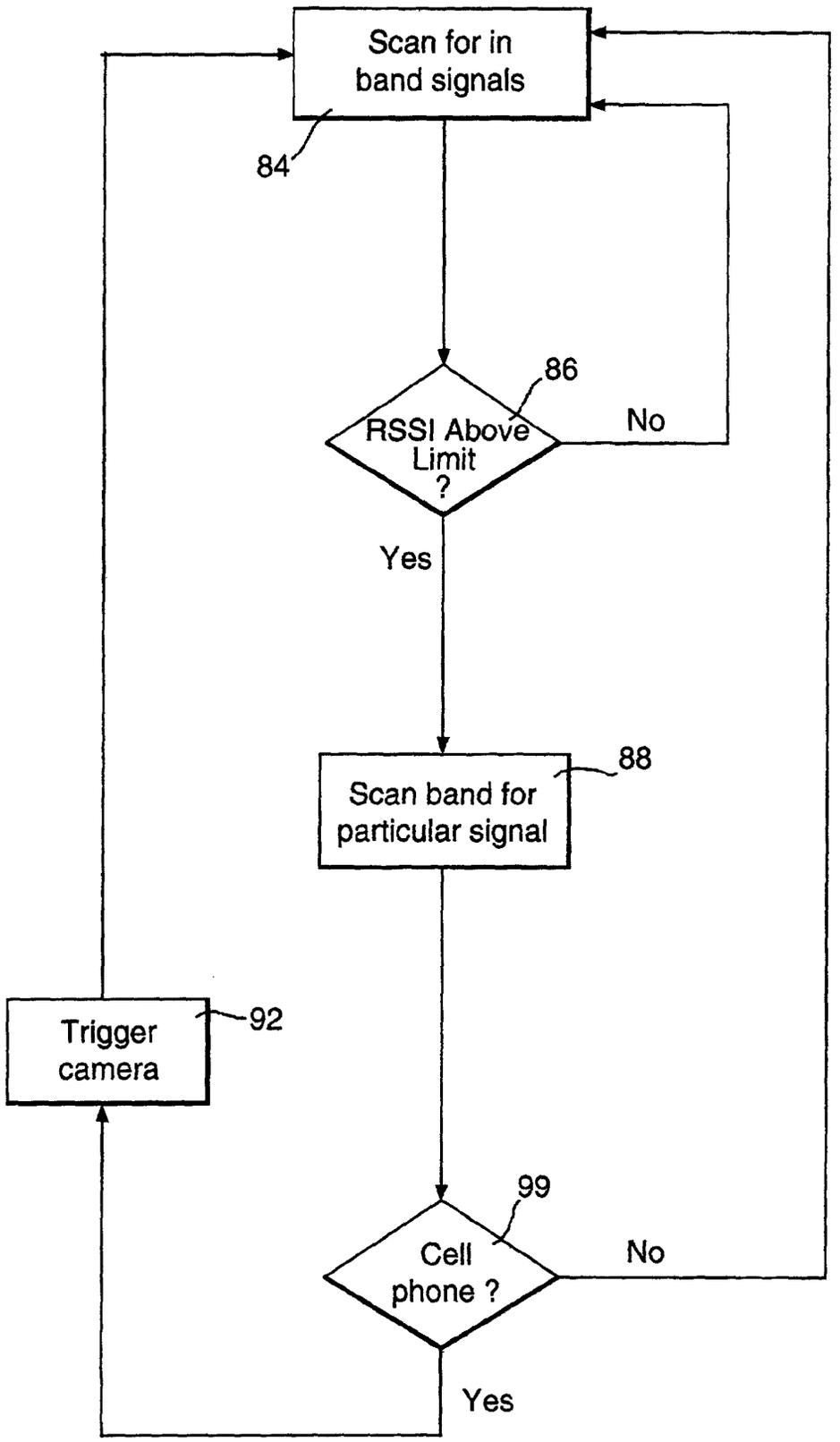
Scan for in band signals
84
86
RSSI Above Limit ?
No
Yes
88
Scan band for particular signal
92
Trigger camera
99
Cell phone ?
No
Yes

Fig.5.