United States Patent [19]

Dauth et al.

[11] **3,741,005**

[45] **June 26, 1973**

[54] **WET WEB TENSILE TESTER**

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[73] Assignee: **Canadian International Paper Company**, Montreal, Quebec, Canada

[22] Filed: **Sept. 28, 1971**

[21] Appl. No.: **184,494**

[52] **U.S. Cl.** **73/95**, 73/103

[51] **Int. Cl.** **G01n 3/08**

[58] **Field of Search** 73/95, 103

[56] **References Cited**

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Primary Examiner—Jerry W. Myracle

Attorney—R. G. McClenahan

[57] **ABSTRACT**

Apparatus for testing weak webs, such as wet webs of paper pulp, for tensile strength and elongation is provided having a relatively flat member for placement of a web specimen, two clamping members superimposed one above the other over the relatively flat member, the lower clamping member clamping one end of the specimen to the flat member and the other clamping member providing means to hold the other end of the specimen, a lifting arm means capable of lifting said other end of the specimen into position to be clamped over the upper clamping member. Means are provided to apply tension on the clamped specimen through the two clamping members and measure the tensile strength of the specimen web.

6 Claims, 8 Drawing Figures

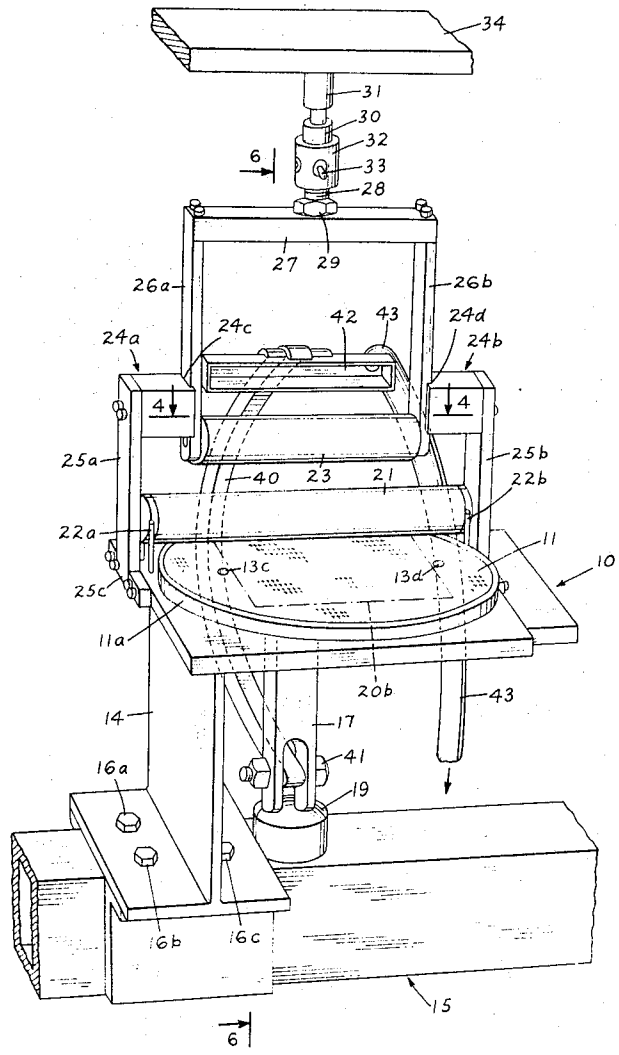


FIG. 1.

