(12) UK Patent Application (19) GB (11) 2 260 878 (13) A

(43) Date of A publication 28.04.1993

(21) Application No 9221436.0

(22) Date of filing 13.10.1992

(30) Priority data
(31) 779991 (32) 21.10.1991 (33) US

(71) Applicant
Ericsson Ge Mobile Communications Inc

(Incorporated in the USA - Delaware)

15 East Midland Avenue, Paramus, New Jersey 07652, United States of America

(72) Inventor
Raymond C Henry Jr

(74) Agent and/or Address for Service
Haseltine Lake & Co
Hazlitt House, 28 Southampton Buildings, Chancery Lane, London, WC2A 1AT, United Kingdom

(51) INT CL[5]
H04Q 7/04

(52) UK CL (Edition L)
H4K KYX KY4M

(56) Documents cited
GB 2253967 A

(58) Field of search
UK CL (Edition K) H4K KYA KYR KYX
INT CL[5] H04Q

# (54) Hands-free call answering system

(57) A hands-free call answering system without voice recognition includes a radio receiver 10 for receiving an incoming call, an alert generator 60 for generating an alert tone, a microphone 20 responsive for receiving the call recipient's voice input and an audio detector 25 for detecting whether there is a change in audio signal strength, wherein if a change is detected the call is answered and two way communication is enabled. The audio detector includes a bandpass filter and a comparison circuit for detecting whether the call has been answered.

