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(54) PHYSICAL THERAPY DEVICES

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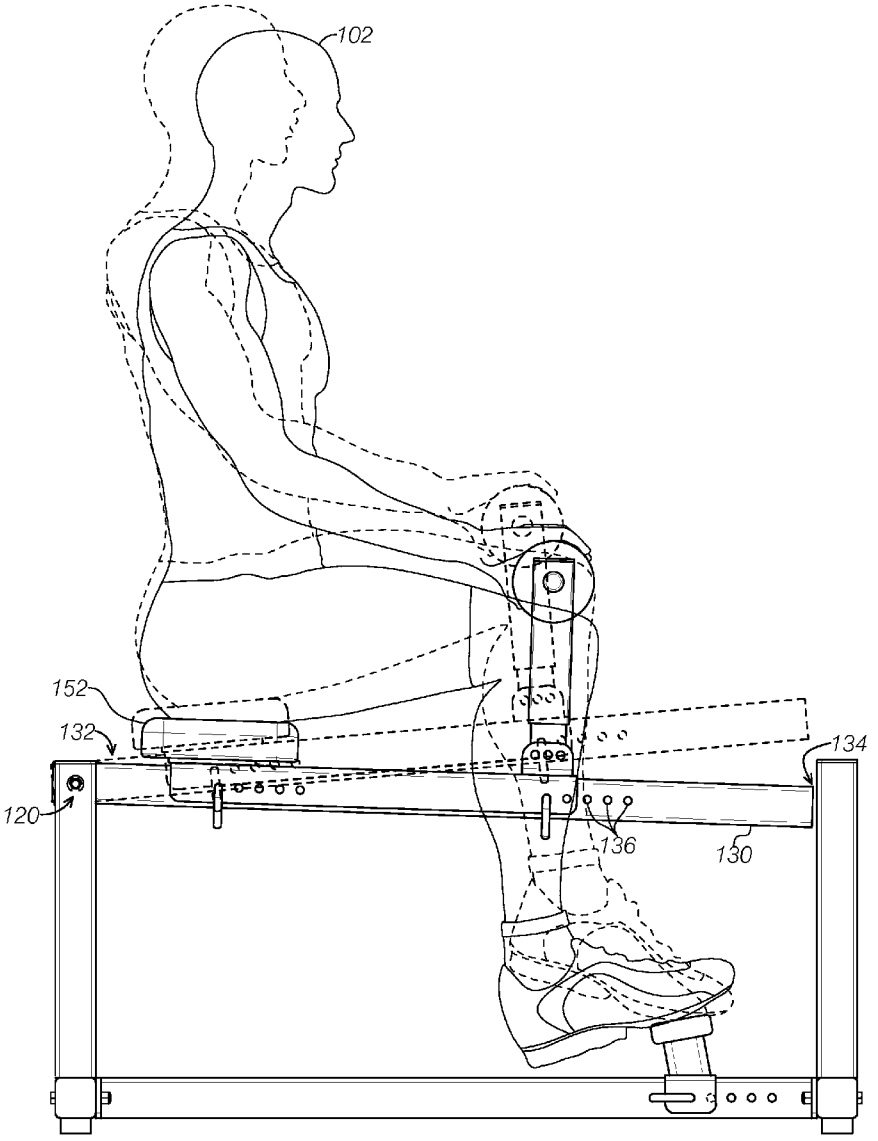
USPC **482/131**

(57) **ABSTRACT**

Physical therapy devices, including vertically extending rear support structures, arm pivots supported by rear support structures at positions vertically spaced from supporting surfaces, arms pivotally supported by the arm pivots, seats resting on the arms at distances selected to apply portions of users' bodyweights the arms when the user is seated in the seat, foot rests supported above supporting surfaces at heights selected to support a forward portion of the user's foot when the user is seated in the seat, and knee saddles attached to the arms. In some examples, the knee saddles including a knee support positioned at a height selected to rest on the user's knee when seated in the seat. In some examples, the arms extend horizontally from a pivot end to a swing end distal the arm pivot. Some examples may additionally or alternatively include adjustably positioned arm pivots. Some examples may include biasing members.