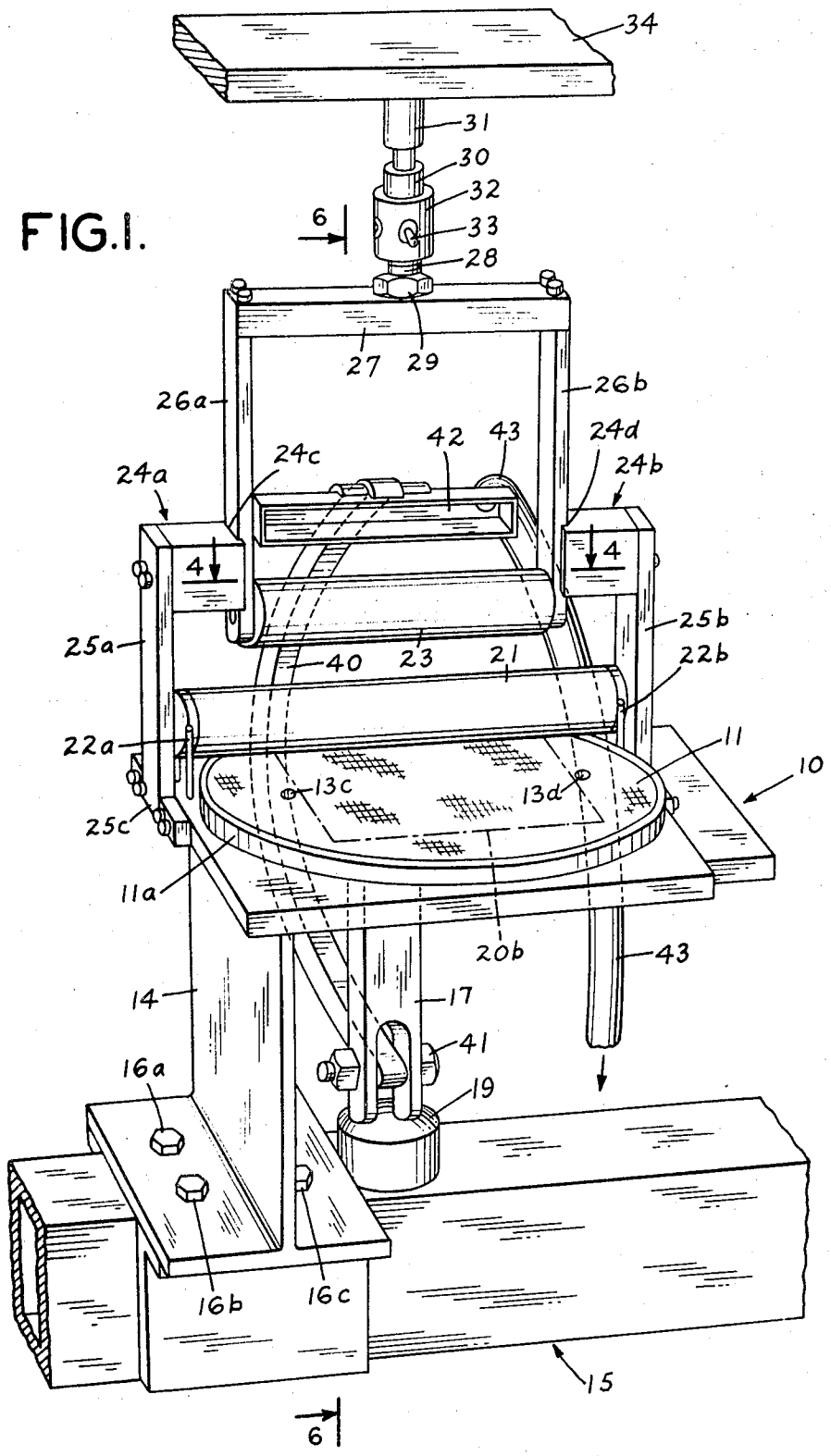

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FIG. 2.

