United States Patent

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[72] Inventor **Mathew G. Boissevain**
Los Altos Hills, Calif.

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[73] Assignee **Measurex Corporation**
Santa Clara, Calif.

[54] **SHEET-GAUGING APPARATUS**
13 Claims, 10 Drawing Figs.

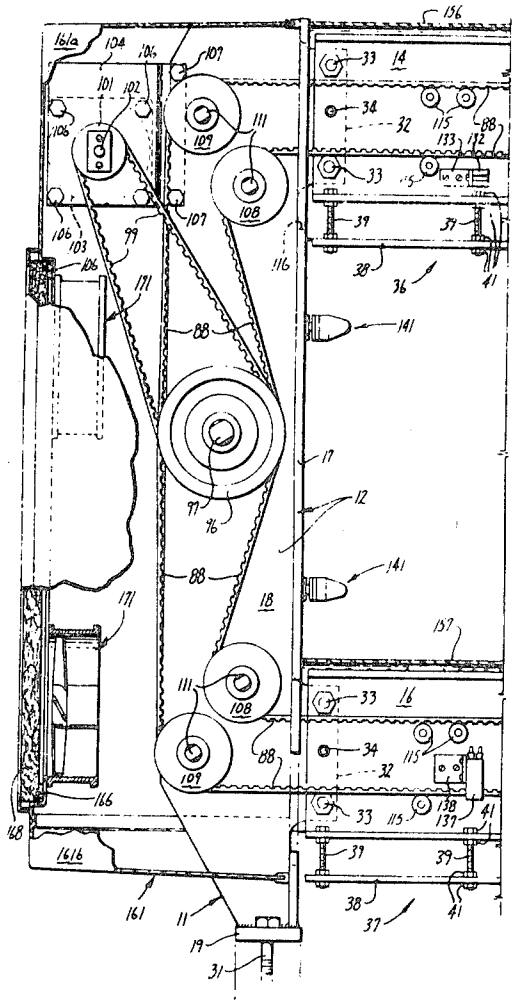
[52] U.S. Cl. ..... **250/83.3 D,**
250/106 S, 250/219 TH
[51] Int. Cl. **G21h 5/00**
[50] Field of Search ..... 250/8.3 D,
92, 106 S; 73/159

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Primary Examiner—James W. Lawrence
Assistant Examiner—Davis L. Willis
Attorney—Flehr, Hohbach, Test, Albritton & Herbert

ABSTRACT: Sheet-gauging apparatus for gauging properties of sheet material and having upper and lower gauging heads with timing belt means for precisely moving the gauging heads with respect to the sheet material.



