United States Patent

Cannon

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[54] **PHYSICAL THERAPY DIAGNOSTIC DEVICE**

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[52] **U.S. Cl.**.....**73/379 R,** 73/380 R, 73/381 R, 138/2 R

[51] **Int. Cl.**.....**G011 5/02**

[58] **Field of Search**.....128/2; 272/83 R, 79 R, 87; 73/379 R, 380 R, 141 R, 141 AB, 381 R

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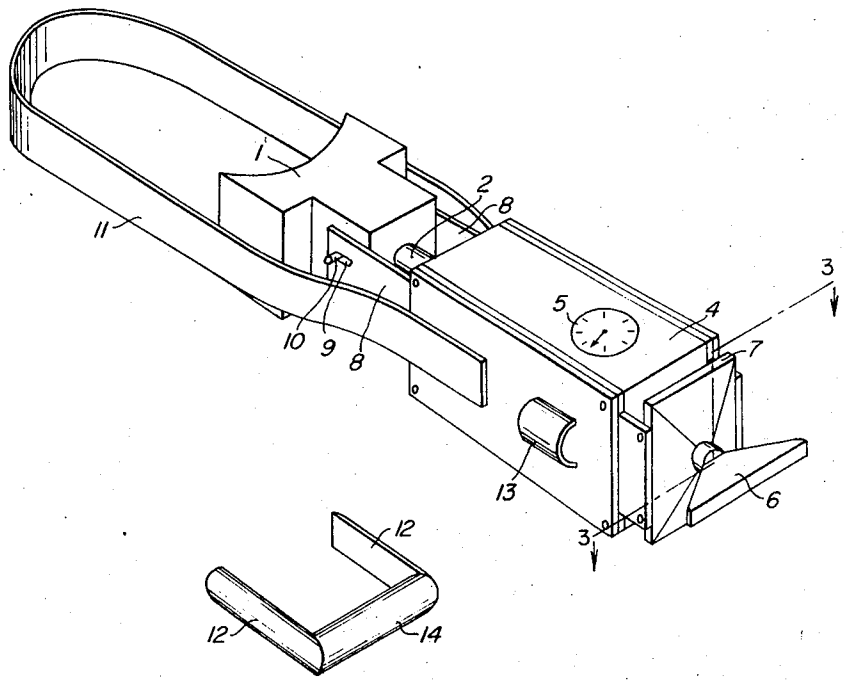
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[57] **ABSTRACT**

A physical therapy diagnostic device for determining muscle strength and tone has now been invented. The device comprises energy absorbing means and an absorbed energy measuring device associated therewith. The energy absorbing means may be a fluid filled cylinder containing a piston connected to a body or muscle contacting member. The energy absorbing means can be rigidly attached to a housing to which pressure may be applied to force the body contacting member against a particular muscle, limb or other body part. The resistance of the muscle, limb or the like to movement causes energy to be absorbed by the energy absorbing means, the quantity of energy absorbed being observable from the measuring device.

4 Claims, 7 Drawing Figures



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SHEET 1 OF 2

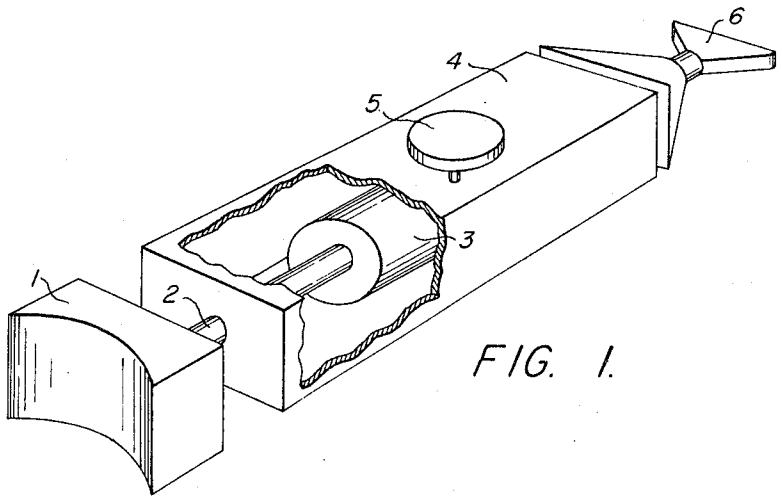


FIG. 1.