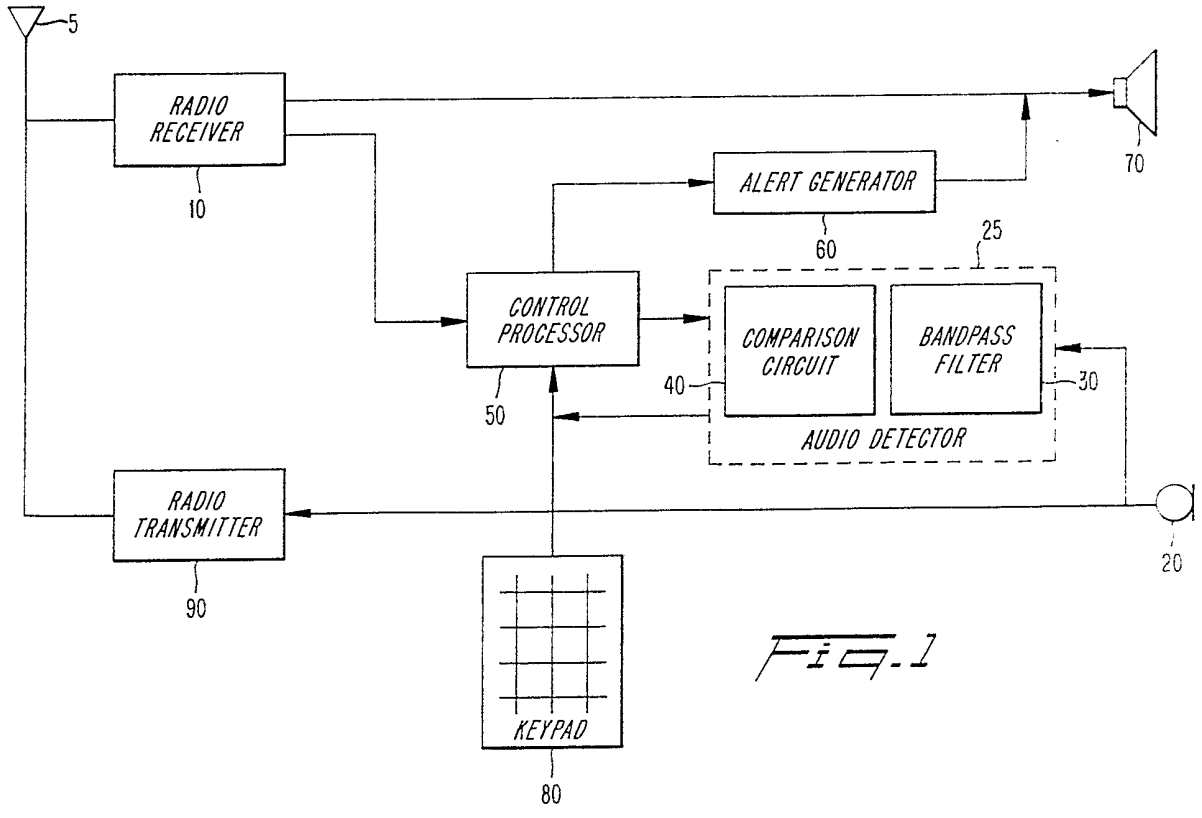


Fig.1

GB 2 260 878 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

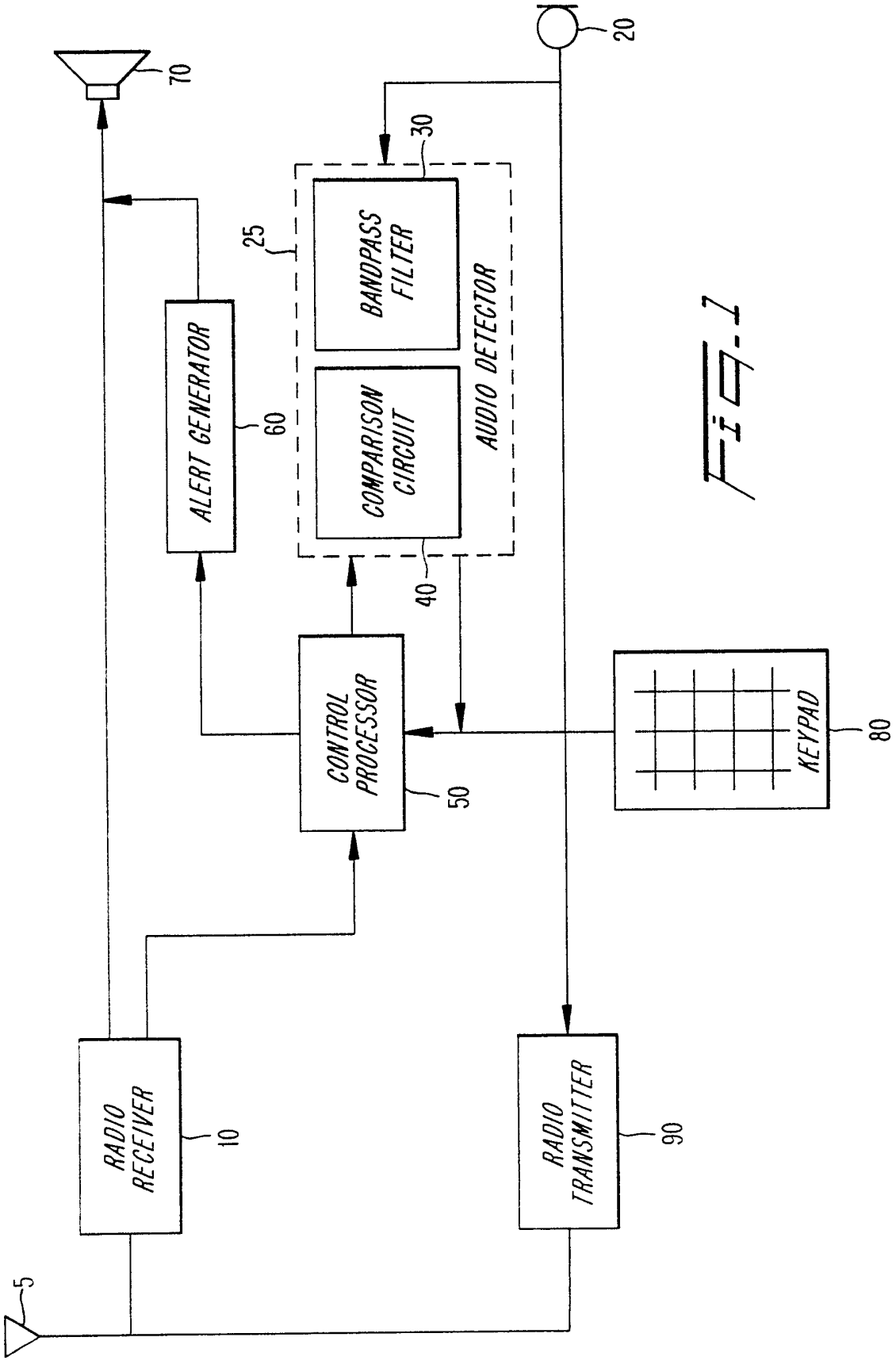
70
20
30
25
BANDPASS FILTER
COMPARISON CIRCUIT
AUDIO DETECTOR
ALERT GENERATOR
60
40
CONTROL PROCESSOR
50
KEYPAD
80
RADIO RECEIVER
10
RADIO TRANSMITTER
90
5