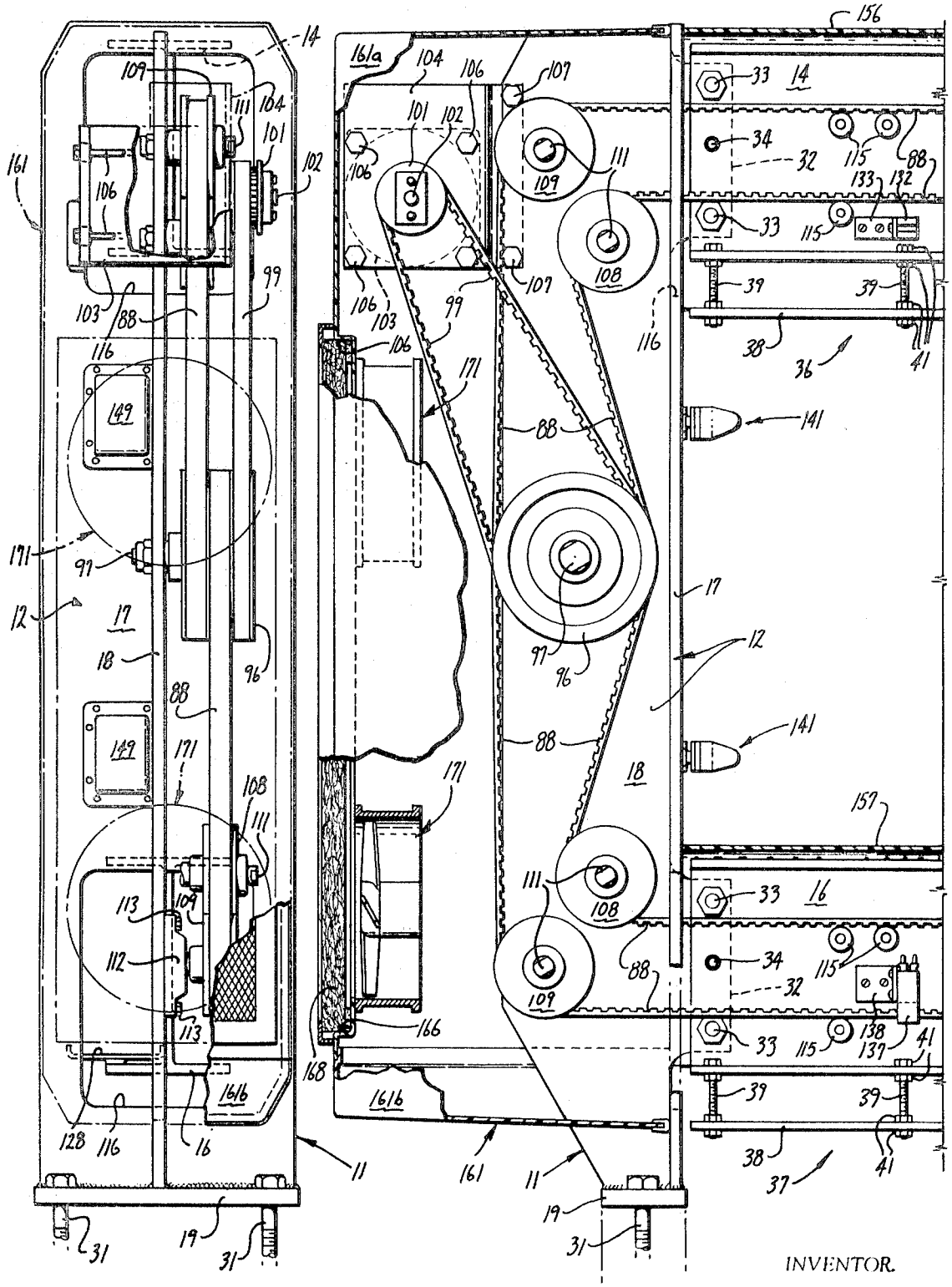


Fig. 2

Fig. 1A

INVENTOR.
Mathew G. Boissevain
BY Flehr, Hohbach, Test, Albritton & Herbert
Attorneys

