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Motor driven spindle assembly for a dispenser

Abstract

A motor driven spindle assembly for a dispenser includes a spindle that defines an interior volume. A motor is disposed within the interior volume of the spindle and is operable to rotate the spindle. A bracket includes a plate, a first leg, and a second leg. The plate of the bracket is positioned within the interior volume of the spindle. Proximal end portions of the first and second legs are positioned at the plate. A distal end portion of the first leg is positioned within a first opening of a bushing such that the distal end portion of the first leg is slidable within the first opening along a lateral direction. A distal end portion of the second leg is positioned within a second opening of the bushing such that the distal end portion of the second leg is slidable within the second opening along the lateral direction.

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Background/Summary

RELATED APPLICATIONS

(1) The present application is the national stage entry of International Patent Application No. PCT/US2021/021711 having a filing date of Mar. 10, 2021, which is incorporated herein in its entirety by reference thereto.

BACKGROUND

(2) Various dispensers for paper products are known in the art. Certain dispensers include a motor that operates to selectively dispense a paper roll. In response to a user input, such as a hand wave, the motor drives rotation of a spindle engaged with a free end of paper on the paper roll. As the spindle rotates, the spindle may translate the free end of the paper on the paper roll out of the dispenser where the user can tear off the dispensed portion of the paper roll. During operation of the motor to rotate the spindle, the paper roll rotates within the dispenser to maintain engagement between the spindle and the paper on the paper roll and allow subsequent dispensing.

(3) Space within dispensers is occupied by various components, including the motor. In known dispensers, the motor occupies valuable internal space and thus increases the overall dispenser size.

(4) Consistently mounting the motor within known dispensers such that the motor operates reliably can also be difficult. For example, the motor support structure in known dispensers can interfere with the motor and cause the motor to draw excessive current. Thus, during manufacturing, large numbers of dispensers may require time-intensive fine tuning to correctly support the motor within the dispenser and allow proper motor operation.

(5) In view of the above, a need exists for improved dispensers for paper products, including an improved support for a motor within dispenser.

SUMMARY

(6) In general, the present disclosure is directed to a motor driven spindle assembly for a dispenser. The motor driven spindle assembly for a dispenser includes a spindle and a motor. The motor is disposed within the spindle. Thus, the motor driven spindle assembly for a dispenser advantageously occupies a smaller volume within the dispenser, e.g., relative to positioning the motor outside of the spindle. The motor driven spindle assembly also includes a bracket for supporting the motor within the spindle. The bracket also allows for axial movement of the motor relative to the spindle. Thus, the bracket may allow the motor to “float” axially within the spindle, and the bracket may advantageously reduce interference between the motor and the spindle, e.g., relative to known brackets that push the motor against the spindle.

(7) In one example embodiment, a motor driven spindle assembly for a dispenser includes a spindle rotatable about an axis. The spindle extends longitudinally between a first end portion of the spindle and a second end portion of the spindle. The spindle defines an interior volume within the spindle at the first end portion of the spindle. A motor is disposed within the interior volume of the spindle. The motor is operable to rotate the spindle about the axis. A bracket is configured for

supporting the motor within the spindle. The bracket includes a plate, a first leg, and a second leg. The plate of the bracket is positioned within the interior volume of the spindle proximate a first end portion of the motor. Each of the first and second legs has a respective proximal end portion and a respective distal end portion. The proximal end portion of the first and second legs are positioned at the plate. Each of the first and second legs extends away from the plate to the distal end portion of the first and second legs. A bushing is positioned proximate a second end portion of the motor. The bushing defines a first opening and a second opening. The distal end portion of the first leg is positioned within the first opening of the bushing such that the distal end portion of the first leg is slidable within the first opening along a lateral direction. The distal end portion of the second leg is positioned within the second opening of the bushing such that the distal end portion of the second leg is slidable within the second opening along the lateral direction. The lateral direction is parallel to the axis.

(8) In a first example aspect, the motor driven spindle assembly may further include a drive gear assembly. The drive gear assembly may include a first gear and a second gear. The first gear may be disposed within the interior volume of the spindle and may be coupled to the spindle. The second gear may be meshed with the first gear and may be coupled a rotor of the motor. The first gear may include a plurality of teeth extending radially inward. The second gear may include a plurality of teeth extending radially outward. The plurality of teeth of the first gear may be meshed with the plurality of teeth of the second gear. The first gear may include a web that extends radially inward from a ring of the first gear. The plurality of teeth of the first gear may be disposed on the ring of the first gear. The second gear may include a web that extends radially inward from a ring of the second gear. The plurality of teeth of the second gear may be disposed on the ring of the second gear. A spacer is disposed between the web of the first gear and the web of the second gear. The rotor of the motor may extend at least partially into the spacer. The spindle may include a plurality of splines disposed within the interior volume of the spindle, and an outer surface of the first gear may be meshed with the plurality of splines to couple the first gear to the spindle. The plate of the bracket may be disposed between the motor and the first gear along the lateral direction.

(9) In a second example aspect, a damping pad may be disposed between the motor and the plate of the bracket along the lateral direction.

