IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
AUSTIN DIVISION

THE BOARD OF REGENTS OF THE UNIVERSITY OF TEXAS SYSTEM,	§	
Plaintiff,	§	
v.	§	NO. A:05CA198 SS
ALCATEL,	§	JURY DEMANDED
AMOI ELECTRONICS, INC.,	§	
ARIMA COMMUNICATION CORP.,	§	
AUDIOVOX COMMUNICATIONS CORP.,	§	
CHI MEI COMMUNICATION SYSTEMS, INC.,	§	
COMPAL COMMUNICATIONS, INC.,	§	
CURITEL COMMUNICATIONS, INC.,	§	
HAIER GROUP CO.,	§	
HAIER AMERICA IMPORT L.L.C.,	§	
HAIER AMERICA TRADING L.L.C.,	§	
HON HAI PRECISION INDUSTRY CO., LTD.,	§	
MIO TECHNOLOGY CORP., USA,	§	
MIO TECHNOLOGY LTD.,	§	
MITAC HOUSTON SERVICE CENTER,	§	
MITAC INTERNATIONAL CORP.,	§	
MITAC INC.,	§	
MITAC USA, INC.,	§	
SHARP CORPORATION, a.k.a.	§	
SHARP KABUSHIKI KAISHA,	§	
TCL COMMUNICATION TECHNOLOGY	§	
HOLDINGS LIMITED,	§	
TCL & ALCATEL MOBILE PHONES LIMITED,	§	
VK CORPORATION,	§	
VK MOBILE USA, INC., AND	§	
UTSTARCOM, INC.	§	
Defendants.	§	

PLAINTIFF'S THIRD AMENDED COMPLAINT FOR PATENT INFRINGEMENT AND JURY DEMAND

Plaintiff The Board of Regents of The University of Texas System brings this action for patent infringement against Defendants, Alcatel, Amoi Electronics, Inc. ("Amoi"), Arima Communication Corp. ("Arima"), Audiovox Communications Corp. ("Audiovox"), Chi Mei Communication Systems, Inc. ("Chi Mei"), Compal Communications, Inc. ("Compal"), Curitel Communications, Inc. ("Curitel"), Haier Group Co. ("Haier Group"), Haier America Import L.L.C. ("Haier Import"), Haier America Trading L.L.C. ("Haier Trading"), Hon Hai Precision Industry Co., Ltd. ("Hon Hai"), MiTAC International Corp. ("MiTAC International"), MiTAC Inc., MiTAC USA, Inc. ("MiTAC USA"), Mio Technology Ltd. ("Mio"), Mio Technology Corp., USA ("Mio USA"), and MiTAC Service Centre (Houston) ("MiTAC Houston"), Sharp Corporation, a.k.a. Sharp Kabushiki Kaisha ("Sharp"), TCL Communication Technology Holdings Limited ("TCL Holdings"), TCL & Alcatel Mobile Phones Limited ("TAMP"), VK Corporation ("VK"), VK Mobile USA, Inc. ("VK Mobile"), and UTStarcom, Inc. ("UTStarcom") (collectively "Defendants") and alleges as follows:

I. THE PARTIES

1. The Board of Regents of The University of Texas System is an agency of the executive branch of the State of Texas.

2. Upon information and belief, Alcatel is a French corporation having its principal place of business at 54, rue La Boetie, 75008 Paris, France. Upon information and belief, Alcatel is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. Alcatel may be served with process in France pursuant to the Hague Convention on the Service Abroad of Judicial and Extrajudicial Documents.

3. Upon information and belief, Amoi is a California corporation having a principal place of business at 17588 Rowland Street, Suite A106, City of Industry, California 91748. Upon information and belief, Amoi is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. This proceeding arises, in part, out of business done in this state. Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon Amoi that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified mail, return receipt requested, to Amoi's home office at 17588 Rowland Street, Suite A106, City of Industry, California 91748.

4. Upon information and belief, Arima is a Taiwanese corporation having its principal place of business at 6F, No. 886, Jhong-Jheng Road, Jhohg-He City, Taipei County, Taiwan. Upon information and belief, Arima Communication Corp. is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. Because Taiwan is not a signatory to the Hague Convention, service upon Arima Communication Corp. requires service in accordance with FED. R. CIV. P. 4(f)(2).

5. Upon information and belief, Audiovox is a Delaware corporation having a principal place of business at 150 Marcus Boulevard, Hauppauge, New York 11788. Upon information and belief, Audiovox is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. This proceeding arises, in part, out of business done in this state.

Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon Audiovox that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified mail, return receipt requested, to Audiovox's home office at 150 Marcus Boulevard, Hauppauge, New York 11788.

6. Upon information and belief, Chi Mei is a Taiwanese corporation having its principal place of business at 11F, No. 39, Chung Hwa Road, Sec. 1, Taipei 100, Taiwan. Upon information and belief, Chi Mei is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. Because Taiwan is not a signatory to the Hague Convention, service upon Chi Mei requires service in accordance with FED. R. CIV. P. 4(f)(2).

7. Upon information and belief, Compal is a Taiwanese corporation having its principal place of business at 3rd Fl., No. 319, Sec. 4 Pa-Teh Rd., Taipei, (105) Taiwan. Upon information and belief, Compal is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. Because Taiwan is not a signatory to the Hague Convention, service upon Compal requires service in accordance with FED. R. CIV. P. 4(f)(2).

8. Upon information and belief, Curitel is a Korean corporation having its principal place of business at Peungwha Seocho Building 1451-34, Seocho-Go, Seoul 137-070, Korea. Upon information and belief, Curitel is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for

service of process in this state. Curitel may be served with process in Korea pursuant to the Hague Convention on the Service Abroad of Judicial and Extrajudicial Documents.

9. Upon information and belief, Haier Group is a Chinese corporation having its principal place of business at 1 Haier Road, Hi-Tech Zone, Qingdao, Shandong 266101, China. Upon information and belief, Haier Group is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. Haier Group may be served with process in China pursuant to the Hague Convention on the Service Abroad of Judicial and Extrajudicial Documents.

10. Upon information and belief, Haier Import is a New York limited liability company having a principal place of business at 1356 Broadway, New York, New York 10018. Upon information and belief, Haier Import is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. This proceeding arises, in part, out of business done in this state. Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon Haier Import that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified mail, return receipt requested, to Haier Import's home office at 1356 Broadway, New York, New York 10018.

11. Upon information and belief, Haier Trading is a New York limited liability company having a principal place of business at 1356 Broadway, New York, New York 10018. Upon information and belief, Haier Trading is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for

service of process in this state. This proceeding arises, in part, out of business done in this state. Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon Haier Trading that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified mail, return receipt requested, to Haier Trading's home office at 1356 Broadway, New York, New York 10018.

12. Upon information and belief, Hon Hai is a Taiwanese corporation having its principal place of business at 2 Tzu Yu St., Tu-Cheng City, Taipei, Taiwan. Upon information and belief, Hon Hai is authorized to do business in the State of Texas and may be served with process by serving its registered agent, Tammy Lee at 10515 Okanella Street, Suite 800, Houston, Texas 77041.

13. Upon information and belief, MiTAC International is a Taiwanese corporation having its principal place of business at No. 200, Wen Hua 2nd Rd., Kwei San Hsiang, Taoyuan, Taiwan. Upon information and belief, MiTAC International is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. Because Taiwan is not a signatory to the Hague Convention, service upon MiTAC International requires service in accordance with FED. R. CIV. P. 4(f)(2).

14. Upon information and belief, MiTAC Inc. is a Chinese corporation having a principal place of business at 674 via De La Valle, #101, Solana Beach, California 92075. Upon information and belief, MiTAC Inc. is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for

service of process in this state. This proceeding arises, in part, out of business done in this state. Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon MiTAC Inc. that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified mail, return receipt requested, to MiTAC Inc.'s home office at 674 via De La Valle, #101, Solana Beach, California 92075.

15. Upon information and belief, MiTAC USA is a California corporation having a principal place of business at 47988 Fremont Blvd., Fremont, California 94538. Upon information and belief, MiTAC USA is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. This proceeding arises, in part, out of business done in this state. Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon MiTAC USA that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified mail, return receipt requested, to MiTAC USA's home office at 47988 Fremont Blvd., Fremont, California 94538.

16. Upon information and belief, Mio is a Taiwanese corporation having its principal place of business at 2th F1., No. 185, Tiding Blvd., Sec. 2, Taipei, Taiwan. Upon information and belief, Mio is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in

this state. Because Taiwan is not a signatory to the Hague Convention, service upon Mio requires service in accordance with FED. R. CIV. P. 4(f)(2).