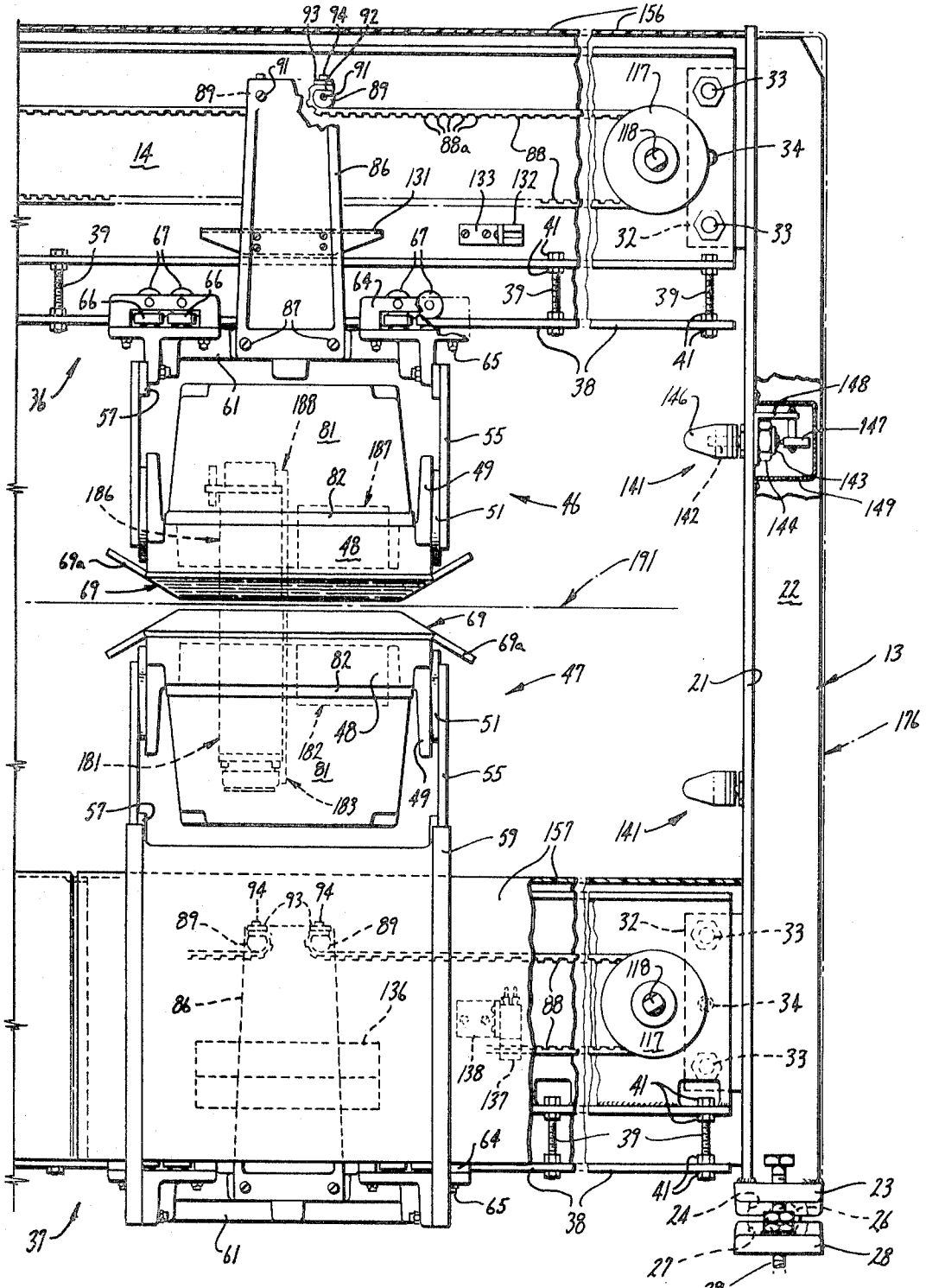


Fig. 1B

INVENTOR.
Mathew G. Boissevain
BY Flehr, Hohbach, Test, Albritton & Herbert
Attorneys

