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(54) **FOLDING KEYBOARD FOR A PERSONAL DIGITAL ASSISTANT**

tinuation-in-part of application No. 09/850,158, filed on May 8, 2001, now Pat. No. 6,594,142.

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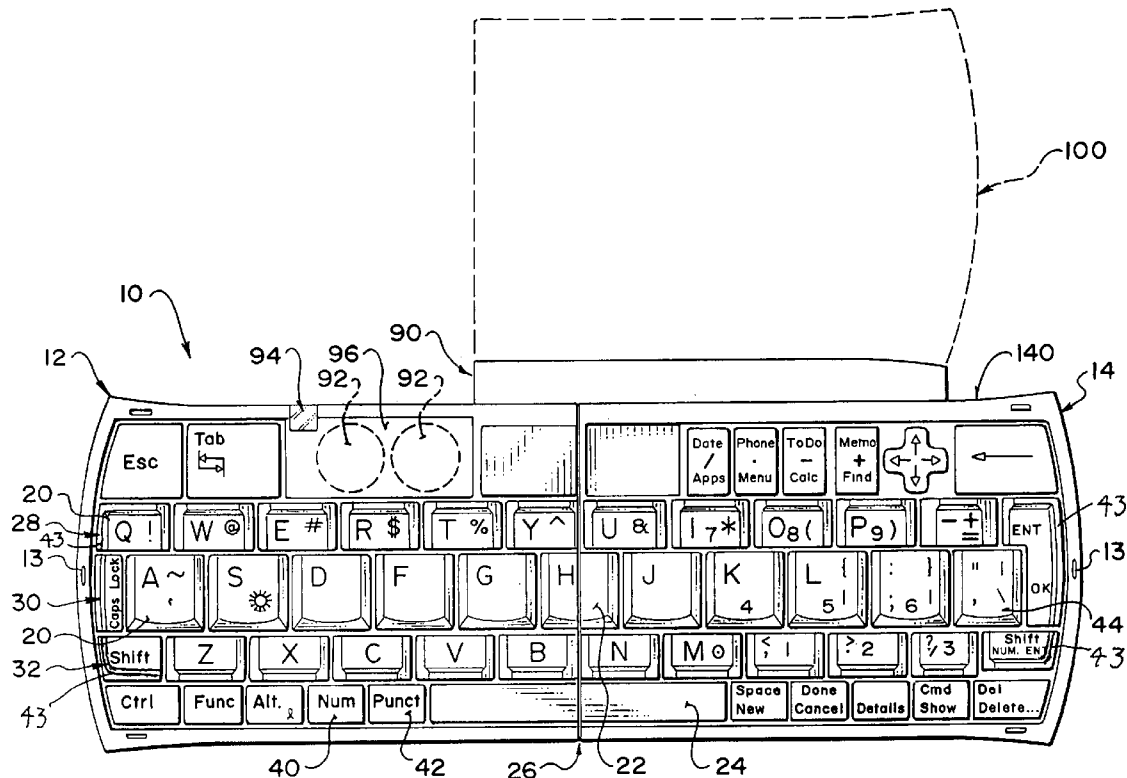
(57) **ABSTRACT**

(22) Filed: **Nov. 6, 2003**

Related U.S. Application Data

(60) Division of application No. 10/179,169, filed on Jun. 26, 2002, now Pat. No. 6,679,639, which is a con-

The present invention provides a wireless folding keyboard for a personal digital assistant which has a stand for supporting the personal digital assistant in the appropriate orientation to receive the wireless signals.