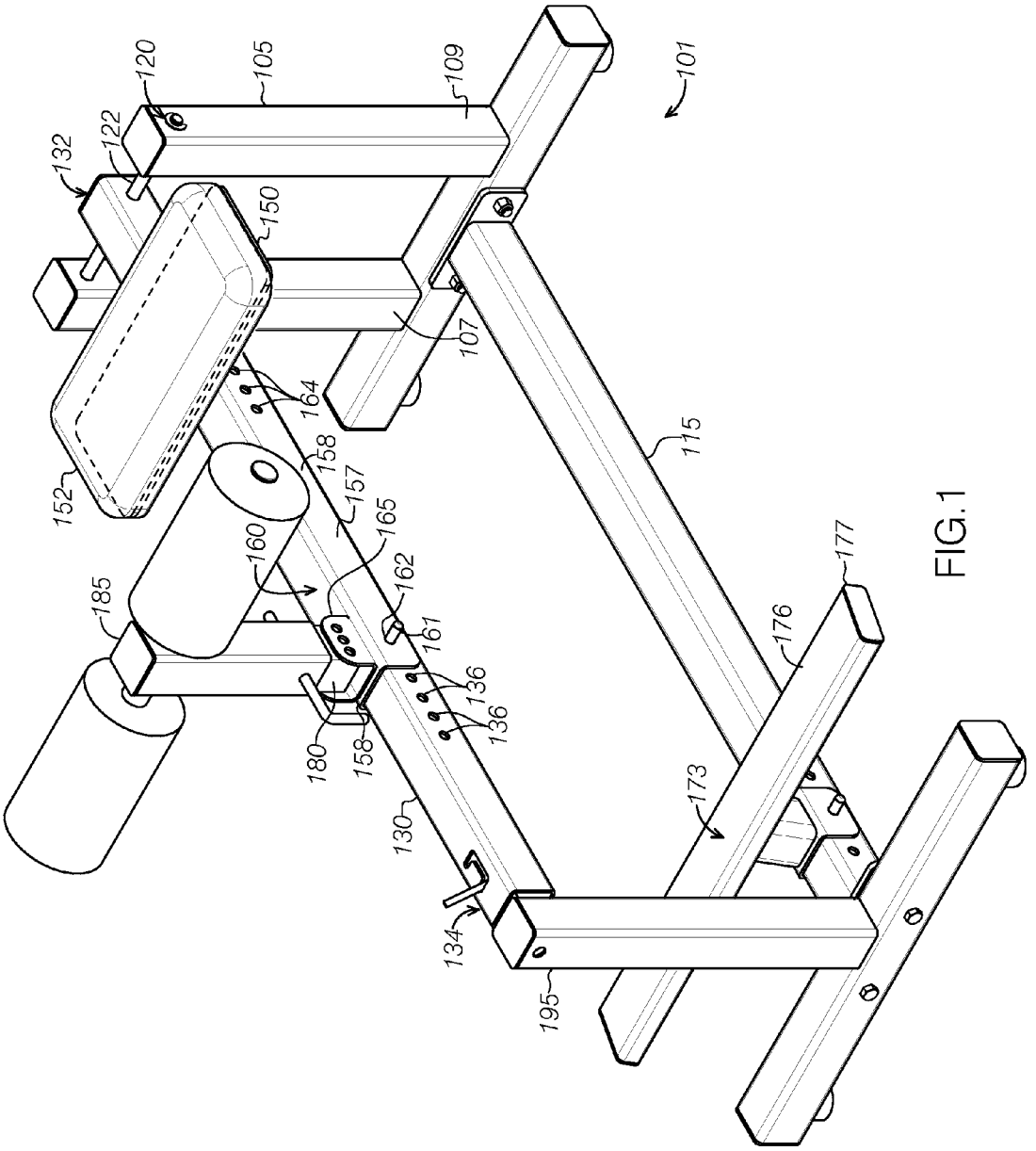

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FIG.1

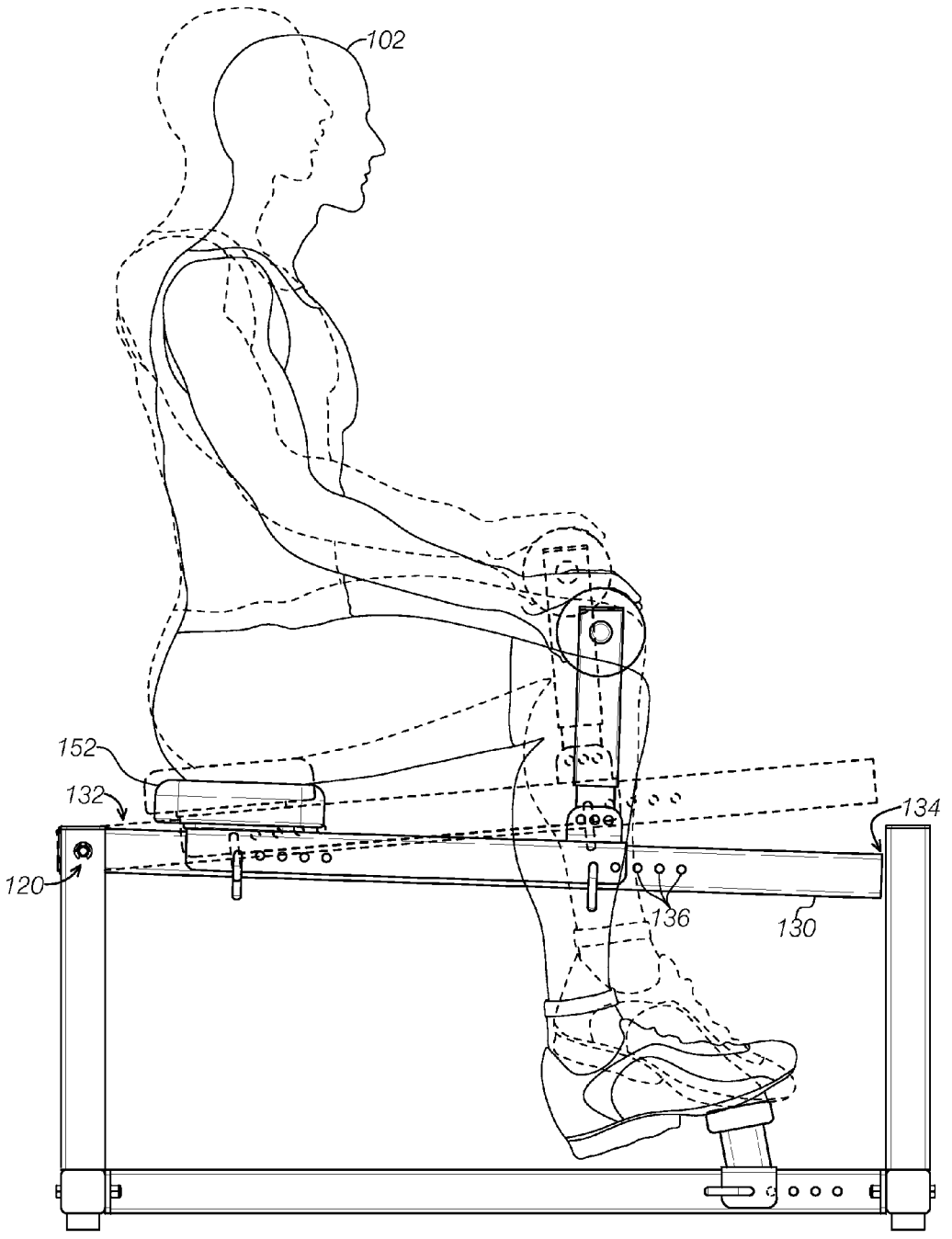

FIG.2

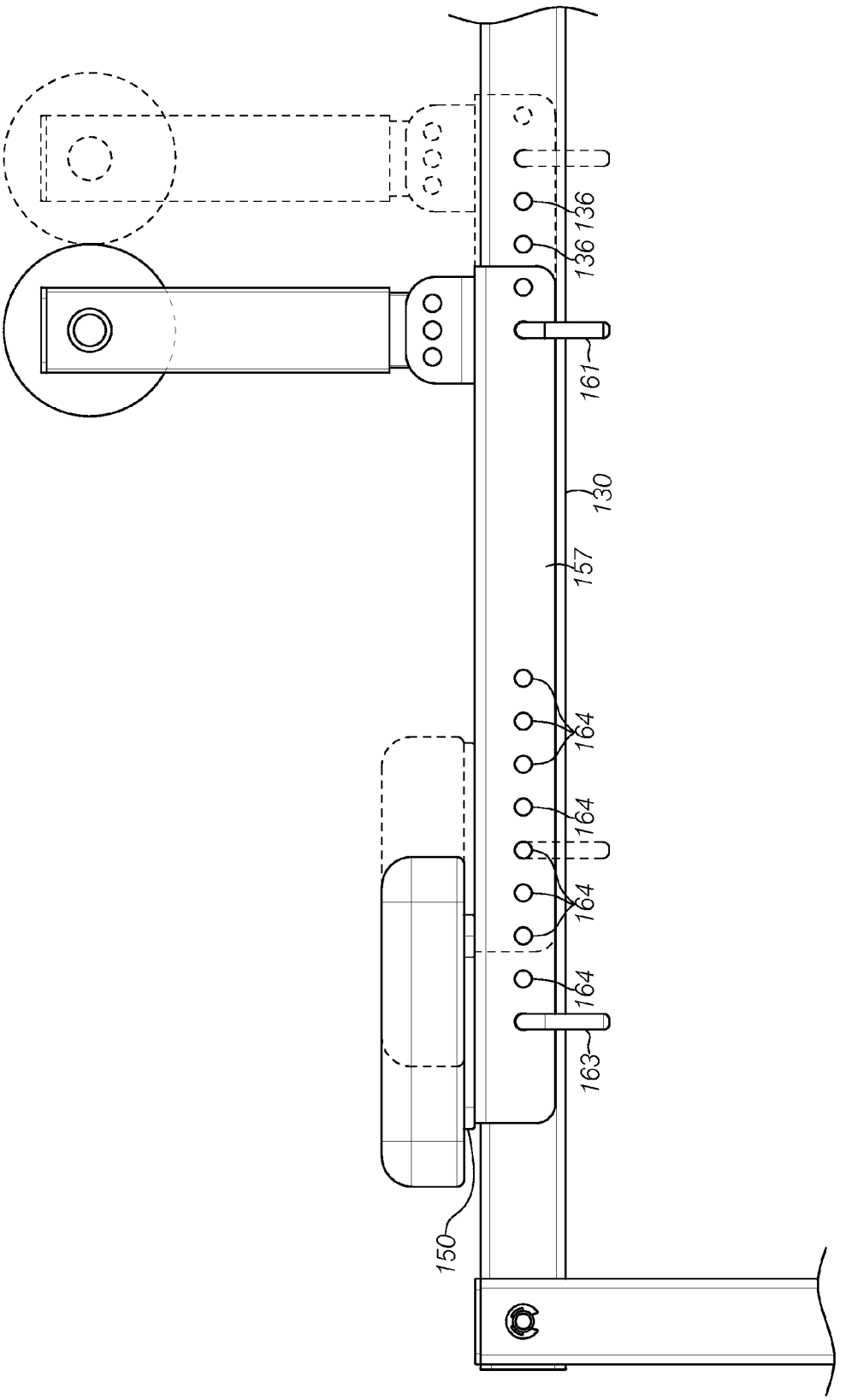

FIG.3

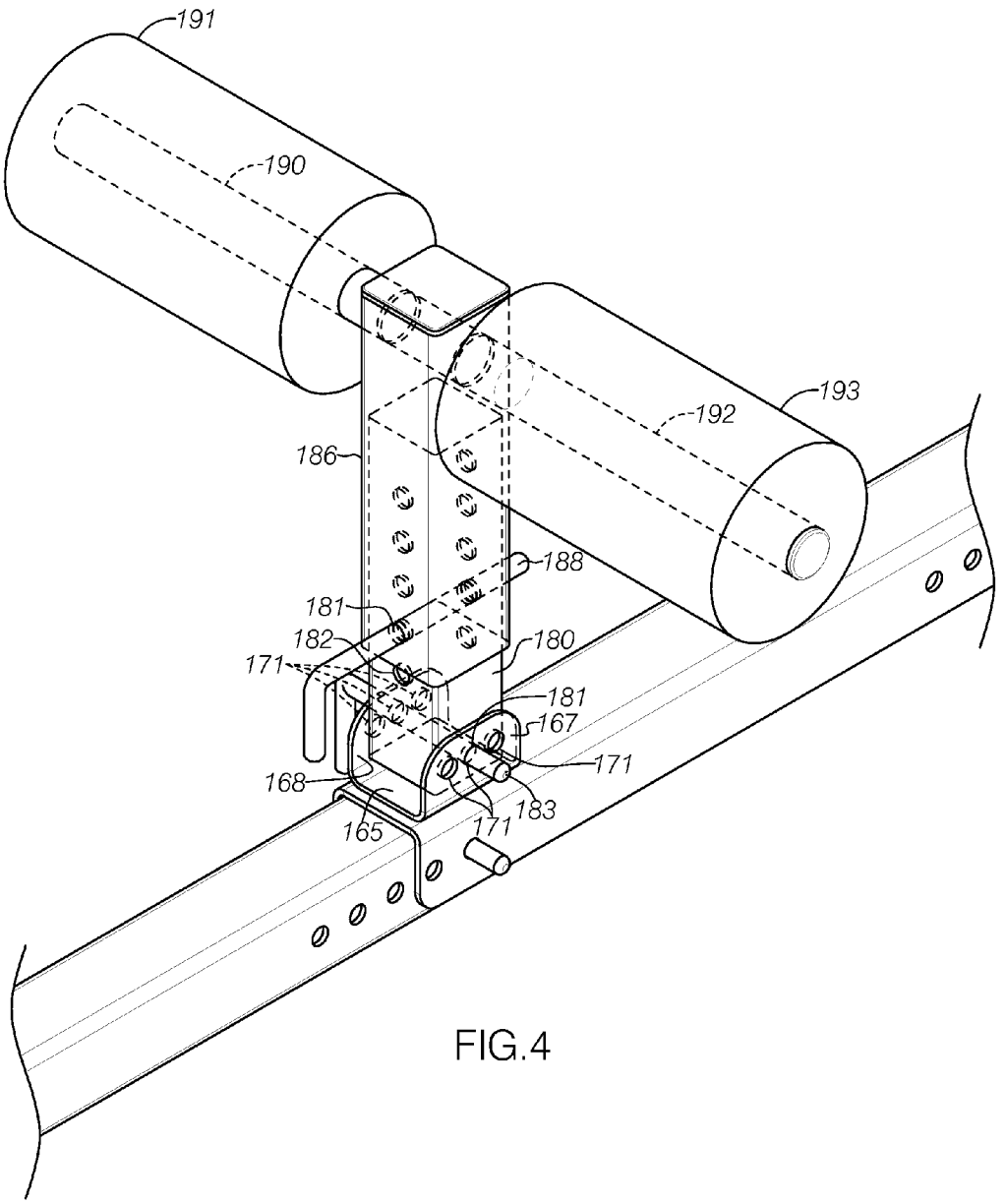
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FIG.4