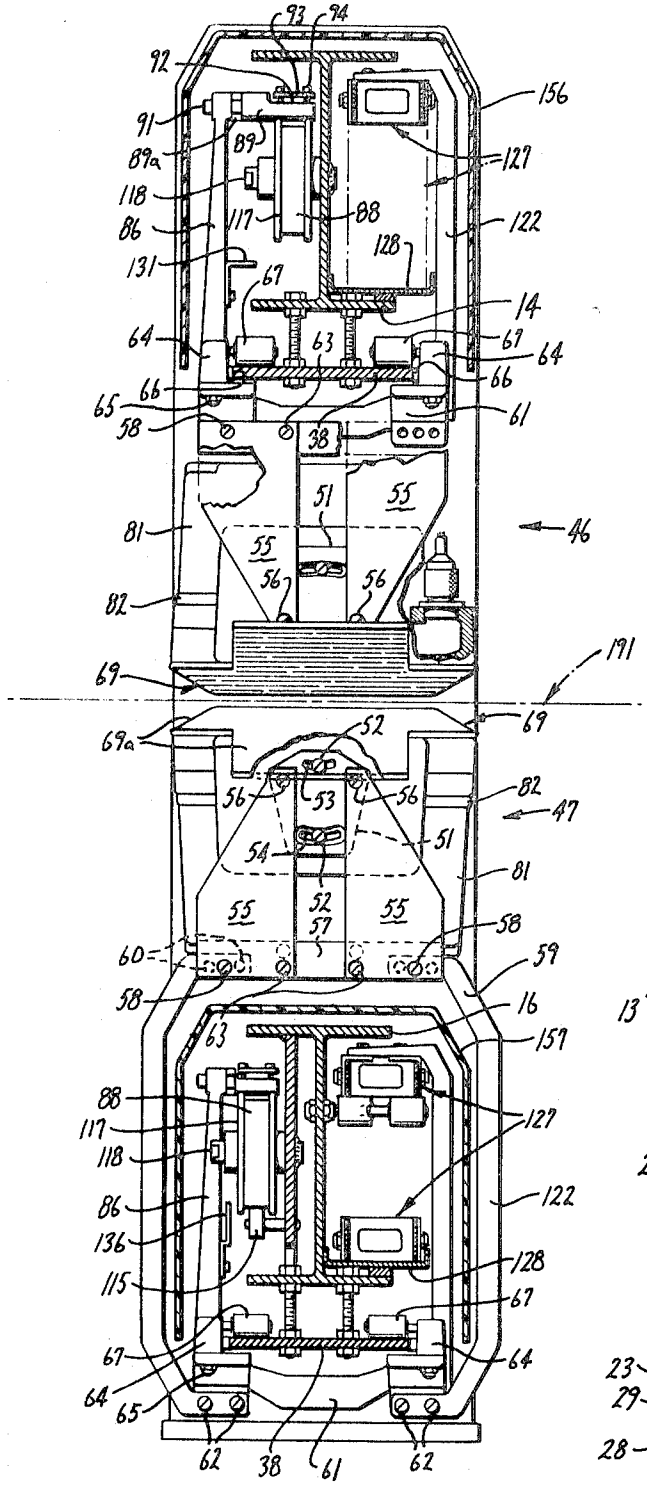


Fig. 3

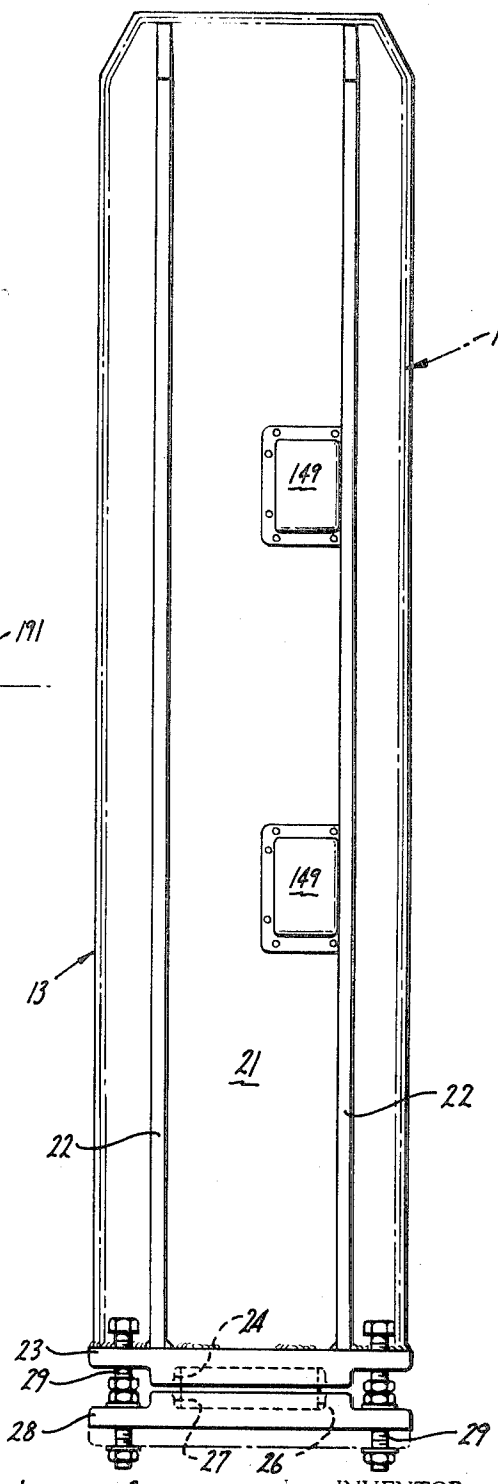