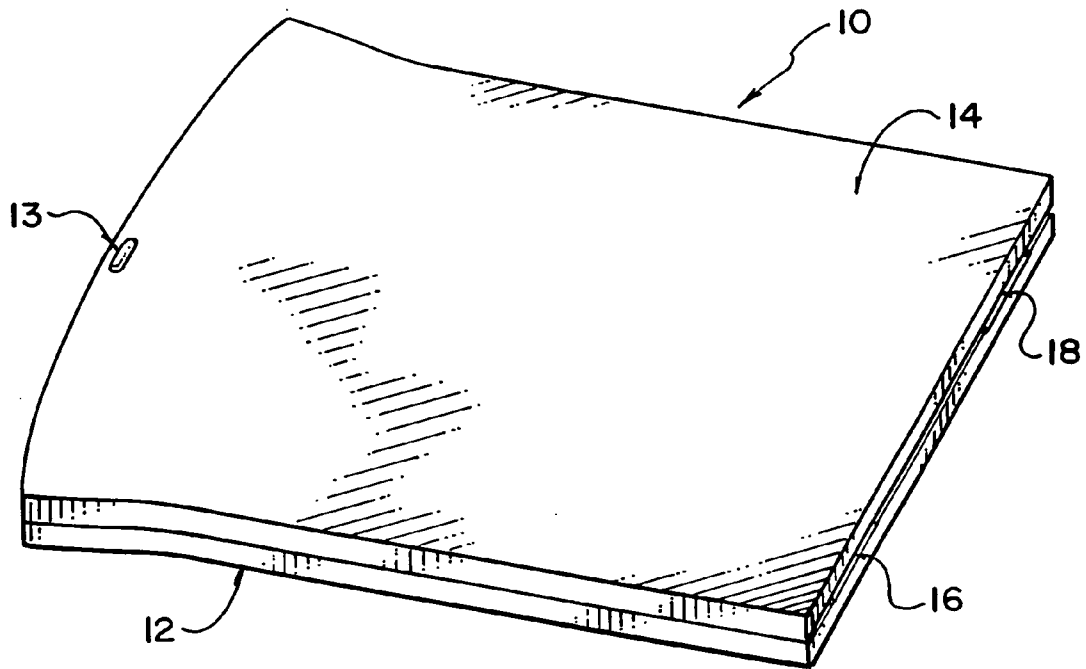


FIG. 1

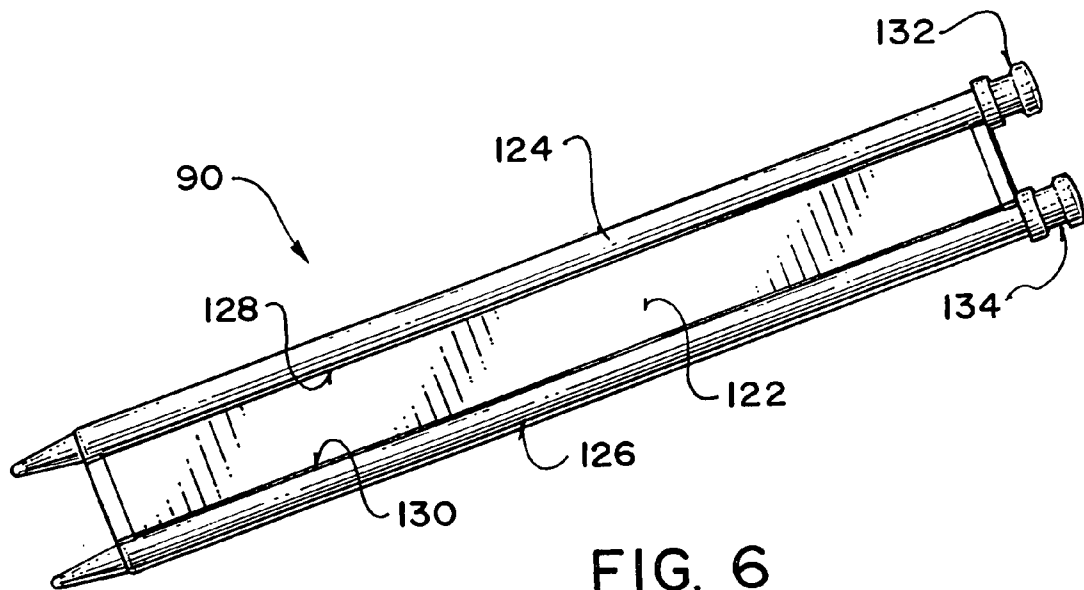