Fig. 1

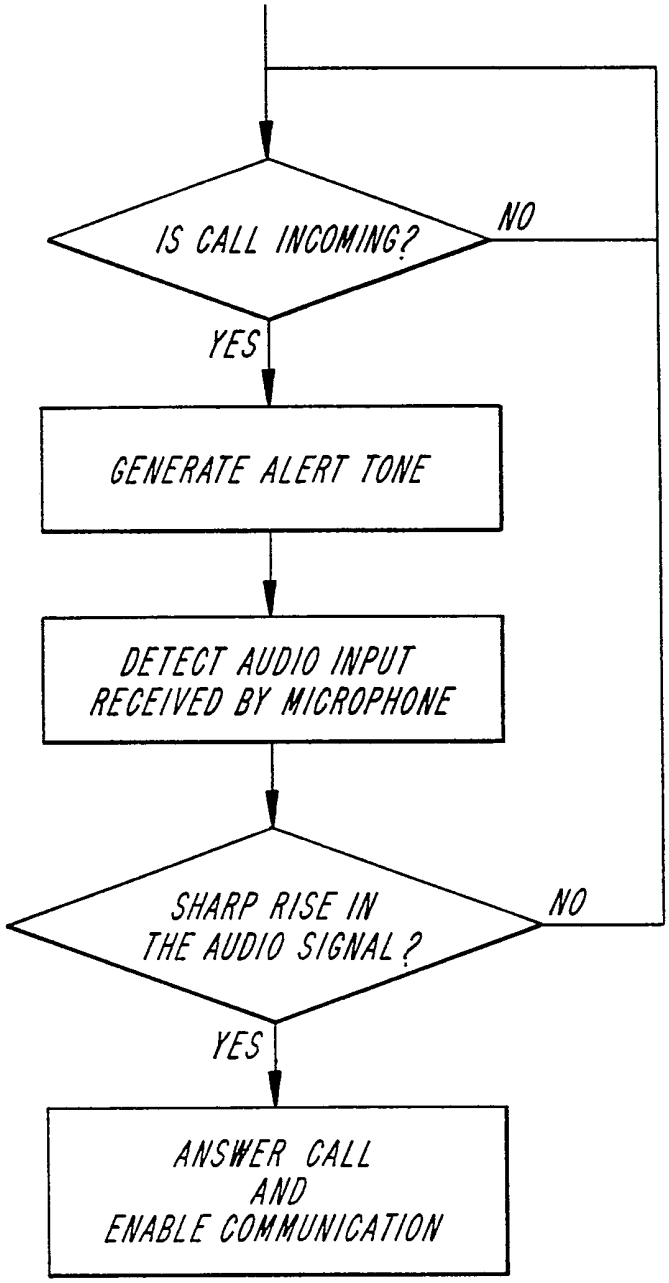
IS CALL INCOMING?
NO
YES
GENERATE ALERT TONE
DETECT AUDIO INPUT RECEIVED BY MICROPHONE
SHARP RISE IN THE AUDIO SIGNAL?
NO
YES
ANSWER CALL AND ENABLE COMMUNICATION

Fig. 2

# MOBILE TELEPHONE HANDS-FREE ANSWERING SYSTEM

## FIELD OF THE INVENTION

The present invention relates to telephone systems, and more particularly to a mobile telephone hands-free answering system without voice recognition.

