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Benden

(10) **Patent No.: US 10,426,260 B2**
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(54) **ADJUSTABLE HEIGHT DESK HAVING A DEPLOYABLE FLOOR MAT**

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(Continued)

(51) **Int. Cl.**
A47B 13/00 (2006.01)
A47B 9/00 (2006.01)

(Continued)

(52) **U.S. Cl.**
CPC ***A47B 13/00*** (2013.01); ***A47B 9/00*** (2013.01); ***A47B 9/04*** (2013.01); ***A47B 97/00*** (2013.01); *A47B 17/02* (2013.01); *A47B 21/02* (2013.01); *A47B 2200/0052* (2013.01); *A47B 2200/0053* (2013.01); *A47B 2200/0059* (2013.01); *A47B 2200/0097* (2013.01)

(58) **Field of Classification Search**
CPC A47B 13/00; A47B 97/00; A47B 9/00; A47B 21/02; A47B 17/02; A47B 2200/0053; A47B 2200/0097; A47B 9/04; A47B 2200/0052; A47B 2200/0059
USPC 108/50.14, 144.11, 147; 312/319.9
See application file for complete search history.

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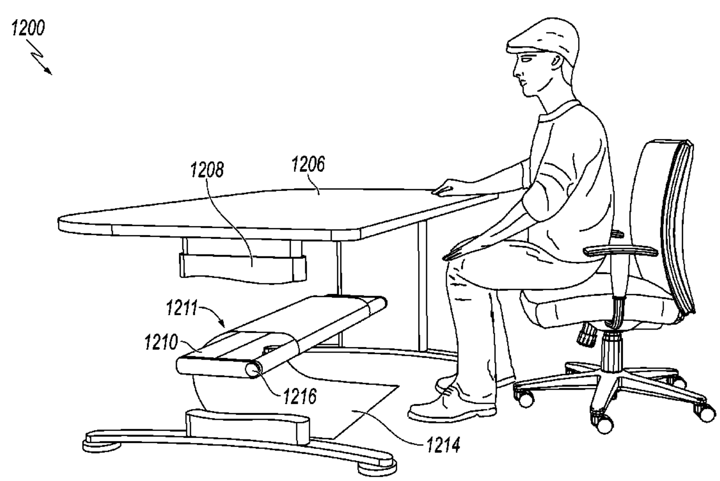
(57) **ABSTRACT**

A desk includes a tabletop and at least one base member supporting the tabletop. A footrest is disposed on the at least one base member beneath the tabletop. The footrest is movable between a stowed position toward a back of the desk and a deployed position toward a front of the desk. At least one mechanism is disposed on the at least one base member and operatively coupled to the footrest. The at least one mechanism moving the footrest between the stowed and deployed positions. A floor mat is disposed with the footrest. The floor mat is movable with the footrest between a stowed mat position and a deployed mat position.

12 Claims, 19 Drawing Sheets



Related U.S. Application Data

(60) Provisional application No. 62/421,686, filed on Nov. 14, 2016.

(51) **Int. Cl.**

A47B 97/00	(2006.01)
A47B 9/04	(2006.01)
A47B 21/02	(2006.01)
A47B 17/02	(2006.01)

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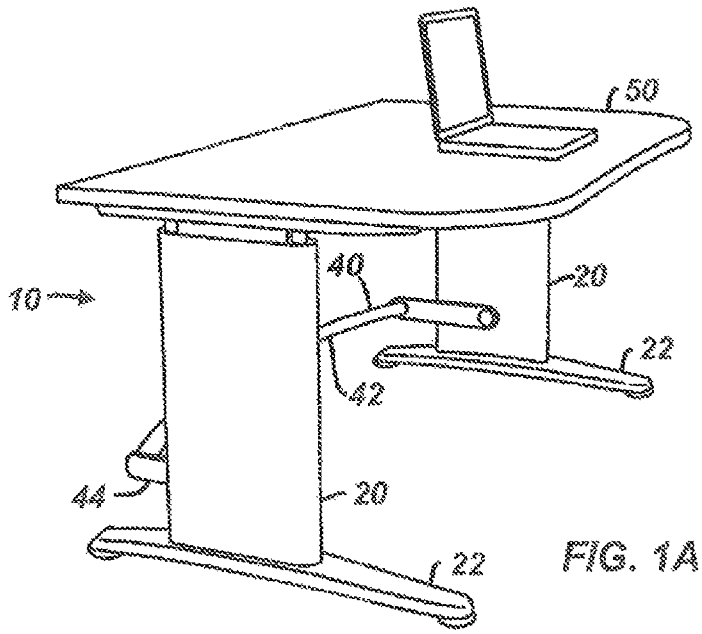
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FIG. 1A

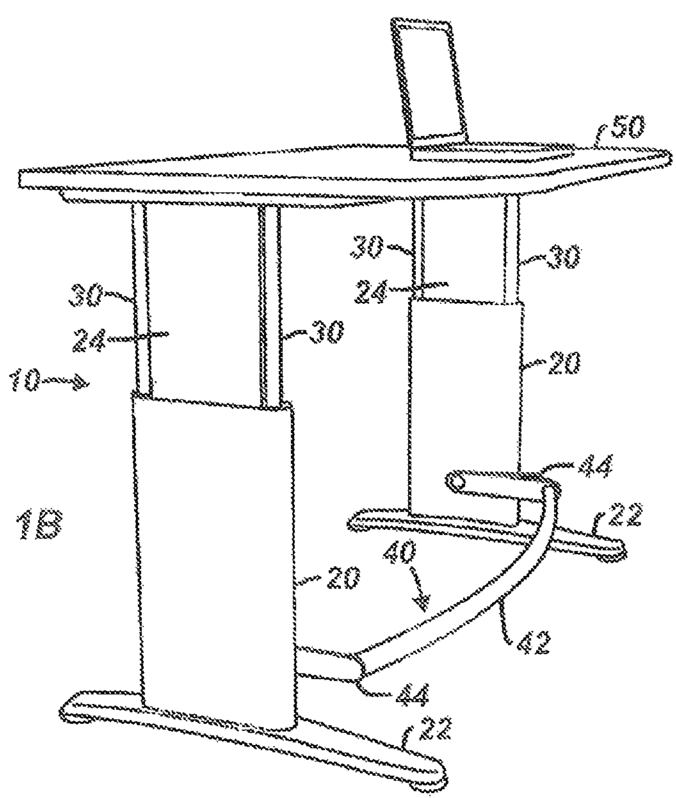
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FIG. 1B

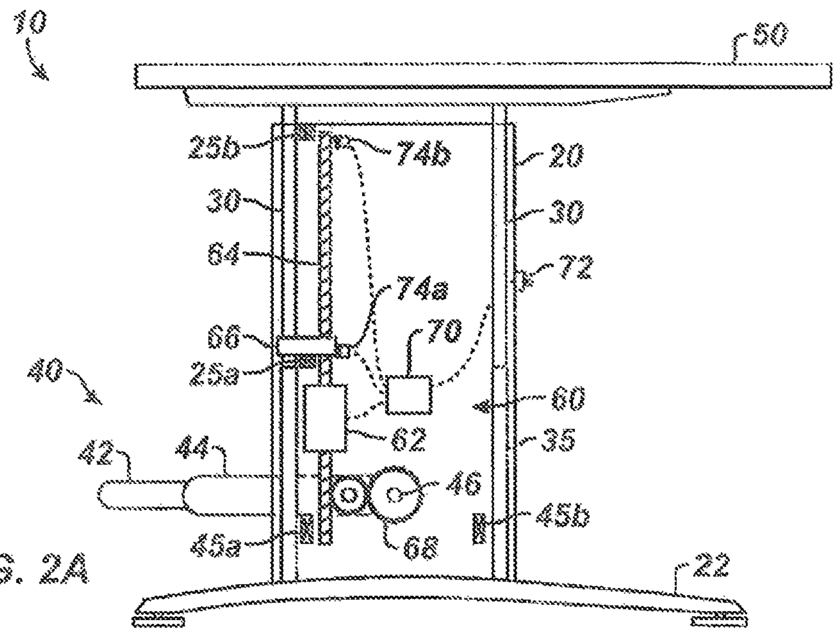
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FIG. 2A

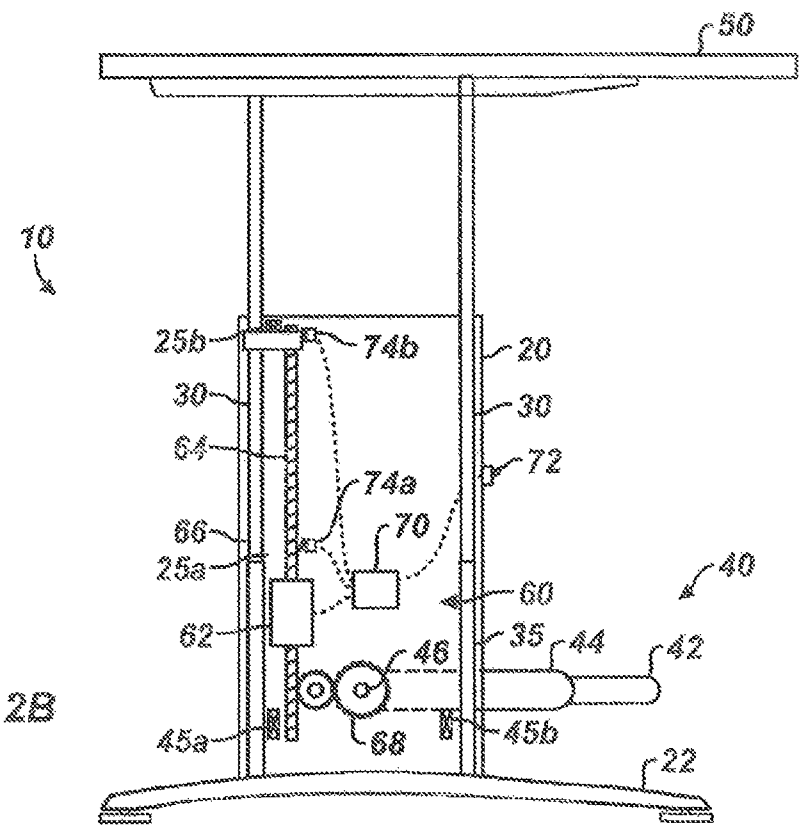
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FIG. 2B

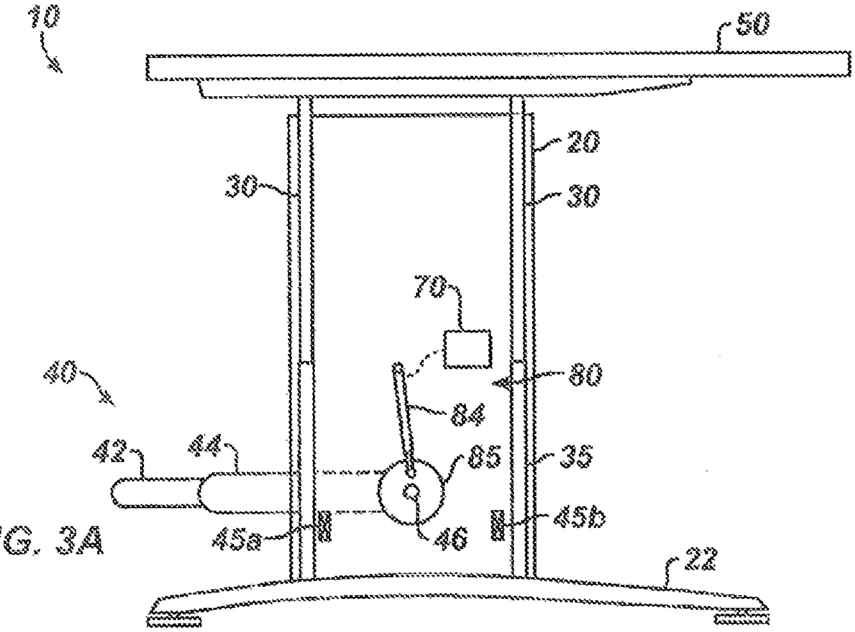
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FIG. 3A

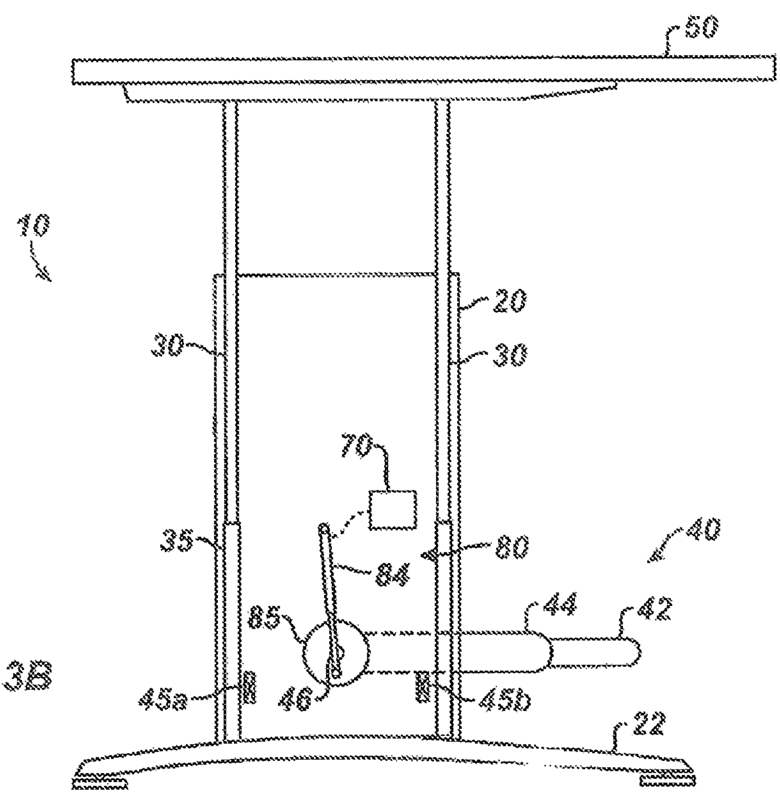
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FIG. 3B