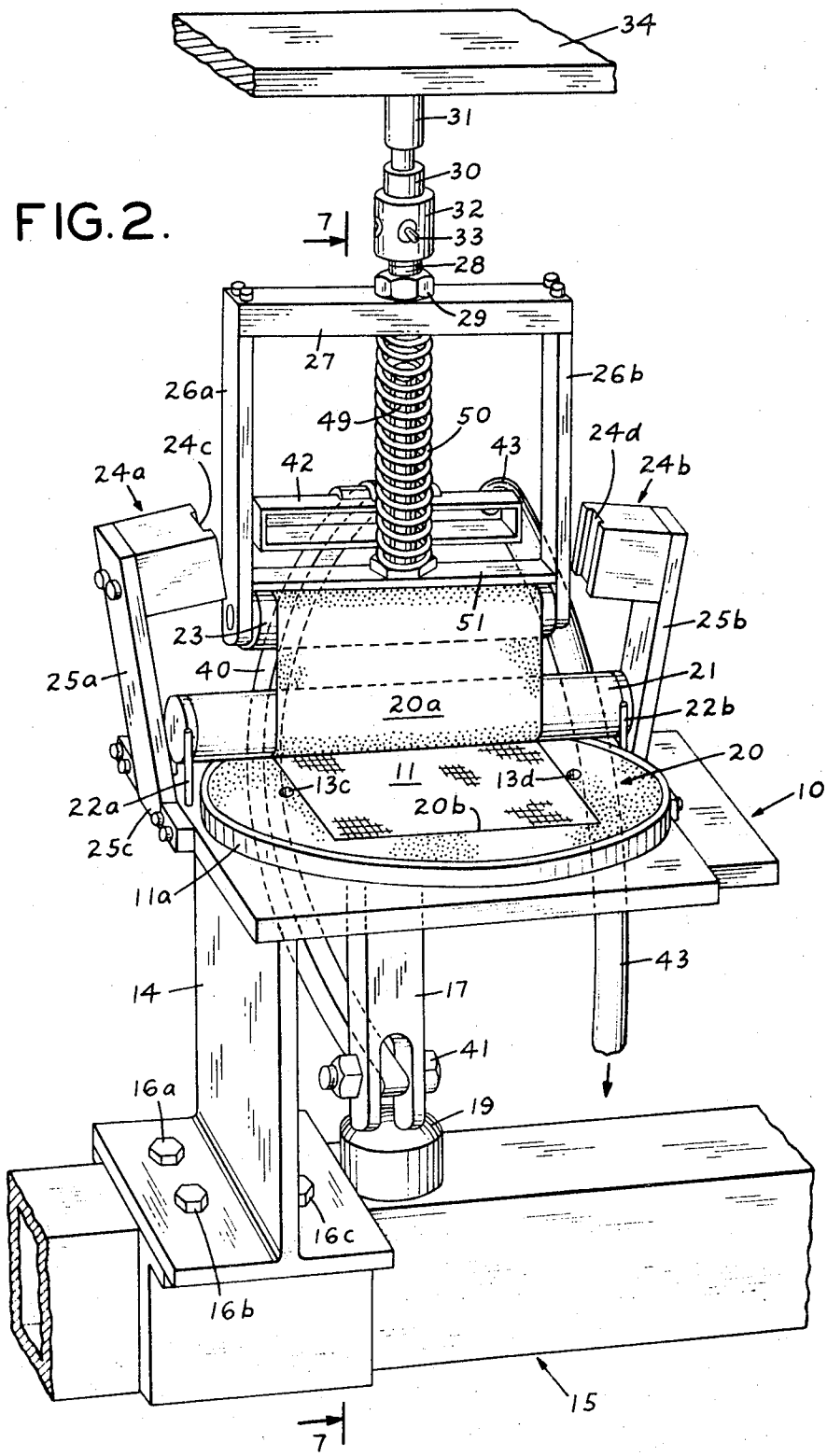

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26b
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24c
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25a
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20a
22b
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13c
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13d
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25c
11a
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16c
16b
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FIG.3.

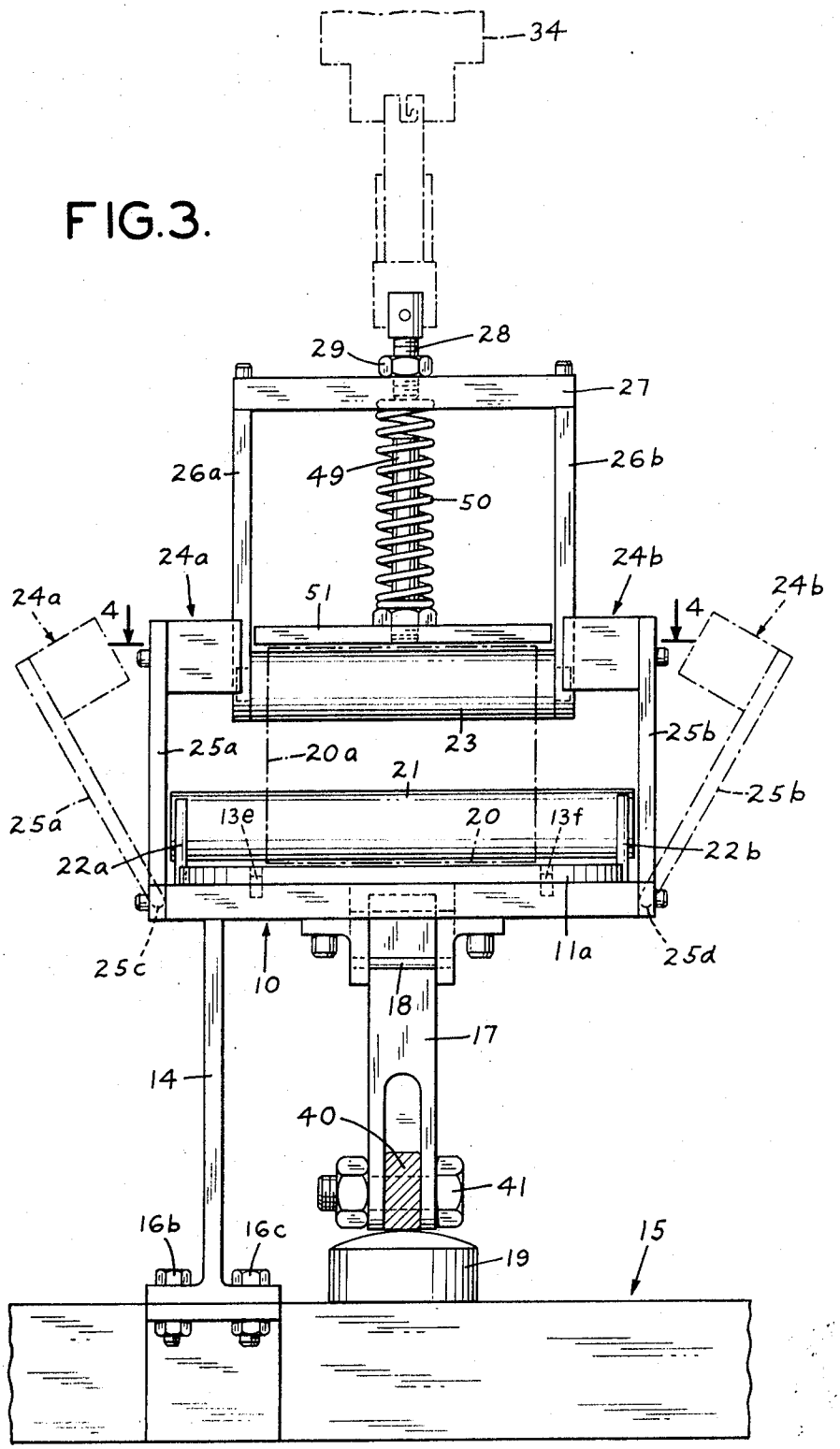

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25b
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25a
13e
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13f
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16b
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FIG. 4.