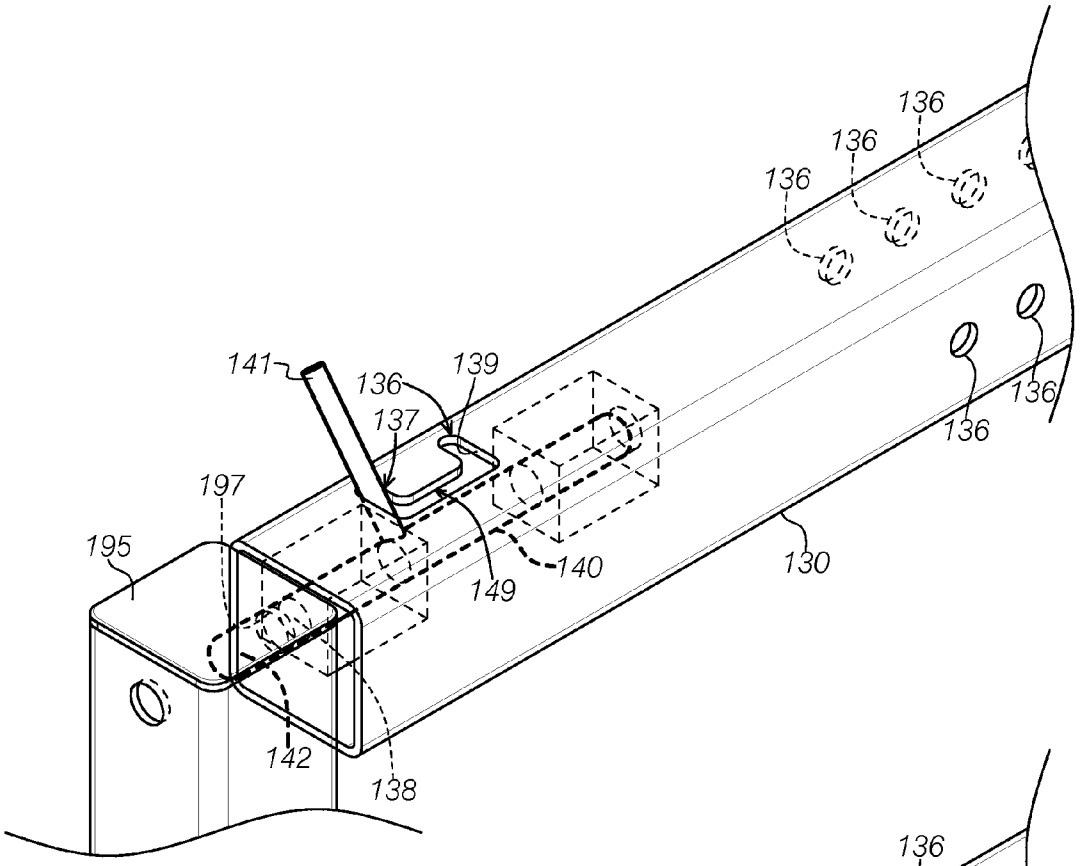
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FIG.5

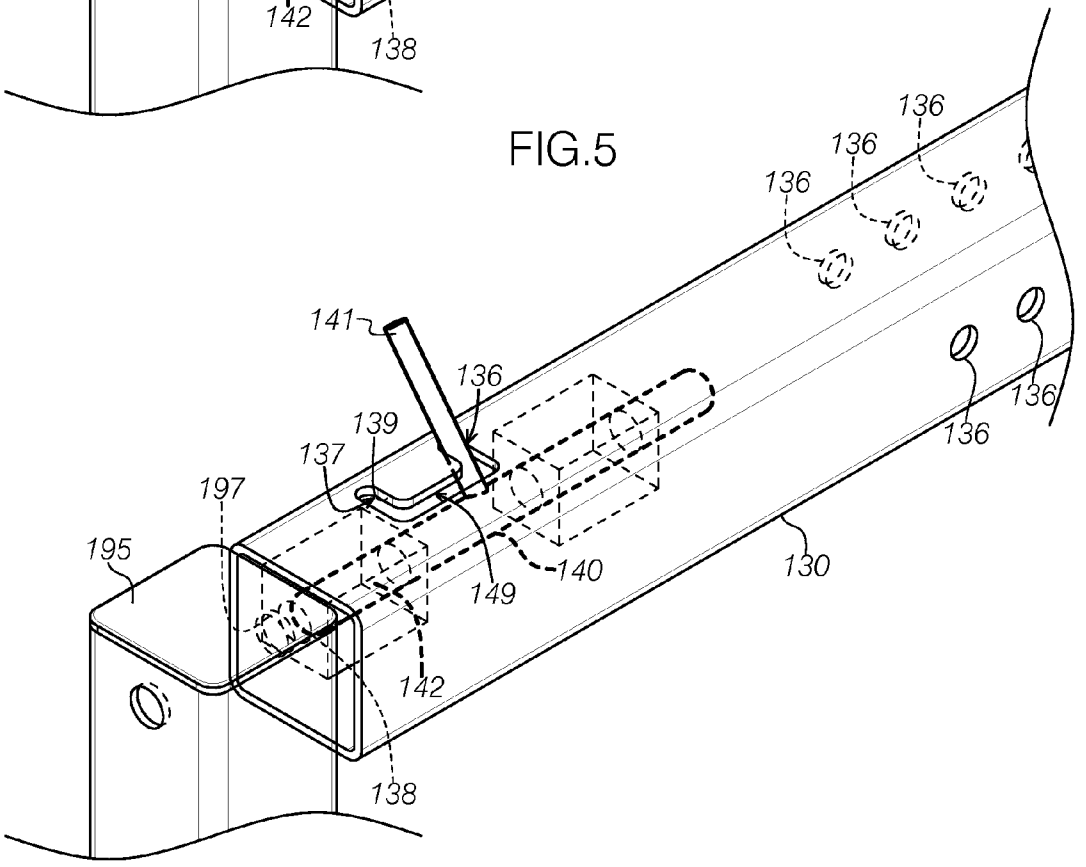
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FIG.6