## BACKGROUND OF THE INVENTION

One of the problems associated with mobile telephone systems has been the distraction of a motor vehicle operator when the operator answers a call while driving the vehicle. In particular, to answer an incoming call, a motor vehicle operator has to either pick up a telephone receiver or depress a button. In either event, the attention of the operator, particularly their hands and vision have been directed to answering the call.

As a result, for a relatively short period of time, the vehicle operator is not wholly focussing on operation of their vehicle. Even such a brief diversion can lead to the operator getting in an accident. Thus, the probability of an accident is increased when a vehicle operator answers an incoming call. Similar problems occur when a user has to input a number into a telephone keypad to place a call.

The current solution to the aforementioned problem is the use of hands-free telephone systems with control systems responsive to the human voice. Voice recognition systems are currently utilized by several companies in the mobile telephone manufacturing industry. These systems are expensive and quite complex.

Further, the use of voice recognition systems for answering calls involves several obstacles. Reliable voice control is particularly difficult to maintain in an environment such as an automobile where a considerable amount of extraneous noise is present. Additionally, the

microphone is typically located some distance from the user's mouth, for example on the overhead sun visor. As a result, the required microphone sensitivity to hear the operator's speech also picks up a substantial amount of background noise and interference.

The present invention solves the aforementioned problems by providing a hands-free call answering system which does not incorporate complex and expensive voice recognition systems. Instead, when a call is incoming to a vehicle operator, an alert tone is generated and a hands-free microphone is activated. The microphone is operable to receive audio transmission and upon reception of a sharp increase in sound answers the call. The sharp increase in sound functions as a substitute for pressing a button on a telephone keypad to answer a call.

**SUMMARY OF INVENTION**

The present invention is a system and method for hands-free answering a telephone call in mobile phone applications without using a voice recognition circuit. The system includes a means for receiving an incoming call, a means for generating an alert tone for a prescribed period when the incoming call is received, a microphone for receiving an audio signal during the alert tone and an audio circuit connected to the microphone for monitoring the audio input signal to detect a marked change in the audio signal input. When a change is detected the incoming call is answered. The alert tone includes a one second ringing sound followed by three seconds of silence. In one embodiment, the audio circuit filters the audio signal to a prescribed bandwidth. The filtered audio signal is monitored and when a sharp increase is detected in that signal, the call is then answered. In another embodiment a digital signal

processor can be applied to perform the operation of the aforementioned audio circuit.

The method of answering a call includes receiving an incoming call, generating an alert tone, and receiving an audio signal during the alert tone. The audio signal is monitored and when a change is detected in the level of the audio signal, the system responds by answering the detected incoming call.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described in more detail with reference to preferred embodiments of the invention, given only by way of example, and illustrated in the accompanying drawings, in which:

FIG. 1 is a block diagram illustrating an embodiment of the present invention.

FIG. 2 is a flow chart representation of an exemplary embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a block diagram illustrating the elements in the mobile hands-free telephone answering system of the present invention. According to the present invention when a call is transmitted to a mobile unit, an antenna 5 passes the call to a radio receiver 10 to receive the incoming call signal. Once a call is received, the receiver 10 transmits a data signal to a control processor 50 which instructs an alert generator 60 to generate an alert tone. The alert tone, a ringing sound followed by a period of silence, is sent to speaker 70 where it is output to inform the call recipient, for example the driver of a vehicle where the mobile unit is located, that a call is incoming.

The alert tone can last any desired duration, however the present Bell telephone mobile specifications call for

a one second ringing, an "on" period, followed by three seconds of silence, an "off" period. The control processor 50, connected with the alert generator 60 controls the duration of the alert tone including the "on" and "off" periods. The alert tone is continually regenerated until one of two events occurs. In one instance the call may not be answered, i.e. the operator of the vehicle is not present when the call is being made and the caller discontinues the call. The other possibility is that the vehicle operator has attempted to answer the call.

During the silent portion or "off" period of the alert tone, the control processor 50 instructs audio detector 25 to listen to hands-free microphone 20. If the desired audio input is not received during the "off" period, the alert tone is repeated with the ringing sounding followed by a period of silence, until either the call is answered or the caller disconnects after having the call not answered. If during the "off" period of the alert tone, the call recipient makes an audible sound, the two parties, the caller and the party being called, are connected, and the call is answered.