Fig. 4

INVENTOR.
Mathew G. Boissevain
BY Flehr, Hohbach, Test, Albritton & Herbert
Attorneys

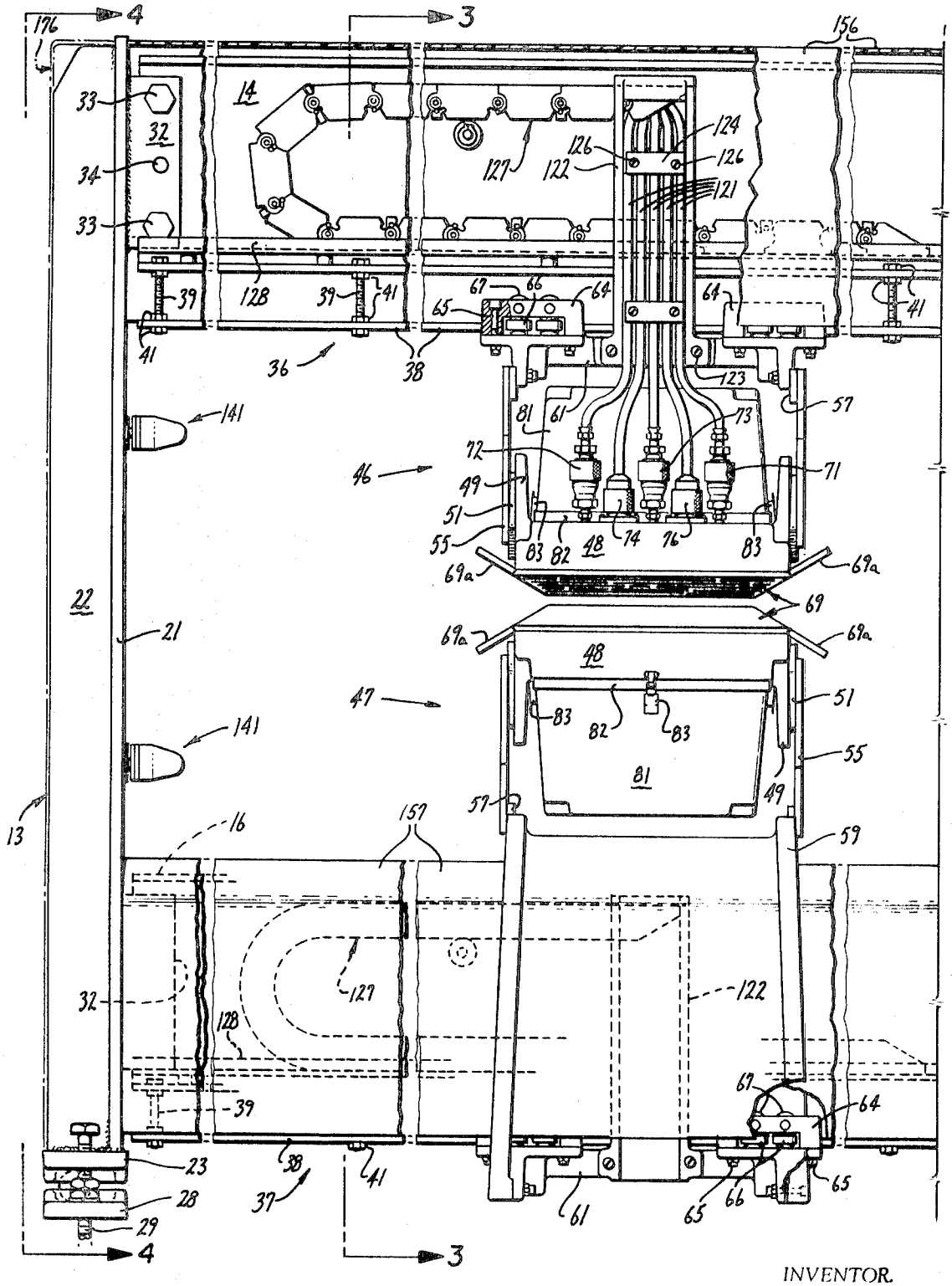
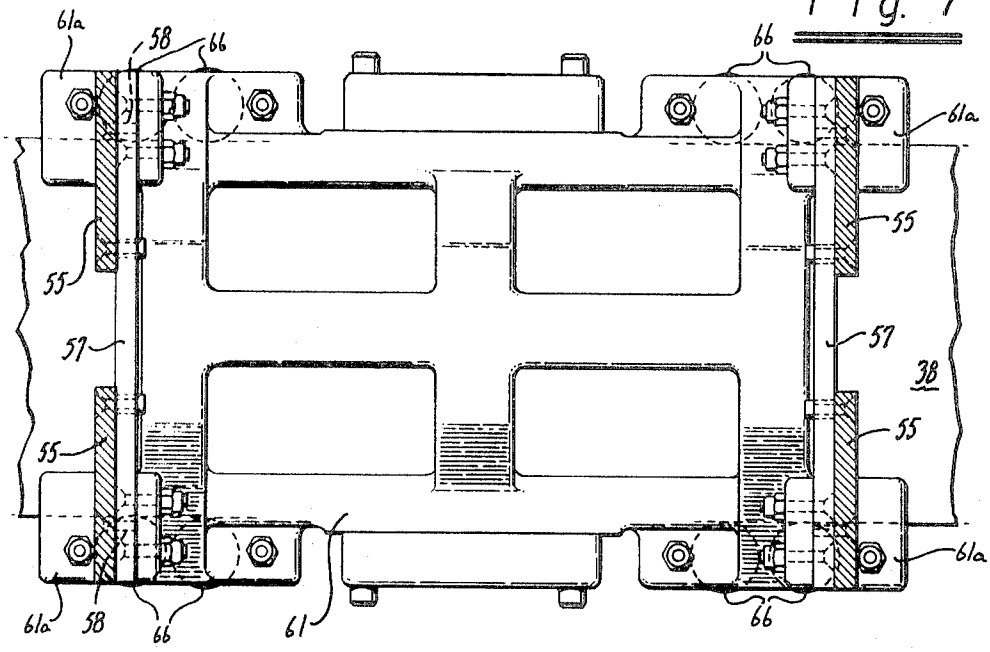