(10) In a third example aspect, the distal end portion of each of the first and second legs may include a respective stop. The stop of the first leg may be engageable with the bushing at the first opening and the stop of the second leg may be engageable with the bushing at the second opening to block translation of the motor along the lateral direction out of the interior volume of the spindle.

(11) In a fourth example aspect, the distal end portion of the first leg may include a tab that is engageable with the bushing at the first opening to block translation of the motor against drive gear assembly within the interior volume of the spindle. The stop of the first leg may be positioned at a first side of the bushing, and the tab of the first leg may be positioned at a second side of the bushing. The stop of the first leg may be spaced from the tab of the first leg by a distance along the lateral direction, and the distance may be selected such that the motor is moveable along the lateral direction within the spindle.

(12) In a fifth example aspect, the motor driven spindle assembly may further include a first damping sleeve and a second damping sleeve. The first damping sleeve may be disposed within the first opening of the bushing between the distal end portion of the first leg and the bushing. The second damping sleeve may be disposed within the second opening of the bushing between the distal end portion of the second leg and the bushing.

(13) In a sixth example aspect, the bracket may be a metal bracket, and the first and second legs may be bent relative the plate in order to form the metal bracket.

(14) In a seventh example aspect, the bracket may be U-shaped, and the motor may be positioned between the first and second legs of the bracket.

(15) In an eighth example aspect, a dispenser may include a housing, a roll holder disposed within the housing, and the motor driven spindle assembly disposed within the housing. The motor driven spindle assembly may be operable to dispenser paper on the roll holder from the housing. The bushing may be fixed to the housing.
(16) Each of the example aspects recited above may be combined with one or more of the other example aspects recited above in certain embodiments. For instance, all of the eight example aspects recited above may be combined with one another in some embodiments. As another example, any combination of two, three, four, five, or more of the eight example aspects recited above may be combined in other embodiments. Thus, the example aspects recited above may be utilized in combination with one another in some example embodiments. Alternatively, the example aspects recited above may be individually implemented in other example embodiments. Accordingly, it will be understood that various example embodiments may be realized utilizing the example aspects recited above.
(17) These and other features, aspects and advantages of the present disclosure will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the disclosure and, together with the description, serve to explain the principles of the disclosure.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) A full and enabling disclosure of the present disclosure, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures.
(2) FIG. **1** is a perspective view of a dispenser with a motor driven spindle assembly according to an example embodiment of the present disclosure.
(3) FIG. **2** is a partially exploded view of the example motor driven spindle assembly of FIG. **1**.
(4) FIG. **3** shows an interior volume of a spindle of the example motor driven spindle assembly of FIG. **1**.
(5) FIG. **4** is a perspective view of certain components of the example motor driven spindle assembly of FIG. **1**.
(6) FIG. **5** is an exploded view of the components of FIG. **4**.
(7) FIG. **6** is a perspective, partial section view of the example motor driven spindle assembly of FIG. **1**.
(8) FIG. **7** is an elevation, partial section view of the example motor driven spindle assembly of FIG. **1**.
(9) FIG. **8** is a partial elevation view of the example motor driven spindle assembly of FIG. **1**.
(10) FIG. **9** is a partial view of an interface between a leg of a bracket and a bushing of the example motor driven spindle assembly of FIG. **1**.
(11) FIG. **10** is a perspective view of a bushing for the example motor driven spindle assembly of FIG. **1**.
(12) FIG. **11** is a partially exploded view of a motor driven spindle assembly according to another example embodiment of the present disclosure.
(13) FIG. **12** is an elevation, partial section view of the example motor driven spindle assembly of FIG. **11**.
(14) Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the present invention.
DETAILED DESCRIPTION