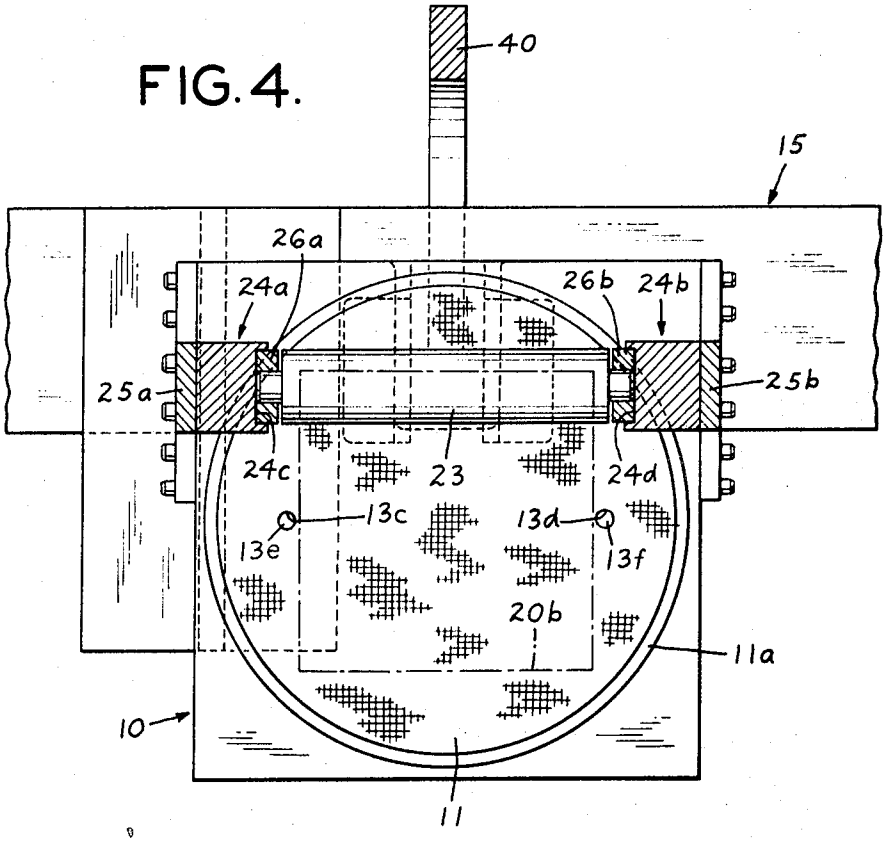


FIG. 5.

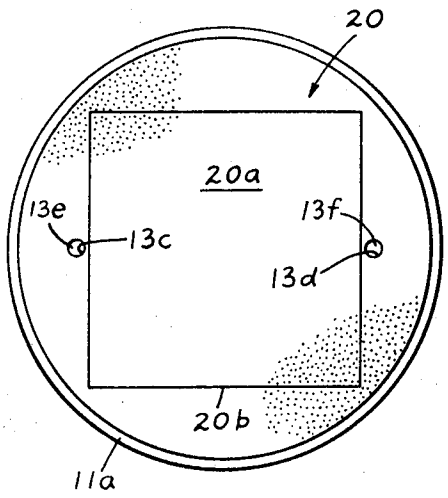


FIG. 8.

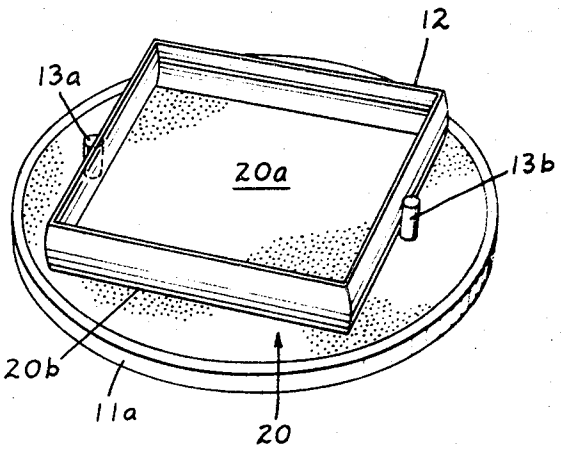


FIG. 6.