Fig. 5

INVENTOR.
Mathew G. Boissevain
BY Flehr, Hohbach, Test, Albritton & Herbert
Attorneys

Fig. 7



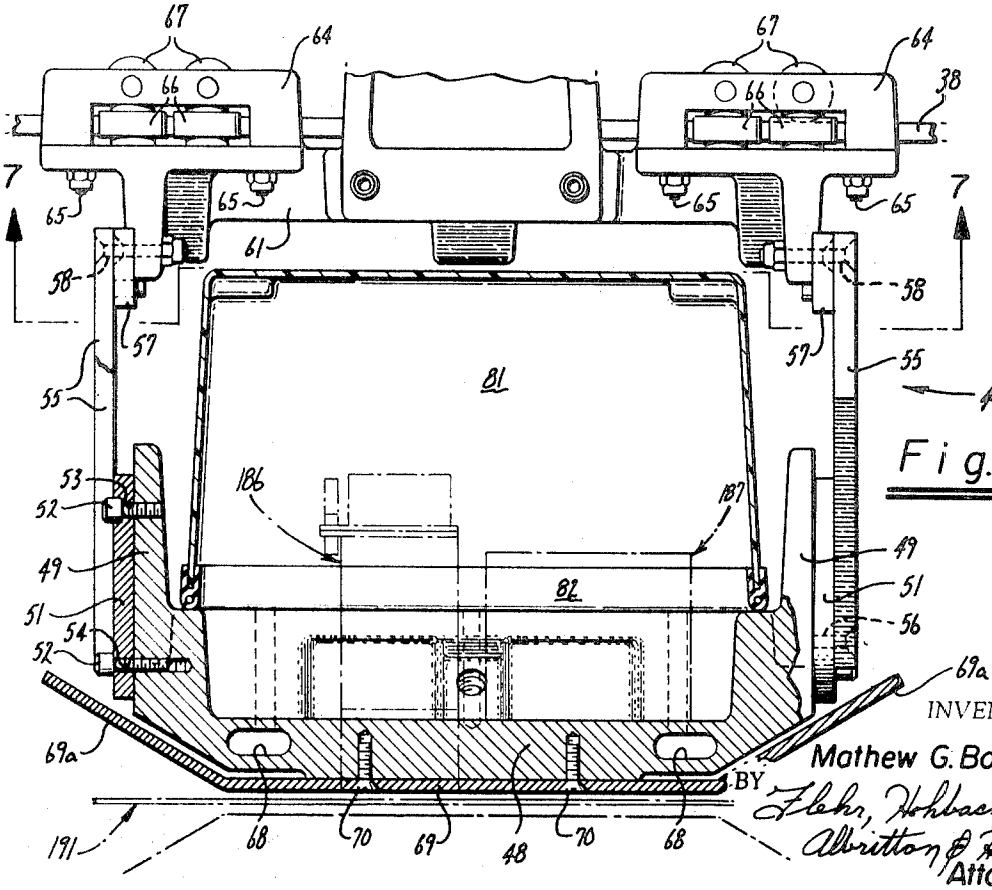


Fig. 6

INVENTOR.
Mathew G. Boissevain
BY Flehr, Hohbach, Test
Albritton & Herbert
Attorneys