(15) It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present disclosure.
(16) As used herein, the terms “includes” and “including” are intended to be inclusive in a manner similar to the term “comprising.” Similarly, the term “or” is generally intended to be inclusive (i.e., “A or B” is intended to mean “A or B or both”). Approximating language, as used herein throughout the specification and claims, is applied to modify any quantitative representation that could permissibly vary without resulting in a change in the basic function to which it is related. Accordingly, a value modified by a term or terms, such as “about,” “approximately,” and “substantially,” are not to be limited to the precise value specified. In at least some instances, the approximating language may correspond to the precision of an instrument for measuring the value. For example, the approximating language may refer to being within a ten percent (10%) margin.
(17) Example embodiments of the present disclosure are directed to a motor driven spindle assembly for a dispenser. The motor driven spindle assembly includes a spindle and a motor disposed within an interior of the spindle. The motor is operable to rotate the spindle. A bracket supports the motor within the spindle. Legs of the bracket may be slidable on a bushing such that the motor is axially movable relative to the spindle. Thus, the bracket may allow the motor to “float” axially within the spindle, and the bracket may advantageously reduce interference between the motor and the spindle, e.g., relative to known brackets that push the motor against the spindle.
(18) With reference to FIG. **1**, a motor driven spindle assembly **100** according to an example embodiment of the present subject matter is shown disposed within a dispenser **200**. However, while described below in context of dispenser **200**, it will be understood that motor driven spindle assembly **100** may be used in or within any suitably dispenser in alternative example embodiments. The particular arrangement of dispenser **200** is provided by way of example. Moreover, the components and operation of known dispensers will be well understood by those of skill in the art and are not described in great detail herein for the sake of brevity.
(19) Dispenser **200** includes a housing **210**. Housing **210** includes a pair of sidewalls **212**, a top wall **214**, and a bottom wall **216**. Sidewalls **212** are spaced apart from each other, e.g., along a lateral direction L. Housing **210** defines an interior **218**. Interior **218** of housing **210** may be defined between sidewalls **212**, e.g., along the lateral direction L, and/or between top and bottom walls **214**, **216**, e.g., along a vertical direction.
(20) Various components of dispenser **200** are positioned within interior **218**. For example, dispenser **200** includes a roll holder **220** and paper guide rollers **230** within interior **218**. A paper roll P may be mounted to roll holder **220** within interior **218**. The paper roll P may be rotatable on roll holder **220**. Thus, e.g., during operation of dispenser **200**, the paper roll P may rotate on roll holder **220** to allow the free end of paper on paper roll P to be dispensed out of dispenser **200**, e.g., proximate bottom wall **216**. The free end of the paper on paper roll P may be guided through interior **218** by paper guide rollers **230**. For instance, the free end of the paper on paper roll P may turn on paper guide rollers **230** as the free end of the paper on paper roll P moves out of dispenser **200**.
(21) Motor driven spindle assembly **100** is operable to drive movement of the free end of the paper on paper roll P. For instance, motor driven spindle assembly **100** may be positioned within interior **218**, e.g., between sidewalls **212**. Moreover, motor driven spindle assembly **100** may extend between and be rotatably supported on sidewalls **212**. The free end of the paper on paper roll P may pass between motor driven spindle assembly **100** and one or more guide rollers **230**. For example, the one or more guide rollers **230** may be biased towards motor driven spindle assembly **100** to clamp or compress the free end of the paper on paper roll P between motor driven spindle assembly **100** and the one or more guide rollers **230**. Thus, motor driven spindle assembly **100** may drive movement of the free end of the paper on paper roll P out of dispenser **200** when motor driven spindle assembly **100** rotates.

(22) Various aspects of motor driven spindle assembly **100** are described in greater detail below in the context of FIGS. **2** through **10**. Motor driven spindle assembly **100** includes a spindle **110** that extends longitudinally between a first end portion **112** and a second end portion **113**, e.g., along the lateral direction L. The spindle **110** is rotatable about an axis X, e.g., that is parallel to the lateral direction L. Spindle **110** may be rotatably supported on sidewalls **212** of housing **210**. For instance, first end portion **112** of spindle **110** may be positioned at and rotatably supported on a first one of sidewalls **212**, and second end portion **113** of spindle **110** may be positioned at and rotatably supported on a second, opposite one of sidewalls **212**. Thus, spindle **110** may extend across interior **218**, e.g., along the lateral direction L, between sidewalls **212**. Spindle **110** may be cylindrical (e.g., and thus have a cylindrical wall **116** that extends between first and second end portions **112**, **113**) and have elastic grips on an outer surface **118** of the spindle **110** to assist with transferring rotation of spindle **110** to paper on paper roll P.

(23) Spindle **110** defines an interior volume **114**, e.g., at first end portion **112** of spindle **110**. As an example, spindle **110** may define an opening **115** at first end portion **112** via which interior volume **114** is accessible. Thus, interior volume **114** may be open at first end portion **112**. Conversely, spindle **110** may include an inner wall **117** positioned within interior volume **114** opposite opening **115**. Thus, interior volume **114** may be defined between opening **115** and inner wall **117**, e.g., along the lateral direction L, within spindle **110**. As discussed in greater detail below, various components of motor driven spindle assembly **100** may be disposed within interior volume **114** and thus within spindle **110**.

(24) Motor driven spindle assembly **100** also includes a motor **120**. Motor **120** is disposed within interior volume **114** of spindle **110**. Thus, motor **120** is positioned within spindle **110**. In such a manner, motor driven spindle assembly **100** may advantageously occupy less space within dispenser **200** relative to positioning motor **120** outside of spindle **110**. Other advantages of motor driven spindle assembly **100** include operating sound reduction and protection of motor **120** and a drive gear assembly **160** within spindle **110** from paper dust.

(25) Motor **120** is operable to rotate spindle **110** about the axis X. Thus, motor **120** is coupled to spindle **110** such that motor **120** is operable to drive rotation of spindle **110**. For example, motor driven spindle assembly **100** may include a drive gear assembly **160**. Drive gear assembly **160** may include a first gear **162** and a second gear **163**. First gear **162** may be disposed within interior volume **114** of spindle **110** and may be coupled to spindle **100**. For example, spindle **110** may include a plurality of splines **172** disposed within interior volume **114** of spindle **110**, e.g., at an inner surface **119** of spindle **110** that faces interior volume **114**. An outer surface of first gear **162** may be meshed with splines **172** to couple first gear **162** to spindle **110**. In particular, splines **172** may extend radially from inner surface **119** into interior volume **114**, and outer surface of first gear **162** may be shaped to complement splines **172** and/or such that interference between first gear **162** and splines **172** blocks relative rotation between first gear **162** and spindle **110**. Thus, first gear **162** may be fixed to spindle **110** within interior volume **114**. First gear **162** may be formed with a two-shot molding process, e.g., with a thermoplastic elastomer (TPE) over-mold that engages second gear **163**, e.g., in order to reduce operating noise of drive gear assembly **160** at the interface between first and second gears **162**, **163**. Thus, e.g., first gear **162** may be a dual material gear with a first, harder material forming a web **166** and/or a ring **168** of first gear **162** and with a second, softer material forming teeth **164** of first gear **162**.