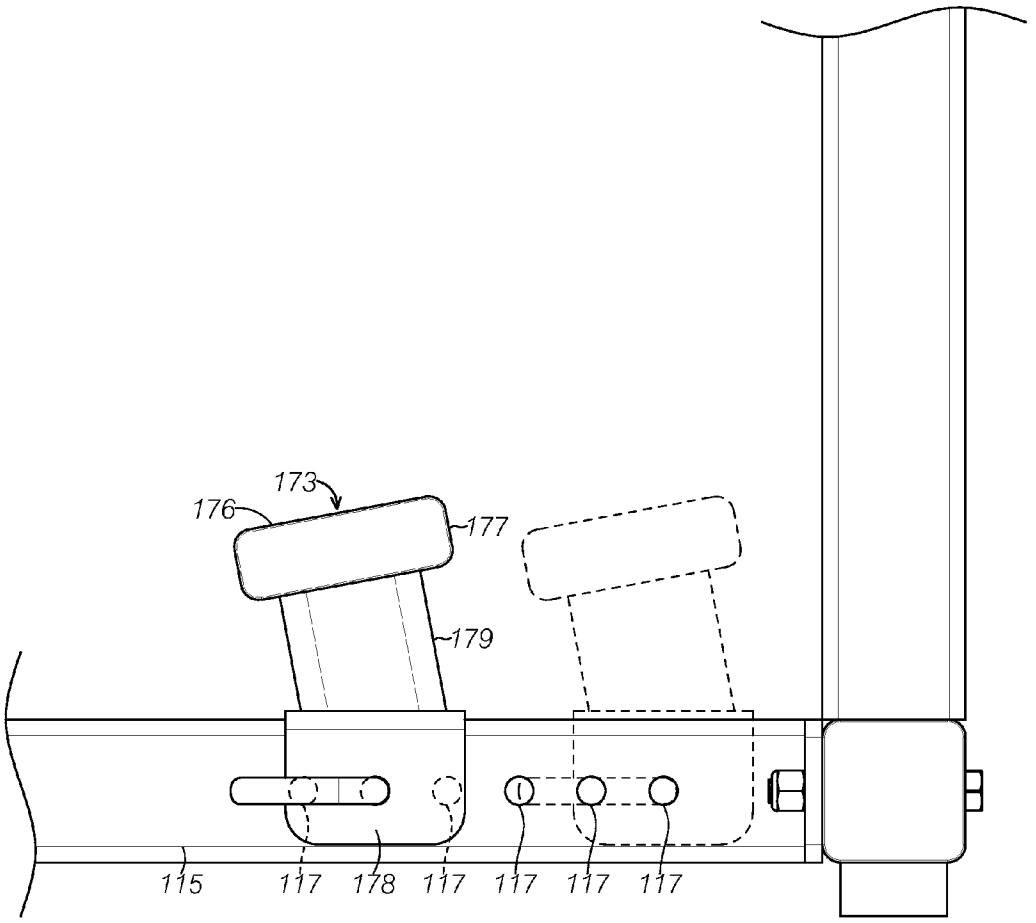

FIG.7

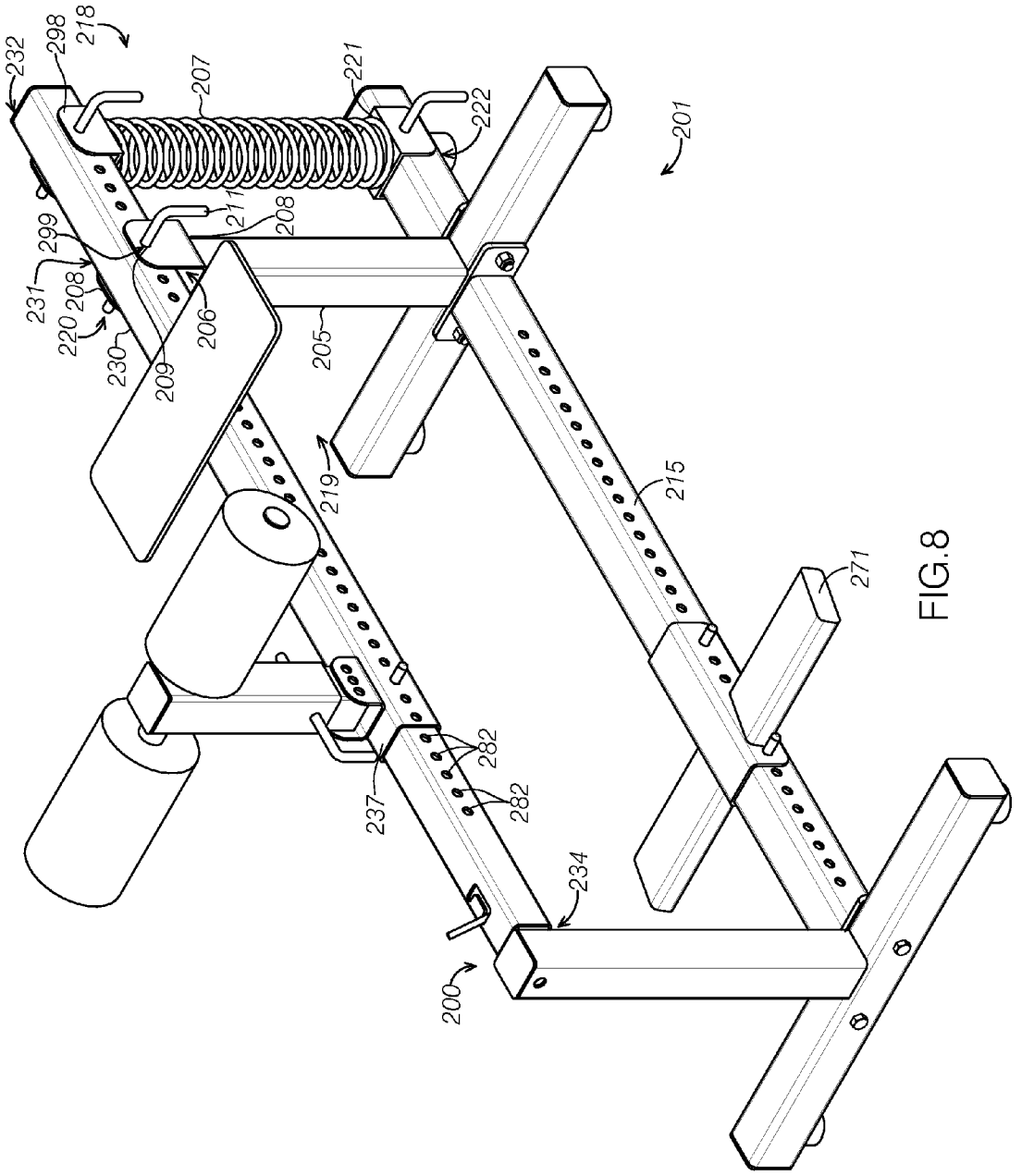
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FIG.8

PHYSICAL THERAPY DEVICES

BACKGROUND

[0001] The present disclosure relates generally to physical therapy devices configured to stretch and exercise users' soleus muscles. In particular, physical therapy devices enabling physical therapy exercises and techniques that may reduce the frequency with which users suffer from leg cramps or other infirmities of the leg are described.

[0002] Many conventional physical therapy and exercise devices do not adequately impact soleus muscles in a therapeutic manner that may reduce leg cramps. Many conventional devices, rather, are designed to provide high impact strength training and lack many features that are conducive to satisfactory physical therapy operation. For example, some existing exercise devices seat users on seats placed on weighted arms and are configured for users to use their legs to drive the weighted end of the arm around pivots supported proximate the users' seats. These devices are configured, however, to direct users' work to lift weights positioned on the arm distal the user and the pivot. While such configurations may be well suited for high-impact strength training, they are ill-suited to performing physical therapy on users' soleus muscles to prevent leg cramps. Whereas strength training often support large (though often imprecise) amounts of weight to increase the impact of users' exercises, physical therapy devices must often support smaller, more finely tuned amounts of weight. Additionally or alternatively, physical therapy devices often require adjustability of such lower quantities of weight, as minute weight differences may lead to significantly different therapeutic results.

[0003] For example, many conventional designs lack adequate adjustability to allow them to ergonomically support user of various shapes and sizes in satisfactory positions for physical therapy techniques. In particular, many designs lack adjustable seats that allow users to apply selected portions of users' bodyweight to exercises. Satisfactory physical therapy operations may often require more precise weight adjustments, which many conventional devices are unable to accommodate, in part because of this lack of an adjustable seat position. Further, these many devices lack many other features adjust the devices to satisfactorily support users in desired positions for therapy purposes. As a result, many existing devices do not provide satisfactory adjustability for physical therapy applications.

[0004] Further, many conventional strength-training designs lack any biasing features that reduce the load that users drive during use. Because physical therapy exercises are often more effective with low-impact exercises, many existing devices that do not implement any impact-reducing measures may leave them ill-suited for therapeutic operation. For example, heavier individuals may, through their bodyweight alone, apply too great of a load on conventional devices for them to effectively operate as a physical therapy device. As a result, many conventional devices are further hampered with regard to physical therapy operation.

[0005] Because strength-training devices are directed primarily toward muscle strengthening, they are ill-suited for physical therapy purposes. Rather, there exists a need for leg muscle lengthening or stretching devices that apply appropriate loads to exercises to restore flexibility and use muscle fiber recruitment to restore normal soleus muscle function.

[0006] Thus, there exists a need for physical therapy devices that improve upon and advance the design of known physical therapy and exercise devices. Examples of new and useful physical therapy devices relevant to the needs existing in the field are discussed below.

SUMMARY

[0007] The present disclosure is directed to physical therapy devices, including vertically extending rear support structures, arm pivots supported by rear support structures at positions vertically spaced from supporting surfaces, arms pivotally supported by the arm pivots, seats resting on the arms at distances selected to apply portions of users' bodyweights the arms when the user is seated in the seat, foot rests supported above supporting surfaces at heights selected to support a forward portion of the user's foot when the user is seated in the seat, and knee saddles attached to the arms. In some examples, the knee saddles including a knee support positioned at a height selected to rest on the user's knee when seated in the seat. In some examples, the arms extend horizontally from a pivot end to a swing end distal the arm pivot. Some examples may additionally or alternatively include adjustably positioned arm pivots. Some examples may include biasing members.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a perspective view of a first example of a physical therapy device.

[0009] FIG. **2** is a side elevation view of a user manipulating the physical therapy device illustrated in FIG. **1** to move an arm between a lowered configuration shown in solid lines and a raised configuration shown in phantom lines.

[0010] FIG. **3** is a side elevation view of an arm and a seat interface shown in FIG. **1** illustrating the seat interface in a rearward seat position in solid lines and in a forward seat position in phantom lines.

[0011] FIG. **4** is a perspective view of the physical therapy device illustrated in FIG. **1** focusing on a knee saddle interface of the physical therapy device.

[0012] FIG. **5** is a perspective view of the physical therapy device shown in FIG. **1** focusing on a locking pin structure of the physical therapy device in a locked position.

[0013] FIG. **6** is a perspective view of the physical therapy device shown in FIG. **1** focusing on the locking pin structure shown in FIG. **5** in an unlocked position.

[0014] FIG. **7** is a side elevation view of the physical therapy device shown in FIG. **1** focusing on a foot rest interface of the physical therapy device sliding between a rearward position in solid lines to a forward position in phantom lines.

[0015] FIG. **8** is a perspective view of a second example of a physical therapy device.

DETAILED DESCRIPTION

[0016] The disclosed diode cell modules will become better understood through review of the following detailed description in conjunction with the figures. The detailed description and figures provide merely examples of the various inventions described herein. Those skilled in the art will understand that the disclosed examples may be varied, modified, and altered without departing from the scope of the inventions described herein. Many variations are contemplated for different applications and design considerations; however, for the sake of brevity, each and every contemplated variation is not individually described in the following detailed description.

[0017] Throughout the following detailed description, examples of various diode cell modules are provided. Related features in the examples may be identical, similar, or dissimilar in different examples. For the sake of brevity, related features will not be redundantly explained in each example. Instead, the use of related feature names will cue the reader that the feature with a related feature name may be similar to the related feature in an example explained previously. Features specific to a given example will be described in that particular example. The reader should understand that a given feature need not be the same or similar to the specific portrayal of a related feature in any given figure or example.

[0018] As FIG. **1** illustrates, device **100** includes a rear support structure **105**, a lower bar **115**, an arm pivot **120**, an arm **130**, a seat **150**, a foot rest **177**, a post **180**, a knee saddle **185**, and a front support structure **195**.

[0019] In some examples, users may perform leg-lifting exercises by sitting in seat **150** with their knees engaged with knee saddle **185**. FIG. **2** illustrates such an example, wherein a user **102** drives arm **130** upward from a lowered configuration shown in solid lines to a raised configuration shown in phantom lines. As FIG. **2** shows, user **102** accomplishes this by applying a driving force to foot rest **177** with the fronts of her feet resting on foot rest **177**. Typically, this driving force opposes the downward force applied to arm **130** by user **102**'s weight in seat **150**. As FIG. **2** illustrates, device **100** does not include any additional weight or other load to be lifted by users during operation, such as is included in many conventional leg-lifting devices, and is rather configured for user only to lift the portion of her weight applied to arm via seat **150**. Indeed, adding any additional load or weight would often render device **100** unsuitable for physical therapy applications while making the device more cumbersome and difficult to operate. As a result, this disclosure specifically considers the benefit of arms without additional weight or weighted elements, including those positioned at the arms' ends, such as those disclosed. Contrasted from strength-training devices directed primarily toward muscle strengthening, device **100** serves as an example leg muscle lengthening or stretching, rather than strengthening, device that applies a portion of user's body weight to exercises. This allows users to use device **100** restore flexibility and use muscle fiber recruitment to restore normal soleus muscle function.