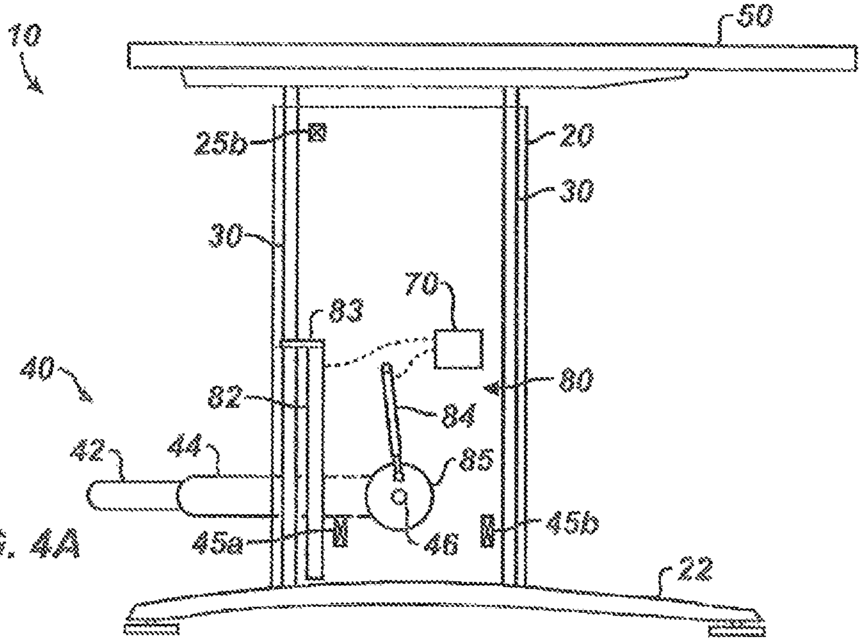
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FIG. 4A

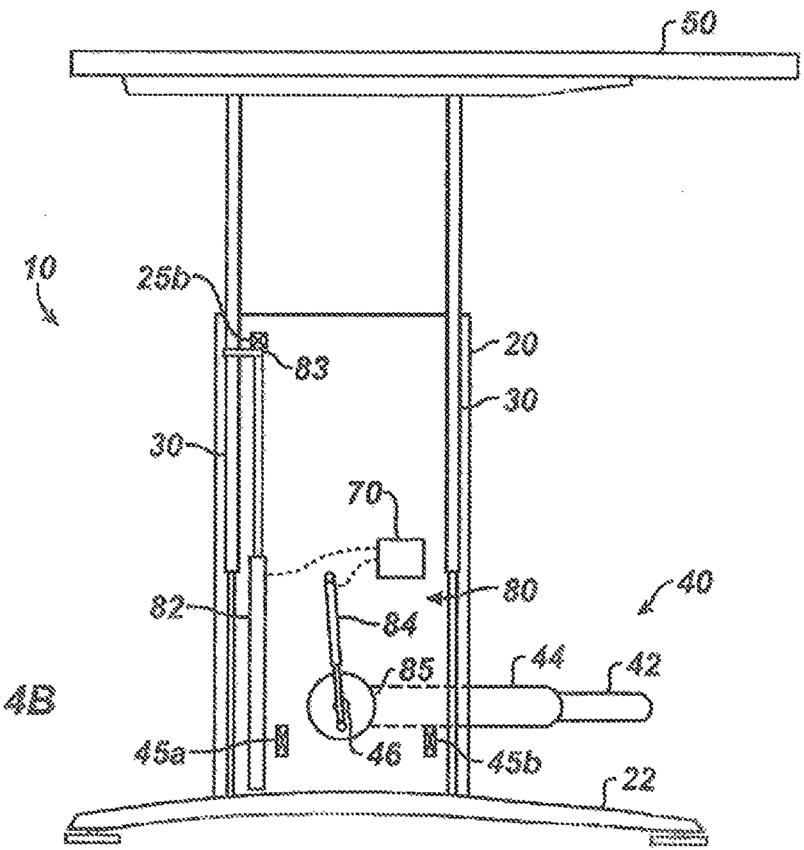
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FIG. 4B

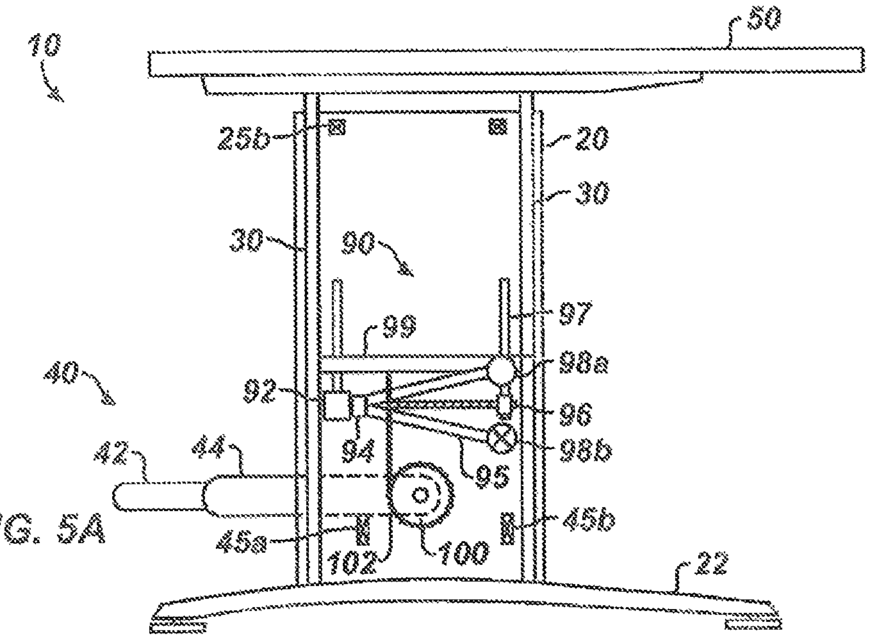

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FIG. 5A

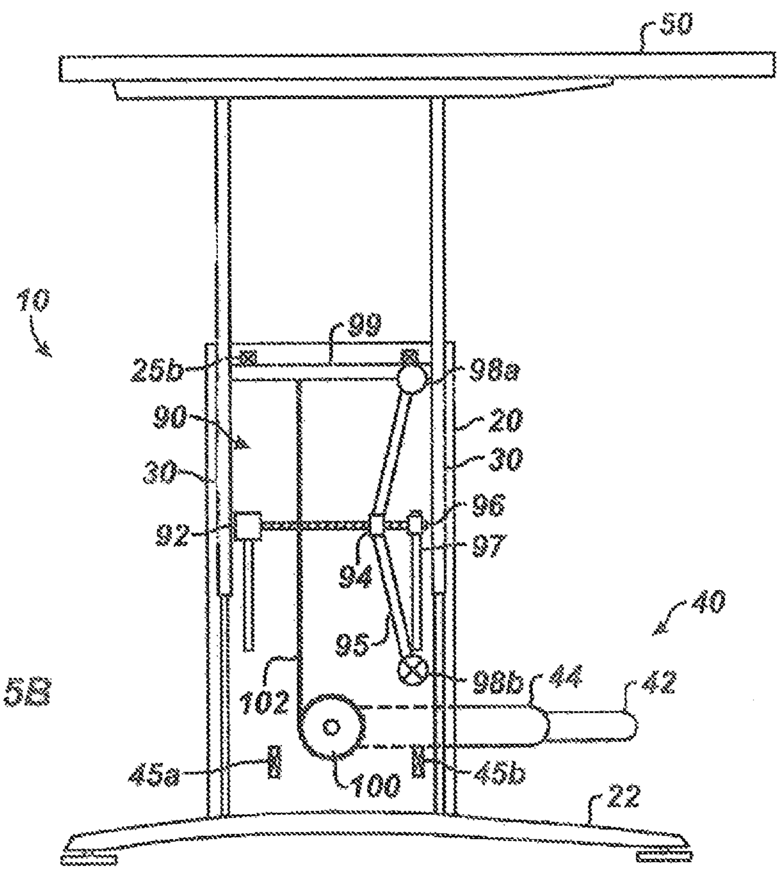

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FIG. 5B

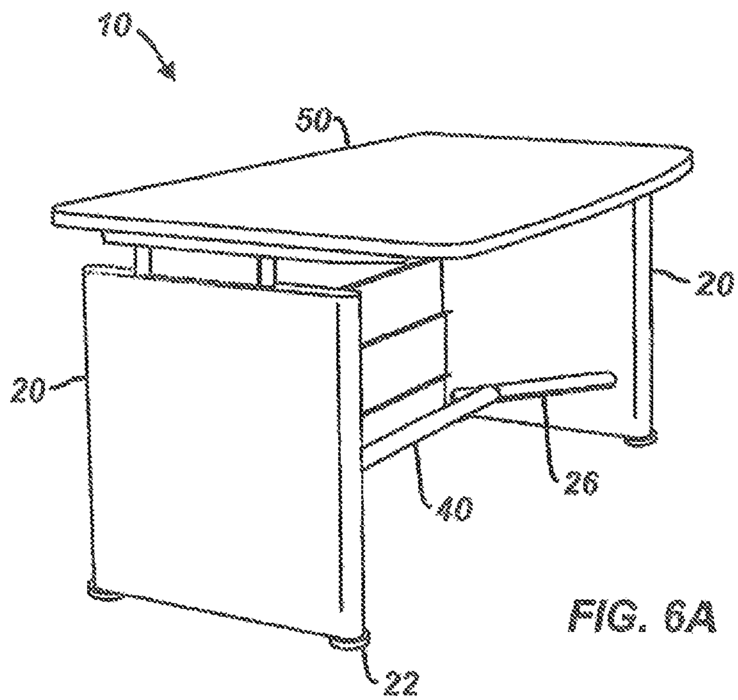

FIG. 6A

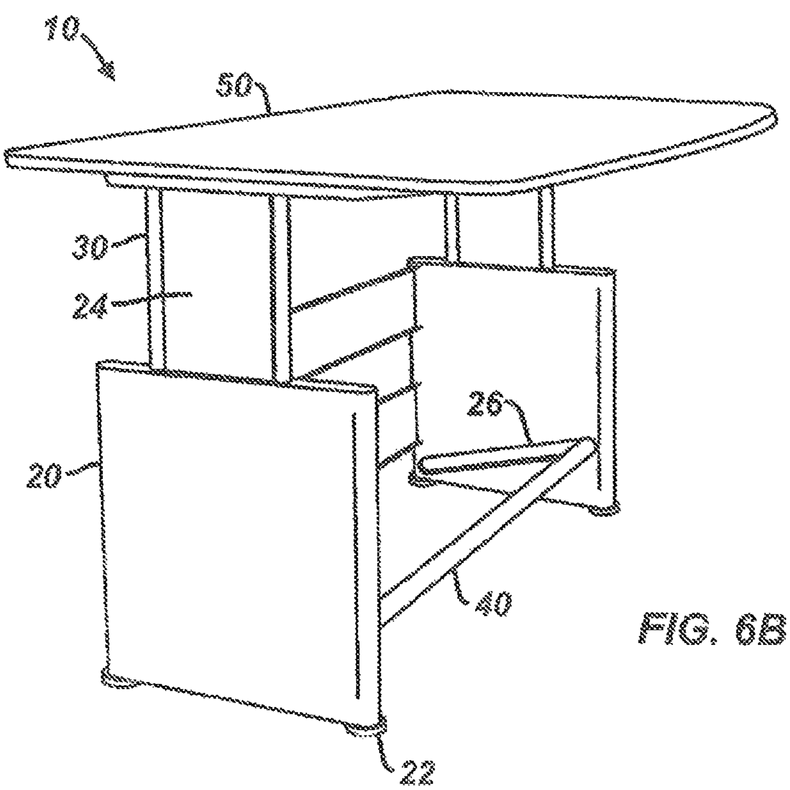

FIG. 6B

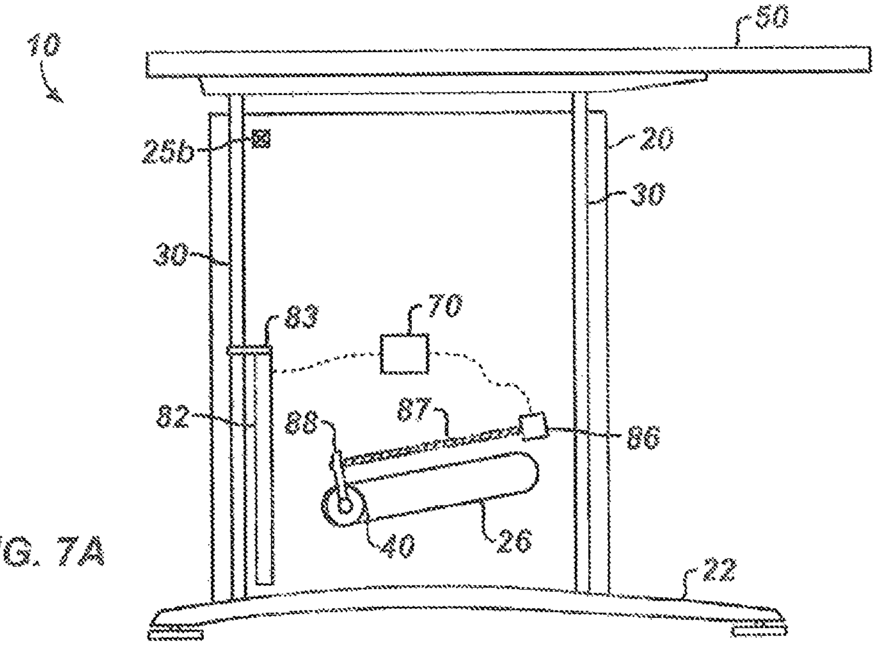
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FIG. 7A

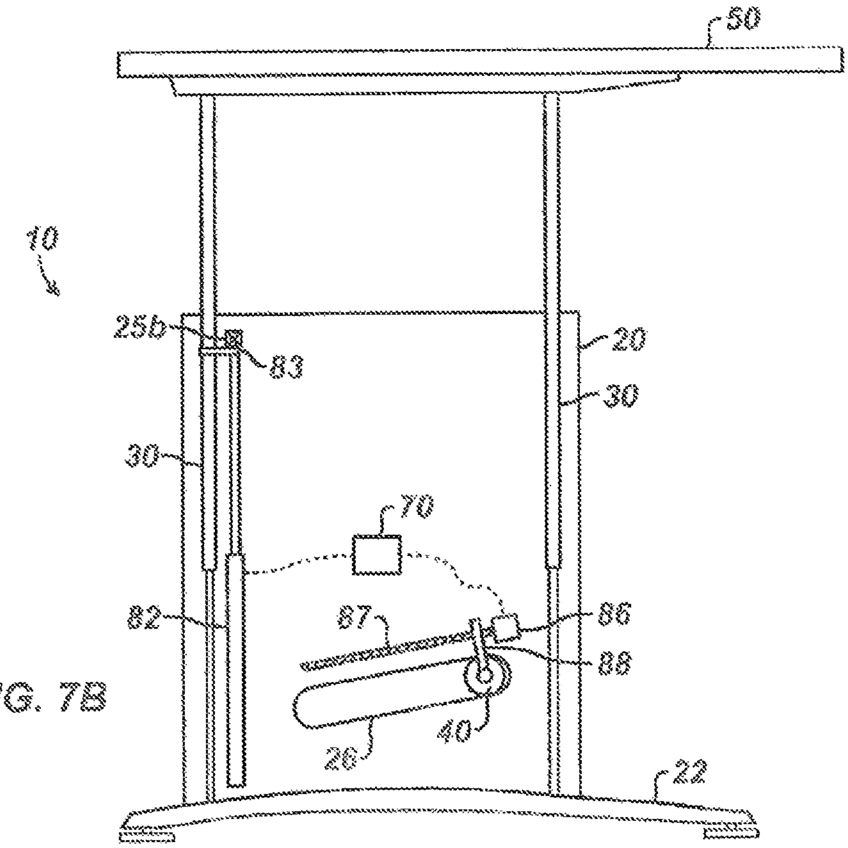
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FIG. 7B