(26) Second gear **163** may be meshed with first gear **162**. For example, first gear **162** may include a plurality of teeth **164** extending radially inward, and second gear **163** may include a plurality of teeth **165** extending radially outward. Teeth **164** of first gear **162** may be meshed with teeth **165** of second gear **163**, e.g., by inserting second gear **163** into first gear **162**. Second gear **163** may also be coupled a rotor **122** of motor **120**. For example, second gear **163** may be positioned on and fixed to rotor **122**. During operation of motor **120**, rotation of rotor **122** may thus rotate second gear **163**, first gear **162**, and spindle **110** due to the connection therebetween.

(27) As may be seen from the above, spindle **110** is rotatable with motor **110**, which is disposed within spindle **110**. Motor driven spindle assembly **100** also include features for mounting motor **120** within interior volume **114**. In particular, motor driven spindle assembly **100** includes a bracket **130** for supporting motor **120** within spindle **110**. Bracket **130** includes a plate **132**, a first leg **134**, and a second leg **136**. Plate **132** of bracket **130** may be positioned within interior volume **114** of spindle **110**. For example, motor **120** may extend longitudinally between a first end portion **126** and a second end portion **128**, e.g., along the lateral direction L. Plate **132** may be positioned proximate first end portion **126** of motor **120** within interior volume **114**. Moreover, rotor **122** of motor **120** may extend through plate **132**, e.g., along the lateral direction L, to first gear **163**. A stator **124** of motor **120** may be fixed to plate **132**. For example, fasteners may extend through plate **132** into stator **124** couple motor **120** to plate **132**. Plate **139** may also be disposed between motor **120** and first gear **162**, e.g., along the lateral direction L.

(28) First and second legs **134**, **136** may be positioned at opposite each other about motor **120** and/or on plate **132**, and motor **120** may be positioned between first and second legs **134**, **136**. In addition, each of first and second legs **134**, **136** may have a respective proximal end portion **140**, **144** and a respective distal end portion **142**, **146**. In particular, first leg **134** may extend between proximal end portion **140** and distal end portion **142**, e.g., along the lateral direction L, and second leg **136** may extend between proximal end portion **144** and distal end portion **146**, e.g., along the lateral direction L. Proximal end portion **140**, **144** of first and second legs **134**, **136** may be positioned at and mounted to plate **132**. Conversely, first and second legs **134**, **136** may extend away from plate **132**, e.g., along the lateral direction L, to distal end portion **142**, **146** of first and second legs **134**, **136**. Proximal end portion **140**, **144** of first and second legs **134**, **136** may be positioned at or proximate first end portion **126** of motor **120**, and distal end portion **142**, **146** of first and second legs **134**, **136** may be positioned at or proximate second end portion **128** of motor **120**.

(29) Bracket **130** may be a metal bracket in certain example embodiments. In addition, first and second legs **134**, **136** may be bent relative plate **132** in order to form bracket **130**. For example, bracket **130** may be U-shaped and formed by bending a piece of metal to angle first and second legs **134**, **136** relative to plate **132**.

(30) A bushing **150** may be positioned proximate second end portion **128** of motor **120**. In addition, bushing **150** may be positioned on housing **210** at opening **115** of spindle **110**. Bushing **150** may be fixed to housing **210**, e.g., such that bushing **150** is not rotatable with spindle **110** by motor **120**. For example, bushing **150** may be fastened, heat staked, ultrasonically welded, etc. to housing **210**, e.g., the one of sidewalls **212** proximate first end portion **112** of spindle **110**.

(31) Bracket **130** is mounted to bushing **150**. In particular, bushing **130** defines a first opening **152** and a second opening **154**, e.g., on opposite sides of bushing **150**. Distal end portion **142** of first leg **134** is positioned within first opening **152** of bushing **150**, and distal end portion **142** of first leg **134** is slidable within first opening **152**, e.g., along the lateral direction L. Distal end portion **146** of second leg **136** is positioned within second opening **154** of bushing **150**, and distal end portion **146** of second leg **136** is slidable within second opening **154**, e.g., along the lateral direction L. By allowing first and second legs **136** to slide relative to bushing **150**, e.g., and thus housing **210**, motor **120** may translate, e.g., along the lateral direction L, relative to spindle **110** within interior volume **114**. Such relative movement between spindle **110** and motor **120** may advantageously avoid interference with operation of motor **120** due to motor **120** being compressed against spindle **110**.