17. Upon information and belief, Mio USA is an unknown entity having a principal place of business at 47988 Fremont Blvd., Fremont, California 94538. Upon information and belief, Mio USA is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. This proceeding arises, in part, out of business done in this state. Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon Mio USA that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified mail, return receipt requested, to Mio USA's home office at 47988 Fremont Blvd., Fremont, California 94538.

18. Upon information and belief, MiTAC Houston is an entity having a principal place of business at 7350 Denny Road, Suite #888, Houston, Texas 77040. Upon information and belief, MiTAC Houston is not known to be a resident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. This proceeding arises, in part, out of business done in this state. Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon MiTAC Houston that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified

mail, return receipt requested, to MiTAC Houston's home office at 7350 Denny Road, Suite #888, Houston, Texas 77040.

19. Upon information and belief, Sharp, is a corporation existing under the laws of Japan with a principal place of business at 22-22 Nagaike-cho, Abeno-ku, Osaka 545-8522, Japan. Upon information and belief, Sharp is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. Sharp may be served with process in Japan, pursuant to the Hague Convention on the Service Abroad of Judicial and Extrajudicial Documents.

20. Upon information and belief, TCL Holdings is a Cayman Islands corporation having its principal place of business at Room 1502, Tower 6, China Hong Kong City, 33 Canton Road, Tsimshatsui, Kowloon, Hong Kong, China. Upon information and belief, TCL Holdings is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. TCL Holdings may be served with process in China pursuant to the Hague Convention on the Service Abroad of Judicial and Extrajudicial Documents.

21. Upon information and belief, TCL Holdings does business under other names including but not limited to TCL Mobile Communication (HK) Company Limited, Huizhou TCL Mobile Communication Co., Ltd., and TCL Mobile Communication (Hohhot) Company Limited.

22. Upon information and belief, TAMP is a joint venture between TCL Holdings and Alcatel and incorporated in China, having its principal place of business at Room 1502, Tower 6, China Hong Kong City, 33 Canton Road, Tsimshatsui, Kowloon, Hong Kong, China. Upon information and belief, TAMP is a nonresident of Texas who engages in business in this state,

but does not maintain a regular place of business in this state or a designated agent for service of process in this state. TAMP may be served with process in China pursuant to the Hague Convention on the Service Abroad of Judicial and Extrajudicial Documents.

23. Upon information and belief, VK is a Korean corporation having its principal place of business at 67, Jie-dong, Pyongtaek-City, Kyonggi-do 450-090, Korea. Upon information and belief, VK is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. VK may be served with process in Korea pursuant to the Hague Convention on the Service Abroad of Judicial and Extrajudicial Documents.

24. Upon information and belief, VK Mobile is a California corporation having a principal place of business at 9 Executive Circle, Suite 290, Irvine, California 92614. Upon information and belief, VK Mobile is a nonresident of Texas who engages in business in this state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. This proceeding arises, in part, out of business done in this state. Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon VK Mobile that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified mail, return receipt requested, to VK Mobile's home office at 9 Executive Circle, Suite 290, Irvine, California 92614.

25. Upon information and belief, UTStarcom is a Delaware corporation having a principal place of business at 1275 Harbor Bay Parkway, Alameda, California 94502. Upon information and belief, UTStarcom is a nonresident of Texas who engages in business in this

state, but does not maintain a regular place of business in this state or a designated agent for service of process in this state. This proceeding arises, in part, out of business done in this state. Accordingly, pursuant to TEX. CIV. PRAC. & REM. CODE §§ 17.044 and 17.045, the Secretary of State is an agent for service of process upon UTStarcom that may be served with process by serving Geoffrey S. Connor, Secretary of State of Texas, State Capitol Room 1E.8, Austin, Texas 78701, who shall then immediately mail a copy of the process by registered mail or by certified mail, return receipt requested, to UTStarcom's home office at 1275 Harbor Bay Parkway, Alameda, California 94502.

II. JURISDICTION AND VENUE

26. This action arises under the patent laws of the United States, Title 35 of the United States Code. The Court's jurisdiction over this action is proper under the above statutes, including 35 U.S.C. § 271 *et seq.* and 28 U.S.C. §§ 1331 and 1338(a).

27. Personal jurisdiction exists generally over the Defendants because they have sufficient minimum contacts with the forum as a result of business conducted within the State of Texas and within the Western District of Texas. Personal jurisdiction also exists specifically over the Defendants because of their conduct in making, using, selling, offering to sell, and/or importing infringing products within the State of Texas and within the Western District of Texas.

28. Venue is proper in this Court under 28 U.S.C. §§ 1391(b), (c), and (d), as well as 28 U.S.C. § 1400(b).

III. PATENT INFRINGEMENT

29. Plaintiff repeats and realleges the allegations in paragraphs 1-28 as though fully set forth herein.

30. Plaintiff, The Board of Regents of The University of Texas System is the patentee and owner of all rights, title, and interest in and under United States Patent No. 4,674,112 ("the '112 Patent"), which duly and legally issued on June 16, 1987.

31. The '112 Patent is for an invention titled "Character Pattern Recognition and Communications Apparatus." A true and correct copy of the '112 Patent is attached hereto as Exhibit A.

32. The '112 Patent is valid and enforceable.

33. Upon information and belief, Alcatel, TCL Holdings and TAMP have been and are infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the products known as "One Touch 332" and "One Touch 756."

34. Upon information and belief, Amoi has been and is infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the product known as "S6."

35. Upon information and belief, Arima has been and is infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the products known as "Sony Ericsson T100," and "Sony Ericsson Z500."

36. Upon information and belief, Audiovox and UTStarcom have been and are infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112

Patent, including but not limited to the products known as "4050," "CDM8410," "CDM8450," "CDM8450SP," "CDM8455," "CDM8600," "CDM8600BA," "CDM8610VM," "CDM8615," "CDM8900," "CDM8900M," "CDM8900US," "CDM8900VW," "CDM8900WW," "CDM8901AL," "CDM8910C,""CDM8910CS," "CDM8910NT," "CDM8910US," "CDM8910VM," CDM8910VW," CDM8910WW," "CDM8940VW," "CDM9155," "CDM9900VW," "CDM9950SP," "PDA2032," "PM8920KIT," 'PPC4100," "PPC6600," "TM150," and "8943."

37. Upon information and belief, Audiovox has infringed the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the products known as "CDM8500," "CDM9100," "SMT5600," "XV6600," and "PPC4100."

38. Upon information and belief, Chi Mei has been and is infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the product known as "Motorola Inc. MPx220."

39. Upon information and belief, Compal has been and is infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the products known as "Panasonic G60."

40. Upon information and belief, Curitel has been and is infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the products known as "GA 400B," "Identity," "Audiovox CDM8410," "Audiovox

CDM8450," "Audiovox CDM8400," "Audiovox CDM8455," "Audiovox CDM8600," "Audiovox CDM8610," "Audiovox CDM8615," "Audiovox CDM8900," "Audiovox CDM8910," and "Audiovox CDM8940."

41. Upon information and belief, Haier Group, Haier Import, and Haier Trading, have been and are infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the products known as "P7," "D6000," "L7000," "V1000," "V2000," "V3000," "V3100," "V3300," "V7000," "Z3000B," "Z3100," "Z3200" and "Z7000."

42. Upon information and belief, Hon Hai has been and is infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the product known as "Motorola Inc. T720."

43. Upon information and belief, MiTAC International, MiTAC Inc., MiTAC USA, Mio, Mio USA, and MiTAC Houston, have been and are infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the product known as "Mio 8390."

44. Upon information and belief, MiTAC International, MiTAC Inc., MiTAC USA, Mio, Mio USA, and MiTAC Houston, have infringed the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the product known as "Mio 8380."

45. Upon information and belief, Sharp has been and is infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the products known as "GX10i," "GX20," "GX30," "GX32," "GZ100," "TM100," "TM150," "Audiovox TM150" and "TM200."

46. Upon information and belief, VK and VK Mobile have been and are infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the products known as "VK530" and "VK900."

47. Upon information and belief, UTStarcom has been and is infringing the '112 Patent by making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, including but not limited to the product known as "CDM8490."

48. By making, using, selling, offering for sale, and/or importing in or into the United States, without authority, products that fall within the scope of the claims of the '112 Patent, Defendants have also induced infringement of the '112 Patent under 35 U.S.C. § 271(b), and have contributed to the infringement of the '112 Patent under 35 U.S.C. § 271(c). The infringing products have no substantial non-infringing uses.

49. As a direct and proximate result of Defendants' acts of patent infringement, Plaintiff has been and continues to be injured and has sustained and will continue to sustain substantial damages in an amount not presently known.