[0020] As FIGS. **2-6** show, device **100** includes several adjustable features that allow device **100** to be used effectively for physical therapy applications. Device **100**, like some conventional leg-lifting exercise devices, allows users to drive a load to impact users' leg calf muscles; in particular, device **100** may focus impact on users' soleus muscles. Device **100**, however, includes many features that provide adjustability, as will be discussed in greater detail below. This adjustability allows users to adjust device **100** to ergonomically support users in positions that increase device **100**'s effectiveness in performing physical therapy on users' legs. Additionally or alternatively, device **100** may allow users to more finely tune the amount of weight operated on by users during exercises, thereby allowing users to adjust the impact of device **100**'s use to a level that is desirable for physical therapy purposes. This may be accomplished, for example, by adjusting the position of seat **150**) on arm **130**, thereby adjusting the amount of users' weight applied to arm **131**). By adjusting the position of seat **150**, users may configure arm **130** may define a therapeutic resistance to be supported by the calf muscles, such as users' soleus muscles, of one or both of users' lower legs when users are seated in the seat. This therapeutic resistance may consist of a combination of the selected portion of the user's bodyweight, the weight of at least a portion of the arm, and the weight of the knee saddle. Therapeutic resistances are often less than resistances associated with strength training exercises; as a result, device **100** does not include any heavy or unwieldy supports for additional weight, which, if included, would make device **100** less suited for therapeutic operation.

[0021] As FIG. **1** illustrates, rear support structure **105** extends vertically from a support surface **101**. As FIG. **1** shows, rear support structure **105** includes a first rear support column **107** and a second rear support column **109**. As FIG. **1** shows, rear support structure **105** is configured to rotatably support arm pivot **120** at position vertically spaced from support surface **101**. In particular, arm **130** is rotatably supported, near a pivot end **132**, at arm pivot **120** between first rear support column **107** and second rear support column **109** such that arm **130** is able to move through the space between the rear support columns as it rotates about arm pivot **120**.

[0022] As FIG. **1** illustrates, front support structure **195** extends vertically, substantially parallel to first rear support column **107** and second rear support column **109**, proximate a swing end **134** of arm **130**. As FIG. **5** illustrates, front support structure **195** defines an arm locking bore **197** distal support surface **101**. Arm locking bore **197** opens toward and is substantially aligned with arm pivot **120**, allowing arm **130** to rest substantially flat between rear support structure **105** and front support structure **195** when in a locked configuration.

[0023] As FIG. **2** shows, arm pivot **120** is supported by rear support structure **105** at a position vertically spaced from support surface **101**. As FIG. **1** shows, arm pivot **120** includes an arm pivot pin **122** routed through the first rear support column **107** and second rear support column **109**. As FIG. **1** shows, arm pivot pin **122** is routed through arm **130** to pivotally support arm **130** in the space between first rear support column **107** and second rear support column **109**. This allows arm **130**) to swing about arm pivot **120** and allows swing end **134** to move between the lowered configuration shown in FIG. **2** in solid lines and the raised configuration shown in FIG. **2** in phantom lines.

[0024] As FIG. **2** shows, arm **130** extends from pivot end **132** proximate arm pivot **120** to swing end **134** distal arm pivot **120** and pivot end **132**. As FIG. **2** shows, arm **130** includes a plurality of seat positioning bores **136** spaced along its length. As FIGS. **5** and **6** illustrate, arm **130** defines a locking pin bore **138** and a locking pin access opening **139** and includes a locking pin structure **140**).

[0025] Arm **130** directs users' weight to push swing end **134** downward when they are seated in seat **150** and locking pin structure **140** is in an unlocked configuration. Users may, in an example physical therapy technique, use their legs to drive swing end **134** upward to counteract the weight pushing swing end **134** downward. As previously mentioned, this technique may impact users' soleus muscles and may reduce the occurrence of leg cramps if the level of impact is appropriately set. Although FIG. **2** illustrates an example range of motion appropriate for an example use of device **100**, arm **130** is not specifically limited to the range of motion illustrated in FIG. **2**.

[0026] As FIGS. **5** and **6** show, locking pin access opening **139** is positioned on the top of arm **130**, extending from an unlocked notch **136** to a locked notch **137**. As FIGS. **5** and **6**

illustrate, locking pin bore **138** is positioned on the swing end **134** of arm **130** opening toward front support structure **195** and is aligned with arm locking bore **197** when arm **130** is substantially horizontal.

[0027] As FIGS. **5** and **6** illustrate, locking pin structure **140** is positioned within arm **130**'s interior. Locking pin structure **140** includes an accessible portion **141** and a forward portion **142**. As FIG. **5** shows, forward portion **142** is a rigid, vertically supported cylindrical structure with sufficient integrity and support arm **130** upright with a user seated in seat **150**. Forward portion **142**, along with the remainder of the lower, cylindrical portion of locking pin structure **140**), may be routed through two supports aligned with locking pin bore **138** to provide additional support. Accessible portion **141** is rigidly attached to forward portion **142**, allowing users to use accessible portion **141** to move forward portion **142** between the locked position shown in FIG. **5** and the unlocked position shown in FIG. **6**.

[0028] For example, FIG. **5** illustrates locking pin structure **140** in a locked configuration, wherein forward portion **142** is inserted through locking pin bore **138** and arm locking bore **197** to front support structure **195**'s interior. As FIG. **5** shows, accessible portion **141** is positioned in locked notch **137** to retain locking pin structure **140** in the locked configuration. FIG. **6** illustrates locking pin structure **144**) in an unlocked configuration, wherein forward portion **142** is fully recessed within arm **130**. A user may manipulate locking pin structure **140** between a locked and unlocked position by manipulating accessible portion **141** between locked notch **137** and unlocked notch **136**. For example, a user may move locking pin structure **140** from a locked to an unlocked position by rotating accessible portion **141** from locked notch **137** to a sliding portion **149** of locking pin access opening **139** and then sliding accessible portion **141** toward unlocked notch **136**. To keep locking pin structure **140** in an unlocked position, accessible portion **141** may be rotated into unlocked notch **136**. Locking pin structure **140** may be similarly rotated and slid from unlocked notch **136** to locked notch **137**.

[0029] As FIG. **2** shows, seat **150** is slidingly supported on arm **130**. As FIG. **2** illustrates, seat **150** includes a seat interface **157** and a cushion **152**. As FIG. **2** shows, seat **150** may slide between a plurality of seat positions along the length of arm **130**. For example, FIG. **2** illustrates seat **150** in a rearward seat position in solid lines and in a forward seat position in phantom lines. Seat **150** is configured to seat a user in position to operate device **100**. Further, seat **150** may be carefully positioned on arm **130** to adjust the amount of force a user's weight applies to swing end **134**.

[0030] Seat **150** is positioned at a distance selected to apply a portion of a user's bodyweight to the swing end of the arm when the user is seated in the seat. The amount of force required for a user to drive arm **130** is at least partially dependent on the distance between seat **150** and arm pivot **120**. For example, users may increase the portion of their weight applied to drive arm **130** by further spacing seat **150** from arm pivot **120**. Because seat **150**'s position on arm **130** is adjustable, users may adjust seat **150** to adjust the level of impact of physical therapy techniques performed using device **100**. This, combined with arm **130**'s lightweight design relative those of many leg-lifting strength training devices, affords greater precision and flexibility in adjusting the level of impact compared to many) conventional leg-lifting devices.

[0031] As FIG. **3** illustrates, seat **150** is configured to slide along arm **130** to a plurality of seat positions. Each seat position represents a position where seat **150** may be locked in position spaced a selected distance from arm pivot **120**. By adjusting the distance between seat **150** and arm **130**, users may adjust the amount of force applied to swing end **134** of arm **130**. This allows users to adjust the level of impact placed on their soleus muscles when performing physical therapy techniques. By carefully adjusting the level of impact in this manner, users are able to precisely tune device **100** specifically for physical therapy activities.

[0032] Further, adjusting seat **150** may allow users to configure device **100**) with a seating position that is ergonomically appropriate for physical therapy applications.

[0033] As FIG. **2** shows, cushion **152** is positioned on seat interface **157** near the end of seat interface **157** proximate rear support structure **105**. In some examples, cushion **152** simply provides users with a comfort when seated to operate device **100**. In other examples, however, cushion **152** may be shaped and sized to better conform to users' figures. Further, cushion **152** may be used to adjust users' vertical positions. These features may support users as they use device **100**, thereby allowing device **100** to operate more effectively in physical therapy applications.

[0034] As FIG. **1** illustrates, seat interface **157** is slidingly fit on arm **130** to slidingly support seat **150** on arm **130**. As FIG. **1** shows, seat interface **157** defines two flanges, flange **158** and flange **159**, each disposed on an opposite side of arm **130** when seat interface **157** is fitted thereon. As FIG. **1** shows, seat interface **157** additionally defines a top surface **160**, a pair of forward seat attachment bores **162** opposing one another on flange **158** and flange **159**, and a pair of rear seat attachment bores **164** similarly opposing one another on flange **158** and flange **159**.

[0035] As FIG. **3** shows, seat interface **157** may be slid between seating positions wherein forward seat attachment bores **162** and rear seat attachment bores **164** are each aligned with seat positioning bores **136** on arm **130**. When in position, a forward seat pin **161** is inserted through forward seat attachment bores **162** and a selected seat positioning bore **136**. Likewise, a rear seat pin **163** is inserted through rear seat attachment bores **164** and another selected seat positioning bore **136**. In some examples, only one seat pin may be inserted to retain seat **150** at a substantially fixed longitudinal position along arm **130** while allowing seat **150** to rotate about the seat pin. The two pin configuration shown in FIG. **2** restricts seat **150** from so rotating.