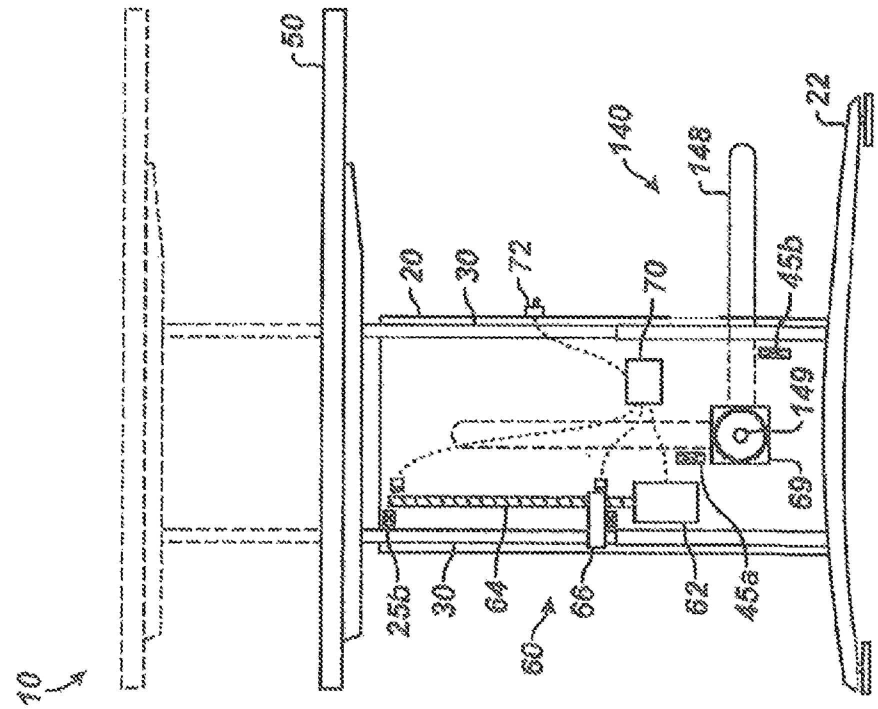
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FIG. 9C

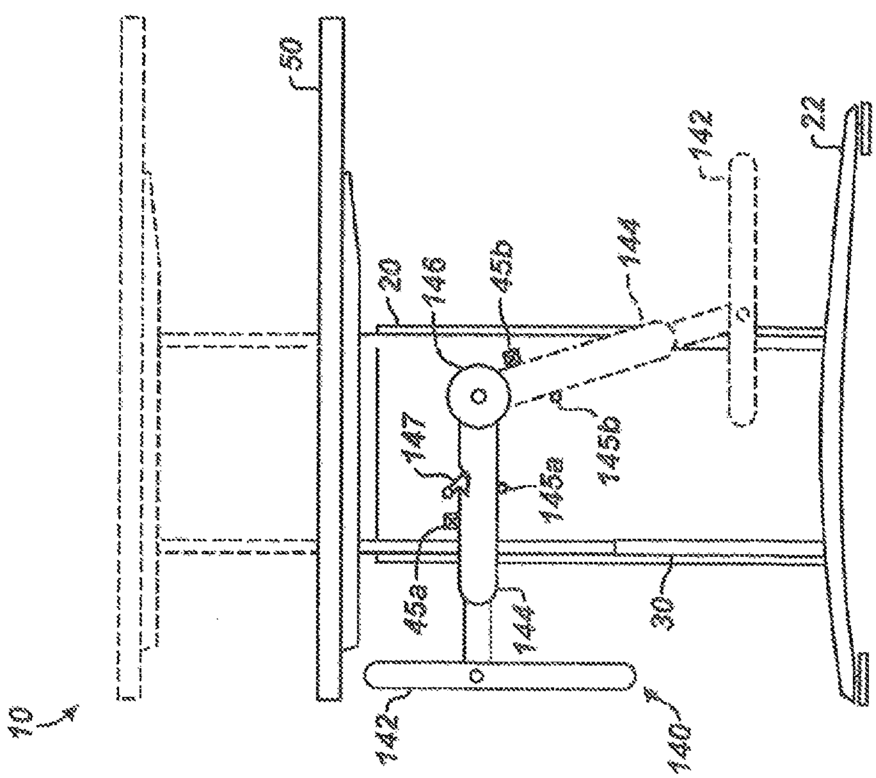
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FIG. 8