50. Plaintiff has no adequate remedy at law against these acts of patent infringement. Unless Defendants are preliminarily and permanently enjoined from their infringement of the '112 Patent, Plaintiff will suffer irreparable harm.

IV. PRAYER FOR RELIEF

Plaintiff, The Board of Regents of The University of Texas System, respectfully requests that judgment be entered in its favor and against Defendants and that the Court grant the following relief to Plaintiff:

A. Declare that the '112 Patent is valid and enforceable:

B. Declare that Defendants have infringed the '112 Patent;

C. Award damages to Plaintiff to which it is entitled for patent infringement;

D. Enter a preliminary and thereafter a permanent injunction against Defendants' direct infringement of the '112 Patent;

E. Enter a preliminary and thereafter a permanent injunction against Defendants' active inducements of infringement and/or contributory infringements of the '112 Patent by others;

F. Award interest on Plaintiff's damages; and

G. Such other relief as the Court deems just and proper.

V. JURY DEMAND

In accordance with FED. R. CIV. P. 38 and 39, Plaintiff asserts its rights under the Seventh Amendment of the United States Constitution and demands a trial by jury on all issues so triable.

Dated: August 15, 2005

Respectfully submitted,

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OF COUNSEL FOR PLAINTIFF
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CERTIFICATE OF SERVICE

I hereby certify that on this date a true and correct copy of **Plaintiff's Third Amended Complaint for Patent Infringement and Jury Demand** was sent to the following persons by the means indicated.

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Exhibit A

United States Patent [19]

Kondraske et al.

[11] **Patent Number: 4,674,112**

[45] **Date of Patent: Jun. 16, 1987**

[54] **CHARACTER PATTERN RECOGNITION AND COMMUNICATIONS APPARATUS**

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[73] Assignee: **Board of Regents, The University of Texas System**, Austin, Tex.

[21] Appl. No.: **773,371**

[22] Filed: **Sep. 6, 1985**

[51] **Int. Cl.**[4] **H04M 11/00**

[52] **U.S. Cl.** **379/96**; 379/97

[58] **Field of Search** ..... 179/2 A, 2 DP, 6.11; 340/825.48, 825.74; 379/52, 77, 93, 96, 97, 105

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Smith et al., "Alphabetic Data Entry Via the Touch-Tone Pad: A Comment", *Human Factors*, vol. 13(2), Apr. 1971, pp. 189–190.

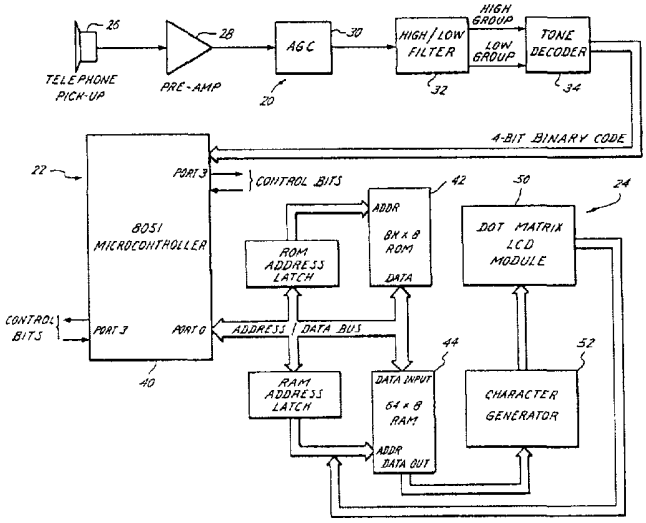
Primary Examiner—Keith E. George

Attorney, Agent, or Firm—Arnold, White & Durkee

[57] **ABSTRACT**

A communication apparatus and method designed to interface with a standard, twelve key, dual tone, multiple frequency telephone, which allows easy, non-verbal entry of a message. Although particularly designed for use by the hearing and/or speech impaired with a dual tone telephone, the apparatus is equally adapted for use with practically any communication network where a keyboard with a limited number of keys is utilized and ambiguity resolution necessary. Generally speaking, the apparatus is connected to the earpiece of a receiving telephone and includes a tone pickup and decoder, a pre-programmed microcomputer and a message display panel. The message sender depresses a single key which corresponds to the alphabetic letter in the word being sent - because most keys on a telephone represent three letters, such a word is ambiguous when sent. The apparatus receives the ambiguous word and resolves the ambiguity in favor of a preprogrammed word which is displayed to the person receiving the message. Although the apparatus can be programmed to recognize words, the apparatus is programmed with a vocabulary of syllabic elements which are used to reconstruct the word. This approach enables an expanded word recognition capability while minimizing memory requirements.