[0036] As FIGS. **4** and **5** show, seat interface **157** includes a post interface **165** extending vertically from top surface **160**. As FIG. **4** shows, post interface **165** includes a pair of opposing flanges, flange **167** and flange **168**, extending vertically from seat interface **157**. As FIG. **4** shows, post interface **165** defines three opposed pairs of post positioning bores **171** positioned on the opposing flanges.

[0037] As FIG. **4** shows, post **180** is fitted between post interface **165**'s opposing flanges, flange **167** and flange **168**. As FIG. **4** illustrates, post **180** defines a post attachment bore **181** positioned to align with post positioning bores **171** of post interface **165**. As FIG. **4** shows, post **180** additionally defines a plurality of knee saddle positioning bores **182** spaced along its length. As FIG. **4** illustrates, post **180** includes a total of five knee saddle positioning bores **182**, useful to support a wide range users' of different sizes. The precise selection of five is not necessary, but was found to be a particularly suitable amount for supporting a large number of potential users for various heights. In particular, knee

saddles positioning bores proximate arm **130** adapt device **100** for use with shorter individuals, whereas knee saddle positioning bores **182** distal arm **130** adapt device **100** for use with taller individuals. The five bore configuration illustrated in FIG. **4** may, in some designs, provides sufficient adjustability to support physical therapy users ranging in height from four feet and ten inches tall to six feet and seven inches tall.

[0038] As FIG. **4** shows, post **180** defines a columnar member extending away from post interface **165** configured to adjustably space knee saddle **185** from arm **130**. Further, post **180** is configured to connect to post interface **165** at a post position by removably routing a post attachment pin **183** through post attachment bore **181** and a selected post positioning bore **171**. As FIG. **4** illustrates, post **180** may be connected at a plurality of post positions, each one defined by a position in which post attachment bore **181** is aligned with a selected post positioning bore **171**. Adjusting the post position may allow device **100** to support users of different shapes and sizes in proper ergonomic position. Additionally or alternatively, adjusting the post position may allow device **100** to modify physical therapy exercises. When so connected, post **180** is able to rotate about a post pivot centered on post attachment pin **183**. This allows knee saddle **185** to ergonomically adjust position as a user performs physical therapy exercises with device **100**.

[0039] As FIG. **4** illustrates, post **180** is configured to be slidingly received within knee saddle **185**.

[0040] As FIG. **4** shows, knee saddle **185** is connected to the arm via post **180**. As FIG. **4** shows, knee saddle **185** includes a knee saddle interface **186**, a first knee support **190**, a first knee cushion **191**, a second knee support **192**, and a second knee cushion **193**. Knee saddle **185** is positioned at a height selected to rest on a user's knee when the user is seated in the seat and having her feet positioned on foot rest **177**. As FIG. **4** illustrates, knee saddle **185** may be adjusted along post **180** to adjust the distance between the knee supports and foot rest **177**, allowing device **100** to be adjusted to ergonomically support users with a variety of body shapes.

[0041] Knee saddle **185** is, in the illustrated example, spaced from seat **150** at a distance of approximately 17 inches. As FIG. **4** illustrates, knee saddle **185** is detachably connected to seat interface **157**. User may detach and reattach knee saddle **185** at a plurality of knee saddle spacings, each defined in the illustrated example by post positioning bores **171**, to position knee saddle **185** at a desired horizontal position along arm **130**. In some examples, the desired horizontal position may be a position substantially horizontally aligned with foot rest **177**. For example, knee saddle **185**'s spacing from seat **150** may be adjusted by attaching post **180** at selected post positioning bores **171**. Some examples may include additional or alternative post positioning bores **171** positioned on flanges that extend further along seat interface **157** than flange **158** and flange **159**. In other examples, seat interfaces may be shorter to retain knee saddles in appropriate positions while increasing the distance between seats and arm pivots.

[0042] As FIG. **4** shows, knee saddle interface **186** defines a hollow columnar member extending away from first knee support **190** and second knee support **192**. As FIG. **4** shows, knee saddle interface **186** is configured to slidingly receive post **180** in its interior. This allows users to adjust the extent to which knee saddle **185** is spaced from arm **130**. Knee saddle interface **186** defines a knee saddle attachment bore **187** positioned to align with knee saddle positioning bores **182** as knee saddle interface **186** is slid on post **180**. As FIG. **4** shows, knee saddle **185** may be locked into a selected knee saddle position by removably routing a knee saddle pin **188** through knee saddle attachment bore **187** and a selected knee saddle positioning bore **182**. Knee saddle **185** may be locked in to a variety of knee saddle positions, each one defined by a point at which knee saddle attachment bore **187** is aligned with a knee saddle positioning bore **182**. Adjusting knee saddle **185** may adapt device **100** to ergonomically support a variety of users for physical therapy applications.

[0043] As FIG. **4** shows, first knee support **190** and second knee support **192** extend from knee saddle interface **186** substantially parallel to support surface **101** to rest on users' knees when they are seated in seat **150** and have their feet positioned on foot rest **177**. As FIG. **4** illustrates, first knee cushion **191** and second knee cushion **193** are positioned around each knee support. In performing physical therapy exercises, users oppose the force applied to arm **130** as a result of their weight by engaging their knees with first knee support **190**) and second knee support **192** and driving their knees upward to drive arm **130**) to a raised position. The cushions shown in FIG. **4** provide additional comfort and ergonomic support, but are not required.

[0044] As FIG. **7** illustrates, lower bar **115** defines a metallic, rigid bar extending between front support structure **195** and rear support structure **105**. As FIG. **7** illustrates, lower bar **115** defines a plurality of foot rest positioning bores **117** spaced along its length proximate front support structure **195**.

[0045] As FIG. **7** shows, foot rest **177** is slidingly supported on lower bar **115**. As FIG. **7** illustrates, foot rest **177** includes a foot rest interface **178** slidingly engaged with lower bar **115**, a foot rest support post **179**. As FIG. **1** illustrates, foot rest **177** additionally includes a foot rest support member **176**. In some examples, foot rest **177** may be substantially horizontally aligned with knee saddle **185**, but this is not specifically required. Foot rest **177** is configured to support a forward portion of a user's foot when user is seated in seat **150**; that is, user's typically support a portion of the bottom of their feet proximate their toes on foot rest **177** when using device **100**. This positions users' feet appropriately for driving arm **130**. Users may, of course, position their feet in other manners to adjust the physical therapy technique being performed.

[0046] As FIG. **7** illustrates, foot rest interface **178** includes a foot rest attachment bore **175** positioned to align with foot rest positioning bores **117** at a plurality of foot rest positions. As FIG. **7** illustrates, foot rest interface **178** allows foot rest **177** to slide between a rearward foot rest position illustrated in solid lines and a forward foot rest position illustrated in phantom lines. As FIG. **7** shows, a foot rest pin **174** may be inserted through foot rest attachment bore **175** and a selected foot rest positioning bore **117** to lock foot rest **177** in a selected foot rest position.

[0047] As FIG. **7** illustrates, foot rest support post **179** extends from foot rest interface **178** to support foot rest support member **176** at a position spaced from lower bar **115**. As FIG. **7** shows, foot rest support post **179** is angled toward seat **150**; this is not required, and this disclosure contemplates foot rest support posts that extend toward seat, substantially vertically, and away from seat **150**.

[0048] As FIG. **7** shows, foot rest support member **176** is supported on foot rest support post **179** and extends substantially transverse to lower bar **115**. By extending transverse to lower bar **115**, foot rest support member **176** provide foot rest

support surfaces **173** positioned for a user to substantially ergonomically support each of her legs and feet on opposite sides of arm **130**. As FIG. **7** illustrates, foot rest support surfaces **173** are substantially aligned with foot rest support post **179** and angled toward seat **150**. In some examples, however, foot rest support member **176** may be angled from foot rest support post **179**. For example, some examples may include foot rest support post **179** angled away from seat **150** and foot rest support member **176** angled from foot rest support post **179** to direct foot rest support surfaces **173** toward seat **150**.

[0049] Turning to FIG. **8**, a second example of a physical therapy device, device **200**, will now be described. Device **200** includes many similar or identical features to device **100** combined in unique and distinct ways. Thus, for the sake of brevity, each feature of device **200** will not be redundantly explained. Rather, key distinctions between device **100** and device **200** will be described in detail and the reader should reference the discussion above for features substantially similar between the two devices.

[0050] As FIG. **8** illustrates, device **200** is configured to accommodate substantially similar physical therapy techniques as device **100**. Device **200**, however, includes additional features that allow users to more precisely tune device **200** to accommodate specific users and applications.

[0051] For example, device **200** includes an arm **230** supported on a rear support structure **205** and spaced from a supporting surface **201**. Similar to arm **130**, arm **230** is configured to rotate about an arm pivot **220** supported on rear support structure **205**. Arm **230** additionally includes a plurality of positioning bores **282** spaced along its length. As FIG. **8** illustrates, arm **230** includes a more extensive set of positioning bores than arm **130**; as a result, each of the adjustable elements attached to arm **230**) may be adjusted to a wide range of positions.

[0052] As FIG. **8** shows, arm **230** extends from a swing end **234** to a biased end **232**. As FIG. **8** shows, arm **230** extends beyond rear support structure **205**, defining an arm biasing portion **231** biased end **232** on a biasing side **218** of arm pivot **220**. As FIG. **8** illustrates, swing end **234** is positioned on a seat side **219** of arm pivot **220**. As FIG. **8** shows, As FIG. **8** illustrates, device **200** additionally includes a lower bar **215** similarly extending to a lower bar biasing portion **222** positioned beyond rear support structure **205**. As FIG. **8** illustrates, device **200** includes an arm biasing support **298** adjustably connected to arm **230** proximate biased end **232**. As FIG. **8** illustrates, arm biasing support **298**'s position on arm **231**) is adjustable using a pin, positioning bore, and attachment bore, similar to many aforementioned adjustable features. A similar lower bar biasing support **221** is similarly connected to lower bar **115** on lower bar biasing portion **222** and substantially aligned with arm **230**. As FIG. **8** illustrates, arm biasing support **298** and arm biasing support **298** are configured to retain a biasing member configured to bias swing end **234** of arm **230** toward a raised position.