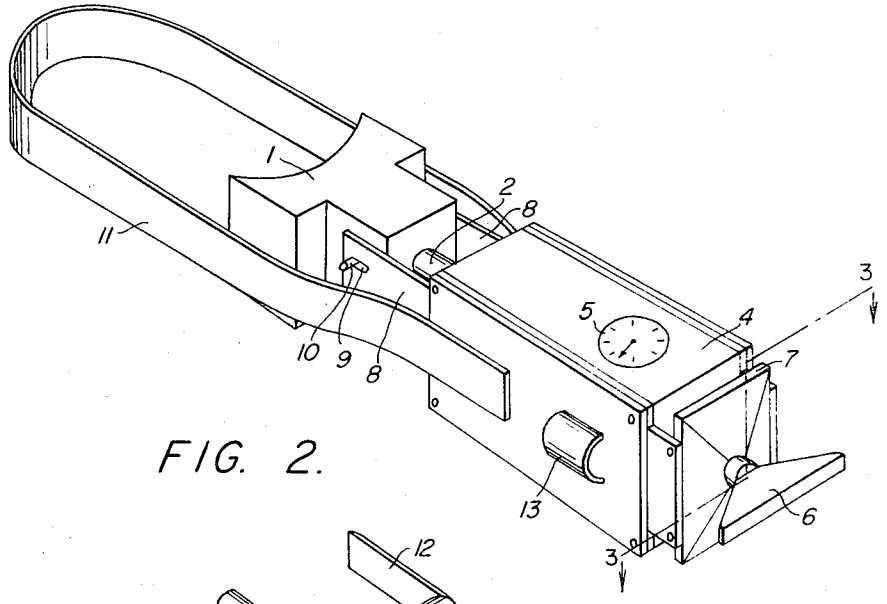
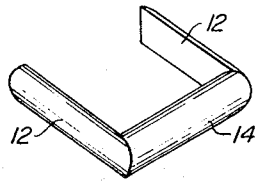


FIG. 2.



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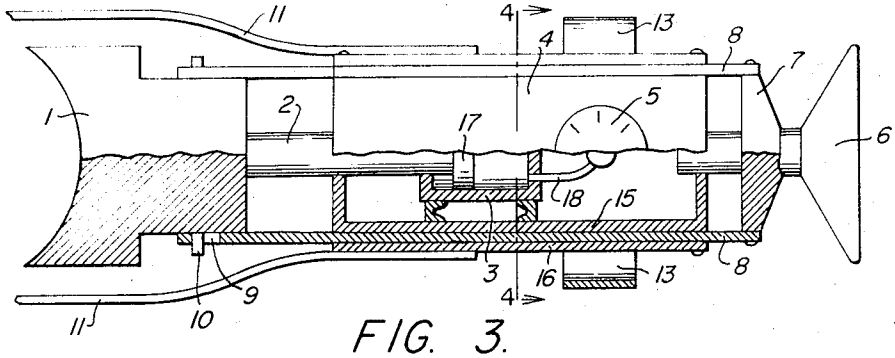


FIG. 3.

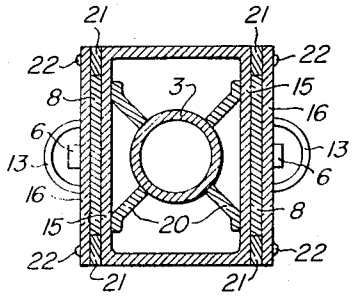


FIG. 4.

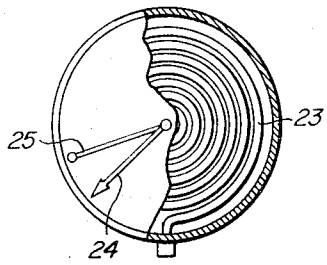


FIG. 5.