14 Claims, 8 Drawing Figures



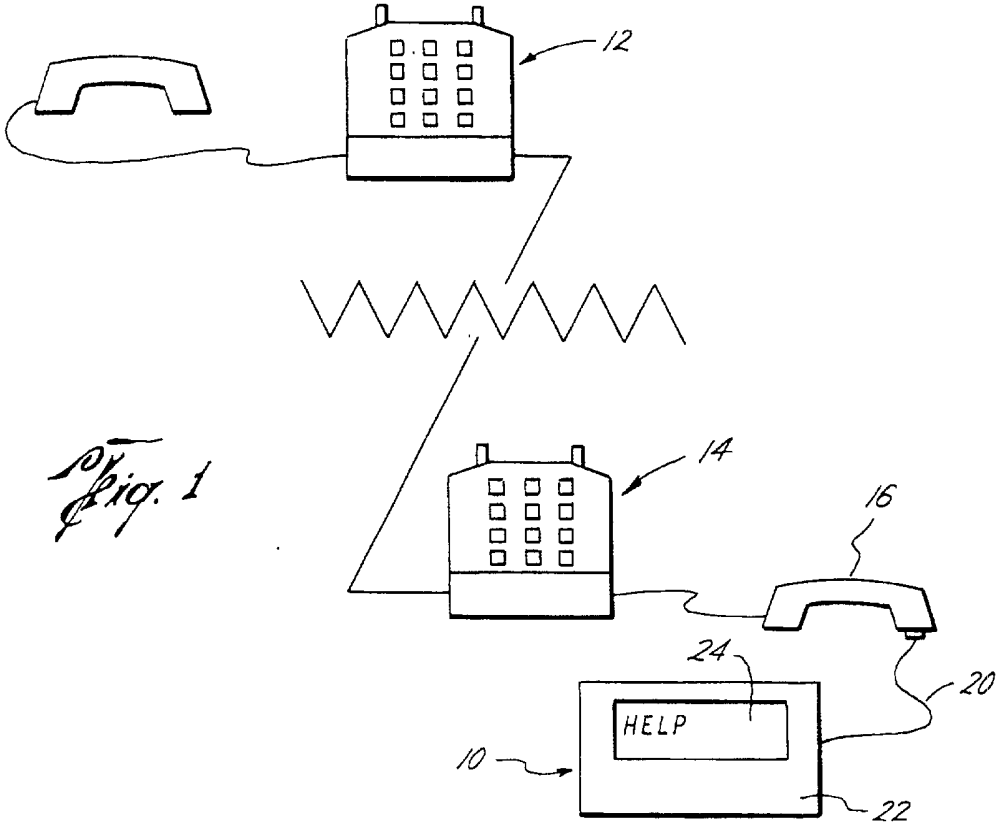


Fig. 1

Q Z 1	ABC 2	DEF 3	ROW 1
GHI 4	JKL 5	MNO 6	ROW 2
PRS 7	TUV 8	WXY 9	ROW 3
✱	OPER 0	#	ROW 4
COL. 1	2	3	

18

Fig. 2

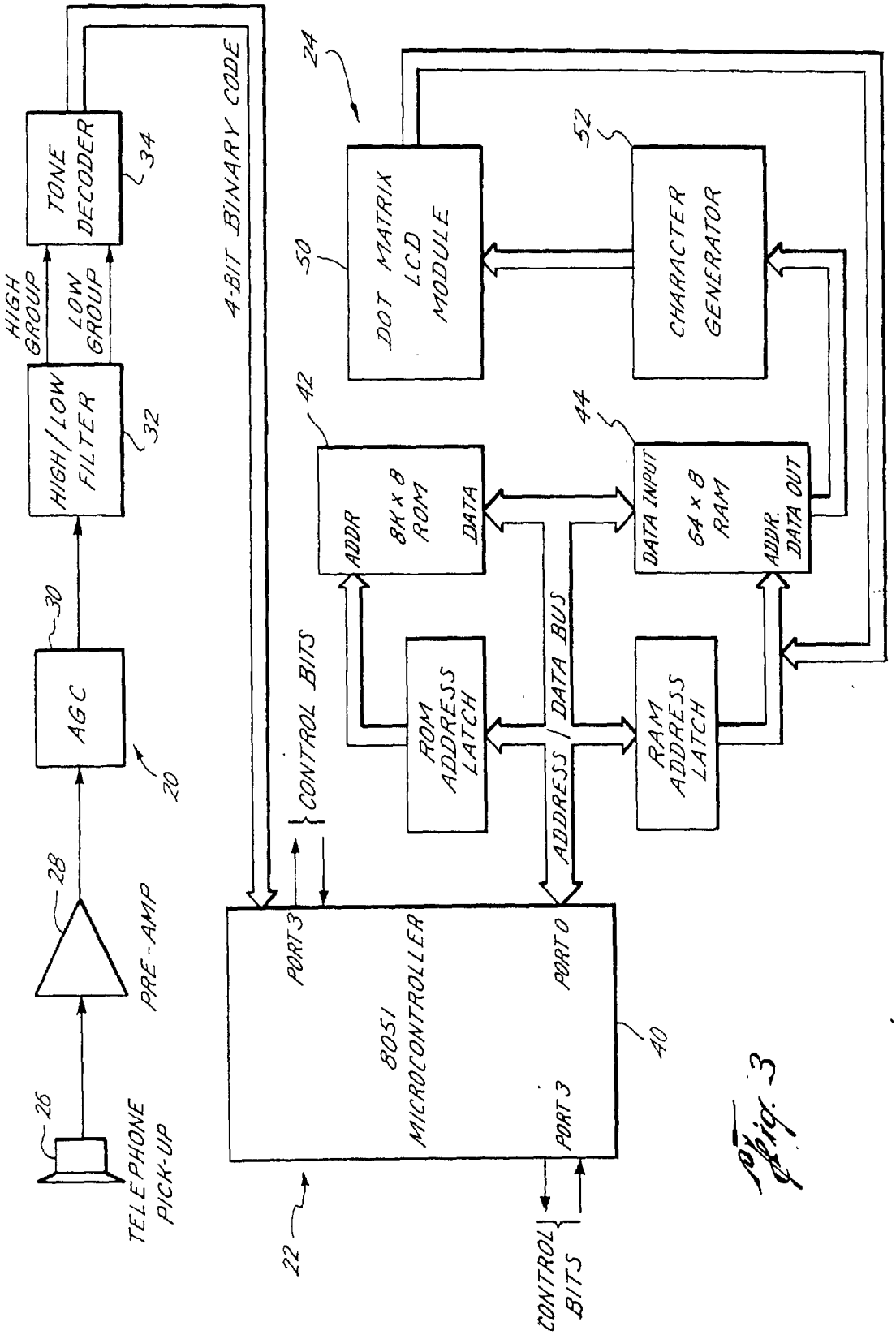

TELEPHONE PICK-UP
26
PRE-AMP
28
AGC
30
20
HIGH/LOW FILTER
32
HIGH GROUP
LOW GROUP
TONE DECODER
34
4-BIT BINARY CODE
24
DOT MATRIX LCD MODULE
50
CHARACTER GENERATOR
52
42
8K x 8 ROM
ADDR
DATA
44
64 x 8 RAM
DATA INPUT
ADDR.
DATA OUT
ROM ADDRESS LATCH
RAM ADDRESS LATCH
CONTROL BITS
DATA BUS
ADDRESS
8051 MICROCONTROLLER
PORT 3
PORT 0
PORT 3
40
22
CONTROL BITS

Fig. 3

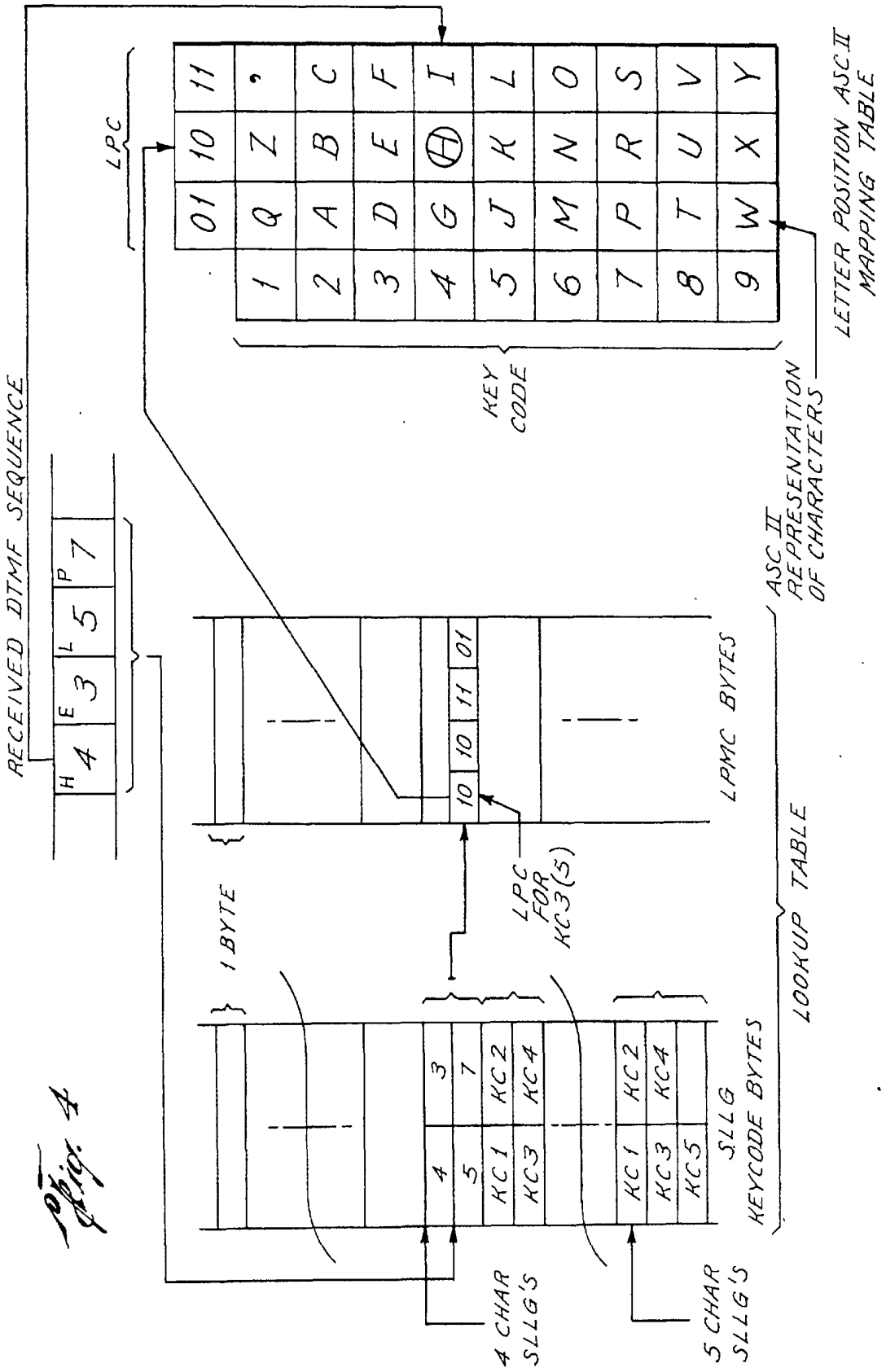

RECEIVED DTMF SEQUENCE
H 4 E 3 L 5 P 7
LPC
1 2 3 4 5 6 7 8 9
01 Q A D G J M P T W
10 Z B E H K N R U X
11 , C F I L O S V Y
KEY CODE
LETTER POSITION ASC II MAPPING TABLE
ASC II REPRESENTATION OF CHARACTERS
LPMC BYTES
01 11 10 10
1 BYTE
LPC FOR KC3(5)
LOOKUP TABLE
KEYCODE BYTES
SLLG
4 5 KC1 KC3
3 7 KC2 KC4
KC1 KC3 KC5
KC2 KC4
4 CHAR SLLG'S
5 CHAR SLLG'S