FIG. 6

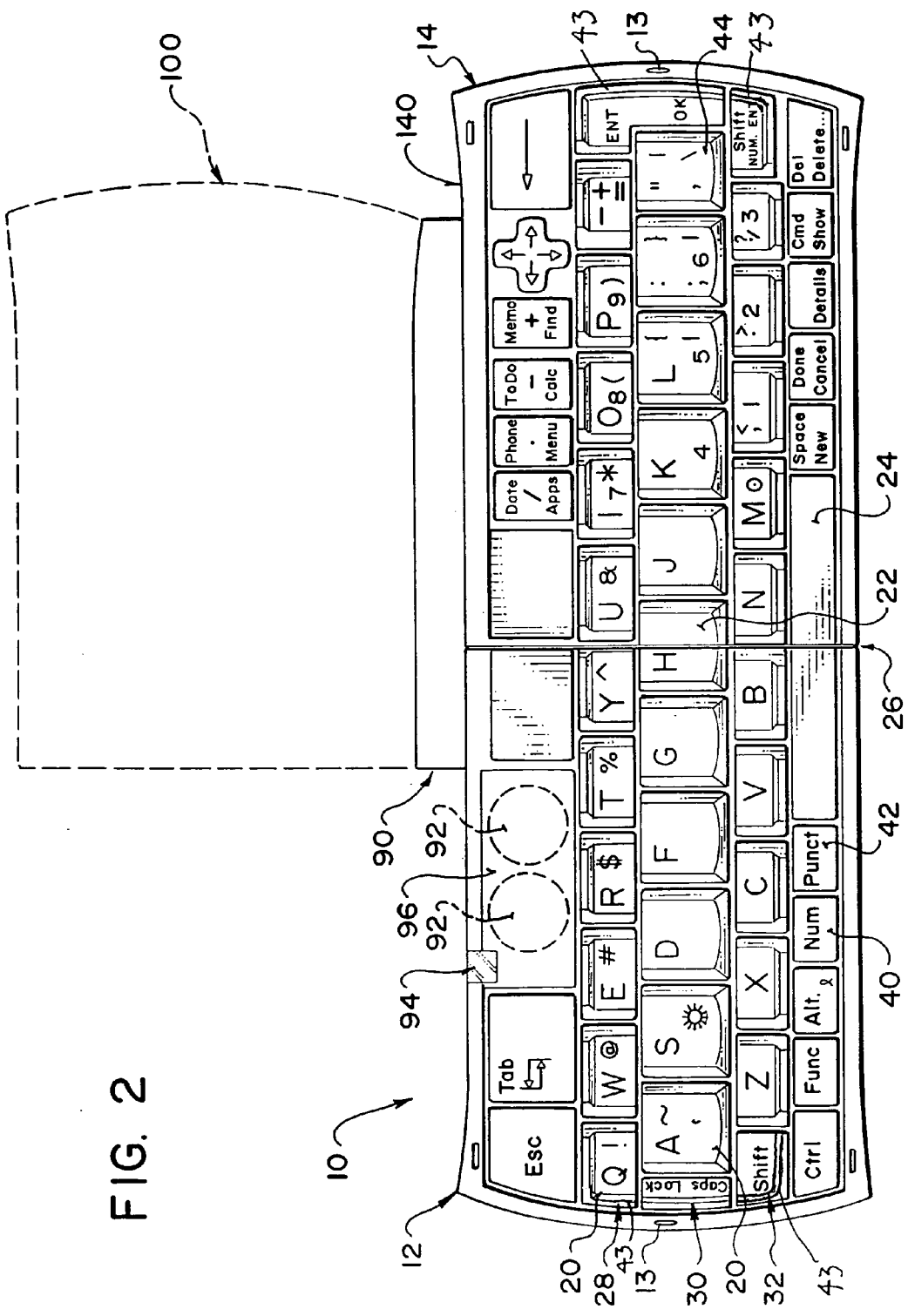


FIG. 2