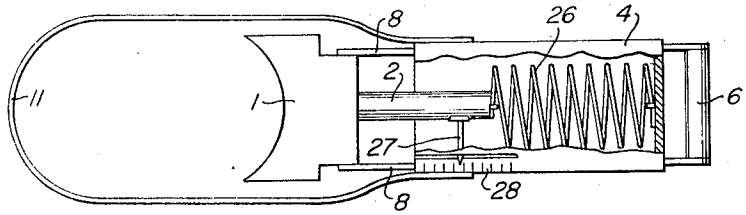


FIG. 6.

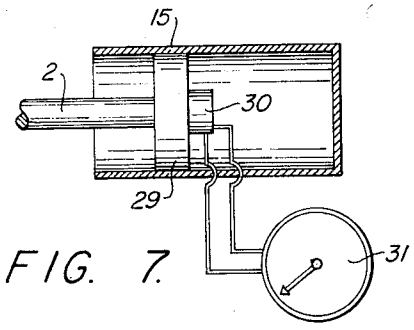


FIG. 7.

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PHYSICAL THERAPY DIAGNOSTIC DEVICE

BACKGROUND OF THE INVENTION

Medical practitioners concerned with the physical condition of muscles, bones, joints and the like must generally rely on qualitative tests to determine their relative condition. A physical therapist, for example, rehabilitating the muscles of a limb can determine its strengthening progress only qualitatively, i.e., by applying pressure to the limb and gauging the force required to overcome the resistance strength of the limb.

The same problem occurs in determining the progress of joints affected with arthritis and similar afflictions. The response of the afflicted joint to a certain medication may be diagnosed by the amount of pressure the joint will withstand without pain. This may be roughly gauged by the physician applying pressure through his own hands.

In some instances a quantitative determination can result from the use of weights, for example, by hanging a weight from a particular limb. This is not always satisfactory and requires considerable repositioning of the patient, weights, pulleys, etc. to obtain a cross-section of readings.

INVENTION

A device for quantitatively determining muscular strength and for related physical therapy diagnostic purposes has been invented. The device may be utilized statically or dynamically to establish a reference point for a certain physical condition and to determine changes in the condition observed. The device may be utilized in compression or tension and the pressure can be applied by the patient or the diagnostician.

The device comprises a member for contacting a portion of the human body, especially limb members, energy absorbing means located in a housing and connected to said body contacting member, and gauge or other display means communicating with said energy absorbing means for indicating quantum of energy absorbed. The device is preferably an integral unit and sufficiently light in weight to be easily hand-operated.

Further description of the invention may be facilitated by reference to the attached drawings.

FIG. 1 is a perspective view of a physical therapy diagnostic device.

FIG. 2 is a perspective view of a physical therapy diagnostic device capable of determining compression and tension forces.

FIG. 3 is a partial cross-sectional view of a physical therapy diagnostic device.

FIG 4 is a plan view of a cross-section of the physical therapy diagnostic device illustrated in FIGS. 2 and 3.

FIG. 5 is a partial sectional view of one type of gauge useful to indicate the energy absorbed by the physical therapy diagnostic device.

FIG. 6 is a sectional view of a physical therapy diagnostic device showing a spring-type energy absorbing means.

FIG. 7 is a sectional view of a physical therapy diagnostic device illustrating an embodiment using a strain gauge to indicate the amount of energy absorbed.

The device illustrated in FIG. 1 is one embodiment of a physical therapy device which may be utilized for checking muscle strength and muscle tone and useful as an exercising device. The device comprises a body

contacting member 1 which may be an appropriately contoured block which can be forced against a portion of the human body without discomfort. The block-like body contacting member 1 illustrated in FIG. 1 has a slight concave contacting surface to accommodate the curvature of an arm or leg of a patient. The device may be constructed to adapt readily to substitute body contacting members so that a single device could be utilized with numerous body contacting members having various shaped, contacting surfaces. For example, a body contacting member designed to contact the thigh of a patient would preferably have a different contacting surface than a block designed to contact an ankle.

The body contacting member 1 is connected by means of a shaft 2 to an energy absorbing device 3 which is rigidly connected to a housing member 4. The energy absorbing device 3 illustrated in FIG. 1 can comprise a fluid filled cylinder containing a piston attached to shaft 2. The fluid in said energy absorbing cylinder communicates with a fluid pressure gauge 5. A handle 6 or other appropriate means for receiving and transmitting a force to the housing 4 of the device is attached to the housing 4 at an opposite end from the body contacting member 1.