The microphone 20 is connected with audio detector 25. Audio detector 25 includes a bandpass filter 30 and a comparison circuit 40. The bandpass filter 30 filters the audio input signals received by the microphone 20 during the "off" period to within a particular bandwidth $F_A$ hertz. In a preferred embodiment, the activation frequency range corresponds to limit the audio input only to frequencies associated with the human voice. The range can either be a fixed range or a programmable dynamic range. If dynamic, the user can adjust the range during system operation. The effect of background noise can be minimized by using a smaller bandwidth, however, the call recipient's response must be more accurate.

The bandpass filter 30 transmits the filtered signal to a comparison circuit 40 which monitors the audio input signals. The comparison circuit 40 compares the filtered audio input signal with the rise-time threshold $T_R$ seconds and a level-peak threshold value $T_L$ volts. The threshold limit $T_L$ is a relative value with respect to a reference level based on the amount of ambient or background noise inherent in the environment. The reference level may be detected just prior to the initial ringing phase of the alert tone by sampling the microphone 20 to determine the amount of ambient noise present. When the comparison circuit 40 is detecting whether the call recipient is responding to the call, the detected level is compared with the reference level. The difference between the two levels is compared to determine if the threshold limit $T_L$ has been exceeded. The threshold limit can be fixed or dynamic and programmable by the call recipient by, for example, entering a different threshold through keypad 80. Likewise, the rise time $T_R$ may also be fixed or dynamic. The duration of the rise time is set such that the energy detected corresponds to a human voice, thus eliminating detection of bangs, pops and other noises.

When both $T_R$ and $T_L$ are exceeded, a sharp rise in the audio signal and a simultaneous level change are respectively detected. This indicates that the call recipient is attempting to answer the call. Upon occurrence of this event, the comparison circuit 40 generates a trigger signal and transmits that signal to the control processor 50 which enables the call to be answered, i.e. two way communication is enabled between the caller and the call recipient. FIG. 2 is a flow chart representative of the operation of the system as described above.

Also, if the call recipient chooses, the call may be answered by the conventional keypad method as well whereby

the call recipient depresses a key or keys on the keypad 80 and that signal is transmitted to the control processor 50 to enable the call to be answered.

When a call is answered, incoming audio (voice) signals are received by radio receiver 10 and output by speaker 70. Outgoing audio (voice) signals are spoken into microphone 20 and sent to radio transmitter 90 which sends those signal to the caller through antenna 5.

While the invention has been described in its preferred embodiments, it is to be understood that the words that have been used are words of description rather than of limitation and that changes within the purview of the appended claims may be made without departing from the true scope and spirit of the invention in its broadest aspects.

**CLAIMS:**

1. An answering system for a telephone comprising:

receiving means for receiving an incoming call;

control means for generating an alert signal when said incoming call is received;

a microphone for receiving an audio input signal; and

audio detection means responsive to said control means for comparing said audio input signal during the alert signal to at least one threshold wherein if each threshold is exceeded said system answers said incoming call.

2. An answering system for a telephone as recited in claim 1 further including a generator for generating an alert tone.

3. An answering system for a telephone as recited in claim 2 wherein said alert tone includes a one second ringing sound followed by a three second silent period.

4. An answering system for a telephone as recited in claim 3 wherein said audio detection means compares the audio input signal with each threshold during the silent period of the alert tone.

5. An answering system for a telephone as recited in claim 1 wherein said audio detection means further includes:

filtering means for filtering said audio input signal to a prescribed bandwidth;

comparing means for comparing each threshold with said filtered audio signal; and

triggering means responsive to said comparing means for triggering said system to answer to said incoming call when each threshold is exceeded.

6. An answering system for a telephone as recited in claim 5 wherein said prescribed bandwidth is within a frequency range corresponding to a human voice.

7. An answering system for a telephone as recited in claim 6, said comparing means further including:

level sensing means for determining whether the filtered signal exceeds a threshold limit; and

rise time sensing means for determining whether the filtered signal corresponds to a rise time associated with the human voice.

8. An answering system for a telephone as recited in claim 7 wherein the threshold limit and the rise time are programmable.