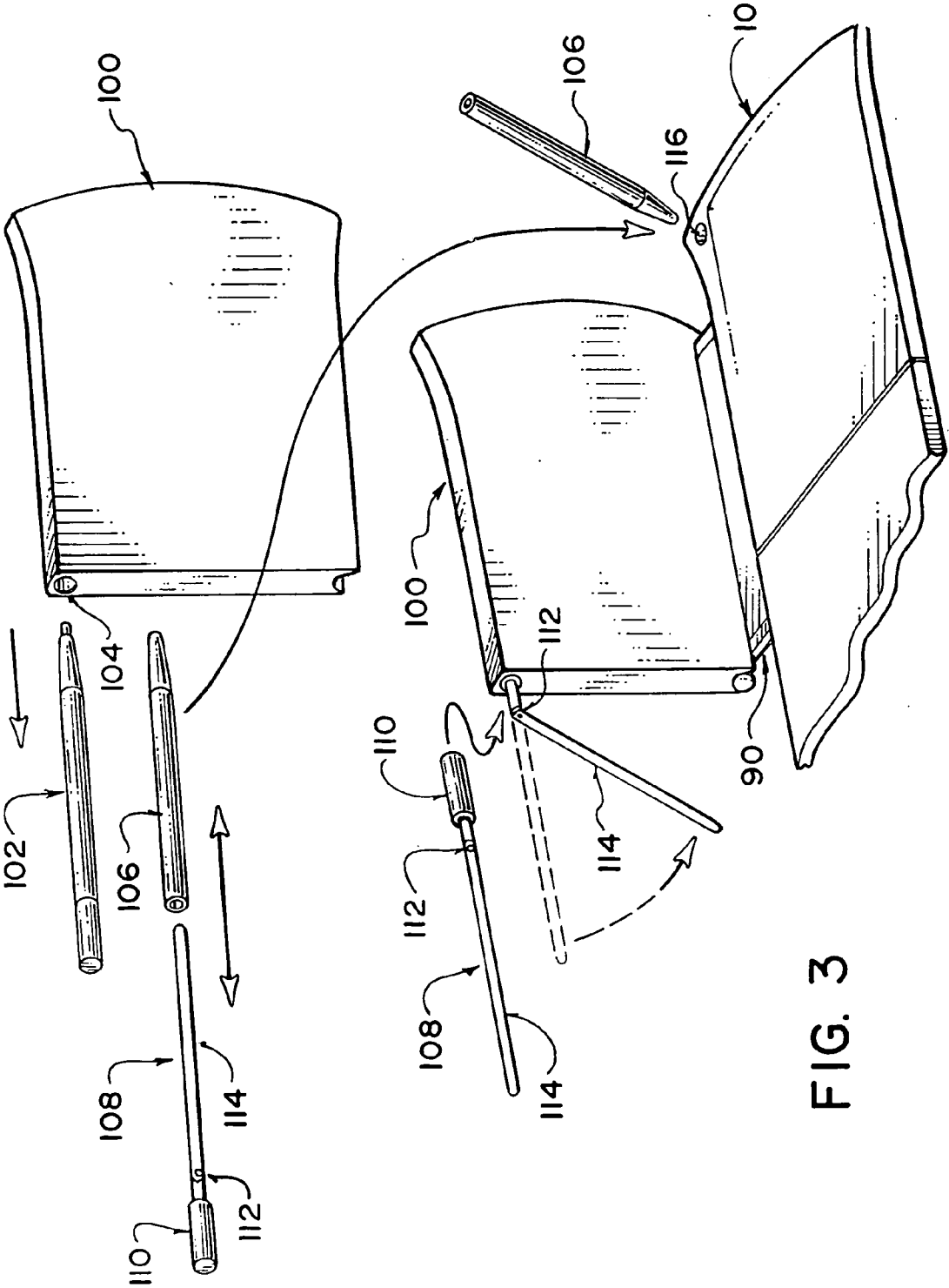
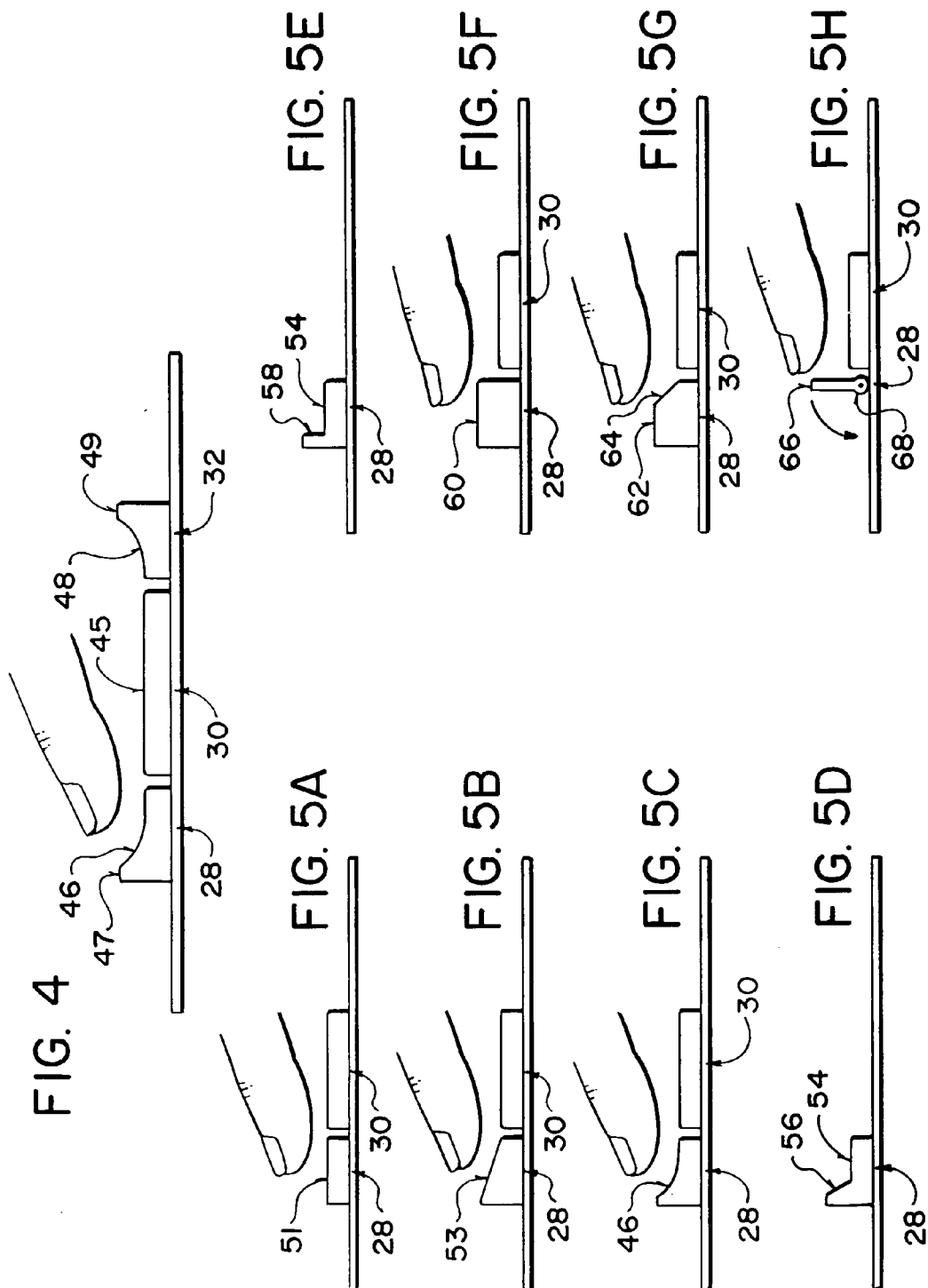