Fig. 4

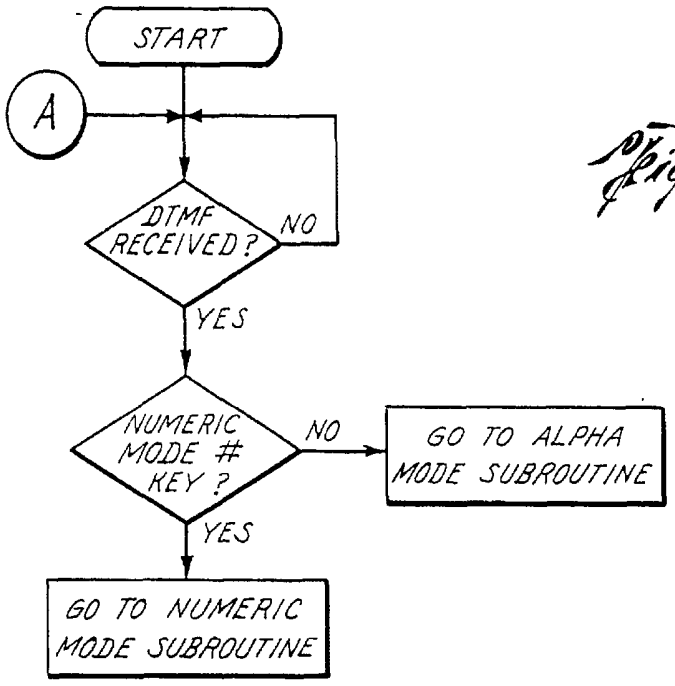

START
A
DTMF RECEIVED?
NO
YES
NUMERIC MODE # KEY ?
NO
GO TO ALPHA MODE SUBROUTINE
YES
GO TO NUMERIC MODE SUBROUTINE

Fig. 5

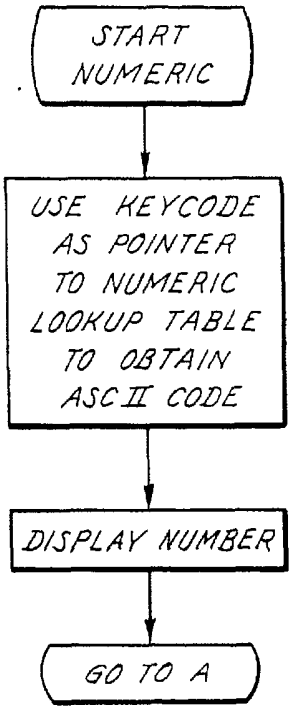
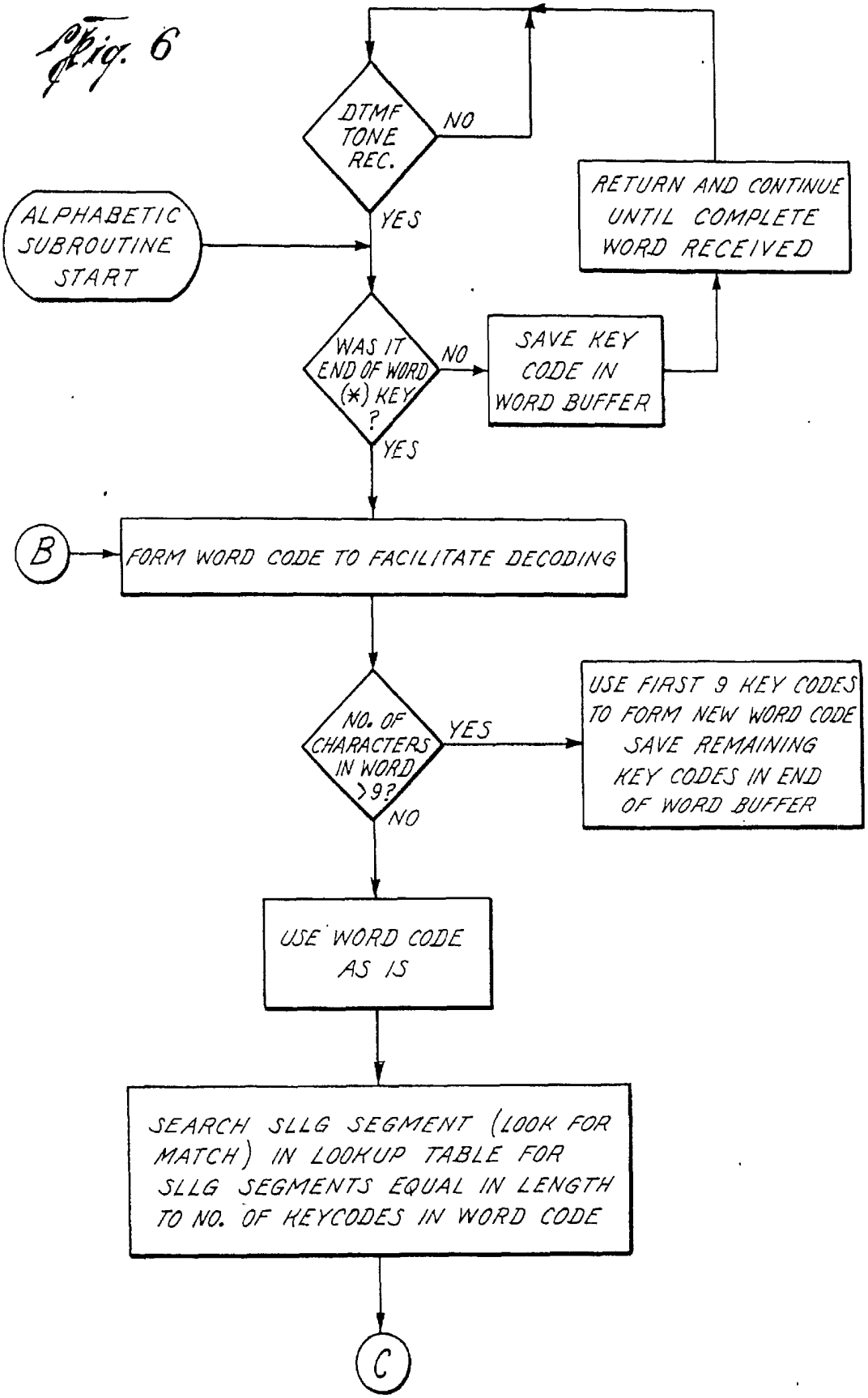

START NUMERIC
USE KEYCODE AS POINTER TO NUMERIC LOOKUP TABLE TO OBTAIN ASC II CODE
DISPLAY NUMBER
GO TO A

Fig. 8

Fig. 6


DTMF TONE REC.
NO
YES
RETURN AND CONTINUE UNTIL COMPLETE WORD RECEIVED
ALPHABETIC SUBROUTINE START
WAS IT END OF WORD (*) KEY ?
NO
SAVE KEY CODE IN WORD BUFFER
YES
B
FORM WORD CODE TO FACILITATE DECODING
NO. OF CHARACTERS IN WORD >9?
YES
USE FIRST 9 KEY CODES TO FORM NEW WORD CODE SAVE REMAINING KEY CODES IN END OF WORD BUFFER
NO
USE WORD CODE AS IS
SEARCH SLLG SEGMENT (LOOK FOR MATCH) IN LOOKUP TABLE FOR SLLG SEGMENTS EQUAL IN LENGTH TO NO. OF KEYCODES IN WORD CODE
C