(32) To assist with mounting motor **120** to spindle **110** with bracket **130**, distal end portion **142**, **146** of each of first and second legs **134**, **136** may include a respective at least one stop **180**. Although only distal end portion **142** of first leg **134** is shown in FIG. **9**, it will be understood that distal end portion **146** of second leg **136** may be formed in the same or similar manner, e.g., with or without hook **184**, to distal end portion **142** of first leg **134** show in FIG. **9**. As shown in FIG. **9**,

first leg **134** may include two stops **180**, each positioned on a respective edge of first leg **134**.
(33) Stop **180** of first leg **134** may be engageable with bushing **150** at first opening **152**, and stop **180** of second leg **136** may be engageable with bushing **150** at second opening **154**. Stops **180** may impact against bushing **150** to block translation of motor **120**, e.g., along the lateral direction L, out of interior volume **114** of spindle **110**. For example, a width of first leg **134** at stop **180** may be greater than a corresponding width of first opening **152** such that first leg **134** at stop **180** interferes with bushing **150** and cannot enter first opening **152**. Distal end portion **142** of first leg **134** may also include a hook **184**. An electrical lead, such as a wire, may be soldered or otherwise electrically coupled to hook **184**, e.g., in order to assist with grounding bracket **130** and/or motor **120** within spindle **110**.
(34) As shown in FIGS. **6** and **7**, first gear **162** may include a web **166** that extends radially inward from a ring **168** of first gear **162**. The teeth **164** of first gear **162** may be disposed on ring **168** of first gear **162**, e.g., and extend radially inward from ring **168** of first gear **162**. Second gear **163** may include a web **167** that extends radially inward from a ring **169** of second gear **163**. The teeth **165** of second gear **163** may be disposed on ring **169** of second gear **163**, e.g., and extend radially outward from ring **169** of second gear **163**. A spacer **170** may be disposed and/or extend between web **166** of first gear **162** and web **167** of second gear **163**, e.g., along the lateral direction L. Spacer **170** may thus block web **166** of first gear **162** from impacting against web **167** of second gear **163**. Spacer **170** may be constructed of or with a suitable thermoset or thermoplastic, e.g., selected for a suitable elasticity. Rotor **122** of motor **120** may extend at least partially into spacer **170**, e.g., along the lateral direction L. Thus, spacer **170** may be annular, such as an O-ring. Motor **120** may float within spindle **110** between spacer **170** and bushing **150**. As an example, motor **120** may float by no less than one-tenth of a millimeter (0.1 mm) and no greater than five millimeters (5 mm) within spindle **110** between spacer **170** and bushing **150**. In certain example embodiments, motor **120** may float by about half a millimeter (0.5 mm) within spindle **110** between spacer **170** and bushing **150**.
(35) Motor driven spindle assembly **100** may also include features for reducing an operating noise of motor driven spindle assembly **100**, e.g., while motor **120** rotates spindle **110**. For example, a damping pad **190** may be disposed between motor **120** and plate **132**, e.g., along the lateral direction L. Damping pad **190** may be configured for reducing or damping vibration transfer from motor **120** to plate **132**. Damping pad **190** may have a shape, e.g., in a plane that is perpendicular to the lateral direction L, that is complementary to the corresponding shape of the motor **120** and/or plate **130**. Thus, e.g., damping pad **190** may be circular. Damping pad **190** may be constructed of or with a suitable thermoset or thermoplastic, e.g., selected for a suitable elasticity and/or damping of vibrations between motor **120** and plate **132**.
(36) Motor driven spindle assembly **100** may also include a first damping sleeve **192** and a second damping sleeve **194**. First damping sleeve **192** may be disposed within first opening **152** of bushing **150**, e.g., between distal end portion **142** of first leg **134** and bushing **150**. First damping sleeve **192** may be configured for reducing or damping vibration transfer from first leg **134** to bushing **150**. Second damping sleeve **194** may be disposed within second opening **154** of bushing **150**, e.g., between distal end portion **146** of second leg **136** and bushing **150**. Second damping sleeve **194** may be configured for reducing or damping vibration transfer from second leg **136** to bushing **150**. First and second damping sleeves **192**, **194** may be constructed of or with a suitable thermoset or thermoplastic, e.g., selected for a suitable elasticity and/or damping of vibrations between bracket **130** and bushing **150**.
(37) FIGS. **11** and **12** show a motor driven spindle assembly **300** according to another example embodiment of the present subject matter. Motor driven spindle assembly **300** includes numerous common components and functions in the same or similar manner to that described above for motor driven spindle assembly **100** shown in FIGS. **1** through **10**. Thus, reference is made to the above description of motor driven spindle assembly **100**, which is not repeated to describe motor

driven spindle assembly **300** for the sake of brevity. The differences between motor driven spindle assembly **300** and motor driven spindle assembly **100** are described in greater detail below.