FIG. 3



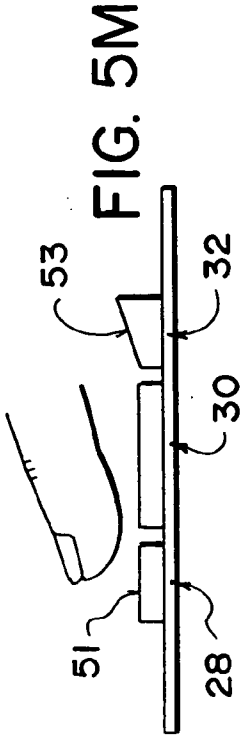


FIG. 5M

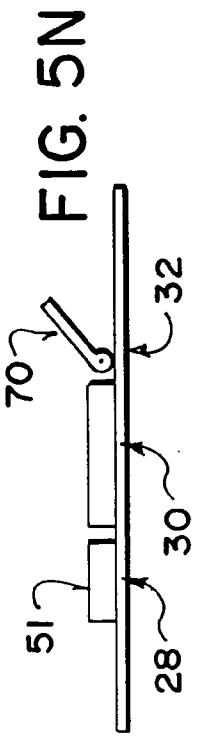


FIG. 5N

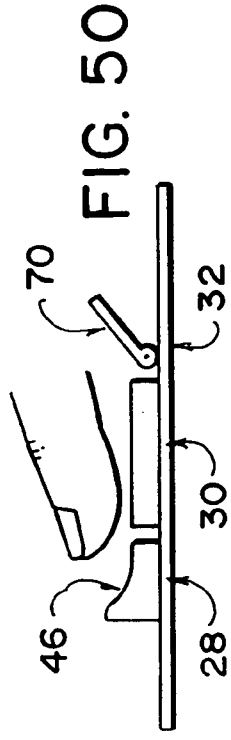


FIG. 5O

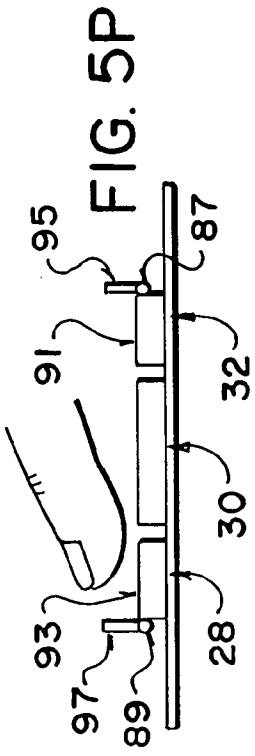


FIG. 5P

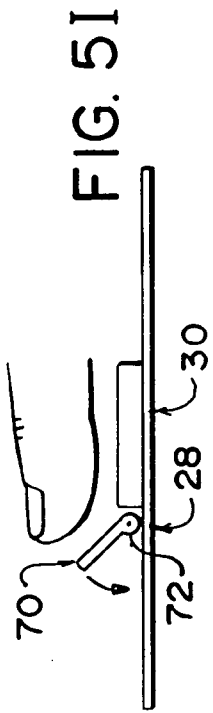


FIG. 5I

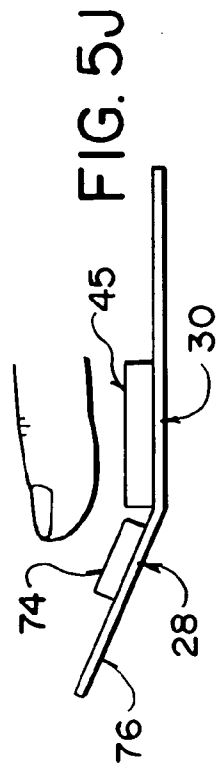


FIG. 5J

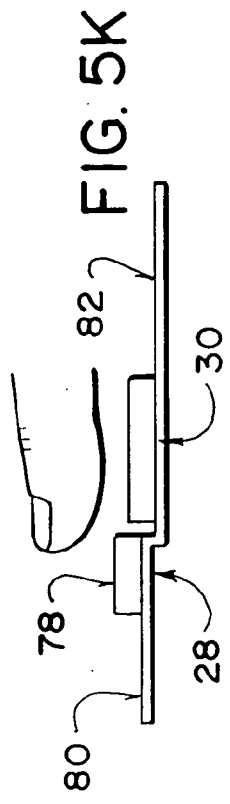


FIG. 5K

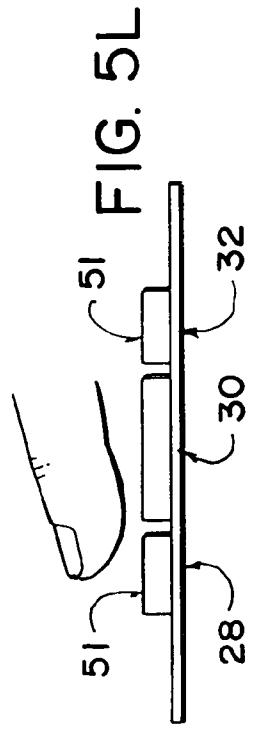


FIG. 5L

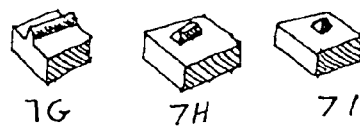
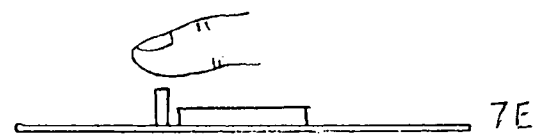
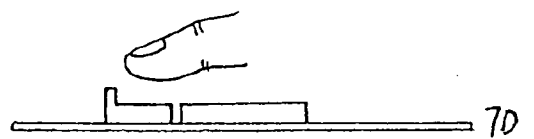
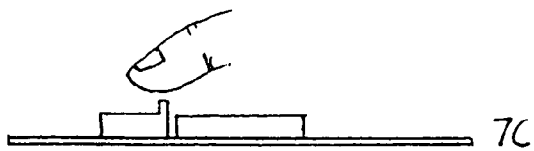
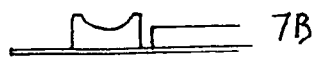
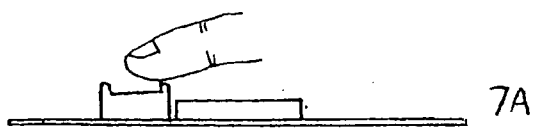
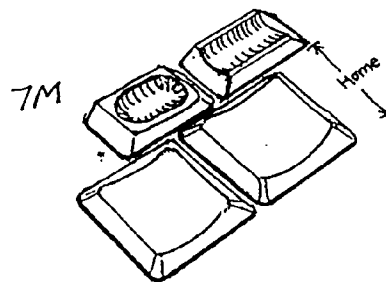
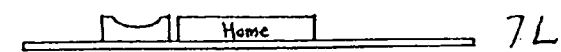
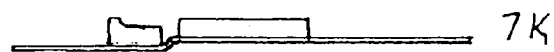
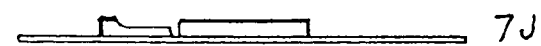


FIG. 7



FOLDING KEYBOARD FOR A PERSONAL DIGITAL ASSISTANT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a division of application Ser. No. 10/179,169 filed Jun. 26, 2002, which is pending and was a continuation-in-part of application Ser. No. 09/850,158 filed May 8, 2001 now U.S. Pat. No. 6,594,142 issued 15 Jul. 2003.