9. An answering system for a telephone as recited in claim 8 wherein the threshold limit is relative to a sampled noise signal corresponding to detected background noise.

10. An answering system for a telephone comprising:

receiving means for receiving an incoming call;

control means for generating an alert signal when said incoming call is received;

a microphone for receiving an audio input signal; and

signal processing means for filtering said audio input signal to a prescribed bandwidth and monitoring said audio signal to detect a substantial increase in said filtered audio signal strength and enabling said system to

answer said incoming call following said substantial increase in said filtered audio signal.

11. An answering system for a telephone as recited in claim 10 further including a generator for generating an alert tone.

12. An answering system for a telephone as recited in claim 11 wherein said alert tone includes a one second ringing sound followed by a three second silent period.

13. An answering system for a telephone as recited in claim 12, wherein said signal processing means compares said audio input signal to each threshold during the silent period of the alert tone.

14. An answering system for a telephone as recited in claim 10 wherein said prescribed bandwidth is within a frequency range corresponding to a human voice.

15. An answering system for a telephone as recited in claim 14, said signal processing means further including:

level sensing means for determining whether the filtered signal exceeds a threshold limit; and

rise time sensing means for determining whether the filtered signal corresponds to a rise time associated with the human voice.

16. An answering system for a telephone as recited in claim 15 wherein the threshold limit and the rise time are programmable.

17. An answering system for a telephone as recited in claim 15 wherein the threshold limit is relative to a

sampled noise signal corresponding to detected background noise.

18. A method for answering a telephone comprising the steps of:

receiving an incoming call;

generating an alert signal when said incoming call is received;

receiving an audio input signal during said alert signal;

comparing said received audio signal with at least one threshold; and

answering said incoming call if said audio signal exceeds each threshold.

19. A method as recited in claim 17 wherein said step of generating an alert signal further includes the step of generating an alert tone including a one second ringing sound followed by a three second silent period.

20. A method as recited in claim 19 wherein said step of comparing occurs during the silent period of the alert tone.

21. A method as recited in claim 20 wherein said step of receiving said audio input signal further includes the step of filtering said audio signal to a prescribed bandwidth.

22. A method as recited in claim 21, said step of comparing including the step of triggering said system to answer said incoming call when each threshold is exceeded.

23. A method as recited in claim 22 wherein said prescribed bandwidth is within a frequency range corresponding to a human voice.

24. A method as recited in claim 23, said step of comparing further includes the steps of:

comparing the filtered signal to a level threshold limit; and

determining whether a rise time of the filtered signal corresponds to a rise time associated with the human voice.

25. A method as recited in claim 24, wherein the threshold limit and the rise time associated with the human voice are programmable.

26. A method as recited in claim 25 wherein the threshold limit is relative to a sampled noise signal corresponding to detected background noise.

27. An answering system for a telephone, substantially as herein described with reference to, and as shown in, the accompanying drawings.

28. A method for answering a telephone, substantially as herein described with reference to the accompanying drawings.

**atents Act 1977**
**Examiner's report to the Comptroller under Section 17 (The Search Report)**

Application number

GB 9221436.0

**Relevant Technical fields**

(i) UK Cl (Edition K ) H4K KYA KYR KYX

(ii) Int Cl (Edition 5 ) H04Q

Search Examiner

AL STRAYTON

**Databases** (see over)

(i) UK Patent Office

(ii)

Date of Search

26 NOVEMBER 1992

Documents considered relevant following a search in respect of claims ALL

| Category (see over) | Identity of document and relevant passages | Relevant to claim(s) |
|---|---|---|
| E X | GB 2253967 A entire document | 1, 2, 18 |

| Category | Identity of document and relevant passages | Relevant to claim(s. |
|---|---|---|
| | | |

## Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

**Databases:** The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

Published 1993 at The Patent Office, Concept House, Cardiff Road, Newport, Gwent NP9 1RH. Further copies may be obtained from Sales Branch, Unit 6, Nine Mile Point, Cwmfelinfach, Cross Keys, Newport, NP1 7HZ. Printed by Multiplex techniques ltd, St Mary Cray, Kent.