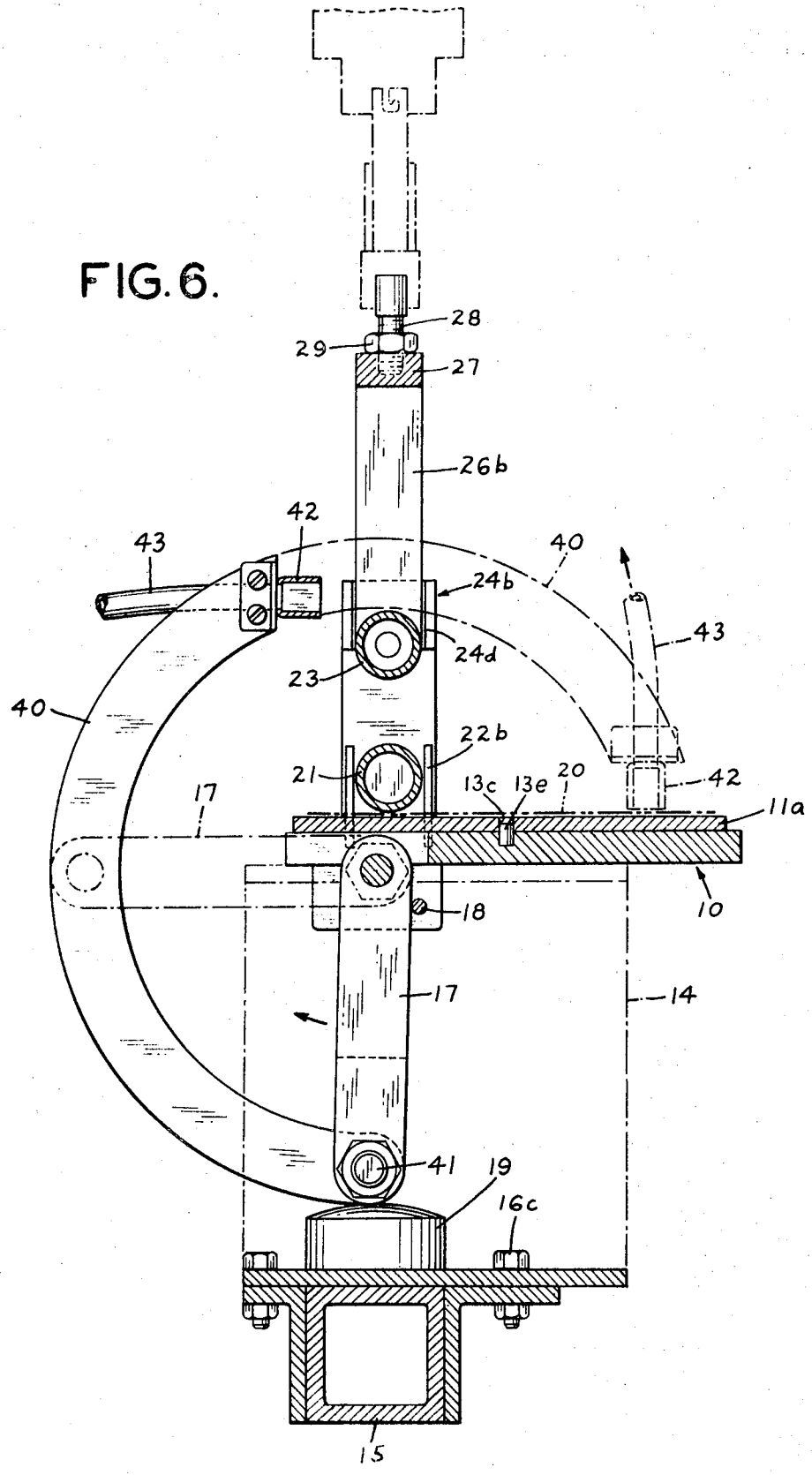
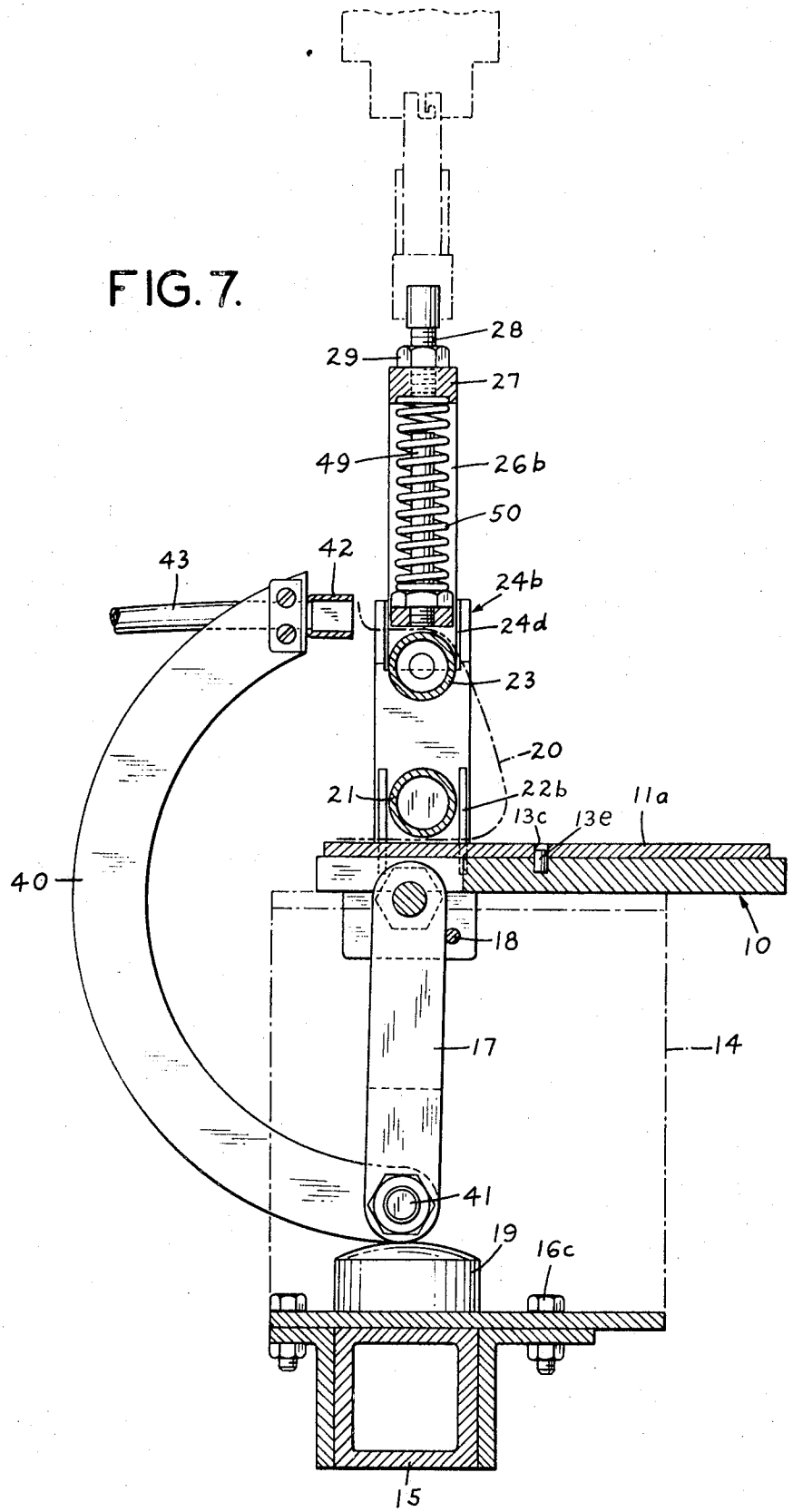