In operation, the physical therapy diagnostic device of FIG. 1 is placed with the body contacting member 1 against a limb or other body part of a patient. The diagnostician applies a force to the handle 6 which forces the body contacting member 1 against the patient. Conversely, the diagnostician can hold the device in a fixed position and permit the force to be applied by the patient through the body contacting member 1. In either event, the body contacting member causes the piston within cylinder 3 to move in a manner compressing the fluid contained therein, thereby registering a reading on the meter or gauge 5. The device can be constructed so that a very slight movement of the piston can provide a maximum reading on the gauge 5. It is desirable in many respects to have a physical therapy testing device which gives an accurate reading of muscle strength without requiring much movement of that portion of the device which is in contact with the patient's body. This is desirable inasmuch as it is frequently preferred to check the strength or muscle tone of a limb, for example, when placed in a certain position. If considerable movement of the contacting member is required then the strength of the limb cannot be determined in a precise position inasmuch as the limb must move to cause a reading on the device. By using a non-compressible fluid within the cylinder 3 a small movement of the piston can cause a maximum reading on a gauge 5 whenever the gauge is selected to have an appropriate range for the purpose of the device. For example, a typical device can be constructed to have a maximum reading whenever a hundred pounds of force is applied to the device. For a cylinder having a piston of one square inch area, an appropriate gauge is one having a maximum reading of 100 pounds per square inch.

The device of FIG. 1 can be utilized by the patient without the help of the diagnostician. The strength of a patient's arms could be determined by having the patient grasp the handle 6 in one hand and place the heel of the other hand against the body contacting member 1 and apply a force on the device by pressing his hands

in a direction towards one another. When a testing device is to be utilized in this manner it is preferred that the device have a maximum length of about 1 foot. This can be readily accomplished inasmuch as the cylinder length of the energy absorbing means **3**, for example, need be only a few inches in length and the body contacting member can be relatively thin and project from the housing only an inch or two.

The device illustrated in FIG. **2** is more versatile than the one previously discussed. In FIG. **2** the physical therapy device can determine the magnitude of a pushing force (compression) or a pulling force (tension). This device is similar to the one illustrated in FIG. **1** however the handle **6** of this device is connected to the block-like body contacting member by a pair of plates **8**, said plates being in a fixed relationship to the handle and slidably connected to the body contacting member **1**. A compressive force is measured in a similar manner to the device of FIG. **1** wherein forces directed towards one another are applied to the handle **6** and to the body contacting member **1**. The base of the handle **7** will be forced into contact with the top of the housing **4** and will tend to force the housing towards the body contacting member **1**. The slide opening **9** in the plates **8** must be sufficiently long so that the pin **10** can still move towards the housing when the handle base plate **7** is in contact with the housing **4**. When the handle base plate **7** comes in contact with the housing **4** and compressive forces are still exerted on the device, the body contact member **1** is forced towards the housing and causes the piston to move within a cylinder rigidly attached to that housing thereby providing a reading on gauge **5** in the sidewall of housing **4**. As indicated above, liquid filled cylinder is only one type of energy absorbing device which may be utilized to register the magnitude of force applied to the device.

The device of FIG. **2** may also be used to test the pulling strength of a patient through a strap-like body contacting member **11**. A force exerted on strap **11** away from the housing and a force applied to handle **6** in an opposite direction will cause plates **8** to move away from the body contacting member until the bottom of slots **9** contact the pin **10**. Continued application of outwardly directed forces will cause plates **8** to pull the body contacting member towards the handle thereby moving the piston against the liquid in the cylinder and providing a reading on gauge **5**. The instant device is especially advantageous inasmuch as the same energy absorbing means and gauge means can be utilized whether a compressive or tensile strength is to be measured.