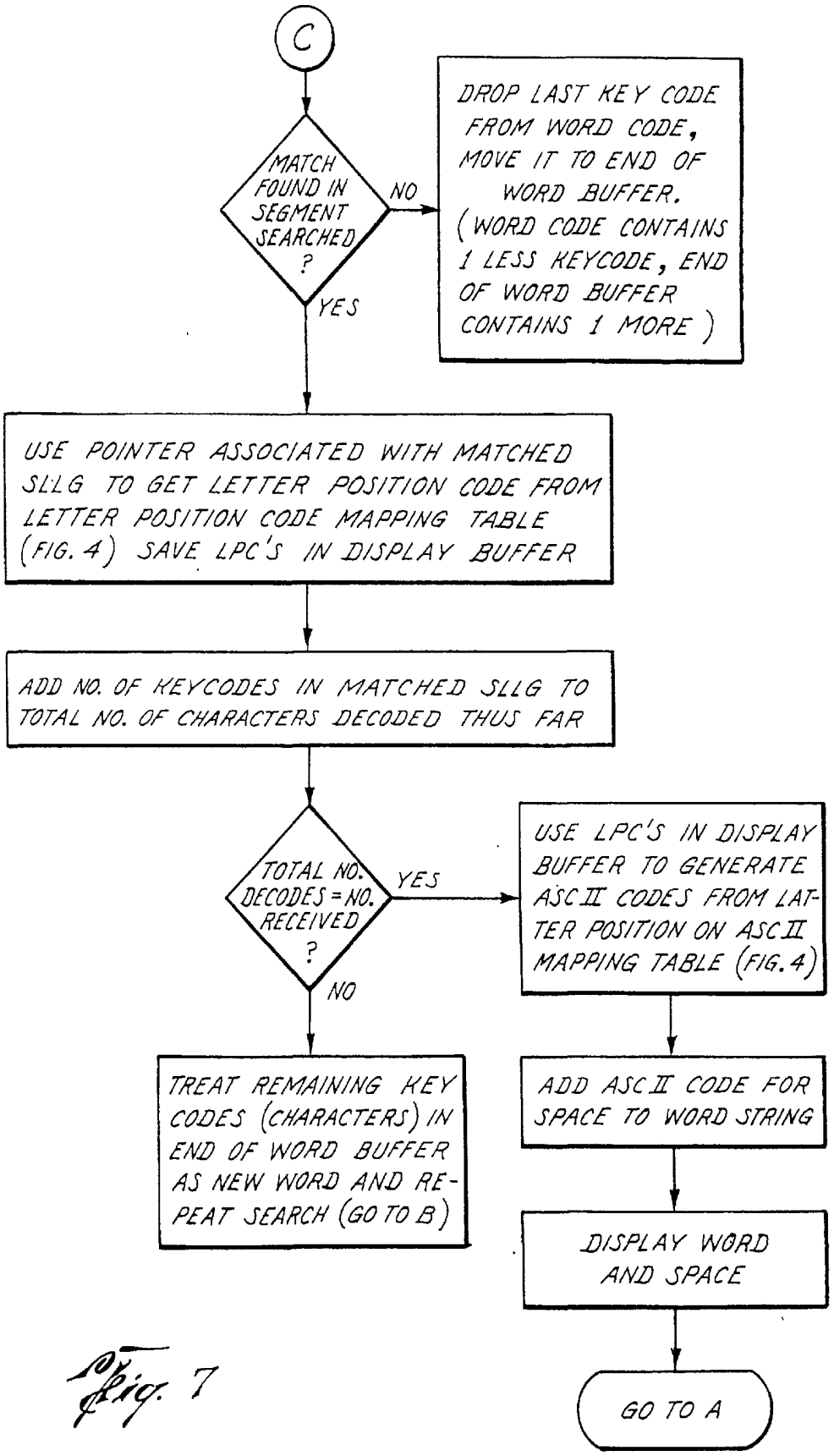

C
MATCH FOUND IN SEGMENT SEARCHED ?
NO
YES
DROP LAST KEY CODE FROM WORD CODE, MOVE IT TO END OF WORD BUFFER. (WORD CODE CONTAINS 1 LESS KEYCODE, END OF WORD BUFFER CONTAINS 1 MORE)
USE POINTER ASSOCIATED WITH MATCHED SLLG TO GET LETTER POSITION CODE FROM LETTER POSITION CODE MAPPING TABLE (FIG. 4) SAVE LPC'S IN DISPLAY BUFFER
ADD NO. OF KEYCODES IN MATCHED SLLG TO TOTAL NO. OF CHARACTERS DECODED THUS FAR
TOTAL NO. DECODES = NO. RECEIVED ?
YES
NO
USE LPC'S IN DISPLAY BUFFER TO GENERATE ASCII CODES FROM LATTER POSITION ON ASCII MAPPING TABLE (FIG. 4)
TREAT REMAINING KEY CODES (CHARACTERS) IN END OF WORD BUFFER AS NEW WORD AND REPEAT SEARCH (GO TO B)
ADD ASCII CODE FOR SPACE TO WORD STRING
DISPLAY WORD AND SPACE
GO TO A

Fig. 7

CHARACTER PATTERN RECOGNITION AND COMMUNICATIONS APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus and method for communicating by manual entry on a keypad using a minimum of key stroke entries. More particularly, the invention relates to an apparatus and method for use by the hearing or speech impaired to communicate over the telephone network using a standard twelve key, dual tone, multi-frequency telephone.

2. Description of the Prior Art

For the hearing or speech impaired to effectively communicate over a long distance, several methods have been devised which enable nonverbal communication over a communications network, such as a telephone grid. Such devices include relatively expensive and nonportable radio teletype terminals and communications-adapted computer terminals. Such terminal keyboards typically employ a standard "QWERTY" keyboard which enables the passage of messages by simply typing in the entire message. Such terminals are, of course, deficient in that they are not only expensive, but also are bulky and difficult to transport.

It has been recognized that it is desirable to use a standard 12 key, dual tone multiple frequency (DTMF or Touch-tone) telephone to communicate between the hearing or speech impaired. Utilizing such a standard "Touch-tone" telephone would be inexpensive and provide a partial solution to the problem of transporting bulky communication equipment. A primary difficulty with using such "Touch-tone" telephones is that the industry standard telephone keypad utilizes 12 keys. Ten of the keys represent a single numeric character, while 8 of the keys each represent 3 alphabetic characters.

To utilize such a standard "Touch-tone" telephone for nonverbal communication, past solutions have used multiple keystroke entries to identify a particular alphabetic letter. For example, a first depression identifies which key the desired letter appears on and a second depression identifies which letter of the three possibilities is desired for input.

The necessity for depressing two keys to identify one letter, is of course a major impedimate to effective telecommunication using a standard "Touch-tone" telephone. That is, even short messages require a large number of keystrokes to enter the message.

SUMMARY OF THE INVENTION

The problems outlined above are in large measure solved by the communications apparatus and chatacter pattern recognition method of the present invention. That is, the method and apparatus hereof provides for a single keystroke to identify which alphabetic character is desired. Because each keystroke can represent three possibilities, each keystroke transmitted—and therefore the composite word—is inherently ambiguous. The apparatus hereof receives the ambiguous word and reconstructs and displays the word based upon a preprogrammed ambiguity resolution. To simplify operation and memory size, the apparatus recognizes a particular word in terms of syllabic elements. The syllabic elements can comprise any number of alphabetic characters (for example, from 1 to 9 alphabetic characters).

Generally speaking, the apparatus hereof includes a receiving mechanism coupled to a telephone which receives a series of transmitted tones corresponding to an inputted word. With a standard "Touch-tone" telephone, each tone received by the receiving mechanism represents three possible alphabetic characters. The receiving mechanism translates each tone into a code—a series of codes corresponding to a word. A controller receives the series of codes and outputs a signal indicative of a particular word which corresponds to the series of codes. The controller advantageously has a recognition means which matches the series of codes received with a programmed code sequence indicative of the particular word. Once the particular word is identified, a signal representative of the particular word is passed to an indicating means which displays the word to the receiving person.

Preferably, the receiving mechanism amplifies the ambiguous tone and decodes the tone into binary code. The binary code is passed to the controller which is preferably a preprogrammed microcomputer. The microcomputer fetches the word or syllabic element vocabulary from memory and begins comparing the binary code with the vocabulary. The controller constructs a particular word corresponding to the received binary code and generates a signal to the indicating mechanism representative of that particular word.

Preferably, the indicating means comprises a liquid crystal diode display which visually represents the word or message to the user. In another embodiment, a speech synthesizer audibly communicates the word or message to the user.

The preferred communication method of the present invention contemplates inputting a word or series of words into a standard "Touch-tone" telephone keyboard by depressing a single key for each alphabetic character of the word. The characters are thus transmitted as a series of tones which are decoded by the apparatus hereof into a binary code. The binary code is matched with a preprogrammed vocabulary code representive of an alphabetic character string, such as a word or syllabic element. The word is then output to the receiving person. Although the preferred embodiment anticipates using the apparatus hereof as a receiving unit, it will be appreciated that the apparatus can be easily modified within the scope of the present invention to act as a transmission unit. For example, the apparatus can be modified to utilize a speech synthesizer, with the message sender inputting a word or a series of words into the telephone with the apparatus converting the input into an audible message.

Another important alternative is to utilize the apparatus and method for other modes of communication. For example, the apparatus and method hereof can be incorporated into a paging system network, radio telephone network, or practically any communications network where ambiguity resolution is necessary because of limited keystroke inputs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagramatic view of a typical transmitting and receiving telephone to which the apparatus hereof is operably connected;

FIG. 2 is a plan layout of a dual tone, multiple frequency, twelve key telephone keyboard;

FIG. 3 is a block diagram of the system components of the apparatus hereof;

FIG. 4 is a schematic representation of the look-up table and ASCII mapping table utilized by the present invention; and

FIGS. 5–8 are flow-charts illustrative of the software utilized in the apparatus of the present invention, where-

FIG. 5 is a flowchart of the main program for determining whether a numeric or alphabetic character is input,

FIGS. 6 and 7 depict the alphabetic subroutine,

FIG. 8 illustrates the numeric subroutine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to the drawings, a communications apparatus **10** is illustrated in FIG. **1** in conjunction with a telephone network having a sending telephone **12** and receiving telephone **14**. Each telephone **12, 14** has a hand piece **16** and a twelve key "Touch-tone" key pad **18**. Each telephone **12, 14** represents a common, industry standard touch tone system in which a key closure generates two tones according to the dual tone multiple frequency standard. As can be seen from FIG. **2**, the standard industry key pad **18** presents twelve keys containing alphabetic and numeric characters, as well as the asterisk (*) and number ("#") characters. FIG. **2** differs slightly from the industry standard in that in a standard touch tone telephone, the alphabetic characters "Q" and "Z" are omitted. In FIG. **2**, the letters "Q" and "Z" are carried by the key representative of numeral "1".