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24d
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13c
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11a
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16c
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FIG. 7.


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26b
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16c
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WET WEB TENSILE TESTER

BACKGROUND OF THE INVENTION

The present invention relates, in general, to an improved apparatus for testing relatively weak webs, such as paper pulp or news print in the wet state, to determine the tensile strength and elongation of the web at break. More particularly, the invention relates to an improved wet web testing apparatus which permits the testing of relatively weak webs to determine their tensile strength and elongation at break without requiring manual handling of the web subsequent to its formation and prior to testing.

Testing of wet webs of paper pulp and other weak webs for their tensile strengths has become an important tool in the process of paper making. By determining the wet strength of the freshly formed web of pulp, it is possible for paper manufacturers to conduct research on the process of paper making and also to obtain better control and reproducibility in paper manufacture. The article by Andrews et al., Pulp and Paper Magazine of Canada, pp. 681–691 (August 1945), discusses the value of determining the wet strength of pulps in the paper making process. Stephens and Pearson in Appita, Vol. 23, No. 4 pp. 261–278 (January 1970), discuss the utility of wet web tensile strength evaluation in controlling the pulp and paper making processes. Brecht and Erfurt in TAPPI, Vol. 42, No. 12, pp. 959–968 (December 1959) discuss an instrument for determining the wet tensile strength and elongation at breaking point of various pulps and compositions and the effect of different treatments in pulp production on the tensile strength of the web of pulp produced. McCallum in Pulp and Paper Magazine of Canada, Vol. 58, pp. 232–240, 1957, discusses a wet web strength testing instrument for testing tensile strengths of webs and the results obtained with different samples produced under different circumstances.

Other wet web tensile testers are described in U.S. Pat. Nos. 2,893,241 and 3,015,230.

While wet web tensile strength testing apparatus is known to the prior art, the prior apparatus requires handling by hand of the test web by the operator in placing the web in the tester. This seriously impairs the accuracy and reproducibility of the results obtained. In most cases the apparatus of prior art is complex and relatively expensive. By means of the present invention there is provided a wet web testing apparatus in which the wet web is not handled or touched by hand from the time it is formed up to testing and a wide specimen of web, such as 4 inches wide, may be employed to improve the reproducibility of the results obtained. The apparatus of the present invention is inexpensive to manufacture and can be employed with standard commercially available sheet forming apparatus and tensile testing and recording equipment, such as the Instron tester, which provides a recorded chart showing the tensile strength and elongation of the specimen at break. The apparatus of the invention may also be employed to measure the force required to peel the web specimen from the forming Fourdrinier wire or screen. The value of this information to the paper maker is discussed in the article by Andrews et al., supra. The apparatus of the present invention also measure the tensile strength and elongation at break of the web while it is in the vertical position, rather than in the horizontal position as required in many prior art apparatus and this improves the reproducibility of the test results. The apparatus of the present invention is especially suitable for routine repeated testing of webs of pulp or other substances in the wet condition.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a weak web or wet web tensile strength tester employing a rectangular test specimen or a wet web formed on a forming Fourdrinier wire or screen. The apparatus of the invention comprises a table to support the Fourdrinier forming wire having on it the wet web which was formed on the wire. Superimposed upon the table are two rolls placed one above the other. Means are provided for clamping one end of the wet web between the lower of the two rolls and the screen by the weight of the roll. By means of a suction box affixed to a movable arm, the other end of the web is lifted from the wire and above the upper of the two rolls and clamped thereon by a spring clamping means. Releasable brackets which had held the upper roll in place disengage and stress is applied on the specimen by tensile testing and recording apparatus known to the art capable of applying predetermined regular application of force. The stress and strain are recorded on a recording chart to measure tensile strength and elongation at break of the specimen.