TECHNICAL FIELD

[0002] The invention relates to folding keyboards, and in particular to a folding keyboard particularly useful for use with a personal digital assistant.

BACKGROUND ART

[0003] Personal digital assistants ("PDA's"), such as the devices manufactured by PALM™ and HANDSPRING™, are popular both as portable computers and as wireless communication devices. These devices use a pen to either hand-write characters or select letters from a simulated keyboard. However the lack of a standard keyboard greatly reduces the usefulness of these devices for word processing, e-mail, internet access or software applications. Touch typists require a standard size keyboard to type at full speed and efficiency. This requires a standard key size of about 18 mm square, with a 1 mm spacing between keys. Thus a standard size keyboard cannot be reduced to a size comparable to the size of a PDA without folding and/or collapsing the keyboard.

[0004] A collapsible full-size keyboard has been developed for PDA's and similar devices. See for example U.S. Pat. No. 6,174,097 issued Jan. 16, 2001 to Simon entitled "Collapsible Keyboard", which keyboard is sold under the trademark STOWAWAY by Think Outside, Inc. While such a device provides a collapsible full-size keyboard for a PDA, it is complex to manufacture due to the need for three folding axes and multiple slidable keys and spring connections to effect collapsing. It is also larger than the PDA when collapsed. Before one can use the STOWAWAY keyboard, a driver program must be installed on the PDA. To connect the PDA with the STOWAWAY keyboard, a popup stand to support the PDA is provided on the keyboard. The connector of the PDA is slid onto a corresponding connector on the keyboard.

[0005] The present inventor has invented a folding keyboard which allows a full-size keyboard to be folded using a split key, as disclosed in U.S. Pat. No. 6,088,220 issued Jul. 11, 2000. However such a keyboard, while useful for a pocket-sized computer is also greater in size than a PDA when folded.

[0006] The present inventor has also invented a combination mobile telephone, personal digital assistant and computer, as disclosed in provisional application No. 60/219,125 filed Jul. 19, 2000 which comprises a computer keyboard comprising a plurality of keys generally corresponding to the keys of a standard personal computer keyboard, and comprising two halves hingedly connected along a fold line extending transversely across the keyboard, each half thereby comprising a portion of the plurality of keys,

whereby the computer is folded from a first open position in which the plurality of keys forms the generally standard personal computer keyboard, to a closed position in which the two halves are in opposed parallel relationship whereby the respective portions of the plurality of keys on the respective halves face each other in close proximity or actual contact, and which includes keys which are reduced in size but act like regular sized keys due to the shape of the key surface.

[0007] There is therefore a need for a folding keyboard for use with PDA's which functions as a full-size keyboard and which folds in a simple manner to the size of a PDA.

DISCLOSURE OF INVENTION

[0008] The present invention provides a combination of a wireless folding keyboard for a personal digital assistant and a stand for supporting the personal digital assistant, wherein the personal digital assistant has a first port for wireless communication, the folding keyboard comprises a second port for wireless communication and the stand is adapted to support the personal digital assistant in an orientation whereby the first and second port are in wireless communication with each other, and wherein the keyboard further comprises a battery, a plurality of keys and computer software for wirelessly communicating a keystroke signal when a key is struck

BRIEF DESCRIPTION OF DRAWINGS

[0009] In drawings which disclose a preferred embodiment of the invention:

[0010] **FIG. 1** is a perspective view of the invention, fully folded;

[0011] **FIG. 2** is a top view of the invention, in open position, with an attached PDA shown in phantom outline;

[0012] **FIG. 3** is a perspective view of the invention, fully open in which a novel pen is used as a stand for the PDA;

[0013] **FIG. 4** is a side view of the key structure for the first and third rows of keys;

[0014] **FIGS. 5a to 5p** are side views, not to scale, of variants of the key structure for the first and third rows of keys and keys at either end of the keyboard;

[0015] **FIG. 6** is a detail perspective view of the hinge construction; and

[0016] **FIG. 7** illustrates further variants of the key structure for the first and third rows of keys and keys at either end of the keyboard.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

[0017] With reference to the drawings, a folding keyboard, shown fully folded in **FIG. 1**, is designated generally as **10**. It comprises keyboard halves **12, 14**. The keyboard is hinged at hinges **16, 18** so that the keyboard halves **12, 14** can be folded as shown in **FIG. 1**. The preferred dimensions for keyboard **10** are such that the fully folded dimensions are approximately the same as the dimensions of a PDA: namely 4.5 inches in length and 3 inches in width. The thickness is approximately 0.44 inches. When fully unfolded as shown in **FIG. 2**, keyboard **10**, composed of keyboard halves **12, 14**

and an array of keys **20** acts as the PDA data input. At least one of the keys **20**, typically the “H” key **22** and the space bar **24**, may be split along the fold line **26** to permit folding of the keyboard as disclosed in the same inventor’s U.S. Pat. No. 6,088,220. Keyboard **10** has three rows **28**, **30**, **32** of letter keys. The keys in the center or “home” row **30** (ASDFGHJKL;,) are standard size, about 18 mm square and spaced at the normal spacing of a standard QWERTY keyboard, and 19 mm measured center to center horizontally (that is, in the direction parallel to the length of the center row). The top row **28** (QWERTYUIOP[]) and bottom row **32** (ZXCVBNM,./) are standard horizontal dimensions but are only about 50% of the vertical dimension, namely about 9 mm. Function keys **40**, **42** are provided so that certain keys such as **44** can also be used to type numbers and additional punctuation symbols. For example to type the numeral “4”, the user depresses function key **40** and letter key “K”. To type the punctuation sign “{”, the user depresses function key **42**, the “shift” key and letter key “L”.