[0053] As FIG. **8** shows, biased end **232** allows users to place counter-weights or biasing members that may counteract or augment the arm-swinging techniques often performed with device **100**. As a result, device **200** allows users to more flexibility in tuning the amount of effort required raise swing end **234** of arm **230** when performing physical therapy techniques.

[0054] For example, device **200** includes a biasing member **207** defining a coil connected between arm biasing support **298** and lower bar biasing support **221**. Biasing member **207** is configured to bias swing end **234** toward a raised configuration, thereby making it easier for users to raise swing end **234** of arm **230** when performing physical therapy techniques.

[0055] Although device **200** includes a biasing member, this example specifically considers additionally or alternatively attaching counterweights proximate to arm **230** on biasing side **218** of rear support structure **205**; for example, weights could be attached to arm biasing support **298**.

[0056] As FIG. **8** illustrates, arm pivot **220** is adjustably connected to arm **230**, unlike device **100**'s static configuration. As FIG. **8** shows, rear support structure **205** defines a support pivot connection point **299** including a pair of pivot support flanges **208**, each pivot support flange **208** defining a support pivot bore **209**.

[0057] As FIG. **8** illustrates, a connector **211** detachably connects arm **230** to rear support structure **205** at an arm pivot connection point and a support pivot connection point. More specifically, FIG. **8** illustrates an example wherein connector **211** defines a pivot pin, and the pivot pin is routed through the support pivot bores **209** and an arm pivot bore, in this case a selected arm positioning bore **282** proximate rear support structure **205**. In this example, the support pivot connection point defines support pivot bores **209**, whereas the arm pivot connection point defines a selected arm positioning bore **282**. As FIG. **8** shows, a user can select a selected arm connection pivot point from the plurality of arm positioning bores **282**. As FIG. **8** illustrates, arm **231**) may be detached and connected at different points along its length to adjust the point at which it pivots about rear support structure **205**. This allows greater flexibility in specifically tuning device **200** for particular physical therapy applications and techniques. As FIG. **8** shows, rear support structure **205** defines an arm rotating space **206** that allows arm **230** to rotate with the full range of motion necessary for physical therapy techniques while permitting the aforementioned adjustability.

[0058] As FIG. **8** illustrates, lower bar **215** additionally includes a greater number of lower bar positioning bores **216** spaced along its length compared to lower bar **115**. This provides users with greater freedom in adjustably connecting elements at various positions along lower bar **215**.

[0059] Further, as FIG. **8** shows, device **200** includes a seat interface **237** and a foot rest **277** that a plurality of additional attachment bores compared to those of device **100**. As a result, device **200** provides users with even greater flexibility in positioning them along arm **231**) and lower bar **215**, respectively.

[0060] Disclosed devices, including device **100** or device **200** may be configured to adjust the amount of force required to lift their arms. By adjusting this force, users may adjust the level of impact of exercises using the devices. By adjusting exercises' level of impact, disclosed devices may be adjusted to enable exercises that are suitable for physical therapy applications, rather than strength training exercises.

[0061] For instance, the amount of force required to raise an arm while a user is seated may, in some examples, be expressed with the following equation:

$$\text{Force to Drive Arm} = \frac{((F_b * Z') + (W + Z))}{(Z + Y)} \qquad \text{Forumla I}$$

Wherein:

[0062] W=weight of the user;

[0063] F_b=biasing force

[0064] Z=distance between the seat and the arm pivot

[0065] Z'=distance between the biasing member and the arm pivot

[0066] Y=distance between the seat and the foot rest

[0067] Table I, provided below, shows example results of the formula provided above where no biasing member is used. Table I illustrates the forces users must impart to drive arms given their weight and seat positions. Table I assumes that the seat and knee saddle are horizontally spaced from one another at a distance of 17 inches, though this disclosure specifically considers seats and knee saddles spaced by different lengths. Table I is provided below:

TABLE 1

	Seat Position (given as inches from arm pivot)																			
Weight (in pounds)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
100	6	11	15	19	23	26	29	32	35	37	39	41	43	45	47	48	50	51	53	54
110	6	12	17	21	25	29	32	35	38	41	43	46	48	50	52	53	55	57	58	59
120	7	13	18	23	27	31	35	38	42	44	47	50	52	54	56	58	60	62	63	65
130	7	14	20	25	30	34	38	42	45	48	51	54	56	59	61	63	65	67	69	70
140	8	15	21	27	32	37	41	45	48	52	55	58	61	63	66	68	70	72	74	76
150	8	16	23	29	34	39	44	48	52	56	59	62	65	68	70	73	75	77	79	81
160	9	17	24	30	36	42	47	51	55	59	63	66	69	72	75	78	80	82	84	86
170	9	18	26	32	39	44	50	54	59	63	67	70	74	77	80	82	85	87	90	92
180	10	19	27	34	41	47	53	58	62	67	71	74	78	81	84	87	90	93	95	97
190	11	20	29	36	43	50	55	61	66	70	75	79	82	86	89	92	95	98	100	103
200	11	21	30	38	45	52	58	64	69	74	79	83	87	90	94	97	100	103	106	108
210	12	22	32	40	48	55	61	67	73	78	83	87	91	95	98	102	105	108	111	114
220	12	23	33	42	50	57	64	70	76	81	86	91	95	99	103	107	110	113	116	119
230	13	24	35	44	52	60	67	74	80	85	90	95	100	104	108	112	115	118	121	124
240	13	25	36	46	55	63	70	77	83	89	94	99	104	108	113	116	120	123	127	130
250	14	26	38	48	57	65	73	80	87	93	98	103	108	113	117	121	125	129	132	135
260	14	27	39	50	59	68	76	83	90	96	102	108	113	117	122	126	130	134	137	141
270	15	28	41	51	61	70	79	86	93	100	106	112	117	122	127	131	135	139	143	146
280	16	29	42	53	64	73	82	90	97	104	110	116	121	126	131	136	140	144	148	151
290	16	31	44	55	66	76	85	93	100	107	114	120	126	131	136	141	145	149	153	157
300	17	32	45	57	68	78	88	96	104	111	118	124	130	135	141	145	150	154	158	162
310	17	33	47	59	70	81	90	99	107	115	122	128	134	140	145	150	155	159	164	168
320	18	34	48	61	73	83	93	102	111	119	126	132	139	145	150	155	160	165	169	173
330	18	35	50	63	75	86	96	106	114	122	130	137	143	149	155	160	165	170	174	178
340	19	36	51	65	77	89	99	109	118	126	134	141	147	154	159	165	170	175	179	184
350	19	37	53	67	80	91	102	112	121	130	138	145	152	158	164	170	175	180	185	189

[0068] Table II, provided below, shows example results of the formula provided above in a device including a biasing member biasing with 25 pounds of force positioned 8 inches from the arm pivot. The negative values shown in Table II reflect situations where the users' weight produces insufficient weight to counteract the biasing member and drive the arm downward. Table II is otherwise similar to Table I. Table II is provided below:

TABLE II

	Seat Position (given as inches from arm pivot)																			
Weight (in pounds)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
100	−6	0	5	10	14	17	21	24	27	30	32	34	37	39	41	42	44	46	47	49
110	−5	1	7	11	16	20	24	27	30	33	36	39	41	43	45	47	49	51	53	54
120	−4	2	8	13	18	23	27	30	34	37	40	43	45	48	50	52	54	56	58	59
130	−4	3	10	15	20	25	30	34	37	41	44	47	50	52	55	57	59	61	63	65
140	−3	4	11	17	23	28	33	37	41	44	48	51	54	57	59	62	64	66	68	70
150	−3	5	13	19	25	30	35	40	44	48	52	55	58	61	64	67	69	71	74	76
160	−2	6	14	21	27	33	38	43	48	52	56	59	63	66	69	72	74	77	79	81
170	−2	7	16	23	30	36	41	46	51	56	60	63	67	70	73	76	79	82	84	86
180	−1	8	17	25	32	38	44	50	55	59	64	68	71	75	78	81	84	87	89	92
190	−1	9	19	27	34	41	47	53	58	63	68	72	76	79	83	86	89	92	95	97
200	0	11	20	29	36	43	50	56	62	67	71	76	80	84	88	91	94	97	100	103
210	1	12	22	30	39	46	53	59	65	70	75	80	84	88	92	96	99	102	105	108
220	1	13	23	32	41	49	56	62	68	74	79	84	89	93	97	101	104	107	111	114
230	2	14	25	34	43	51	59	66	72	78	83	88	93	97	102	105	109	113	116	119
240	2	15	26	36	45	54	62	69	75	81	87	92	97	102	106	110	114	118	121	124
250	3	16	28	38	48	57	65	72	79	85	91	97	102	106	111	115	119	123	126	130
260	3	17	29	40	50	59	68	75	82	89	95	101	106	111	116	120	124	128	132	135

TABLE II-continued

	Seat Position (given as inches from arm pivot)																				
Weight (in pounds)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
270	4	18	31	42	52	62	70	78	86	93	99	105	110	115	120	125	129	133	137	141
280	4	19	32	44	55	64	73	82	89	96	103	109	115	120	125	130	134	138	142	146
290	5	20	34	46	57	67	76	85	93	100	107	113	119	125	130	135	139	143	148	151
300	6	21	35	48	59	70	79	88	96	104	111	117	123	129	134	139	144	149	153	157
310	6	22	37	50	61	72	82	91	100	107	115	121	128	134	139	144	149	154	158	162
320	7	23	38	51	64	75	85	94	103	111	119	126	132	138	144	149	154	159	163	168
330	7	24	40	53	66	77	88	98	107	115	123	130	136	143	148	154	159	164	169	173
340	8	25	41	55	68	80	91	101	110	119	126	134	141	147	153	159	164	169	174	178
350	8	26	43	57	70	83	94	104	113	122	130	138	145	152	158	164	169	174	179	184

[0069] Although the tables illustrate seat positions spaced in one inch increments, this is not specifically required. Because seat interfaces are slidingly supported on arms, seats may be positioned at any position on arms. For example, As Tables I and II illustrate, disclosed devices allow users to precisely adapt devices for impact levels appropriate for physical therapy applications. For most individuals of normal health, positioning a seat in one of seat positions 17, 18, 19, and 20 shown above will apply an appropriate amount of a user's weight to oppose the user's lifting action. As a result, in many cases, seat positions 17, 18, 19, and 20, as illustrated in both Tables I and II, may be particularly well adapted for physical therapy contexts. Adjusting toward or away from these positions, however, may be desirable for heavier or lighter than average users, as well as users that are taller or shorter than average.