Comparing FIGS. **1** and **3**, the communications apparatus **10** is shown in more detail. Broadly speaking (see FIG. **1**), the apparatus **10** includes receiving means **20**, controller means **22**, and indicating means **24**. In more detail, the receiving means **20** includes an inductive pick-up **26** attachable to the ear portion of the hand piece **16** by a suction cup. In the preferred embodiment, a preamp **28** provides a fixed gain of 60 dB to the automatic gain control amplifier **30**. The automatic gain control amplifier **30** has a gain range of 0.1–20 dB resulting in a total gain for the amplifier section (**28,30**) in the range of 30–100 dB. The output of the automatic gain control (1.5 volts p—p) is fed to a filter section **32** (AMI S3525A intergraded circuit) to separate the high and low dual tone multiple frequency bands. As shown in FIG. **6**, the high and low group filter outputs are fed to a tone decoder **34** (e g , Mostek MK-5102). The tone decoder **34** provides a four-bit binary code to the controller means **22** for each signal received at its input.

The controller means **22** preferably incorporates a microcomputer (Intel 8051) with on-chip RAM and ROM. In FIG. **3**, the controller means **22** is illustrated somewhat schematically and depicts the microcomputer **40**, ROM **42** (preferably 8K byte EPROM) and 64 bytes × 8 RAM **44**. Preferably, the programed vocabulary is stored on the ROM **42** with the RAM **44** used to store word codes as received, thus providing a buffer to the indicating means **24**.

Preferably, the indicating means **24** includes a liquid crystal diode (LCD) display **50** capable of displaying two rows of alpha numeric characters of twenty characters per row. A character generator **52** is coupled to the RAM **44** and the LCD display **50** to generate standard dot matrix characters on the display **50**. The LCD display **50** also addresses the RAM **44** to periodically scan ASCII character data in the RAM **44**.

Software

FIGS. **4–8** generally refer to the implementation of the recognition process employed by the controller means **22**. FIG. **4** illustrates an example of a recognition search initiated in a segmented look-up table (left-hand portion of FIG. **4**). The right-hand portion of FIG. **4** illustrates the ASCII mapping table where the ASCII code for the proper character is stored and fetched for each alpha numeric character. It should be apparent that use of the mapping table results in a considerable memory saving over the alternative of storing complete ASCII strings in memory. FIGS. **5–8** illustrate the flow-charts for the operating programs. The flow-charts are self explanatory. The operation of the lookup table and ASCII mapping table is readily apparent from a comparison of FIGS. **4** and **6–7**.

Operation

The initial problem addressed by the present invention was to provide a simple method for the hearing or speech impaired to communicate using standard "Touch-tone" telephones without the need for complicated equipment, such as teletypes, etc. Several devices and methods have been devised which allow for effective communication, but are slow and difficult to use; a large number of keystrokes are involved in inputting a message. As can be seen from FIG. **2**, most keys represent three alphabetic letters. Therefore, in the past, a single letter has been input using two keystrokes. For example, to input the alphabetic letter "H" in the word "HELP", the Operator would first push the number "4" key (row 2 column 1) followed by the "0" key (row 4, column 2) to designate the second character on the number "4" key.

In a broad sense, the present invention recognizes the possibility of using a microprocessor-based device to enable a single keystroke per alphabetic letter. That is, it has been found that most English words are identified by the keystroke sequence required to enter the letters of the word—a character pattern recogniton. Of course, the invention is equally applicable to the identification of words in other languages as well.

For example, to enter the word "HELP" the numbered keys "4, 3, 5, and 7" are depressed followed by a "*". The "*" key is used to delineate the end of a word. The term "word code" is used to denote the key sequence for a particular word; that is "4357" is the word code for the word "HELP." Of the 3^4 possibilities (3 characters on each key, four keys to enter the word), there is only one English word—"HELP"—from the 3^4 possibilities involved.

Because each key on a standard "Touch-tone" keyboard presents three alphabetic characters per key, using the single keystroke entry contemplated by the present invention results in an inherently ambiguous key code. Thus, the dual tones for each key depression presents an ambiguous series of tones to the receiver. However, as with the word "HELP," it was found that over 96% of the most commonly used words could be identified by the word codes generated.

Therefore, in a broad sense, the apparatus **10** could incorporate a stored vocabulary of word codes and the corresponding ASCII representation for each word in a memory look-up table. When a sequence of word codes is entered followed by an "*", a search could be initiated in memory which points to the correct ASCII characters to be displayed. In practice, storing complete

word codes and ASCII representations in memory was found to limit word recognition capability to the stored word vocabulary, and even then, large memory size was necessary.

In the preferred embodiment, "syllabic elements" are stored in memory and combined to create the words. For example, the "CON" letter group in contest, silicon, conference, contact, etc. is such a stored syllabic element. Thus, the vocabulary stored in the preferred embodiment includes common letter-groups, suffixes, prefixes, single letters, and a few complete words, genericly referred to as "syllabic elements." In the preferred embodiment, it was found most efficient to include several letter strings which provide and enhance word recognition capability; therefore the vocabulary of syllabic elements in the preferred embodiment includes elements having one alphabetic letter to as many as nine alphabetic letters. Most syllabic elements have a three to six letter group size.

To further reduce memory size, the preferred embodiment enclosed incorporates an ASCII mapping table illustrated schematically in FIG. **4**. That is, instead of allocating memory for the ASCII representation for each syllabic element, the ASCII representation is developed from the mapping table.

In use, the receiving individual must attach the conductive pick-up **26** to the ear portion of the hand piece **16** (see FIG. **1**). The sending individual simply enters the desired alphabetic letters of the desired message on the touch-tone telephone **12** sequentially. The asterisk key "*" is used as a space to separate words. The number key "#" is used before or after any information that should be interpretated as numeric information. Of course, the sender cannot use abbreviations. The apparatus **10** responds in real time, beginning the recognition process as soon as the space key is received. The text of the message is displayed on the LCD display **50** from the lower left position to the right. When the lower row is filled the entire row is scrolled upward to allow new text to appear in the lower row.

As can be seen from FIG. **3**, the series of tones constituting each word are decoded into a binary code. In the preferred embodiment each key depression represents a "key code" indicative of the key depressed. Two key codes are entered per byte, thus, the first byte contains the four bit binary code representation of the first two key codes of a word. The word code comprises a series of key codes entered between the asterisk "*," and in the preferred embodiment can occupy up to 7 bytes, accommodating word sizes up to fourteen characters. If the word has an odd number of characters, and therefore an odd number of key codes, the last key code is stored in the high order four bits of the last byte and the low order bits are set to zero.

The microcomputer **40** (FIG. **3**) reads the four bit binary code upon receiving a latch signal from the tone decoder **34**. The program (FIGS. **5–8**) and stored syllabic element vocabulary are fetched from ROM **42**. The word recognition process is initiated as soon as an entire word code is received (as indicated by the asterisk input).

Turning to FIG. **4**, the recognition search is initiated in the segmented look-up table that contains the key codes in the four bit format for the syllabic element vocabulary. The look-up table is segmented according to syllabic element size with the size of the word to be decoded determining the point of entry into the look-up table. In the preferred embodiment, there are nine segments in the look-up table corresponding to syllabic elements ranging from one to nine characters in size. For words having more than nine characters, the search is initiated in the ninth segment and a new word code corresponding to the first nine keystrokes (key codes) of the word is formed (see also FIG. **6**). Of course, the size of the syllabic element is known upon entry into a given segment, therefore the number of bytes required to store the key codes for each of the syllabic elements will also be known.

Although the word code typically occupies more than one byte, only the first byte is checked for a match initially. The other bytes are checked only when a match occurs for all the previous bytes for the given syllabic element. If no match is detected, the search proceeds to the next syllabic element in the segment of the table. If no match is found in the segment of the table for the syllabic element size equal to the size of the word, the search is continued in the segment of the next lower size. That is, the word code is recomputed to exclude the last received key code for later use in the recognition process. This procedure is repeated until a match occurs. At the latest, a match will occur upon entering the single character segment of the look-up table.