At no time is it necessary for the operator to handle the wet web during or prior to determination of tensile strength and elongation. The web is tested for its tensile strength and elongation while in the vertical position and the results obtained are highly reproducible.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be further described in connection with one preferred embodiment by reference of the more detailed description which will follow and the appended drawings, in which:

FIG. **1** is a perspective view of the tensile testing apparatus in its initial position prior to operation.

FIG. **2** is a perspective view of the apparatus showing the web specimen being tested for tensile strength.

FIG. **3** is a front elevation of the apparatus showing the web specimen in dotted position while being tested.

FIG. **4** is a plan view of the apparatus taken generally along the plane **4—4** of FIGS. **1** and **3**.

FIG. **5** is a plan view of the web specimen on the Fourdrinier wire before being raised to testing position.

FIG. **6** is a vertical sectional view of the apparatus taken generally along line **6—6** of FIG. **1** and shows in broken lines the suction arm in position to lift the end of the specimen for testing purposes.

FIG. **7** is a vertical section similar to FIG. **6** taken generally along line **7—7** of FIG. **2** showing the web specimen being lifted up into testing position and one end clamped into position above the upper roll.

FIG. **8** is a perspective view of web specimen as formed on the Fourdrinier wire with the template in position as it outlines the specimen.

DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

Referring to the drawings, the apparatus of the present invention includes a table **10** equipped to accommodate a circular Fourdrinier forming wire or screen **11** of the type sometimes referred to in the art as a British Sheet forming wire, mounted on the frame **11***a* and

desirably having a Twill weave 68 × 56, upon which the wet web **20** is formed in the sheet forming apparatus using the standard sheet forming procedure outlined in Canadian Pulp and Paper Association (CPPA) Standard Method C–4, (approved October 1940, revised May 1950). The specimen **20***a* is outlined within the web **20** by template **12**, as shown in FIG. **8**, desirably of the dimensions of 10.15 cm. wide by 10.4 cm. long, positioned on the screen by positioning pins **13***a* and **13***b* which fit into holes **13***c* and **13***d* on the screen, respectively, prior to filling the cylinder of the sheet forming apparatus with the pulp slurry. After excess water is drained from the pulp through the screen, the template **12** is removed from the screen and the web is dried by suction (not shown) and blotting paper. The screen **11** with web **20** and rectangular specimen **20***a* defined within it by outline **20***b* is then mounted on table **10** using two positioning pins **13***e* and **13***f* on table **10** which fit into holes **13***c* and **13***d* in the screen.

The table **10** is affixed by means of the arm **14** to the crosshead **15** (equipped with knob **19**) of a continuous tensile testing and recording instrument of the Instron type (not shown) by bolts **16***a*, **16***b* and **16***c*.

Superimposed over the table **10** and the web specimen **20***a*, one above the other, is a lower roll **21** held in position by pins **22***a*, **22***b*, **22***c*, **22***d* and an upper roll **23** of shorter length than roll **21**. Upper roll **23** is held in position until tensile measurement is to be made by movable brackets **24***a* and **24***b*. Bracket **24***a* is movably affixed to table **10** by means of arm **25***a* and **25***c* as shown in FIG. **3** and clamp **24***b* is affized to table **10** by means of arm **25***b* at **25***d*. Upper roll **23** is affixed to vertical arms **26***a* and **26***b* which are in turn affixed to cross arm **27**. Brackets **24***a* and **24***b* have indentations **24***c* and **24***d*, respectively, which register with vertical arms **26***a* and **26***b*, respectively, as shown in FIG. **1**. Cross arm **27** is affixed to connecting bolt **28** which can be screwed tight to cross arm **27** by means of nut **29** mounted on cross arm **27**. The bolt **28** is connected to pin **30** which is in turn held to pin **31** by disconnecting means **32** having a removable peg **33** which permits disconnecting the apparatus from the upper arm **34** which forms part of the Instron continuous tensile testing and recording instrument (not shown).

Rolls **21** and **23** are each desirably about 2.6 cm. in diameter and covered with Fourdrinier wire or screens to aid in clamping the specimen for testing.

Suction arm **40** is movably connected to linkage **17** by means of bolt **41**. Linkage **17** is in turn movably connected to table **10** through bolt **44** as shown in FIG. **6**. The suction arm **40** is provided at its upper end with suction box **42** held to the suction arm **40** by suitable means. The suction box **42** is equipped at one end with suction tube **43** which is connected to a suitable source of vacuum (not shown). Arresting pin **18** in FIG. **6** provides a stop or resting means for the suction arm **40** and its associated parts. FIG. **6** illustrates in broken lines the movement of the suction arm **40** to lift the specimen for testing.