(38) Various aspects of motor driven spindle assembly **300** are described in greater detail below in the context of FIGS. **11** and **12**. As shown, stops **180** of first and second legs **134**, **136** may be formed as shoulders and/or projections on first and second legs **134**, **136**. Distal end portion **142** of first leg **134** may also include a tab **310**, e.g., rather than hook **184**. An electrical lead, such as a wire, may be fastened or otherwise electrically coupled to tab **310**, e.g., in order to assist with grounding bracket **130** and/or motor **120** within spindle **110**. Tab **310** may be positioned opposite stop **180** of first leg **134** about bushing **150**, and tab **310** may be engageable with bushing **150** at first opening **152**. For example, tab **310** may impact against bushing **150** and block translation of motor **120**, e.g., along the lateral direction L, against drive gear assembly **160** within interior volume **114** of spindle **110**. Spacer **170** within spindle **110** may be omitted in motor driven spindle assembly **300**.

(39) Stop **180** of first leg **134** may be spaced from tab **310** of first leg **134** by a distance D, e.g., along the lateral direction L. Similarly, first opening **152** may have a length N, e.g., along the lateral direction L. The distance D and the length N may be selected such that motor **120** is moveable within interior volume **114**, e.g., along the lateral direction L, by about a difference F between the distance D and the length N while still being supported by bracket **130**. Thus, motor **120** may float by about the difference F on bracket **130** within spindle **110**. The difference F may be a suitable spacing. For example, the difference F may be no less than one-tenth of a millimeter (0.1 mm) and no greater than five millimeters (5 mm). In certain example embodiments, the distance D may be about half a millimeter (0.5 mm).

(40) These and other modifications and variations to the present invention may be practiced by those of ordinary skill in the art, without departing from the spirit and scope of the present invention, which is more particularly set forth in the appended claims. In addition, it should be understood that aspects of the various embodiments may be interchanged both in whole or in part. Furthermore, those of ordinary skill in the art will appreciate that the foregoing description is by way of example only, and is not intended to limit the invention so further described in such appended claims.

Example Embodiments

(41) First example embodiment: A motor driven spindle assembly (**100**) for a dispenser, comprising: a spindle (**110**) rotatable about an axis (X), the spindle (**110**) extending longitudinally between a first end portion (**112**) of the spindle (**110**) and a second end portion (**113**) of the spindle (**110**), the spindle (**110**) defining an interior volume (**114**) within the spindle (**110**) at the first end portion (**112**) of the spindle (**110**); a motor (**120**) disposed within the interior volume (**114**) of the spindle (**110**), the motor (**120**) operable to rotate the spindle (**110**) about the axis (X); a bracket (**130**) for supporting the motor (**120**) within the spindle (**110**), the bracket (**130**) comprising a plate (**132**), a first leg (**134**), and a second leg (**136**), the plate (**132**) of the bracket (**130**) positioned within the interior volume (**114**) of the spindle (**110**) proximate a first end portion (**126**) of the motor (**120**), each of the first and second legs (**134**, **136**) having a respective proximal end portion (**140**, **144**) and a respective distal end portion (**142**, **146**), the proximal end portions (**140**, **144**) of the first and second legs (**134**, **136**) positioned at the plate (**132**), each of the first and second legs (**134**, **136**) extending away from the plate (**132**) to the distal end portions (**142**, **146**) of the first and second legs (**134**, **136**); and a bushing (**150**) positioned proximate a second end portion (**128**) of the motor (**120**), the bushing (**150**) defining a first opening (**152**) and a second opening (**154**), the distal end portion (**142**) of the first leg (**134**) positioned within the first opening (**152**) of the bushing (**150**) such that the distal end portion (**142**) of the first leg (**134**) is slidable within the first opening (**152**) along a lateral direction (L), the distal end portion (**146**) of the second leg (**136**) positioned within the second opening (**154**) of the bushing (**150**) such that the distal end portion (**146**) of the second leg (**136**) is slidable within the second opening (**154**) along the lateral direction (L), the