[0070] Some examples may include locking mechanisms that vary from the pin and bore examples described above; such examples may allow users to more precisely set the distance between the seat and the arm pivot. Likewise, pin-and-bore based seat positioning systems are not required to be spaced at even, one-inch increments. For example, various devices may implement a alternative bore location, allowing users to select and use a device with bore spacings specifically tuned for physical therapy purposes given their weight and level of fitness.

[0071] Although much of this disclosure focuses the benefit of adjusting devices for physical therapy purposes, disclosed devices are not specifically limited to this purpose. For example, the adjustability discussed in this disclosure may be adapted to strength training contexts as well, including in contexts where a weight is attached to swing ends of arms. For example, as Tables I and II illustrate, moving the seat away from the arm pivot may increase the amount of weight required to drive arms upward; this may be a simple way to augment strength training. Further, adjusting the seat position may adjust the angle at which users drive arms upward, which may allow a diverse range of strength training exercises.

[0072] The disclosure above encompasses multiple distinct inventions with independent utility. While each of these inventions has been disclosed in a particular form, the specific embodiments disclosed and illustrated above are not to be considered in a limiting sense as numerous variations are possible. The subject matter of the inventions includes all novel and non-obvious combinations and subcombinations of the various elements, features, functions and/or properties disclosed above and inherent to those skilled in the art pertaining to such inventions. Where the disclosure or subsequently filed claims recite "a" element, "a first" element, or any such equivalent term, the disclosure or claims should be understood to incorporate one or more such elements, neither requiring nor excluding two or more such elements.

[0073] Applicant(s) reserves the right to submit claims directed to combinations and subcombinations of the disclosed inventions that are believed to be novel and non-obvious. Inventions embodied in other combinations and subcombinations of features, functions, elements and/or properties may be claimed through amendment of those claims or presentation of new claims in the present application or in a related application. Such amended or new claims, whether they are directed to the same invention or a different invention and whether they are different, broader, narrower or equal in scope to the original claims, are to be considered within the subject matter of the inventions described herein.

1. A physical therapy device, comprising:

a vertically extending rear support structure;

an arm pivot supported by the rear support structure at a position vertically spaced from a supporting surface;

an arm pivotally supported by the arm pivot, the arm extending horizontally from a pivot end to a swing end distal the arm pivot;

a seat resting on the arm at a distance selected to apply a selected portion of a user's bodyweight to the swing end of the arm to be supported by the calf muscles of one or both lower legs of the user when the user is seated in the seat;

a foot rest supported above the supporting surface at a height selected to support a forward portion of the user's foot when the user is seated in the seat; and

a knee saddle attached to the arm, the knee saddle including a knee support positioned at a height selected to rest on the user's knee when seated in the seat;

wherein a therapeutic resistance to be supported by the calf muscles of one or both lower legs of the user when the user is seated in the seat consists of a combination of the selected portion of the user's bodyweight, the weight of at least a portion of the arm, and the weight of the knee saddle.

2. The physical therapy device of claim **1**, wherein the seat rests on the arm at a distance from the arm pivot selected to require a desired force to drive the arm based on the user's weight.

3. The physical therapy device of claim **1**, wherein the seat rests on the arm at seven to ten inches from the arm pivot.

4. The physical therapy device of claim **1**, further comprising a front support structure extending from the supporting surface, the front support structure including an arm locking bore;

wherein the arm includes a locking pin structure slidingly housed at least partially within the arm, the locking pin configured slidingly fit within the arm locking bore.

5. The physical therapy device of claim **4**, wherein the arm includes:

a locking pin access opening extending along the length of the arm for at least a portion of its length; and

a locking pin bore that opens substantially away from the arm pivot; and

wherein the locking pin structure defines:

a forward portion extending along the length of the arm; and

an accessible portion extending through the locking pin access opening;

wherein the locking pin structure is configured to slide between a locked position, wherein the forward portion of the locking pin extends through the locking pin bore and the arm locking bore, and an unlocked position, wherein the forward portion is fully housed within the arm.

6. The physical therapy device of claim **1**, wherein the seat includes a seat interface configured to slidingly support the seat on the arm.

7. The physical therapy device of claim **6**, wherein the knee saddle is detachably connected to the seat interface, the knee saddle being horizontally spaced from the seat at a distance selected to substantially horizontally align the knee saddle with the foot rest.

8. The physical therapy device of claim **7**, further comprising a post extending between the knee saddle and the arm, wherein the knee saddle is detachably connected to the post at a selected distance from the arm.

9. The physical therapy device of claim **8**, further comprising:

a post interface attached to the seat interface, the post interface including a plurality of post positioning bores spaced along the length of the arm;

a post attachment bore extending through the post distal the knee saddle; and

a post attachment pin removably routed through the post attachment bore and a selected post positioning bore to define a post pivot around which the post may rotate.

10. The physical therapy device of claim **8**, further comprising one or more knee saddle positioning bores spaced along the length of the post;

wherein the knee saddle includes a knee saddle interface slidingly engaged with the post, the knee saddle interface:

configured to slide along the length of the post to adjust the position of the knee saddle relative the user's knee; and

defining a knee saddle attachment bore; and

a knee saddle pin removably routed through a selected knee saddle positioning bore and the knee saddle attachment bore.

11. The physical therapy device of claim **6**, wherein the seat interface is configured to slide between a plurality of seat positions along the length of the arm.

12. The physical therapy device of claim **11**, wherein:

the arm includes one or more seat positioning bores along the length of the arm; and

the seat interface includes a seat attachment bore positioned to align with a seat positioning bore at each seat position; and

further comprising a seat pin removably routed through a selected seat positioning bore and the seat attachment bore when the seat interface is positioned at a selected seat position.

13. The physical therapy device of claim **12**, wherein:

the seat attachment bore is positioned proximate the swing end of the arm;

the seat interface includes a rear seat attachment bore proximate the pivot end of the arm, the rear seat attachment bore positioned to positioned to align with a seat positioning bore at each seat position;

further comprising a rear seat pin removably routed through a selected seat positioning bore and the rear seat attachment bore when the seat interface is positioned at a selected seat position.

14. The physical therapy device of claim **1**, further comprising a lower bar extending from the rear support structure proximate the support surface and substantially aligned with the arm.

15. The physical therapy device of claim **14**, wherein:

the lower bar extends to a lower bar biasing portion extending on the side of the rear support structure opposite the swing end of the arm; and

the arm defines an arm biasing portion on the side of the rear support opposite the swing end of the arm; and

further comprising a biasing member connected between the arm biasing portion and the lower bar biasing portion.

16. The physical therapy device of claim **14**, wherein:

the lower bar includes a plurality of foot rest positioning bores spaced along its length; and

the foot rest includes a foot rest interface slidingly supported on the lower bar, the foot rest interface:

configured to slide along the length of the lower bar to adjust the position of the foot rest relative the seat; and

including a foot rest attachment bore; and

further comprising a foot rest pin removably routed through a selected foot rest positioning bore and the foot rest attachment bore.

17. The physical therapy device of claim **1**, wherein the foot rest defines a support surface angled to partially face the seat.

18. A physical therapy device, comprising:

a vertically extending rear support structure, the rear support structure defining a rear support column defining a support pivot connection point spaced from a supporting surface;

an arm extending horizontally from a pivot end proximate the rear support to a swing end distal the pivot end, the arm defining one or more arm pivot connection points spaced along the length of the arm;

a connector connecting arm to the rear support column at a selected arm pivot connection point;

a seat resting on the arm;

a foot rest supported above the supporting surface at a height selected to support a forward portion of a user's foot when the user is seated in the seat; and

a knee saddle connected to the arm at a height selected to rest on the user's knee when seated in the seat.

19. The physical therapy device of claim **18**, wherein:

the support pivot connection point includes a support pivot bore;

each of the arm pivot connection points include an arm pivot bore; and

the connector defines a pivot pin routed through the support pivot bore and a selected arm pivot bore.

20. A physical therapy device, comprising:

a vertically extending rear support structure;

an arm pivot supported at a position vertically spaced from a supporting surface;

an arm extending horizontally from a biased end on a biasing side of the arm pivot to a swing end on a seat side of the arm pivot opposite the biasing side;

a seat resting on the arm at a distance selected to apply a portion of a user's bodyweight to the swing end of the arm when the user is seated in the seat;

a foot rest supported above the supporting surface at a height selected to support a forward portion of the user's foot when the user is seated in the seat;

a knee saddle connected to the arm at a height selected to rest on the user's knee when seated in the seat; and

a biasing member connected to arm proximate the biasing end and a biasing support positioned below the arm.

* * * * *