The strap **11** of the device of FIG. **2** must be relatively rigid at its juncture with the device housing and beyond the point at which it flares to encompass the body contacting member. The portion of the strap lying beyond the body contacting member **1** may be flexible and may be constructed so that the strap member **11** may be opened to accommodate passing of a limb of the body therethrough and then latched or closed about such limb member. If the housing **4** is wider than the body contacting member **1** then the strap **11** could be flexible for its entire length, such as a nylon belt. The device with the strap member **11** may be utilized by opening the strap member and passing it about a limb of a patient, for example, the patient's leg and attaching the device to a wall or other support by a hook passing about the handle **7** and secured to an anchor in the wall or other permanent support. The patient could then move his limb member, for example his leg, against the base of the strap member **11** in a direction opposite to the housing to provide a reading on gauge **5**. Since very little movement of the piston within the cylinder is required to obtain a reading, the strength of a limb member in a rather precise position may be measured.

The device of FIG. **2** is very versatile inasmuch as the bracket **12** may be inserted in cups **13** located on each side of the housing so that the top or transverse part of bracket **12** is substantially parallel with the handle **6** and is farther from housing **4** than handle **6**. The device so adapted may be utilized to test the strength of the hands whereby a patient places the heel of his hand against the transverse bar **14** of bracket **12** while gripping under handle **6** with his fingers. This causes movement of plates **8** away from the body contacting member **1** until the slots **9** engage pin **10** at the bottom of the slots and move the body contacting member **1**, shaft **2** and the piston within the liquid filled cylinder in a direction towards the handle to give a reading on gauge **5**. The device is especially advantageous inasmuch as the single device can be utilized to test the muscle strength or joint condition of any part of the patient's body.

As indicated hereinabove and as will be explained in further detail hereinafter, the piston and liquid filled cylinder is only one type of energy absorbing means which may be utilized in the instant invention. A piston and liquid filled cylinder is one preferred embodiment inasmuch as an accurate maximum reading can be obtained with very little movement of the piston. A coil spring could be utilized and a measurement of deformation of the compressed spring be read as the magnitude of force applied. However, the measure of deformation is proportional to the force applied and unless large deformation is permitted the reading is relatively inaccurate. In other words, it is difficult to determine the amount of force applied when the maximum deformation is an eighth of an inch and half the maximum force causes a one-sixteenth inch deformation. If a large deformation is permitted, however, the device does not measure accurately the strength of the patient's muscle in a precise position.

FIGS. **3** and **4** are cross-sectional views of the device illustrated in FIG. **3**. The partial cross-sectional view of FIG. **3** shows the plate members **8** connected to the handle base **7** and slidably engaging pin **10** and passing between the inner wall **15** and outer wall **16** of the housing. FIG. **3** further shows the body contacting member **1** attached to shaft **2** which drives piston **17** in cylinder **3**. The cylinder **3** communicates with gauge means **5** through a hollow tubing **18**. A short shaft or a stud member **19** is attached to the base plate **7** of handle **6** and passes through a hole in the top of housing **4** as a guide for the handle **6** so that forces applied to handle **6** will be directed axially through the device.

FIG. **4** is a transverse view of the device illustrated in FIG. **2** and FIG. **3** showing the cylinder **3** attached in a fixed position to the interior walls **15** of the housing by support members **20**. FIG. **4** also shows the manner in which plates **8** pass between the interior walls **15** and

exterior walls **16** of the housing. The interior walls **15** could be omitted by having the cylinder attached to the pair of walls perpendicular to the plates **8**. The interior and exterior walls are separated by a separator strip **21** and the interior and exterior walls are held in position by rivets or other securing means **22**.

In FIG. **5** a type of pressure gauge useful as a force indicator for the device of the instant invention is illustrated. Gauges of this type are common for measuring pressure and comprise a coiled tube **23** which is filled with liquid and communicates through tubing to the liquid filled cylinder of the physical therapy diagnostic device. As liquid is forced from the cylinder into the spiraled tube **23** the tube tends to uncoil, i.e., it tends to straighten. A needle or indicator **24** attached to the end of the tube is rotated as the coiled tip of the tube tends to straighten. The degree of straightening or uncoiling of the tube **23** is proportional to the amount of pressure applied by the liquid that is in the coiled tube and the needle **24** gives an accurate reading which may be calibrated to indicate the amount of pressure applied to the gauge. The indicator **25** is a maximum reading indicator which is moved along with needle **4** and remains at the maximum reading obtained. A reset nob may pass through the face of the gauge so that the maximum reading indicator **25** can be returned to a zero position before the next reading of the meter is to occur. Other types of pressure gauges may, of course, be utilized and the gauge illustrated in FIG. **5** is merely typical of gauges useful in the instant invention.