As shown at FIGS. **2**, **3** and **7**, the cross arm **27** is equipped with rod **49** having a spring tensioning means **50** and fitted at its lower end with a clamping bar **51** which provides a means for clamping the upper end of specimen **20***a* to upper roll **23** in a taut position as shown in FIG. **2**. Rod **49** equipped with spring tensioning means **50** is fitted into position as shown in FIGS. **2**, **3** and **7** after suction arm **40** has lifted the specimen **20**a into position over roll **23**, otherwise it would block passage of arm **40** with suction box **42** over upper roll **23**.

In the operation of the apparatus the web **20** is first formed on the screen **11** by pouring a pulp slurry in the desired amount into the cylinder of the sheet forming apparatus (not shown). The rectangular specimen **20***a* within the circular web **20** is outlined by a template **12** which is affixed to the wire **11**, prior to filling the cylinder, by means of positioning pins **13***a* and **13***b*, as shown in FIG. **8**. After drainage of excess water the template **12** is removed and the sheet is dried by suction (not shown) and blotting paper. The web **20** and the specimen portion **20***a* at this stage of the procedure is shown in FIG. **5**. Screen **11** with web **20**, and specimen **20***a* circumscribed within it, is affixed on table **10** by means of two pins **13***e* and **13***f* placed in holes **13***c* and **13***d* in the screen. Of course, other alternative means may be provided for placing the specimen on the apparatus.

Lower roll **21** is placed over one end of the specimen **20***a* to hold by its weight that end of the specimen rigidly in place. Suction arm **40** is then turned over moving linkage **17** as shown by the dotted lines in FIG. **6** to place the suction box **42** over one end of the specimen **20***a*. Suction is applied to the suction box **42** through the tube **43** and the suction arm is then moved back peeling the sample from the screen at a slow uniform rate as shown in FIG. **7** so that the upper end of the specimen **20***a* is placed over the top of the upper roll **23**. Spring tensioning means **50** is then placed in position and released, placing the clamping bar **51** over the upper edge of the topside of the upper roll **23** thereby fastening the upper end of the specimen **20***a* over upper roll **23**. Movable brackets **24***a* and **24***b* are moved aside as shown in FIG. **2** and the apparatus is then in position to start the continuous recording chart and applied tension to the specimen. This is done by moving crosshead **15** downward until the specimen **20***a* is taut as shown in FIGS. **2** and **3** and stress is applied at a rate of about 1 cm. per minute until the specimen **20***a* breaks. The Instron recording chart records the maximum load and elongation at break. The ruptured specimen is then unclamped, weighed immediately and oven dried to determine moisture content and basis weight. The apparatus is then ready to prepare and receive another specimen to determine its tensile strength and break at elongation.

When it is desired to measure the tension necessary to peel the specimen **20***a* from the forming wire **11**, this is done by starting measurement readings on the Instron recording chart before specimen **20***a* is completely peeled from the wire **11**, as shown in FIG. **7**. The early portion of the recorded stress measurement or tension is that required to peel the specimen **20***a* from the wire **11**.

The results obtained with the apparatus of the invention are highly reproducible. Duplicate and triplicate runs with the same pulp show variation in tensile strength values of approximately ± 4.5%.

The terms and expressions which have been employed are used as terms of description and not of limitation, are there is no intention in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

What is claimed is:

1. An apparatus for testing the tensile strength of relatively weak webs, which comprises a relatively flat member for placement of the web to be tested, two clamping members superimposed one above the other over said flat member, said clamping members providing means for clamping each end of the specimen web, and lifting means capable of lifting one end of the specimen web over the upper clamping member, said lifting means being rotatably connected to said apparatus by an arm, and means for applying tension to the two clamping members and thereby to the clamped specimen web.

2. An apparatus in accordance with claim 1, wherein the two clamping members are rolls.

3. An apparatus in accordance with claim 1, wherein the relatively flat member is in the form of a table with which the lower clamping member is in contact.

4. An apparatus in accordance with claim 1 wherein said lifting means comprises a rotating arm having a suction means at one end capable of lifting one end of a specimen web over the upper clamping member.

5. An apparatus in accordance with claim 1, wherein removable brackets are provided to hold the upper clamping member in place, said removable brackets being capable of holding said upper clamping member in place until tensile strength measurement is to be made.

6. An apparatus for testing the tensile strength of relatively weak webs, which comprises a table for placement of the web to be tested, two rolls superimposed one above the other over said table, said lower roll providng means for clamping one end of the specimen web to said table and said upper roll being provided with clamping means to hold the other end of the specimen web, and lifting means equipped with a suction source and being capable of lifting one end of the specimen web over the upper roll for clamping and means for applying tension to the two rolls and thereby to the clamped specimen web, said lifting means being rotatably connected to said apparatus by an arm.

* * * * *