lateral direction (L) being parallel to the axis (X).
(42) Second example embodiment: The motor driven spindle assembly (**100**) of the first example embodiment, further comprising a drive gear assembly (**160**) comprising a first gear (**162**) and a second gear (**163**), the first gear (**162**) disposed within the interior volume (**114**) of the spindle (**110**) and coupled to the spindle (**110**), the second gear (**163**) meshed with the first gear (**162**) and coupled a rotor (**122**) of the motor (**120**).
(43) Third example embodiment: The motor driven spindle assembly (**100**) of the second example embodiment, wherein the first gear (**162**) comprises a plurality of teeth (**164**) extending radially inward, the second gear (**163**) comprises a plurality of teeth (**165**) extending radially outward, and the plurality of teeth (**164**) of the first gear (**162**) are meshed with the plurality of teeth (**165**) of the second gear (**163**).
(44) Fourth example embodiment: The motor driven spindle assembly (**100**) of the third example embodiment, wherein the first gear (**162**) comprises a web (**166**) that extends radially inward from a ring (**168**) of the first gear (**162**), the plurality of teeth (**164**) of the first gear (**162**) are disposed on the ring (**168**) of the first gear (**162**), the second gear (**163**) comprises a web (**167**) that extends radially inward from a ring (**169**) of the second gear (**163**), the plurality of teeth (**165**) of the second gear (**163**) are disposed on the ring (**169**) of the second gear (**163**), and a spacer (**170**) is disposed between the web (**166**) of the first gear (**162**) and the web (**167**) of the second gear (**163**).
(45) Fifth example embodiment: The motor driven spindle assembly (**100**) of the fourth example embodiment, wherein the rotor (**122**) of the motor (**120**) extends at least partially into the spacer (**170**).
(46) Sixth example embodiment: The motor driven spindle assembly (**100**) of the second example embodiment, wherein the spindle (**110**) comprises a plurality of splines (**172**) disposed within the interior volume (**114**) of the spindle (**110**), and an outer surface of the first gear (**162**) is meshed with the plurality of splines (**172**) to couple the first gear (**162**) to the spindle (**110**).
(47) Seventh example embodiment: The motor driven spindle assembly (**100**) of the second example embodiment, wherein the plate (**132**) of the bracket (**130**) is disposed between the motor (**120**) and the first gear (**162**) along the lateral direction (L).
(48) Eighth example embodiment: The motor driven spindle assembly (**100**) of any one of the first through seventh example embodiments, further comprising a damping pad (**190**) disposed between the motor (**120**) and the plate (**132**) of the bracket (**130**) along the lateral direction (L).
(49) Ninth example embodiment: The motor driven spindle assembly (**100**) of any one of the first through eighth example embodiments, wherein the distal end portions (**140**, **144**) of each of the first and second legs (**134**, **136**) comprises a respective stop (**180**, **182**), the stop (**180**) of the first leg (**134**) engageable with the bushing (**150**) at the first opening (**152**) and the stop (**182**) of the second leg (**136**) engageable with the bushing (**150**) at the first and second openings (**152**, **154**) to block translation of the motor (**120**) along the lateral direction (L) out of the interior volume (**114**) of the spindle (**110**).
(50) Tenth example embodiment: The motor driven spindle assembly (**100**) of the ninth example embodiment, wherein the distal end portion (**142**) of the first leg (**134**) comprises a tab (**310**) that is engageable with the bushing (**150**) at the first opening (**152**) to block translation of the motor (**120**) against the drive gear assembly (**160**) within the interior volume (**114**) of the spindle (**110**).
(51) Eleventh example embodiment: The motor driven spindle assembly (**100**) of the tenth example embodiment, wherein the stop (**180**) of the first leg (**134**) is positioned at a first side of the bushing (**150**), and the tab (**310**) of the first leg (**134**) is positioned at a second side of the bushing (**150**).
(52) Twelfth example embodiment: The motor driven spindle assembly (**100**) of the eleventh example embodiment, wherein the stop (**180**) of the first leg (**134**) is spaced from the tab (**310**) of the first leg (**134**) by a distance (D) along the lateral direction (L), and the distance (D) is selected such that the motor (**120**) is moveable along the lateral direction (L) within the spindle (**110**).
(53) Thirteenth example embodiment: The motor driven spindle assembly (**100**) of any one of the

first through twelfth example embodiments, further comprising a first damping sleeve (**192**) and a second damping sleeve (**194**), the first damping sleeve (**192**) disposed within the first opening (**152**) of the bushing (**150**) between the distal end portion (**142**) of the first leg (**134**) and the bushing (**150**), the second damping sleeve (**194**) disposed within the second opening (**154**) of the bushing (**150**) between the distal end portion (**146**) of the second leg (**136**) and the bushing (**150**).
(54) Fourteenth example embodiment: The motor driven spindle assembly (**100**) of any one of the first through thirteenth example embodiments, wherein the bracket (**130**) is a metal bracket, and the first and second legs (**134**, **136**) are bent relative the plate (**132**) in order to form the metal bracket.
(55) Fifteenth example embodiment: The motor driven spindle assembly (**100**) of any one of the first through fourteenth example embodiments, wherein the bracket (**130**) is U-shaped, and the motor (**120**) is positioned between the first and second legs (**134**, **136**) of the bracket (**130**).
(56) Sixteenth example embodiment: A dispenser (**200**), comprising: a housing (**210**); a roll holder (**220**) disposed within the housing (**210**); and the motor driven spindle assembly (**100**) of any one of the first through fifteenth example embodiments, disposed within the housing (**210**), the motor driven spindle assembly (**100**) operable to dispenser paper on the roll holder (**220**) from the housing (**210**).
(57) Seventeenth example embodiment: The dispenser of the sixteenth example embodiment, wherein the bushing (**150**) is fixed to the housing (**210**).
REFERENCE CHARACTERS
(58) **100** Motor driven spindle assembly **110** Spindle **112** First end portion of spindle **113** Second end portion of spindle **114** Interior volume **115** Opening of spindle **116** Cylindrical wall **117** Inner wall **118** Outer surface of spindle **119** Inner surface of spindle **120** Motor **122** Rotor **124** Stator **126** First end portion of motor **128** Second end portion of motor **130** Bracket **132** Plate **134** First leg **136** Second leg **140** Proximal end portion of first leg **142** Distal end portion of first leg **144** Proximal end portion of second leg **146** Distal end portion of second leg **150** Bushing **152** First opening **154** Second opening **160** Drive gear assembly **162** First gear **163** Second gear **164** Teeth of first gear **165** Teeth of second gear **166** Web of first gear **167** Web of second gear **168** Ring of first gear **169** Ring of second gear **170** Spacer **172** Splines **174** Outer surface of first gear **180** Stop **184** Hook **190** Damping pad **192** First damping sleeve **194** Second damping sleeve **200** Dispenser **210** Housing **212** Sidewalls **214** Top wall **216** Bottom wall **218** Interior **220** Roll holder **230** Paper guide rollers **300** Motor driven spindle assembly **310** Tab X Axis L Lateral direction P Paper roll D Distance N Length of opening F Difference