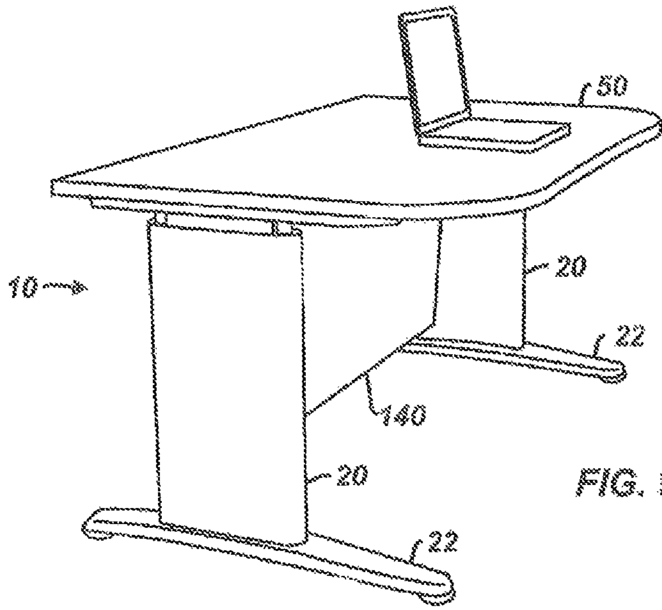

FIG. 9A

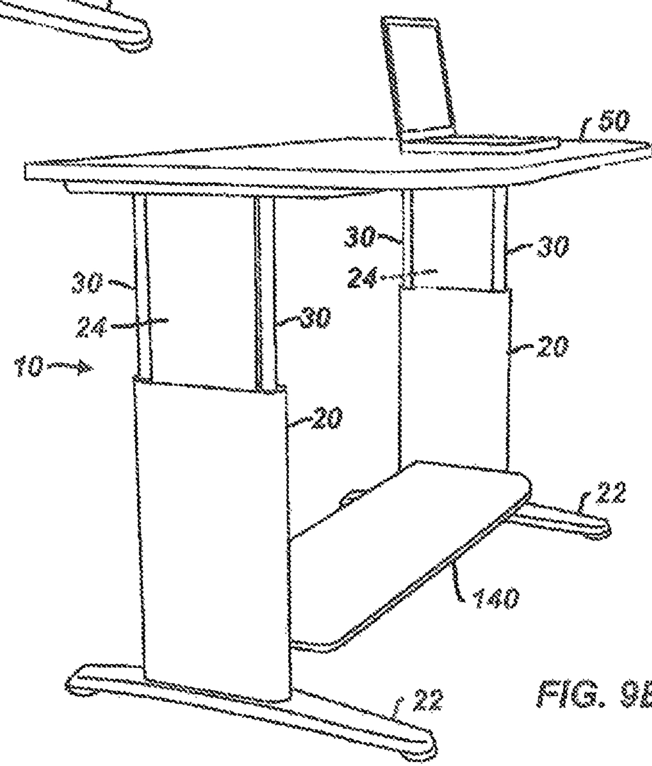

FIG. 9B

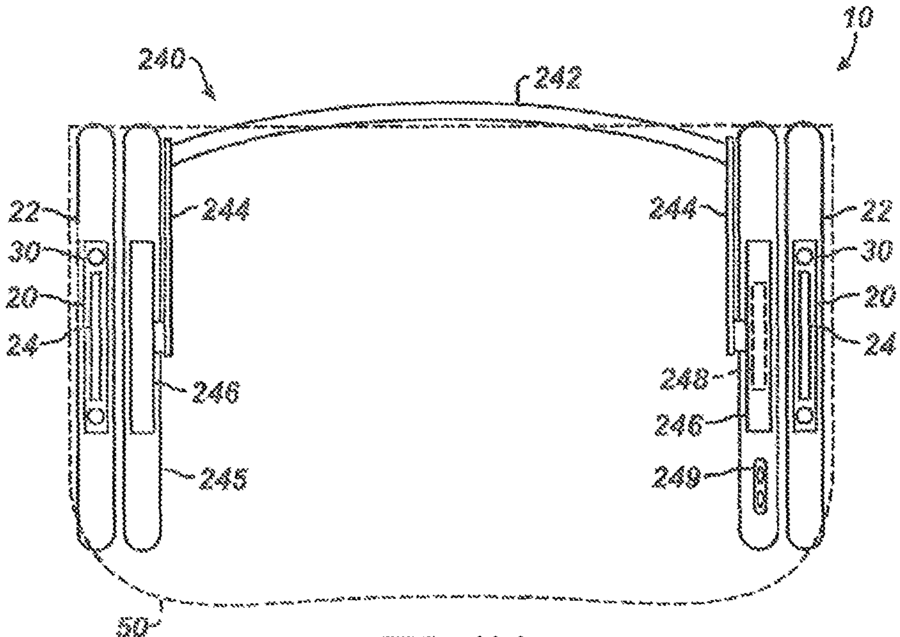

FIG. 10A

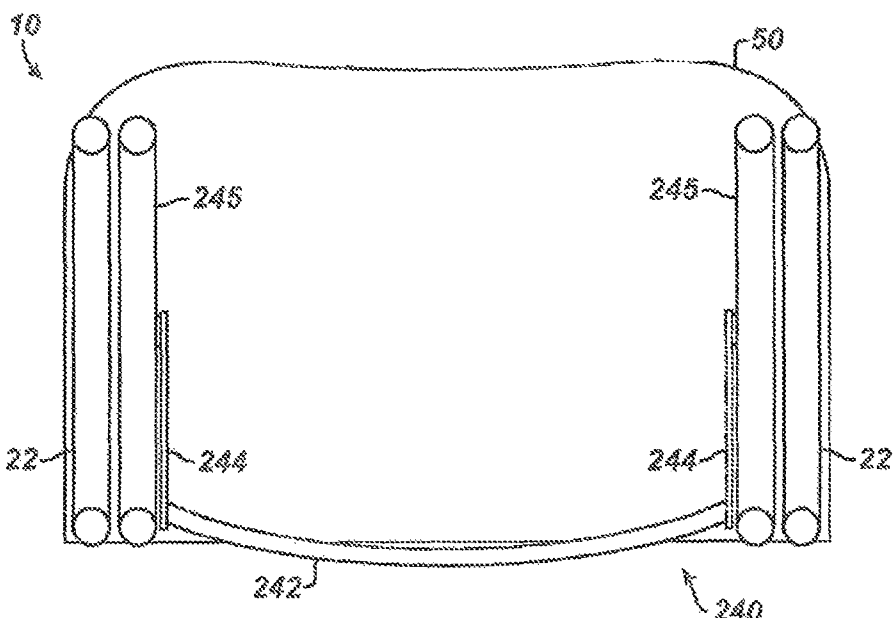

FIG. 10B

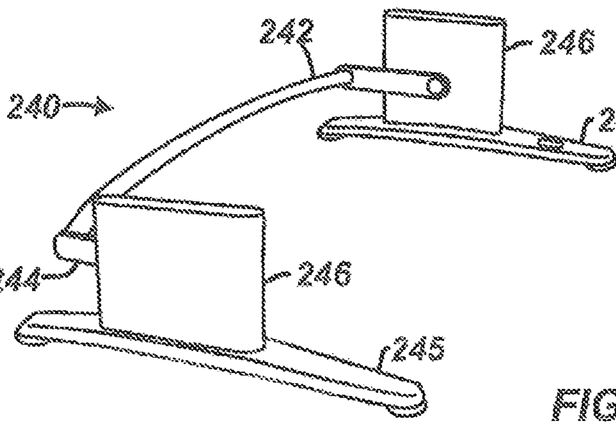

FIG. 10C

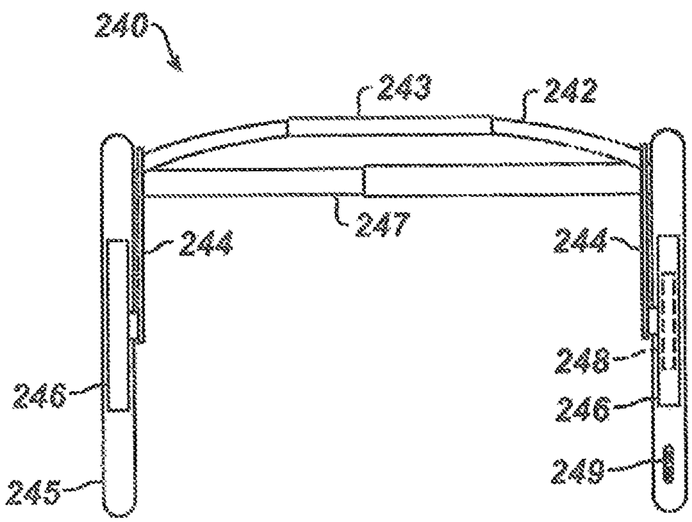

FIG. 11

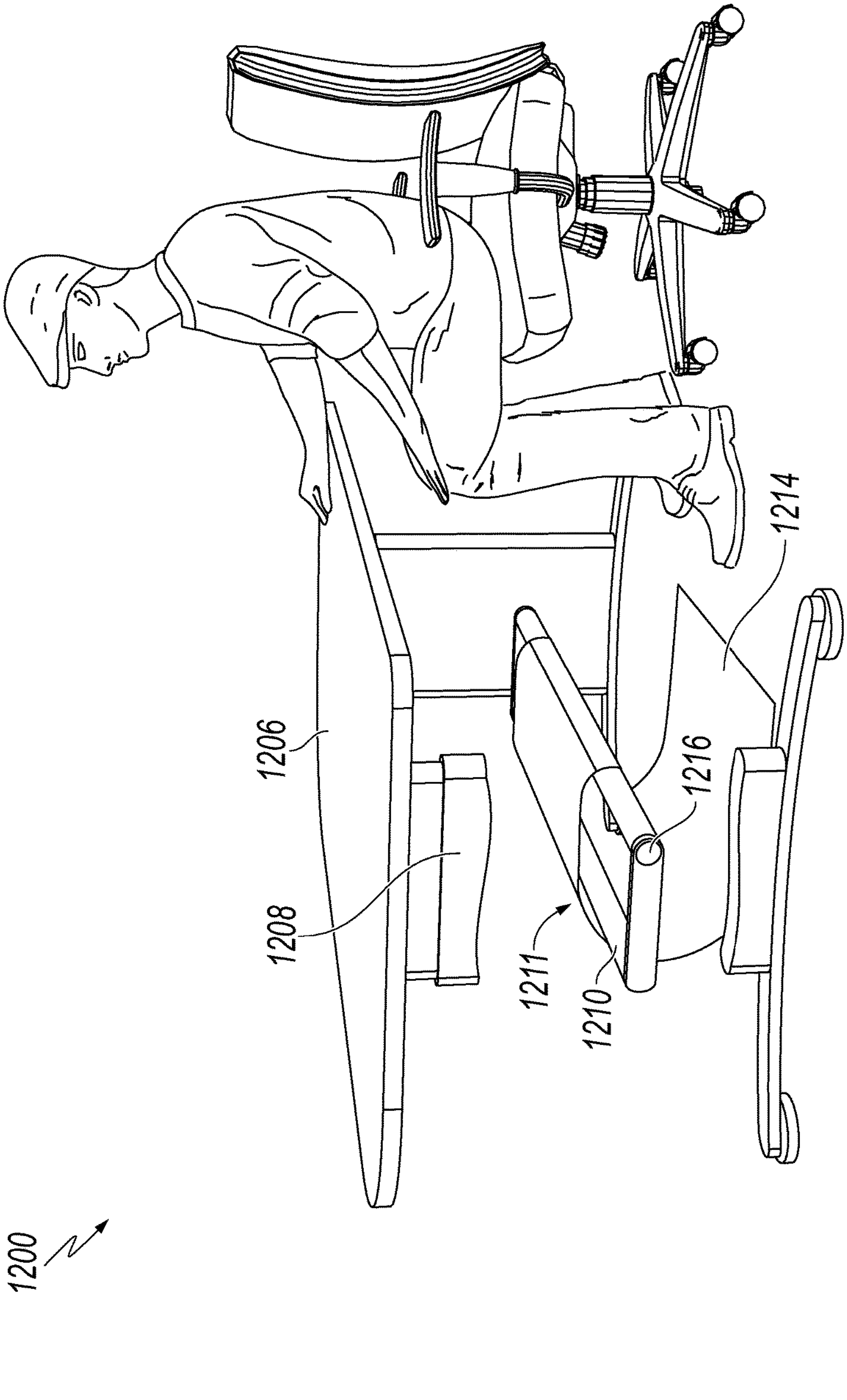

FIG. 12

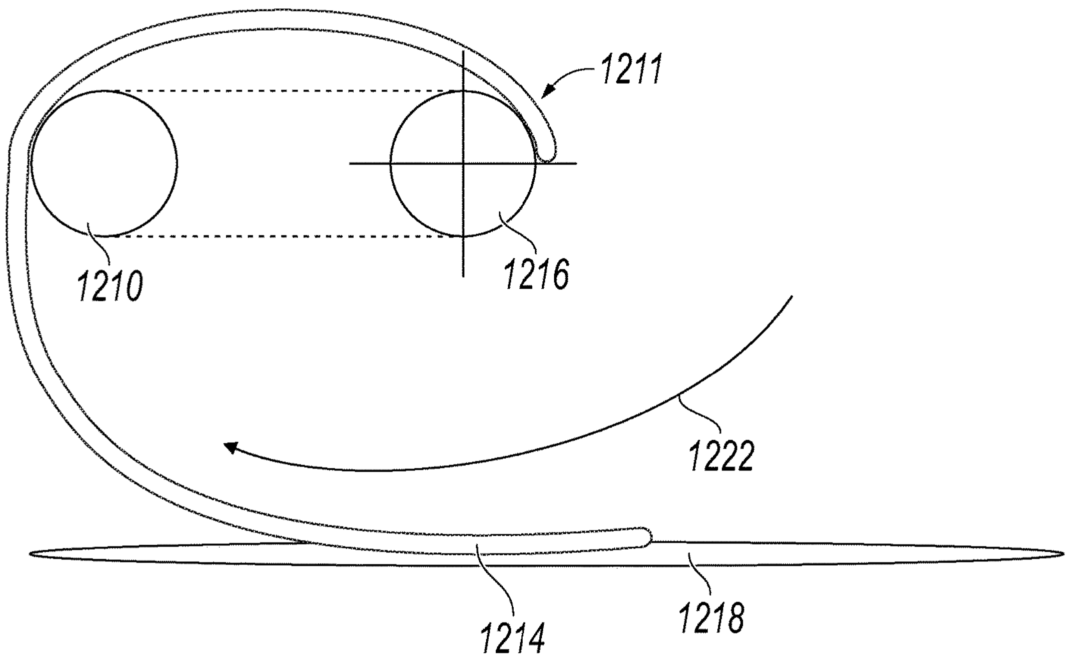

FIG. 13

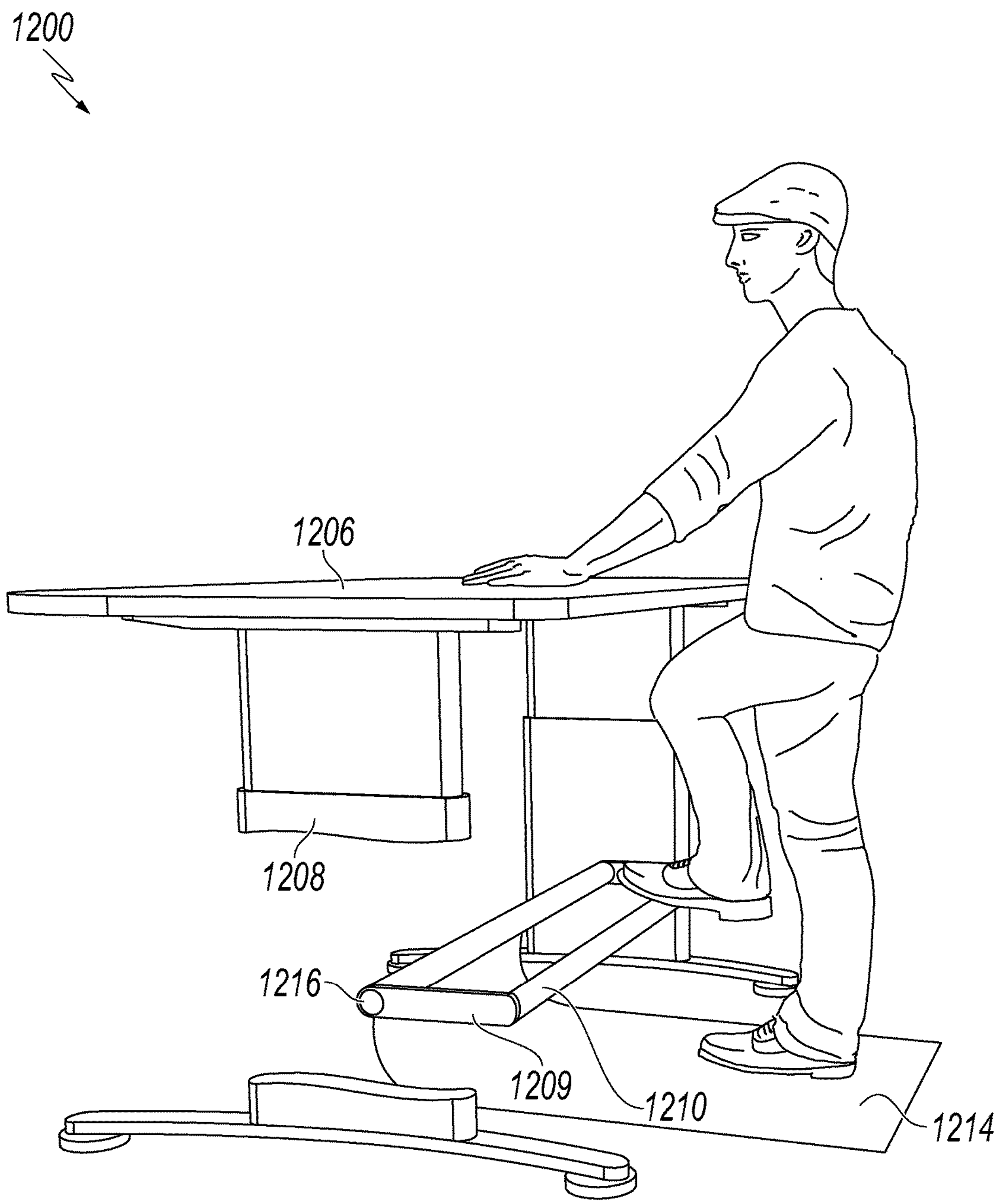

FIG. 14

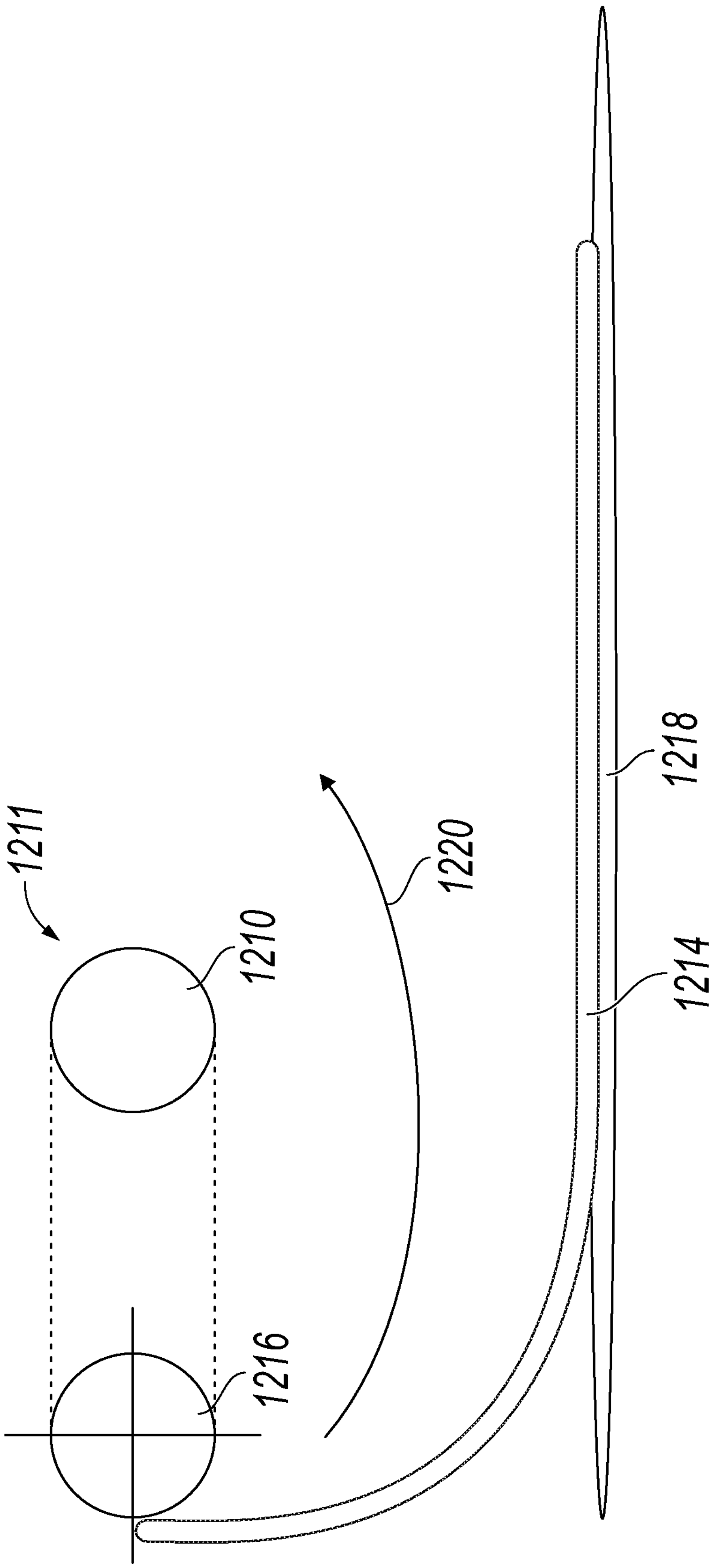

FIG. 15

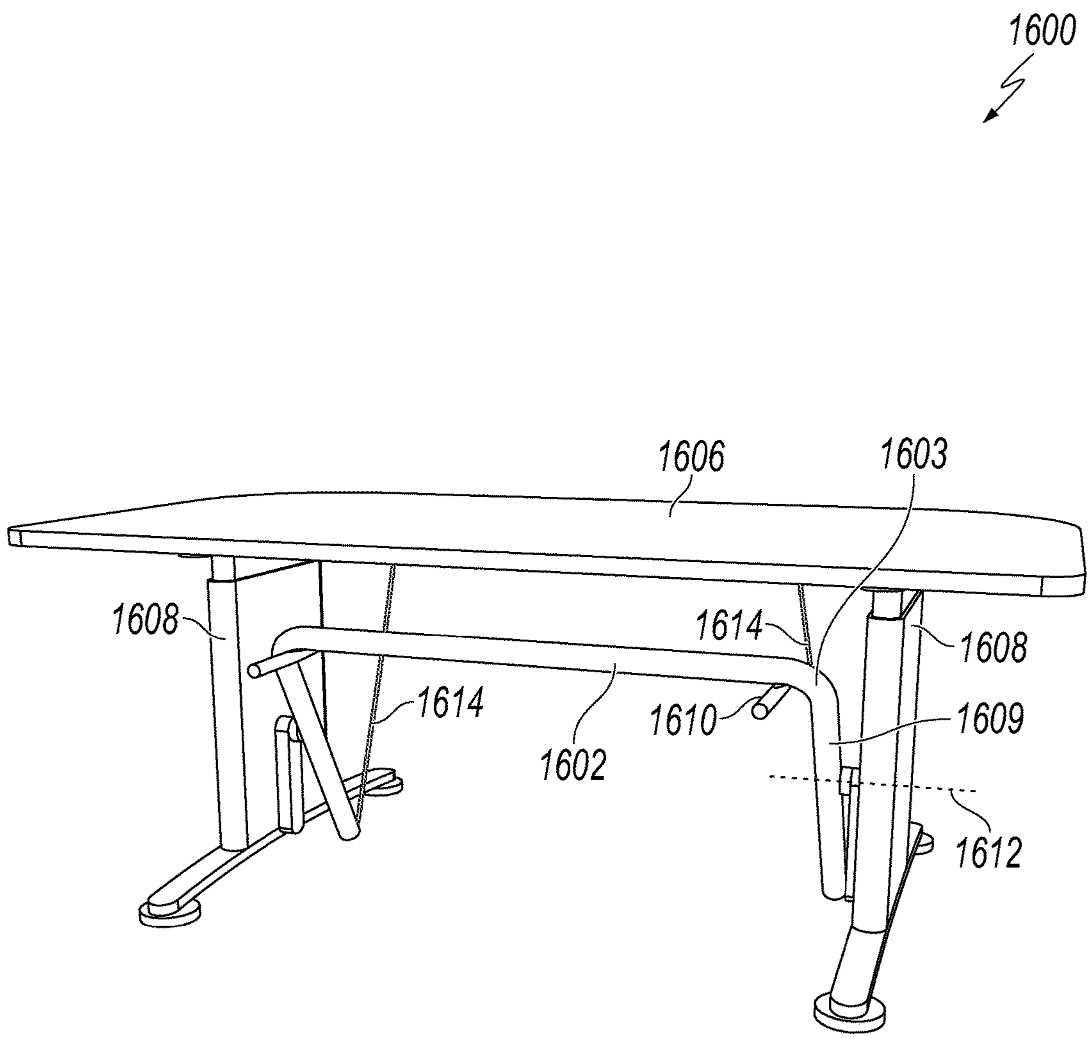

FIG. 16

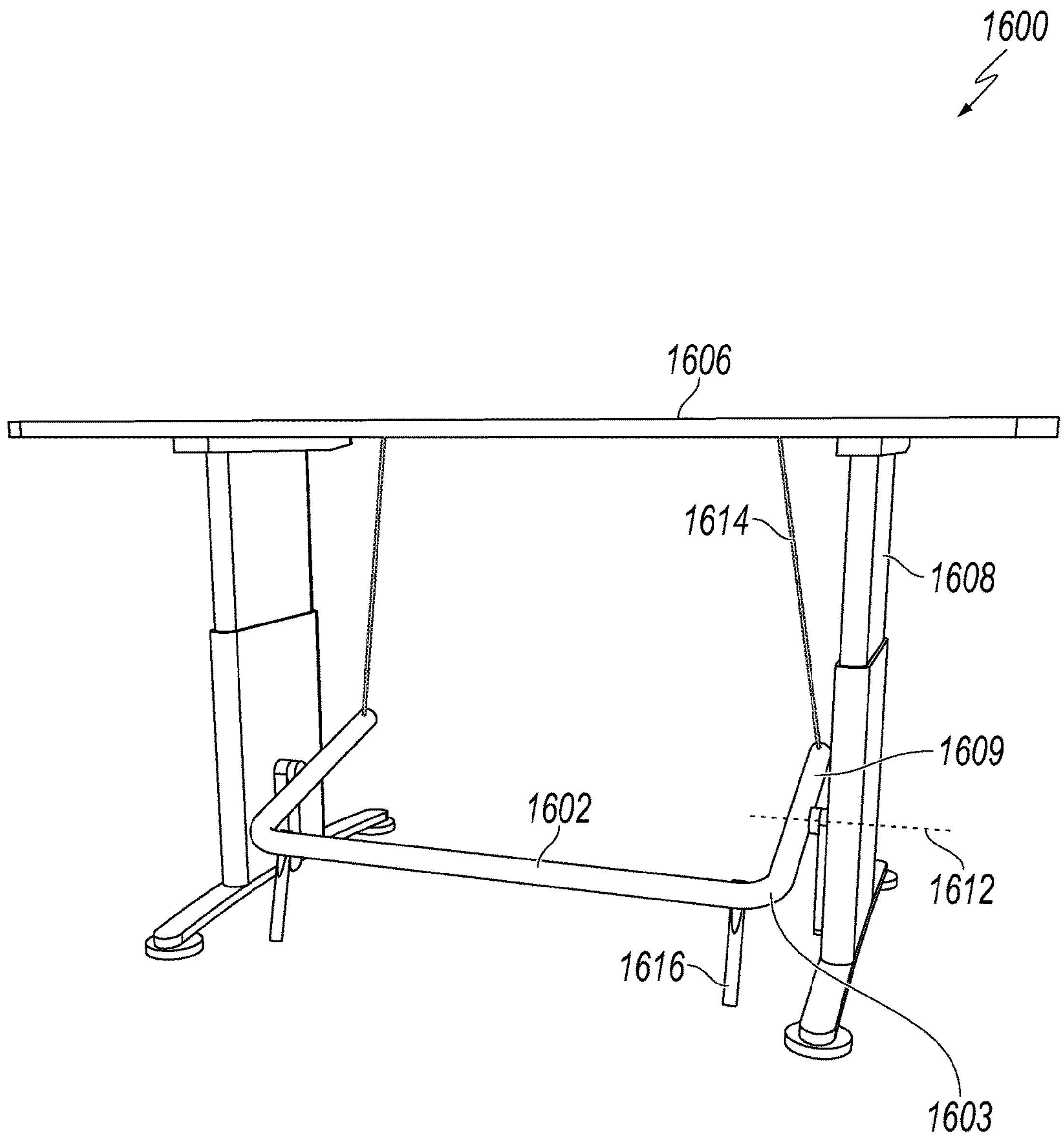

FIG. 17

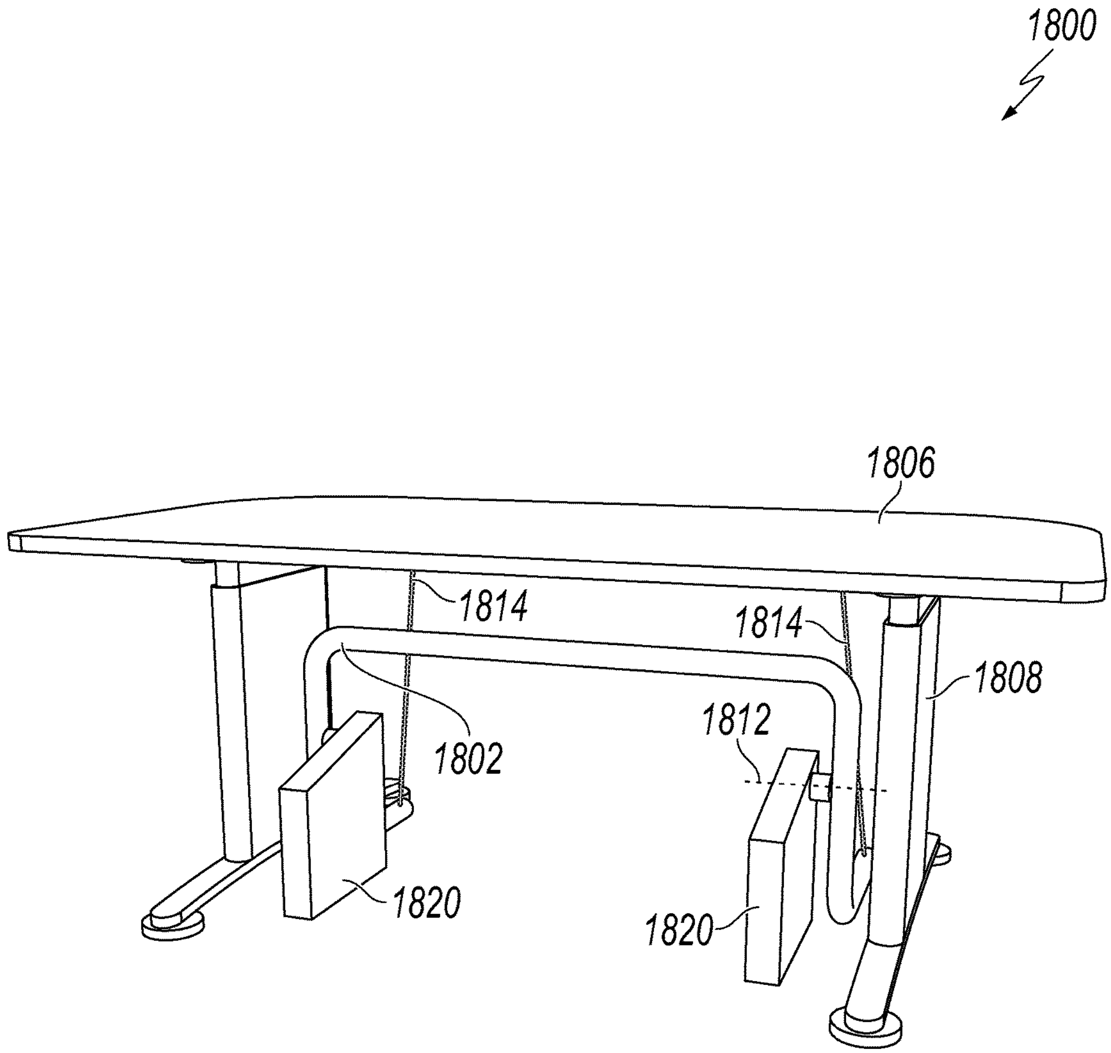

FIG. 18

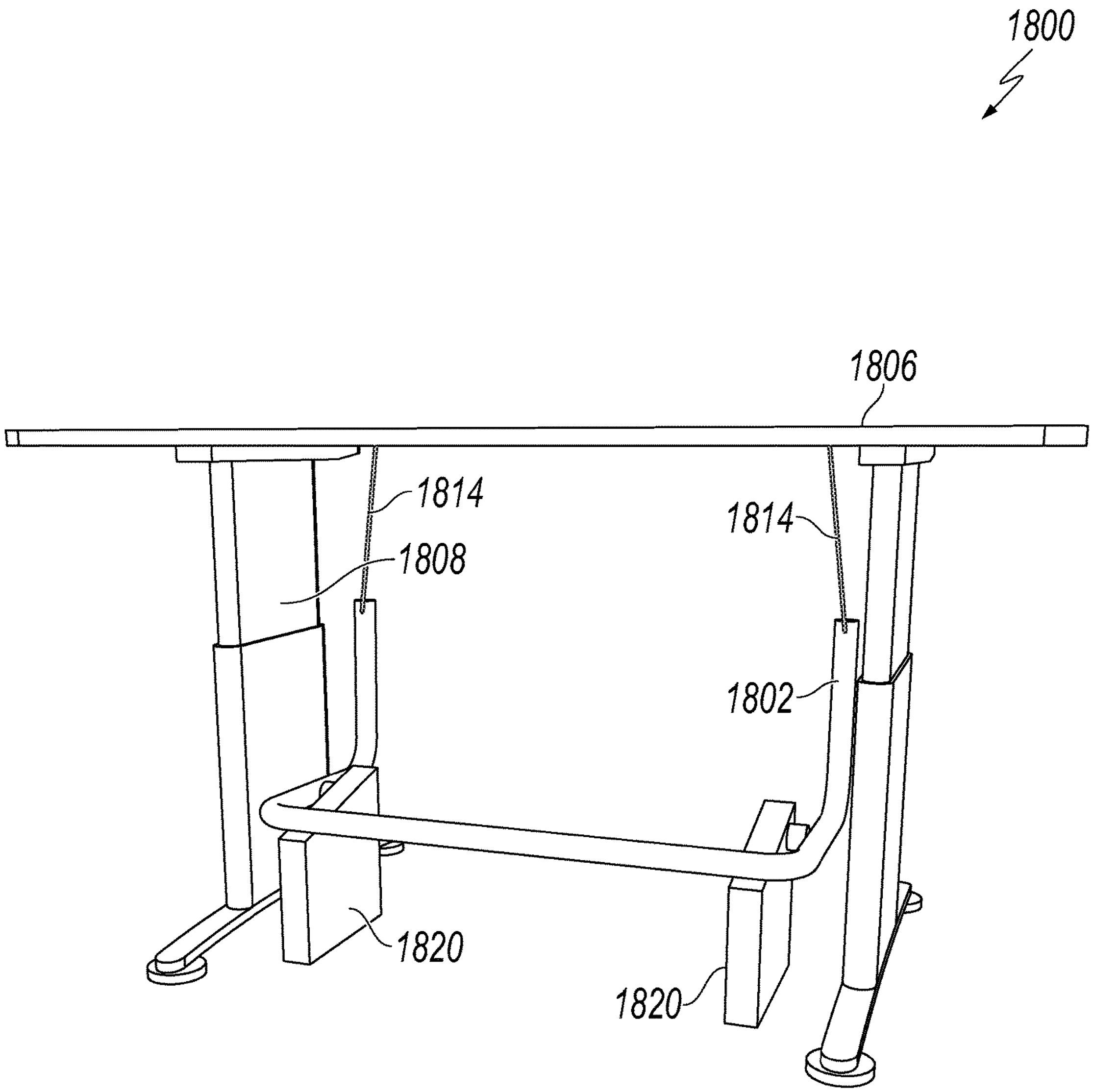

FIG. 19

ADJUSTABLE HEIGHT DESK HAVING A DEPLOYABLE FLOOR MAT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of, and incorporates by reference, U.S. patent application Ser. No. 13/946,004, filed on Jul. 19, 2013. This application claims priority to, and incorporates by reference the entire disclosure of, U.S. Provisional Patent Application No. 62/421,686, filed on Nov. 14, 2016.

BACKGROUND

Field of the Invention

The present invention relates generally to adjustable-height desks and more particularly, but not by way of limitation, to adjustable-height desks having a deployable footrest and a deployable floor mat associated therewith.

History of the Related Art

Recent research shows that standing for part of one's day to offset seated time improves the health of workers and students alike. In fact, recent epidemiological studies show that decreasing total sedentary time can have significant positive health implications for office workers and students. For this purpose, desks can be adjusted in height from sitting to standing for the purpose of reducing standing fatigue and thereby increasing total standing time.

Historically, footrests and floor mats that are left on the floor under the desk could not be used with an adjustable-height desk due to space limitations under the desk and the inability of desk chairs to roll over the floor mat. Moreover, floor-based footrests and floor mats are also a challenge for cleaning crews. Further, floor-based footrests and floor mats complicate the management of phone lines and computer cables under the desk. For these reasons, a floor-mounted footrest can be undesirable.