FIG. **6** illustrates a physical therapy diagnostic device wherein a coiled spring is utilized as the energy absorbing means and the indication of force or pressure applied is determined by calibrating the deformation of the spring with a known quantity of force. The coiled spring **26** is attached to the face of the housing **4** and connected to the body contacting member **1** by a shaft **2**. A handle **6** is slidably connected through plates **8** to the body contacting member **1**. The device operates in a manner similar to the devices described hereinabove except that accurate readings can be obtained only by utilizing a spring wherein a large deformation occurs when a maximum force is applied. An indicator **27** may be attached to shaft **2** and move along a graduated scale **28** which can be calibrated to correlate deformation with the amount of force applied to the device. As indicated hereinabove devices of this type are not as desirable as a diagnostic device but may have more utility as an exercise device.

In FIG. **7** a partial view of a device is illustrated showing a shaft **2** connected to a bar or spring **29** which may be attached rigidly at its opposite ends to the housing or may be attached to only one wall of the housing in a cantilevered manner. A strain gauge **30** is attached to the bar and is electrically connected to a gauge **31** which can be calibrated to give readings proportional to the amount of deflection occurring in bar **29** which correlates with the amount of force applied to the device. A physical therapy diagnostic device of this type provides accurate readings of the force applied to the device without substantial movement of the shaft **2** and consequently gives an accurate reading of the force applied by or against a patient at a precise position of the muscles being tested.

The above devices illustrate the nature of the invention. Other types of pressure transducers could be utilized to translate the force applied to the device into a reading in pounds or pounds per square inch. For example, a coiled spring such as that illustrated in FIG. **6** could be utilized which deforms only slightly when maximum force was applied thereto, but the accuracy of the reading therefrom could be enhanced by connecting the shaft to a core of an induction coil and measuring the difference in induction as the core entered the coil. In this manner, an accurate reading could be obtained even for slight movements of the shaft within the coil. Other energy absorbing devices and means for reading the force applied can be utilized when an accurate reading is required.

The device of this invention is particularly useful inasmuch as both tension and compression forces can be determined with the same device and accurate readings can be obtained without substantial movement of the portion of the body being diagnosed. The pressure or force applied to the device can come from either the patient or the diagnostician. Furthermore, the device is light in weight and can be easily handled by the diagnostician. Thus, the condition of the patient can be determined with the patient in any desired position. Also, the condition of limbs of the patient can be measured in a precise position with accuracy inasmuch as very little movement of the limb against the body contacting member is required.

Although specific embodiments of the invention have been described hereinabove, it is not intended that the invention be limited solely thereto, but to include all the variations and modifications falling within the scope of the appended claims.

I claim:

1. A therapy diagnostic device for measuring muscle strength comprising:

a. a body contacting member comprising a block-like, body contacting member;

b. a liquid filled cylinder having a movable piston therein;

c. shaft means connecting the said body contacting member to said piston;

d. a housing embodying said liquid filled cylinder and rigidly connected thereto;

e. a fluid pressure gauge communicating with said liquid filled cylinder and attached to a sidewall of said housing;

f. a strap-like body contacting member attached to the end of said housing from which said block-like, body contacting member projects to form a loop;

g. handle means located at the opposite end of said housing from said block-like, body contacting member, said handle means attached to a pair of plates slidably connected by slot and pin means to said block-like, body contacting member, said plates slidably passing through said housing wherein the relationship between the plate members and housing is such that when the handle means is in contact with the end of said housing the block-like, body contacting member can be moved in the slots in said plates towards the housing a sufficient distance to get a maximum reading on the fluid pressure gauge.

2. The device of claim **1** wherein the area of said piston is about one-square inch.

3. The device of claim 2 wherein the fluid pressure gauge has a maximum reading of about 100 psi.

4. The device of claim 1 wherein a detachable bracket having a pair of legs and a transverse member is attached to one end of the housing such that the transverse member of said bracket is substantially parallel with the handle means and is farther from the housing than said handle and so adapted that said handle and bracket can be gripped by one hand.

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