Claims

1. A motor driven spindle assembly for a dispenser, comprising: a spindle rotatable about an axis, the spindle extending longitudinally between a first end portion of the spindle and a second end portion of the spindle, the spindle defining an interior volume within the spindle at the first end portion of the spindle; a motor disposed within the interior volume of the spindle, the motor operable to rotate the spindle about the axis; a bracket for supporting the motor within the spindle, the bracket comprising a plate, a first leg, and a second leg, the plate of the bracket positioned within the interior volume of the spindle proximate a first end portion of the motor, each of the first and second legs having a respective proximal end portion and a respective distal end portion, the proximal end portion of the first and second legs positioned at the plate, each of the first and second legs extending away from the plate to the distal end portion of the first and second legs; and a bushing positioned proximate a second end portion of the motor, the bushing defining a first opening and a second opening, the distal end portion of the first leg positioned within the first opening of the bushing such that the distal end portion of the first leg is slidable within the first opening along a lateral direction, the distal end portion of the second leg positioned within the second opening of the bushing such that the distal end portion of the second leg is slidable within

the second opening along the lateral direction, the lateral direction being parallel to the axis.
2. The motor driven spindle assembly of claim 1, further comprising a drive gear assembly comprising a first gear and a second gear, the first gear disposed within the interior volume of the spindle and coupled to the spindle, the second gear meshed with the first gear and coupled a rotor of the motor.
3. The motor driven spindle assembly of claim 2, wherein the first gear comprises a plurality of teeth extending radially inward, the second gear comprises a plurality of teeth extending radially outward, and the plurality of teeth of the first gear are meshed with the plurality of teeth of the second gear.
4. The motor driven spindle assembly of claim 3, wherein the first gear comprises a web that extends radially inward from a ring of the first gear, the plurality of teeth of the first gear are disposed on the ring of the first gear, the second gear comprises a web that extends radially inward from a ring of the second gear, the plurality of teeth of the second gear are disposed on the ring of the second gear, and a spacer is disposed between the web of the first gear and the web of the second gear.
5. The motor driven spindle assembly of claim 4, wherein the rotor of the motor extends at least partially into the spacer.
6. The motor driven spindle assembly of claim 2, wherein the spindle comprises a plurality of splines disposed within the interior volume of the spindle, and an outer surface of the first gear is meshed with the plurality of splines to couple the first gear to the spindle.
7. The motor driven spindle assembly of claim 2, wherein the plate of the bracket is disposed between the motor and the first gear along the lateral direction.
8. The motor driven spindle assembly of claim 1, further comprising a damping pad disposed between the motor and the plate of the bracket along the lateral direction.
9. The motor driven spindle assembly of claim 1, wherein the distal end portion of each of the first and second legs comprises a respective stop, the stop of the first leg engageable with the bushing at the first opening and the stop of the second leg engageable with the bushing at the second opening to block translation of the motor along the lateral direction out of the interior volume of the spindle.
10. The motor driven spindle assembly of claim 9, wherein the distal end portion of the first leg comprises a tab that is engageable with the bushing at the first opening to block translation of the motor against drive gear assembly within the interior volume of the spindle.
11. The motor driven spindle assembly of claim 10, wherein the stop of the first leg is positioned at a first side of the bushing, and the tab of the first leg is positioned at a second side of the bushing.
12. The motor driven spindle assembly of claim 11, wherein the stop of the first leg is spaced from the tab of the first leg by a distance along the lateral direction, and the distance is selected such that the motor is moveable along the lateral direction within the spindle.
13. The motor driven spindle assembly of claim 1, further comprising a first damping sleeve and a second damping sleeve, the first damping sleeve disposed within the first opening of the bushing between the distal end portion of the first leg and the bushing, the second damping sleeve disposed within the second opening of the bushing between the distal end portion of the second leg and the bushing.
14. The motor driven spindle assembly of claim 1, wherein the bracket is a metal bracket, and the first and second legs are bent relative the plate in order to form the metal bracket.
15. The motor driven spindle assembly of claim 1, wherein the bracket is U-shaped, and the motor is positioned between the first and second legs of the bracket.
16. A dispenser, comprising: a housing; a roll holder disposed within the housing; and the motor driven spindle assembly of claim 1 disposed within the housing, the motor driven spindle assembly operable to dispenser paper on the roll holder from the housing.
17. The dispenser of claim 16, wherein the bushing is fixed to the housing.