[0018] In order to facilitate a typist utilizing the same finger action as that employed on a standard full-size QWERTY keyboard, the top and bottom rows of keys **28**, **32** preferably have a scalloped or contoured upper surface **46**, **48** (see FIG. 4) whereby the upper edge **47** of keys in row **28** and the lower edge **49** of keys in row **32** is raised above the surface **45** of center row **30**. Thus, when a typist types on keyboard **10** he/she will use the same finger action as for a standard keyboard, but to prevent the typist from missing the upper and lower keys, the upper surfaces of the top and bottom rows **28**, **32** are shaped to prevent the fingers from overrunning the keys by curving the upper or lower edges of the keys in the top and bottom rows upwardly. To be useful, it has been found that the height of upper edges **47** and **49** should be approximately 1.5 mm. higher than the surface **45** of row **30**.

[0019] Also as shown in FIG. 2, the “Q”. “Caps Lock”, “Shift” and “Enter” keys are narrower than in a standard keyboard but the outer edges **43** of the “Q”. “Caps Lock”, “Shift” and “Enter” keys are raised, scalloped or contoured in the same way as the keys in rows **28**, **32** in order to facilitate a typist utilizing the same finger action as that employed on a standard full-size QWERTY keyboard when striking the left-most and right-most keys.

[0020] Further embodiments of the configuration of the keys for the top and bottom rows **28**, **32** and end keys are shown in FIGS. 5a through 5p. In the embodiment shown in FIG. 5a, the tops **51** of the half-keys in row **28** are flat. In this case, the typist can still strike the half keys as if they are full size without missing the key entirely, although it is preferable to have a configuration to the key which assists in directing the typist’s finger to the key. In the embodiment shown in FIG. 5b, the top surface **53** of the key in row **28** slopes uniformly upwardly rather than having a curved or scalloped upper surface as in FIGS. 4 and 5c. Further variants of the scalloped key are shown in FIGS. 5d and 5e, wherein the upper surface of the key, rather than being smoothly curved, has a horizontal portion **54** adjacent to an angled surface **56** or vertical surface **58** (the vertical scale of FIG. 5e is exaggerated for illustrative purposes, but there should be a height of surface **58** of 1.5 mm, and it could be hinged as discussed below concerning FIG. 5p). In the embodiment shown in FIG. 5f, the keys in row **28** are thicker than those in home row **30** so the top surface **60** of

the keys in row **28** is raised above center row **30** but is horizontal or flat. In the embodiment shown in FIG. 5g, the top surface **62** of the keys in row **28** is raised above center row **30** and is horizontal for part of the surface but angled on the face **64** adjacent the center or home row.

[0021] In the embodiment shown in FIG. 5h, the keys in row **28** are configured as hinged vertical tabs **66** which pivot about hinge **68**, and cause the key to be struck when pivoted a certain amount from vertical. In the embodiment shown in FIG. 5i, the keys in row **28** are also configured as hinged tabs **70** which pivot about hinge **72**, but when in the rest position are angled rather than vertical. The key is caused to be struck when pivoted a certain amount from the rest angle. In the embodiment shown in FIG. 5j, the keys in row **28** have a flat upper surface **74** and are the same thickness as the keys in row **30**, as in FIG. 5a, but the underlying support surface **76** is angled, causing surface **74** to be angled in relation to the upper surface **45** of the keys in row **30**. In the embodiment shown in FIG. 5k, the keys in row **28** have a flat upper surface **78** and are the same thickness as the keys in row **30**, as in FIG. 5a, but the underlying support surface **80** is raised above the underlying support surface **82** of center row **30**, causing surface **78** to be higher than the upper surface of the keys in row **30**.

[0022] As shown in FIGS. 5l through 5o, the lower row **32** can have the same key configuration as upper row **28** (FIGS. 4, 5l) or a combination of different key configurations as described above. For example, the keys in FIG. 5o have the scalloped upper surface **46** of FIG. 5c for top row **28** and the angled pivoting tab **70** of FIG. 5i for row **32**. To minimize the thickness of the keyboard when folded, the scalloped key itself may be formed of two parts, as shown in FIG. 5p. In this embodiment, top row keys **28** and/or bottom row keys **32** are formed of a flat key **91**, **93** to which is attached a hinged vertical tab **95**, **97** connected by hinges **87**, **89** to keys **91**, **93**. Hinges **87**, **89** are stiff enough to permit the tabs **95**, **97** to redirect the typists fingers when the keyboard is unfolded, but allow the tabs to be folded either on top of keys **91**, **93** or in the direction above or below rows **28**, **32** when the keyboard is folded. The direction of folding of tabs **95**, **97** is determined by causing the rest position of the tabs to be slightly off vertical in the chosen direction of folding.