SUMMARY

The present invention relates generally to adjustable-height desks and more particularly, but not by way of limitation, to adjustable-height desks having a deployable footrest and a deployable floor mat associated therewith. In one aspect, the present invention relates to a desk. The desk includes a tabletop and at least one base member supporting the tabletop. A footrest is disposed on the at least one base member beneath the tabletop. The footrest is movable between a stowed position toward a back of the desk and a deployed position toward a front of the desk. At least one mechanism is disposed on the at least one base member and operatively coupled to the footrest. The at least one mechanism moving the footrest between the stowed and deployed positions. A floor mat is disposed with the footrest. The floor mat is movable with the footrest between a stowed mat position and a deployed mat position.

In one aspect, the present invention relates to a desk. The desk includes at least one base member having a support movable vertically relative to the at least one base member. A tabletop is supported on the support above the at least one base member. A footrest is disposed on the at least one base member beneath the tabletop. The footrest is movable between a stowed position toward a back of the desk and a deployed position toward a front of the desk. At least one mechanism is disposed on the at least one base member and operatively coupled to the support and to the footrest. The at least one mechanism moves the support vertically relative to the at least one base member to raise and lower the tabletop relative to the at least one base member. The at least one mechanism moving the footrest between the stowed position and the deployed position. A floor mat is disposed with the footrest. The floor mat is movable with the footrest between a stowed mat position and a deployed mat position.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

FIG. **1**A illustrates a perspective view of an adjustable desk having a tabletop in a lowered condition and a rotatable footrest in a back position for a sitting user according to an exemplary embodiment;

FIG. **1**B illustrates a perspective view of the adjustable desk of FIG. **1**A having the tabletop in a raised condition and the rotatable footrest in a front position for a standing user according to an exemplary embodiment;

FIGS. **2**A-**2**B show exposed side views of the adjustable desk of FIG. **1**A having an automatic mechanism for adjusting the tabletop and for rotating the footrest according to an exemplary embodiment;

FIGS. **3**A-**3**B show exposed side views of the adjustable desk of FIG. **1**A having a gas spring or strut for raising the tabletop and having an automated mechanism for rotating the footrest according to an exemplary embodiment;

FIGS. **4**A-**4**B show exposed side views of the adjustable desk of FIG. **1**A having linear actuators for adjusting the tabletop and for rotating the footrest according to FIG. **1**A according to an exemplary embodiment;

FIGS. **5**A-**5**B show exposed side views of the adjustable desk of FIG. **1**A having another automated mechanism for adjusting the tabletop and for rotating the footrest according to an exemplary embodiment;

FIGS. **6**A-**6**B show perspective views of an adjustable desk having a tabletop in a lowered condition and in a raised condition and having a footrest in a back position and in a front position according to an exemplary embodiment;

FIGS. **7**A-**7**B show exposed side views of the adjustable desk of FIGS. **6**A-**6**B having automated mechanisms for adjusting the tabletop and for moving a sliding footrest according to exemplary embodiments;

FIG. **8** shows an exposed side view of the adjustable desk having an alternative rotating footrest according to an exemplary embodiment;

FIGS. **9**A-**9**B show perspective views of an adjustable desk having a tabletop in a lowered condition and in a raised condition and having a footrest in a back position and in a front position according to an exemplary embodiment;

FIG. **9**C shows an exposed side view of the adjustable desk of FIGS. **9**A-**9**B having an automatic mechanism for adjusting the tabletop and for rotating the footrest according to an exemplary embodiment;

FIGS. **10**A-**10**B show plan and bottom views of another embodiment of an automatic footrest for use alone or with a desk according to an exemplary embodiment;

FIG. **10**C shows a perspective view of the automatic footrest alone according to an exemplary embodiment;

FIG. **11** shows a plan view of another automatic footrest according to an exemplary embodiment;

FIG. **12** is a diagrammatic illustration of an adjustable-height desk having a deployable footrest and a deployable floor mat when the desk is arranged in a sitting position according to an exemplary embodiment;

FIG. **13** is a schematic diagram of the deployable footrest and the deployable floor mat in a retracted position of the adjustable-height desk of FIG. **12** according to an exemplary embodiment;

FIG. **14** is a diagrammatic illustration of the adjustable-height desk of FIG. **12** in a standing position;

FIG. **15** is a schematic diagram of the deployable footrest and the deployable floor mat in a deployed position of the adjustable-height desk of FIG. **12** according to an exemplary embodiment;

FIG. **16** is a perspective view of an adjustable-height desk with a gravity-driven footrest in a stowed position;

FIG. **17** is a perspective view of the adjustable-height desk of FIG. **16** with the gravity-driven footrest in a deployed position;

FIG. **18** is a perspective view of an adjustable-height desk with a floor-mounted gravity-driven footrest in a stowed position; and

FIG. **19** is a perspective view of the adjustable-height desk of FIG. **18** with the gravity-driven footrest in a deployed position.

DETAILED DESCRIPTION

Various embodiments of the present invention will now be described more fully with reference to the accompanying drawings. The invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

FIG. **1**A illustrates a perspective view of an adjustable desk **10** according to the present disclosure having a tabletop **50** and a footrest **40**. As provided in more detail below, the desk **10** also includes an apparatus using electric actuation, manual crank, counterbalance (spring and gas lift), and/or other mechanism to adjust the height of the desk's tabletop **50** and to switch the position of the desk's footrest **40**.

For example, FIG. **1**A shows the tabletop **50** in a lowered condition and shows the footrest **40** in a back position for a user who is sitting. By contrast, FIG. **1**B shows the tabletop **50** in a raised condition and shows the footrest **40** in a front position for a user who is standing.

As can be seen, the desk **10** incorporates the adjustable tabletop **50** with an adjustable footrest **40**. The tabletop **50** is made to be anthropometrically correct and offers a work surface with adjustable height for the user. For an adult, the tabletop **50** can be raised to a height of about 36-46" for standing and can be lowered to a height of about 26-33" for sitting. Other ranges of adjustment can be provided and can be tailored to children as well.

The footrest **50** is user-adjustable to set a proper range for foot support during standing and sitting. In this way, the footrest **40** provides a useful ergonomic feature for the desk **10** when the tabletop **50** is raised to a standing height or lowered to a sitting height. Overall, the footrest **40** can increase the user's total standing time, which has health benefits and which adds to the overall comfort of the user.

Because the height of the tabletop **50** can be adjusted as desired by the user, the footrest **40** is preferably at or near its back position when the tabletop **50** is in the sitting height. By contrast, the footrest **40** is preferably at or near its front position when the tabletop **50** is at the lower range of the standing heights. In this way, a standing user who has the tabletop **50** set at a lower standing height can still use the footrest **40**. As expected, moving the footrest **40** in or out of the way may require movement of the footrest **40** that is timed, delayed, or accelerated in comparison to the tabletop's movement depending on the mechanism used.

Automated and manual mechanisms can be used to move the tabletop **50** and footrest **40**, but preferably movement of the tabletop **50** and footrest **40** to their different positions uses an automated mechanism. In addition, the footrest **40** preferably transitions automatically between standing and sitting positions as the tabletop **50** is raised and lowered, but this is not strictly necessary.

The adjustable table **10** has sidewalls or base members **20** with feet **22** that rest on the floor and support the tabletop **50** using supports or columns **30**. In general, the column or support **30** can be a panel, beam, planar support, or other structure and need not be a cylindrical post as illustrated. Although each sidewall **20** has two columns **30** as shown, it will be appreciated that only one column or support **30** may be used in a given implementation. For stability, however, a wide support or more than one cylindrical post are preferably used on both sides of the tabletop **50** so that the tabletop **50** will not exhibit a tendency to warp, which can inhibit the up and down movement of the tabletop **50**.

As shown, each sidewall **20** has two columns **30**, and a central area between the columns **30** preferably has a panel **24**. In the lowered condition, the columns **30** and panels **24** retract into the sidewalls **20** as the tabletop **50** is brought close to the top edge of the sidewalls **20**. In the raised condition, the columns **30** extend from the sidewalls **20** as the tabletop **50** is raised. The side panels **24** disposed between the columns **30** also extend from the sidewalls **20** to complete the side coverage of the desk **10**. In this arrangement, the panels **24** can provide further stability, but they can also prevent objects from inserting between the tabletop **50** and sidewalls **20**, which could hinder operation or cause injury. Overall, the sidewalls **20** provide a robust physical structure so the support columns **30** in each support **20** are essentially tied together to provide stability even when the tabletop **50** is raised to the greatest standing height.

Relative to the user, the footrest **40** deploys from a back position (toward the back edge of the desk **10**) while the user is seated to a front position (toward the front edge of the desk **10**) while the user is standing. Movement of the footrest **40** can be coordinated with the lift mechanism for moving the tabletop **50** as detailed below. In this way, the footrest **40** can move out of the way in the back position (FIG. **1**A) while the tabletop **50** is in a seated height and the user is seated in a normal chair at the desk, although the footrest **40** may allow the user to extend his or her legs outward to the footrest **40** for foot support while sitting. Then, the footrest **40** can be moved automatically to a front position (FIG. **1**B) appropriate for intermittent foot support while the user is standing at the raised tabletop **50**. In general, the footrest **40** allows the user to put one foot on the rest while standing on the other leg. The tabletop **50** may typically be raised to waist level or higher for standing.

In particular, the footrest **40** has a crossbar **42** connected at its ends to pivot arms **44**. Connected to the inside of the sidewalls **20**, the pivot arms **44** can rotate the crossbar **42** between the back position (FIG. **1**A in which the crossbar **42** disposes toward the back edge of the tabletop **50**) to the front position (FIG. **1**B in which the crossbar **42** disposes toward the front edge of the tabletop **50**).

As noted above, raising the tabletop **50** from the lowered condition to the raised condition may be coordinated with the rotation of the footrest **40**, although this is not strictly necessary. For example, a user may typically want to have the footrest **40** in the front position while the tabletop **50** is raised, but there may be times where this is not the case. In such an instance, the user may be able to override any automatic, coordinated movement of the tabletop **50** and footrest **40** and may instead separately actuate one or the other.

As noted above, movement of the tabletop **50** and footrest **40** can be driven manually or automatically. Any number of mechanical and electrical mechanisms can be used to raise and lower the tabletop **50** and move the footrest **40**. Some examples are provided below. As one skilled in the art will appreciate with the benefit of the present disclosure, additional mechanisms can be used depending on the available space in the sidewalls **20**, power requirements, and other factors, and the various mechanisms disclosed can be combined in different ways.

In an automated embodiment, FIGS. **2**A-**2**B show an exposed side view of the adjustable desk **10** having an automated mechanism **60** for adjusting the tabletop **50** and for rotating the footrest **40**. The mechanism **60** raises the tabletop **50** to an upright standing height and lowers it to a seated height using an electric motor **62** and any of a number of gear mechanisms. As shown in FIGS. **2**A-**2**B, for example, the electric motor **62** can use a screw shaft **64** to raise and lower the tabletop **50**. The shaft **65** has a threaded collar **66** thereon that connects to a telescoping member of one or both of the columns **30**. When the motor **62** rotates the shaft **64** in one direction, the collar **66** moves upward along the shaft **64**, moving the telescoping member of the column **30**. When rotated in the opposite direction, the collar **66** moves downward on the shaft **64** to distend the telescoping column **30**.

As shown, a controller **70** activated by a switch **72**, button, or the like operates the motor **62**. The desk **10** can have its own power supply for the controller **70**, motor **62**, and other electronic components, or the desk **10** can connect by conventional means to an external power supply. Limit switches **74***a-b* at the lower and upper limits along the shaft **62** can be used by the controller **70** to stop activation of the motor **62** when lowering and raising the tabletop **50**. Moreover, hard stops **25***a-b* can limit the lower and upper extents of the movement by engaging against the collar **66**. The hard stops **25***a-b* or other portions of the mechanism **60** can have lock mechanisms (not shown) to engage the tabletop's movement, and the lock mechanisms can be configured to provide the user with an audible "click" to indicate full extension or retraction.

In this embodiment, movement of the footrest **40** is coordinated with the movement of the tabletop **50**. For instance, a pivot point **46** of the footrest's arm **44** can use one or more rotatable gears **62** interfaced with the screw shaft **64**. As the electric motor **62** moves the tabletop **50** by rotating the screw shaft **64**, the rotatable gears **68** rotate the footrest **40** about its pivot point **46**. As with the movement of the tabletop **50**, hard stops **45***a-b* can limit the back and front extents of the footrest's movement by engaging against the lever arms **44** or other portion of the footrest **40**. Limit switches (not shown) may also be used.

As noted above, the height of the tabletop **50** can be adjusted by the user to a preferred height within some range, but the user may want to use the footrest **40** for standing regardless of the height of the raised tabletop **50**. Therefore, movement of the footrest **40** can be controlled independently from the movement of the tabletop **50** in one implementation. In this case, the footrest **40** may have its own actuator or motor (not shown) independently controlled by the controller **70**. This would allow a user to select movement of the tabletop **50** with the switch **72** independent of selecting movement of the footrest **40**, which could be controlled with its own switch.

Alternatively, the footrest's movement when coordinated with the tabletop's movement can complete the rotation between the back and front positions separately to some extent. For example, the limit switches **74***a-b* disposed at appropriate locations along the screw drive **62** can activate a separate electric motor (not shown) to rotate the footrest **40** into position. A mechanical arrangement of gears and trigger points could achieve the same result.

Movement of the tabletop **50** and footrest **40** preferably has a shut-off mechanism to prevent their movement if an obstruction is encountered. For example, if the torque on the motor **62** exceeds a predetermined threshold, the rotation of the motor **62** can be stopped or reversed when the controller **70** senses the increased torque. Alternatively, the automated mechanism **60** can use a mechanical torque limiter (not shown) between the coupling of the motor **62** to the screw shaft **64**. If the torque exceeds a threshold, the mechanical torque limiter will prevent the motor's rotation from rotating the screw shaft **62** so the tabletop **50** will no longer move.

Moreover, the tabletop **50** and footrest **40** can have break-away mechanisms that release or break their movement if an obstruction is encountered. As will be appreciated, these and other mechanisms can reduce the chances of the movement of the tabletop **50** and footrest **40** damaging the desk **10** or causing injury.

In one manual mechanism, FIGS. **3**A-**3**B show an exposed side view of the adjustable desk **10** having gas springs or struts **35** for raising the tabletop **50** and an actuator **84** for rotating the footrest **40**. The gas springs **35** are incorporated into or part of the columns **30** used to support the tabletop **50** to the sidewalls **20**, and the gas springs **35** can be similar to those used for other types of furniture, such as chairs.

Raising the tabletop **50** involves the user activating a manual lever or electric actuator (not shown), which diverts the compressed gas in the springs **35**. In the absence of sufficient counterforces, the springs **35** will tend to extend, and the columns **30** will lift the tabletop **50** away from the sidewalls **20**. To lower the tabletop **50**, the user can again activate the lever or actuator (not shown) and can apply a counterforce on the tabletop **50** to distend the gas springs **35**, causing the tabletop **50** to move closer to the sidewalls **20**.