After the first syllabic element is identified, the search is repeated using a reduced word code. The reduced word code comprises the original word code less the first N characters, where N is the size of the first syllabic element identified. This cycle is repeated until the complete word is identified. Most words are identified by connected syllabic elements 2 to 4 characters in size. However, there are a limited number of large syllabic elements of 5 to 9 characters which are used to identify words that are difficult to separate into unambiguous short syllabic elements.

Some syllabic elements have the same word code and therefore can have multiple interpretations. Such multiple meaning syllabic elements are specially flagged in the look-up table and stored in a way that the most frequently occurring interpretation is decoded first. If the element displayed on the LCD display **50** does not make sense to the reader, he can replace the string with the alternate interpretation by pressing a retry button (such as the operator or "O" key). Of course, in many cases the user can interpret such alternative interpretations from the context of the other syllabic elements forming the word or other words in the message.

Although the display could be generated by storing a pointer to the proper ASCII string representing each syllabic element in the look-up table, the preferred embodiment utilizes an indirect referencing technique. As illustrated in FIG. **4**, an ASCII mapping table is utilized to identify the proper ASCII string for the syllabic element recognized in the look-up table. The first input to the ASCII mapping table is the key code which is known and limits the possible choices for the alphabetic character to a maximum of three.

The second pointer to the ASCII mapping table is generated to correspond with the position of the alphabetic character on the particular key depressed. To this end, a series of letter position mapping codes (LPMC) bytes are formulated for each word code. Each LPMC byte contains four 2-bit letter position codes (LPC). Each LPC can take the value of either 1, 2, or 3 depending upon the letter position on the key As can be seen from FIG. **4**, the binary representation of the letter position is used to enter the ASCII mapping table, **01**

for the first letter positioning, **10** for the second letter positioning and **11** for the third letter positioning Thus, the key code (KC) and letter position code (LPC) act as column and row pointers into the ASCII mapping table to find the proper ASCII code for the character. The ASCII code is fetched and moved to an output buffer. This method requires only 27 bytes of ASCII character storage as each possible character is stored only once, and an additional 8 bits per 4 characters to store the letter position codes (LPC).

FIG. **4** illustrates the recognition process for the word "HELP". The word code, "4357" is passed to the four character segment of the look-up table. As previously discussed, the microcomputer **40** begins the search process until a match is formed. The matched word code points to a letter position mapping code (LPMC) byte. As illustrated in FIG. **4**, the first letter position code (LPC) in the letter positioning mapping code (LPMC) byte has the binary code (10) for "2" which is the letter position of "H" on the number "4" key. The LPC is used as the column pointer in the ASCII mapping table with the key code used as the row pointer to identify the letter "H".

In practice, the apparatus **10** recognizes the entered words as fast as the words can be entered by the sender. Thus, the apparatus **10** is real time, displaying the decoded word on the LCD display **50** less than 1 second after the asterisk key is depressed. A prime advantage of the method and apparatus **10** is that single character entry is sufficient for communication. This represents a significant advance as a communication aid for the handicapped.

Of course, the apparatus **10** hereof is equally adaptable for use in many other situations. For example, with a paging system where space is limited, a small number of keys could be incorporated to efficiently send a message using the single character entry recognition of the present invention.

Although the present invention contemplates that the sender will simply use a standard touch-tone telephone and the receiver will utilize the apparatus **10**, roles could be reversed. The apparatus **10** can be used as a sending device which incorporates a speech synthesizer. That is, the sender would couple the device **10** to the mouth section of hand piece **16** of the sending telephone **12** and generate the message on the key pad **18**. Apparatus **10** would generate synthetic speech audibly conveyed to the receiving telephone **14**.

Still another alternative would be to use the apparatus **10** of the present invention for remote computer control by non-handicapped individuals. For example, using the single character entry, words like PRINT, LIST, SAVE could be easily recognized and the output controlled. If fact, better results and an expanded vocabulary can be obtained if the characters on the standard telephone key pad **18** are distributed differently. That is, the sender could use an overlay with optimum character distribution to send his message. While this approach may be feasible for remote computer use, simplicity considerations for the handicapped dictate using the standard key pad **18** with suboptimum character distribution.

The apparatus **10** could also be used for consumers to enter orders to a vendor's computer. Many variations exist; the apparatus **10** enabling the entry of messages easily into a computer or practically any message receiver.

We claim:

1. A communications apparatus comprising:

receiving means operably connectable to a telephone or the like for receiving a series of transmitted tones corresponding to an input word and for decoding the tones into a series of codes, each tone being representative of a letter of the word, which letter is one of two or more alphabetic characters corresponding to the tone;

controller means coupled to said receiving means for processing said series of codes and outputting a signal indicative of a particular word which corresponds to said series of codes, said controller means including, recognition means for matching said series of codes with a programmed code sequence indicative of said particular word,

said recognition means including a stored vocabulary comprising a plurality of syllabic elements, each being representative of one or more alphabetic characters, said recognition means being operable for matching said series of codes with one or more syllabic elements and outputting a signal indicative of a particular word represented by said one or more syllabic elements; and

indicating means for receiving said signal and communicating the signal in a form perceptible to the user.

2. The apparatus according to claim **1**, wherein said receiving means includes an inductive pickup couplable to the ear piece of a telephone receiver.

3. The apparatus according to claim **1**, wherein said receiving means includes an amplifier section for receiving and amplifying said tones.

4. The apparatus according to claim **1**, wherein said receiving means includes a tone-decoder for decoding the tones into a binary code.

5. The apparatus according to claim **1**, wherein said indicating means includes a visual display for communicating said particular word.

6. The apparatus according to claim **5**, wherein said indicating means comprises a liquid crystal display module.

7. The apparatus according to claim **1**, wherein said receiving means is operable for receiving tones indicative of numeric characters, said controller means is operable for receiving and processing said numeric-representative tones and outputting a numeric-representative signal, and said indicating means being operable for displaying said numeric-representative signal.

8. The apparatus according to claim **1**, said recognition means including mapping means operably coupled to said receiving means and operable for identifying the two or more alphabetic characters represented by a discrete tone.

9. The apparatus according to claim **8**, said mapping means operable for utilizing said programmed code sequence and said identified two or more alphabetic characters for generating an ASCII code representative of each character of said particular word, said plurality of ASCII codes generated being output from said controller means as a portion of said signal.

10. A method of communicating, utilizing a signal-generating keyboard where at least some of the keys represent two or more alphabetic characters, comprising the steps of:

inputting a word into said keyboard by depressing a single key for each alphabetic character of said word;

transmitting signals generated by the key depressions;

receiving said transmitted signals and decoding the signals into binary code;

matching said binary code with one or more pre-programmed codes, each pre-programmed code being representative of a syllabic element;

Forming a representation of the word from the one or more syllabic elements represented by the matched one or more pre-programmed codes; and

outputting the word representation in a form perceptible to the user.

11. The method of claim **10**, wherein the outputting step includes displaying said word in a visually perceptible form.

12. The method of claim **10**, wherein the signal generated by the keyboard is a dual tone multiple frequency and the keyboard comprises a touch-tone telephone.

13. The method according to claim **10**, wherein each pre-programmed code of the syllabic elements corresponds to the key depressed and the position of the character of the syllabic element on that key including the steps of:

providing an ASCII mapping table presenting the ASSCII strings corresponding to respective alphabetic characters;

identifying the ASCII string for each character of each matched syllabic element by

entering the mapping table with reference to the key depressed on the keyboard for each character of the matched one or more syllabic elements,

cross-referencing the position of the character on said depressed key to determine the discrete ASCII string for the alphabetic character; and

outputting the ASCII string for each character of each syllabic element to an output buffer.

14. A method of recognizing an input word from an input series of codes in which each input code represents one letter of the word which letter is one of two or more letters that the code corresponds with, comprising the steps of:

establishing a limited vocabulary of syllabic elements representing one or more letters and comprising one or more codes in a lookup table, in which said word is not represented by a single syllabic element in the lookup table,

the lookup table being separated into segments according to the number of letters of the syllabic elements;

matching the series of codes to two or more syllabic elements comprising the substeps of considering two or more successive codes of said word as a group,

entering the lookup table in the segment corresponding to the number of codes in said group,

comparing said group of codes with the codes of each syllabic element in said segment until a match is found, or if no match is found, decrementing the number of codes in the group, entering the lookup table in another segment corresponding to the number of codes in said decremented group, and comparing the decremented group of codes with codes of each syllabic element in said another segment until a match is found, or if no match is found, successively decrementing the number of codes in the group and comparing the decremented group of codes with the codes of each syllabic element in another segment until a match is found, and

considering the remaining unmatched codes in said word as one or more additional groups and repeating the entering and comparing steps using each additional group until all of the syllabic elements of the word are identified; and

outputting the two or more matched syllabic elements as said word.

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