[0023] Further variants of the scalloped key are shown in FIG. 7. In FIGS. 7A, 7B, 7L and 7M, the upper surface of the key has a central trough or groove. In FIGS. 7A, 7B, 7L and 7M, the upper surface of the key has a central trough or groove. In FIGS. 7C and 7E a vertical ridge is provided on the upper surface of the key. In FIG. 7E the key itself is a vertical ridge. In FIGS. 7F, 7G, 7H and 7I, a central ridge or protrusion is provided on, the upper surface of the key. In FIGS. 7J and 7K the upper surface of the key is lower than the central row’s upper surface.

[0024] Keyboard **10** can be connected to PDA **100** either by a direct plug-in connection or by infrared (IR) communication. If infrared connection is utilized, the PDA **100** is connected to the keyboard **10** by hinge **90** as shown in FIG. 2 and as further described below. In that case, the screen display on the PDA is rotated 90 degrees, using HACK-MASTER™ or other available software. Electrical power is provided by batteries **92**. The infrared port from the keyboard is provided at **94** and is directed so that it communicates with the infrared port of the PDA when the PDA is

connected to the keyboard as shown in **FIGS. 2 and 3**. Suitable software is either loaded on the PDA to process the infrared keyboard signals either through a personal computer or directly from the keyboard **10**. If a direct plug-in connection is used, then a compatible plug-in connection is provided at **96** rather than an IR port and the PDA connector is plugged in in the normal orientation as in the existing STOWAWAY keyboard.

[0025] When an IR connection is provided, pen or stylus **102** of the PDA **100** (**FIG. 3**), which is stored in cavity **104** can also be used to provide a stand for the PDA **100** to form a configuration like a laptop computer in conjunction with the keyboard as shown in **FIG. 3**. The stylus **102** has an outer shell **106** and an inner element **108** consisting of a cylinder **110** connected by a hinge **112** to leg **114**. Stylus **102** is removed from cavity **104** and outer shell **106** is removed and can be held for storage in a rubber cup **116** provided in keyboard **10**. Cylinder **110** is inserted into cavity **104** and leg **114** is pivoted to the appropriate angle about hinge **112** to act as a support for the PDA. Hinge **112** is sufficiently tight so that the leg **114** will stay in a given position once pivoted or twisted into that position.

[0026] Hinge **90**, shown in **FIG. 2** and in more detail in **FIG. 6**, serves to attach the PDA **100** to the keyboard **10**. The keyboard **10** is also locked in the open position by sliding hinge **90** to the position shown in **FIG. 2**. Hinge **90** has a central panel **122** which connects stylus-shaped rods **124, 126** by hinge joints **128, 130**. Stylus-shaped rods **124, 126** are sized and shaped as a PDA stylus to fit into the stylus cavity **104** in a PDA. As in the PDA stylus, stylus-shaped rods **124, 126** have heads **132, 134** with a cammed shape to allow the stylus to be tightened into a secure fit in cavity **104**. To connect the PDA **100** to the keyboard **10** as in **FIG. 2**, one of the rods **124** is slid into cavity **104** of PDA **100**. The other rod **126** is slid into a similar cavity **140** along the edge of keyboard **10**. Hinge **90** is sized so that it can be left in cavity **140** when keyboard **10** is folded by sliding it to the right in **FIG. 2**. When the keyboard is unfolded hinge **90** is slid to the position shown in **FIG. 2** which locks the keyboard in the open position.

[0027] To minimize the thickness of the keyboard **10** when folded, the keys **20** are compressed or squeezed to their maximum depression and minimum height between halves **12** and **14** through contact with the keys on the opposing half, and a snap or clasp **13** (**FIGS. 1 and 2**) locks the halves in the closed configuration until released.

[0028] As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention

without departing from the spirit or scope thereof. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

What is claimed is:

1. A combination of a wireless folding keyboard for a personal digital assistant and a stand for supporting said personal digital assistant, wherein said personal digital assistant has a first port for wireless communication, said folding keyboard comprises a second port for wireless communication and said stand is adapted to support said personal digital assistant in an orientation whereby said first and second port are in wireless communication with each other, and wherein said keyboard further comprises a battery, a plurality of keys and computer software for wirelessly communicating a keystroke signal from said second port when a key is struck.

2. The combination of claim 1 wherein said wireless communication comprises infrared communication and said first and second ports are infrared ports.

3. The combination of claim 1 wherein said stand for supporting a personal digital assistant comprises a stylus-shaped element having a first end sized to be removably received in a stylus-receiving cavity of said personal digital assistant, and a rigid elongated element pivotally connected to said first end, whereby when said first end is received in said stylus-receiving cavity said rigid elongated element may be pivoted to support said personal digital assistant in an orientation whereby said first and second port are in wireless communication with each other.

4. The combination of claim 1 wherein personal digital assistant is hingedly connected to said folding keyboard and said stand supports said personal digital assistant in an orientation to permit wireless communication between said first and second ports.

5. The combination of claim 3 further comprising a hinge to removably and hingedly connect said personal digital assistant to said folding keyboard in an orientation to permit wireless communication between said first and second ports.

6. The combination of claim 3 wherein the screen display of the personal digital assistant is rotated 90 degrees.

7. The combination of claim 4 wherein the screen display of the personal digital assistant is rotated 90 degrees.

8. The combination of claim 5 wherein said hinge comprises a stylus-shaped rod which is sized and shaped to fit into the stylus cavity of said personal digital assistant.

9. The combination of claim 5 wherein said hinge when removably installed on said keyboard thereby locks said keyboard in an open position.

* * * * *