As for the footrest **40**, its movement can be coupled to the raising and lowering of the tabletop **50** by the gas springs **35** using any number of arrangements of belts, gears, drives, etc. Additionally, the footrest **40** can have its own separate actuator, such as a linear actuator. In the example shown in FIGS. **3**A-**3**B, the footrest **40** has an electrical linear actuator **84** coupled to the controller **70**. When activated, the linear actuator **84** extends or retracts so that the eccentric pivot point of the actuator **84** to a rotating gear **85** on the footrest's pivot **46** will rotate the footrest **40** to the front or back position. The controller **70** can activate the linear actuator **84** when the user selects a manual switch (e.g., **72**: FIGS. **2**A-**2**B), when a limit switch (e.g., **75**: FIGS. **2**A-**2**B) at some point along the gas spring **35** is activated, or when some other initiation is performed.

In yet another alternative, the footrest **40** can have its own separate mechanical actuator, such as a gas spring. For example, the actuator **84** in FIGS. **3**A-**3**B may actually be a gas-spring **84**. Movement of the gas spring **84** is released when the tabletop **50** hits a certain height where a limit switch (not shown) is disposed, for example, and the expansion of the gas spring **84** can move the footrest **40** from one position to the other. Once expanded, the gas spring **84** can be free to retract once the tabletop **50** returns to a certain height near the seated position. This arrangement, therefore, can use an electrically initiated, but manually assisted deployment of the footrest **40**.

In another automated embodiment, FIGS. **4**A-**4**B show an exposed side view of the adjustable desk **10** having another automated mechanism **80** for raising and lowering the tabletop **50** and for rotating the footrest **40**. This mechanism **80** has linear actuators **82** and **84** coupled to a controller **70**, and the linear actuators **82** and **84** can be similar to those used in electronic automation.

As shown, the main actuator **82** couples to one of the columns **30**, although several of the columns can have such an actuator **82**. When controlled by the user, the controller **70** activates the main actuator **82**, which extends as shown in FIG. **4**B. As a result, the telescoping columns **30** likewise extend and raise the tabletop **50**. The main actuator **82** may raise the tabletop **50** to its pinnacle position, at which point a lock or catch mechanism (not shown) may engage the telescoping columns **30** preventing inadvertent lowering of the tabletop **50**. In one alternative, the telescoping column **30** may include a ratcheting mechanism (not shown) that catches the extension of the column **30** at multiple points along its extension. Otherwise, the linear actuator **82** may remain supplied with power to maintain the tabletop **50** raised. Either way, lowering the tabletop **50** would require the user to deactivate any lock, catch, or ratchet mechanism, which can be achieved manually or automatically.

In the arrangement of FIGS. **4**A-**4**B, the footrest **40** is separately actuated by a linear actuator **84**, although a rotatable motor could be just as easily used. As with the previous embodiment, the linear actuator **84** has one fixed end connected to the side support **20** or elsewhere, and the actuator **84** has another rotatable end eccentrically connected to a wheel or pivot gear **85** of the footrest's pivot **46**. When the linear actuator **84** is extended, its eccentrically connected end causes the gear **85** to rotate, which in turn rotates the footrest **40** to switch between the back and front positions. Reverse rotation and switching occurs when the linear actuator **84** is distended. If a rotatable motor is used, simply rotating in one or another direction can achieve the same result.

In yet another embodiment, FIGS. **5**A-**5**B show an exposed side view of the adjustable desk **10** having another automated mechanism **90** for raising and lowering the tabletop **40** and for rotating the footrest **40**. This mechanism **90** has a motor **92** that rotates a scroll rod **96** and causes a collar **94** threaded on the rod **96** to move along the scroll rod **96** depending on the rotation of the rod **96**.

As the collar **94** moves, a scissor linkage **95** pivotably connected to the collar **94** opens or closes to raise and lower the tabletop **50**. For instance, one arm of the linkage **95** connects at its distal end to a fixed pivot point **98***b* attached to the side support **20**, while the other scissor arm of the linkage **95** connects at its distal end to a moving pivot point **98***a* attached on a cross member **99** between the adjacent columns **30**. The motor **92** and rod **96** move with the opening and closing of the linkage **95** so tracks **97** may be provided for the motor **92** and rod **96** to move up and down.

To raise the tabletop **50** from the lowered condition in FIG. **5**A, the user operates a controller (not shown), such as discussed above, which actuates the motor **92** and rotates the rod **96**. The collar **94** on the rod **96** moves away from the motor **92**, causing the linkage **95** to begin to spread open. Because one point **98***b* is fixed, the opening linkage **95** lifts the columns **30** with the cross member **99** and raises the

tabletop **50**. Lowering the tabletop **50** simply requires a reverse operation in which the motor **92** rotates the scroll rod **96** in an opposite direction to close the linkage **95**.

As noted previously, the footrest **40** can have a separate actuator to switch the footrest's position, and the separate actuator may or may not be coordinated to the automated mechanism **90** for the tabletop **50**. For example, a motor, linear actuator, gas spring, or the like can be used, as discussed elsewhere.

As shown in FIGS. **5**A-**5**B, however, movement provided by the automated mechanism **90** can switch the footrest **40** as well. Here, the footrest's pivot **46** has a pivot wheel **100** with an internal spring that biases the footrest **40** to pivot toward the back position in FIG. **5**A. A line **102**, chain, belt, or the like is connected and wrapped counterclockwise around the wheel **100** and extends up to the cross member **99** of the mechanism **90**.

When the tabletop **50** is lowered (FIG. **5**A), the bias of the wheel **100** retracts the line **102** to its shortest length and rotates the footrest **40** to its back position. As the tabletop **50** is raised as in FIG. **5**B, the cross member **99** pulls the line **102** and rotates the wheel **100** against its bias so that the footrest **40** rotates to the front position. This and any other suitable mechanism of gears, belts, and the like can be used to coordinate the movement of the automated mechanism **90** and the footrest **40**.

Turning to another embodiment, an alternative footrest **40** can slide between back and front positions rather than rotating or pivoting as in previous embodiments. FIGS. **6**A-**6**B show perspective views of an adjustable desk **10** having a sliding footrest **40** that slides in slots **26** in the sidewalls **20**. The desk **10** is shown with the tabletop **50** in the lower condition (FIG. **6**A) and in the raised condition (FIG. **6**B). Likewise, the footrest **40** is shown in a retracted condition (FIG. **6**A) and an extended condition (FIG. **6**B).

Again, any number of the mechanisms disclosed herein can be used to manually or automatically move the tabletop **50** and footrest **40** either together or independently. For example, FIGS. **7**A-**7**B show an exposed side view of the adjustable desk **10** having the footrest **40** that slides in the slots **26** in the sidewalls **20**. As shown in the particular example of FIGS. **7**A-**7**B, a linear actuator **83** is used for moving the tabletop **50** as described previously. Additionally, a motor **86**, scroll rod **87**, and collar **88** are used for sliding the footrest **40**.

Raising and lowering of the tabletop **50** with the linear actuator **82** and controller **70** can be similar to that described above. The footrest **40**, however, fits its end inside the slanted channel **26** in the side support **20**. The motor **86** rotates the scroll rod **87**, causing the threaded collar **88** connected to the footrest **40** to move along the rod **87** up or down depending on the motor's rotation. As the tabletop **50** is raised, for example, the motor **86** can rotate the scroll rod **87** so that the footrest **40** moves from the back position (FIG. **7**A) to the front position (FIG. **7**B).

Turning to another embodiment of a footrest, the pivot point of a footrest can be set higher relative to the tabletop **50**, and the footrest can be pivoted 90-degrees rather than 180-degrees between positions. As shown in FIG. **8**, for example, an exposed, inside view of one of the sidewalls **20** shows components of another rotating footrest **140**. An arm **144** connects to a pivot **146** set higher inside the sidewall **20**, and a cross member **142** connects onto the end of the arm **144**. As shown, the cross member **142** can be a platform, although it could be a bar or other shaped feature.

Not all of the mechanisms of the desk **10** are shown. For instance, although not visible in the view of FIG. **8**, the other sidewall of the desk **10** would have a comparable arm **144** connected to a pivot **146**, and the platform **142** would extend between both arms **144** to form the rest underneath the tabletop **50**. The platform **142** may also be able to pivot to a limited extent on the arms **144**.

The footrest **140** rotates about 90-degrees between a retracted (seated) position near the back of the tabletop **50** (as shown in solid line) to a rotated (standing) position towards the front of the tabletop **50** (as shown in dashed line). In the retracted position (solid lines), for example, the platform **142** of the footrest **140** can form a privacy screen. When a user is seated at the desk **10** with the tabletop **50** lowered, the platform **142** provides the seated user with privacy by covering the exposed front of the desk **10**. When the tabletop **50** is raised, the footrest **140** can deploy from the retracted (seated) position to the rotated (standing) position (in dashed lines) so the user can use the platform **142** while standing.

Deployment of the footrest **140** can use any of the various mechanism disclosed herein and can be automatically coordinated with the movement of the tabletop **50** as with other embodiments. For example, the footrest **140** may begin deploying when the tabletop **50** reaches about 34" in height, and the footrest **140** can be fully deployed when the tabletop **50** is at about 38" in height. Moreover, as noted above, deployment of the footrest **140** can be automatic but not coordinated with the movement of the tabletop **50** so the user can adjust the footrest **140** to retracted, fully lowered positions, or any point therebetween as desired regardless of the height of the tabletop **50**.

As with previous embodiments, hard stops **45***a-b* can be used to limit the movement of the footrest **140** by limiting the rotation of the arms **144**, although other stops can be used. Additionally, various types of locks may be used to keep the footrest **140** in position. For example, a mechanical catch **147** can engage the footrest **140** by engaging in a profile in the arm **144** for example to hold the footrest **140** in the retracted position. Another comparable catch disposed elsewhere on the sidewall **20** can be used to catch the arm **144** when in the rotated position. The catch **147** can be spring biased to engage the arm's profile and may be mechanically or electrically deactivated.

In another example, actuatable locks **145***a-b*, such as solenoids, linear actuators, or the like can engage opposite edges of the arm **144** when in the retracted and rotated positions respectively. These actuatable locks **145***a-b* can thereby hold the arm **144** and footrest **140** in place and can be actuated to release the arm **144** when the footrest **140** is to be pivoted.

Yet another embodiment of an adjustable desk **10** shown in FIGS. **9**A-**9**B has a footrest **140** that pivots and a tabletop **50** that raises and lowers. The footrest **140** pivots between a retracted condition (FIG. **9**A) and an extended condition (FIG. **9**B), and the tabletop **50** moves between a lower condition (FIG. **9**A) and a raised condition (FIG. **9**B). Again, the tabletop **50** and footrest **140** can be operated separately or together, and the footrest **140** preferably rotates to its position for standing when the tabletop **50** is at a height set for standing.

The footrest **140** in this embodiment is a flat panel **148** that rotates at one edge connected to the sidewalls **20**. In the raised condition for sitting, the panel footrest **148** is rotated vertically so that it forms a privacy screen for a user sitting at the desk **10**. When the tabletop **50** is raised to a height for standing, the panel footrest **148** rotates down to a lowered condition so that it lies horizontally under the tabletop **50** near the floor.

Again, any number of the mechanisms disclosed herein can be used to manually or automatically move the tabletop **50** and footrest **140** either together or independently. For example, FIG. **9**C show an exposed side view of the adjustable desk **10** having an automatic mechanism **60** for adjusting the tabletop **50** and for rotating the footrest **140**. The mechanism **60** has a motor **62**, a scroll rod **64**, and a collar **66** for raising and lowering the tabletop **50**. The mechanism **60** also uses a motor **69** for rotating the footrest **140** about a pivot **149**, and a controller **70** operates the motors **62** and **69**. Of course, consistent with the present disclosure, any number of the mechanisms disclosed herein can be used.

In previous embodiments, the adjustable footrests have been incorporated into the desks. In another embodiment, FIGS. **10**A-**10**B show plan and bottom views of an automatic footrest **240** for use alone or with a desk **10**, which may or may not have a height-adjustable tabletop **50**. FIG. **100** shows a perspective view of the footrest **240** by itself.

The footrest **240** has a set of feet **245** arranged parallel to one another. Each foot **245** has a stand **246** extending from the top of the foot **245**. An interconnecting rest **242** affixes to lever arms **244** on the stands **246** and extends between the feet **245**. One or both of these stands **246** holds components of an automatic mechanism **248** (e.g., self-contained motor, springs, gas pistons, etc.) for moving the levers **244** and the interconnecting rest **242**.

Although lever arms **244** and rest **242** that pivot are shown, the footrest **240** could have a rotating panel, sliding cross bar, or any of the other arrangements disclosed herein. Additionally, although two feet **245** and stands **246** are shown, the footrest **240** may use one foot **245** and stand **246** having the rest **242** extending in a cantilever fashion from the lever **244** on the stand **246**. Such an arrangement can be used as long as the foot **245** can support the rest **242** with a person's foot resting thereon and can resist tilting, turning, or the like.

The length of the rest **242** can be adjustable so that the separation between the two feet **245** and stands **246** can be adjusted to accommodate the desk **10**, table, counter, or other area under which the footrest **240** is used. Additionally, the stands **246** need not have an extended height so the footrest **240** can position underneath a desk, table, counter, or other area. Although not visible in the plan views shown, the stands **246** may be shorter than or at least as tall as the supports **20** of the desk **10** under which the footrest **240** can be used. Either way, the stands **246** enable the footrest **240** to fit underneath the tabletop **50** of the desk **10**.

As noted above, the tabletop **50** of the existing desk **10** may or may not be height-adjustable, and the footrest **240** fits underneath the tabletop **50** as disclosed herein. In the present example, the tabletop **50** is height-adjustable, either automatically or not. Regardless, the footrest **240** having its own internal mechanism **248** can be activated independently of (or in conjunction with) the desk's tabletop **50**. For example, a user can manually press a button, switch, or control **249** to actuate the footrest **240** when either automatically or manually raising the tabletop **50** of the desk **10**. This control **249** can be disposed on one of the feet **245** for the user to engage with her foot to extend and retract the rest **242**.

Alternatively, the footrest **240**, even though a separate device from the desk **10**, can be activated automatically in response to the raising and lowering of the desk's tabletop **50**. An interconnecting cable or other connection (not shown) can connect between the footrest's mechanism **248** and the desk's mechanism (not shown) and can be used to activate the footrest **240** when the tabletop **50** raises and lowers on the desk **10**. Such a connection can convey an electronic signal from the desk's mechanism (not shown) to the footrest's mechanism **248** or visa-versa to coordinate operation between the two. In other alternatives, the footrest's mechanism **248** may have a motion sensor, a proximity sensor, or the like to detect the tabletop **50** moving from seated to standing positions (or visa-versa) so the footrest **140** can auto-deploy in like manner with the movement of the tabletop **50**. These and other techniques for automated operation can be used.

FIG. **11** shows a plan view of yet another automatic footrest **240**. Here, the footrest **240** is shown alone without a desk, tabletop, counter, or other work surface, although the footrest **240** could and likely would be used with one. The feet **245** are interconnected on this footrest **240** with an interconnecting bar **247** that holds the feet **245** at a particular distance and can help stabilize the footrest **240**. The bar **247** can be flat and can lie close to the floor to maintain a low profile.

The lengths of the bar **247** and the rest **242** can be adjustable so that the separation between the two feet **245** and stands **246** can be adjusted to accommodate the table or area under which the footrest **240** is used. For example, an intermediate piece or bar **243** can affix as part of the rest **242** between the levers **244** to adjust the length of the rest **242**. The bar **247** between the feet **245** may telescope to change the length of the bar **247** and adjust the separation between the feet **245**. These and other forms of adjustment can be used.

The foregoing description of preferred and other embodiments is not intended to limit or restrict the scope or applicability of the inventive concepts conceived of by the Applicants. It will be appreciated with the benefit of the present disclosure that features described above in accordance with any embodiment or aspect of the disclosed subject matter can be utilized, either alone or in combination, with any other described feature, in any other embodiment or aspect of the disclosed subject matter.

In the examples above, only one side support **20** has been shown with a manual or automated mechanism for moving the tabletop and/or switching the footrest. It will be appreciated that the other side support **20** of the adjustable desk **10** may or may not have the same mechanism or a different mechanism, depending on the balance required, the forces of friction and weight involved, etc. Moreover, although two side supports **20** are shown, the desks **10** may use one side support **20** having the rest **40** or **140** and the tabletop **50** extending in a cantilever fashion from the support **20**. Such an arrangement can be used as long as the support **20** can support the rest **40** or **140** and tabletop **50** with weight resting thereon and can resist tilting, turning, or the like. For example, feet for such a single side support **20** may extend laterally under the tabletop **50** to support the desk **10**.

Various mechanisms have been described for raising and lower the tabletop **50** and/or for switching the footrests **40**, **140**, and **240**. Each of the described mechanisms can be used in any of the disclosed desks **10** and footrests **40**, **140**, and **240**, including those desks **10** having the footrest **140** that acts as a privacy screen and flips down about 90-degrees to form the rest for the user, the footrest **40** that rotates 180 degrees, the footrest **40** that slides, and the footrest **240** that can be used separate from a desk. In general, the mechanisms can use cables, rotating gears, screw gears, rack and pinion gears, motors, actuators, cranks, levers, hydraulic pistons, gas-lifts, gas struts, springs, counter balances, and the like for manually and automatically raising and lowering the tabletop **50** and/or for switching the footrests **40**, **140**, and **240**. Moreover, any combination of such mechanisms can be used with one another in a given embodiment.

Pickup gear stops and pre-set electric actuators, switches, and the like can allow for the required movement to occur between hard stops during transitions of the tabletop **50** and footrest **40**, **140**, or **240**. The automatic, direct drive arrangements preferably have a break-away or fail-safe stop and/or a panic button. Manual systems can have a free rotational shaft, a dampened rotational or torsional shaft, or spring-loaded hinge.

FIG. **12** is a diagrammatic illustration of an adjustable-height desk **1200**, shown in a sitting position, having a deployable footrest **1210** and a deployable floor mat **1204**. In a typical embodiment, the adjustable-height desk includes a work surface **1206** and at least two legs **1208**. A height of the work surface **1206** and the legs **1208** is capable of being adjusted between a sitting height and a standing height. In a typical embodiment, adjustment of the work surface **1206** and the legs **1208** may be actuated in accordance with any of the embodiments described above with respect to FIGS. **1-11**. A footrest assembly **1211** is disposed between two oppositely disposed legs **1208**. The footrest assembly **1211** is capable of rotating about an axis **1212** between a stowed position and a deployed position. In a typical embodiment, the footrest assembly **1211** is co-actuated with adjustment of the height of the legs **1208** and the work surface **1206** such that when the work surface is moved to the standing position, the footrest assembly **1211** rotates automatically to the deployed position. When the work surface **1206** is moves to the sitting position, the footrest assembly **1211** rotates automatically to the stowed position thereby facilitating use of the adjustable-height desk **1200** with a chair. A floor mat **1214** is coupled to the footrest assembly **1211**. In various embodiments, the floor mat **1214** may be, for example, an anti-fatigue mat, an electrical isolation mat, an anti-slip mat, or any other appropriate type of floor mat as dictated by design requirements and working conditions. In a typical embodiment, actuation of the footrest assembly **1211** is accomplished in accordance with any of the embodiments described above according to FIGS. **1-11**.

FIG. **13** is a schematic diagram of the footrest assembly **1211** and the deployable floor mat **1214** in a retracted position. The footrest assembly **1211** includes a connection bar **1216** and a footrest **1210**. A connection bar **1216** is disposed between the pivot points of the footrest **1210**. The connection bar **1216** is disposed along the axis **1212**. In a typical embodiment, the footrest **1210** is offset from, and rotates about, the connection bar **1216**. The footrest **1210** is coupled to the connection bar **1216** via oppositely disposed spaced arms **1209**. The floor mat **1214** is coupled to the connection bar **1216** and rotates with the connection bar **1216**. When in the stowed position, the floor mat **1214** extends rearwardly from the connection bar **1216** over the footrest **1210**. The floor mat **1214** then wraps around the footrest **1210** and extends to the floor **1218**. Positioning the floor mat **1214** around the footrest **1210** ensures that the floor mat **1214** does not interfere with the use of a chair when the adjustable-height desk **1200** is in the sitting position.

FIG. **14** is a diagrammatic illustration of the adjustable-height desk **1200** standing position. FIG. **15** is a schematic diagram of the footrest assembly **1211** and the deployable floor mat **1214** in a deployed position. Referring to FIGS. **14-15** collectively, when the work surface **1206** is raised to the standing position, the footrest **1210** rotates underneath and about the connection bar **1216** to a forward deployed position. In a typical embodiment, the footrest **1210** may be co-actuated with the work surface **1206** in accordance with any of the embodiments discussed relative to FIGS. **1-11**. In other embodiments, the footrest **1210** may be independently actuated. Rotation of the footrest **1210** is illustrated in FIG. **15** by arrow **1220**.

Still referring to FIGS. **14-15**, as the footrest **1210** rotates to the deployed position, the floor mat **1214** rotates about the connection bar **1216**. As the footrest **1210** rotates to the deployed position, the floor mat **1214** becomes unimpeded by the footrest **1210**. Thus, the floor mat **1214** is able to extend to the floor **1218** and extend forward under the adjustable-height desk **1200**. Positioning of the footrest **1210** and the floor mat **1214** in the deployed position allows the adjustable-height desk to be utilized while a user is standing.

Referring again to FIGS. **12-13**, as the work surface **1206** is lowered to the sitting position, the footrest **1210** rotates rearwardly under the connection bar **1216** to the stowed position. In a typical embodiment, the footrest **1210** may be co-actuated with the work surface **1206** in accordance with any of the embodiments discussed relative to FIGS. **1-11**. In other embodiments, the footrest **1210** may be independently actuated. Rotation of the footrest **1210** to the stowed position is illustrated in FIG. **13** by arrow **1222**. Still referring to FIGS. **12-13**, as the footrest **1210** rotates to the stowed position, the footrest **1210** engages a portion of the floor mat **1214** and pulls the floor mat **1214** rearwardly to a stowed position. Such movement of the floor mat **1214** allows the adjustable-height desk **1200** to be utilized with, for example, a chair when the adjustable-height desk **1200** is in the sitting position.

FIG. **16** is a perspective view of an adjustable-height desk **1600** with a gravity-driven footrest assembly **1603** in a stowed position. The adjustable-height desk **1600** includes a work surface **1606** and at least two legs **1608**. A height of the work surface **1606** and the legs **1608** is capable of being adjusted between a sitting height and a standing height. In a typical embodiment, adjustment of the work surface **1606** and the legs **1608** may be actuated in accordance with any of the embodiments described above with respect to FIGS. **1-11**. The gravity-driven footrest assembly **1603** is disposed between two oppositely-disposed legs **1608**. The gravity-driven footrest assembly **1603** includes two parallel spaced arms **1605** and a footrest **1602**. The footrest **1602** is capable of rotating about an axis **1612** between a stowed position and a deployed position. Two tension members **1614** connect a rear aspect of the footrest **1602** to the work surface **1606**. For example, the tension members **1614** are connected to a rear aspect of the parallel spaced arms **1605** such that, when tension is applied to the tension members **1614**, the arms **1609** rotate the footrest **1602** to the deployed position. In a typical embodiment, the tension members **1614** are a cord, a rope, or any other appropriate device capable of transmitting tension force as dictated by design requirements. When the work surface **1606** is set to the sitting height, the tension members **1614** become slack. In this situation, a weight of the footrest **1602** causes the footrest **1602** to rotate to and remain in the stowed position.

FIG. **17** is a perspective view of the adjustable-height desk **1600** with the gravity-driven footrest **1602** in a deployed position. When the work surface **1606** is raised to standing height, tension is applied to the tension members **1614**. The tension members **1614** apply an upward force to the rear aspect of the arms **1609**. Such force causes the footrest **1602** to rotate about the axis **1612** to the deployed position. At least one leg **1616** is disposed on a front aspect of the footrest **1602**. The at least one leg **1616** contacts the ground upon movement of the footrest **1602** to the deployed position. In a typical embodiment, when the work surface **1606** is lowered to the sitting position, the tension members **1614** again become slack. In this situation, no upward force is applied to the rear aspect of the footrest **1602**. The weight of the footrest **1602** causes the footrest to rotate about the axis **1612** to the stowed position.

FIG. **18** is a perspective view of an adjustable-height desk **1800** with a floor-mounted gravity-driven footrest **1802** in a stowed position. The adjustable-height desk **1800** includes a work surface **1806** and at least two legs **1808**. A height of the work surface **1806** and the legs **1808** is capable of being adjusted between a sitting height and a standing height. In a typical embodiment, adjustment of the work surface **1806** and the legs **1808** may be actuated in accordance with any of the embodiments described above with respect to FIGS. **1-11**. The gravity-driven footrest **1802** is disposed between and rotatably coupled to two oppositely-disposed floor stops **1820**. In a typical embodiment, the floor stops **1820** are arranged so as to position the footrest **1802** between the at least two legs **1808**. The footrest **1802** is capable of rotating about an axis **1812** between a stowed position and a deployed position. Two tension members **1814** connect a rear aspect of the footrest **1802** to the work surface **1806**. In a typical embodiment, the tension members **1814** are a cord, a rope, or any other appropriate device capable of transmitting tension force as dictated by design requirements. When the work surface **1806** is set to the sitting height, the tension members **1814** become slack. In this situation, a weight of the footrest **1802** causes the footrest **1802** to rotate to and remain in the stowed position. In other embodiments, the floor-mounted gravity-driven footrest **1802** may be placed beneath a fixed-height desk having an after-market variable-height attachment coupled thereto. In such embodiments, the floor-mounted gravity-driven footrest **1802** is coupled to the variable-height attachment via the tension members **1814**. Thus, when the variable-height attachment is moved from a sitting position to a standing position, the floor-mounted gravity-driven footrest **1802** is deployed in the manner described above.

FIG. **19** is a perspective view of the adjustable-height desk **1800** with the gravity-driven footrest **1802** in a deployed position. When the work surface **1806** is raised to standing height, tension is applied to the tension members **1814**. The tension members **1814** apply an upward force to the rear aspect of the footrest **1802**. Such force causes the footrest **1802** to rotate about the axis **1812** to the deployed position. The footrest **1802** contacts the floor stop **1820** upon movement of the footrest **1802** to the deployed position. The floor stop **1820** prevents further movement of the footrest **1802** past the deployed position. In a typical embodiment, when the work surface **1806** is lowered to the sitting position, the tension members **1814** again become slack. In this situation, no upward force is applied to the rear aspect of the footrest **1802**. The weight of the footrest **1802** causes the footrest to rotate about the axis **1812** to the stowed position.

Although various embodiments of the method and system of the present invention have been illustrated in the accompanying Drawings and described in the foregoing Specification, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications, and substitutions without departing from the spirit and scope of the invention as set forth herein. It is intended that the Specification and examples be considered as illustrative only.

What is claimed is:

1. A desk, comprising:

a tabletop;

at least one base member supporting the tabletop, the at least one base member being slidably movable between a sitting position and a standing position;

a connection bar rotatably coupled to the at least one base member;

a footrest coupled to and displaced from the connection bar, the footrest rotatable with the connection bar between a stowed position toward a back of the desk and a deployed position toward a front of the desk;

at least one mechanism disposed on the at least one base member and operatively coupled to the footrest, the at least one mechanism rotating the footrest between the stowed and deployed positions while moving the base member between the sitting position and the standing position; and

a floor mat coupled to the connection bar, wherein rotation of the footrest and the connection bar causes movement of the floor mat between a stowed mat position and a deployed mat position.

2. The desk of claim **1**, comprising two spaced base members.

3. The desk of claim **2**, wherein the connection bar is disposed between the two spaced base members.

4. The desk of claim **1**, wherein the footrest rotates about the connection bar.

5. The desk of claim **1**, wherein rotation of the footrest from the deployed position to the stowed position gathers the floor mat into the stowed mat position.

6. The desk of claim **1**, wherein the footrest is coupled to the connection bar by at least one arm.

7. The desk of claim **1**, wherein the base member moves telescopically.

8. A method of deploying a floor mat with an adjustable-height desk, the method comprising:

coupling a base member to a tabletop, the base member having a support that is vertically movable relative to the base member so as to move the tabletop between a sitting position and a standing position;

coupling a footrest assembly to the base member the footrest being rotatable between a stowed position and a deployed position;

coupling a floor mat with the footrest assembly such that the floor mat is in a deployed mat position when the footrest is in the deployed position; and

co-actuating the footrest assembly with the tabletop such that, when the tabletop moves from the sitting position to the standing position, the footrest rotates to the deployed position and the floor mat moves to the deployed mat position.

9. The method of claim **8**, wherein the footrest assembly comprises a connection bar coupled to and displaced from a footrest.

10. The method of claim **9**, wherein the floor mat is coupled to the connection bar.

11. The method of claim **10**, wherein the footrest gathers the floor mat into a stowed mat position when the connection bar rotates to the stowed position.

12. The method of claim **9**, wherein the footrest rotates around the connection bar.

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