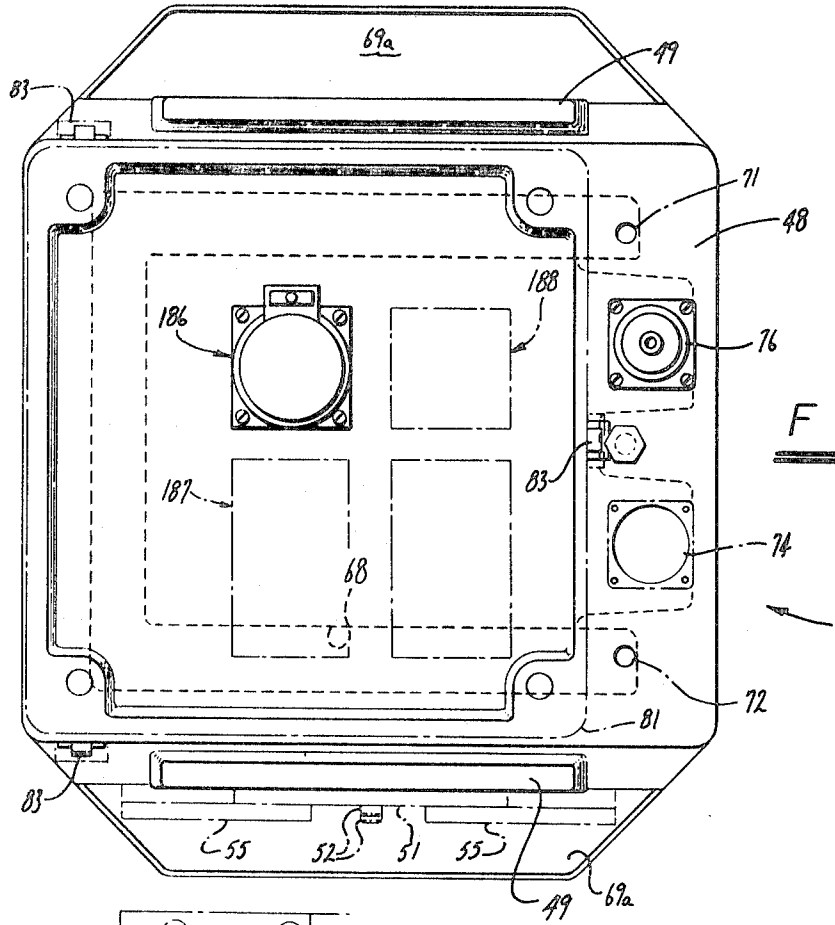


Fig. 9

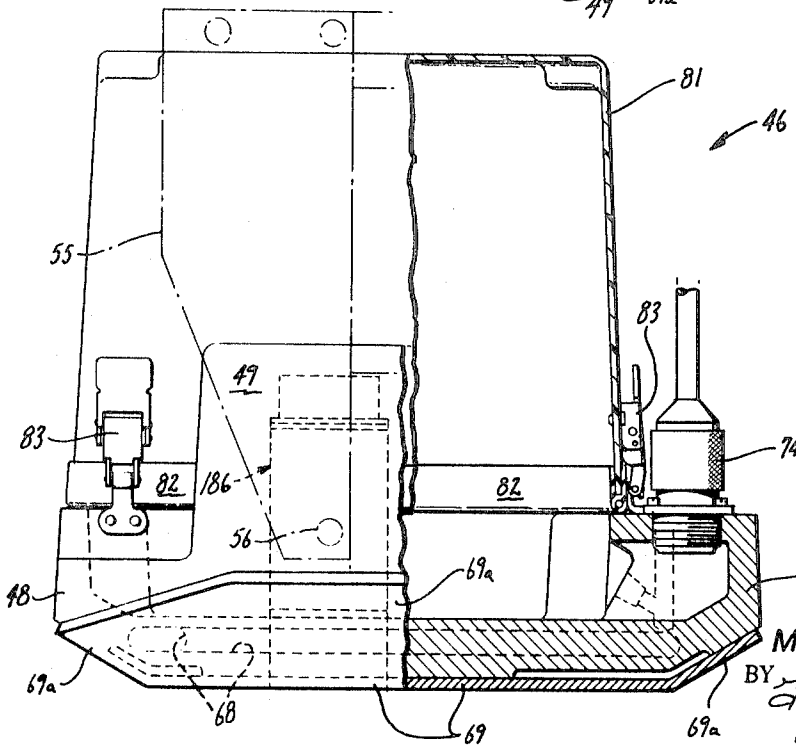


Fig. 8

INVENTOR.
Mathew G. Boissevain
BY Fleh, Hohbach, Test
Albritton & Herbert
Attorneys

SHEET-GAUGING APPARATUS

BACKGROUND OF THE INVENTION

Sheet-gauging apparatus has heretofore been provided. However, such sheet-gauging apparatus have had some disadvantages. For example, with such apparatus it has been difficult to precisely move the gauging heads in a precise manner with respect to each other and with respect to the sheet of paper being gauged. In addition, it has been difficult to maintain the necessary desired precise positioning of the gauging heads during movement of the same. There is, therefore, a need for a new and improved sheet-gauging apparatus.

SUMMARY OF THE INVENTION AND OBJECTS

The sheet-gauging apparatus for gauging properties of a sheet of material consists of a frame which has a pair of spaced upper and lower parallel beams extending laterally of the sheet. Upper and lower track means are carried by the upper and lower beams respectively. Upper and lower gauging heads are provided which are adapted to be disposed on opposite sides of the sheet. Carriage means is provided for mounting the gauging heads on the upper and lower track means. Drive means is also provided and timing belt means is connected to the drive means and to the carriage means for shifting the gauging heads longitudinally of the beams and laterally of the sheet of paper. Gauging means is carried by the gauging heads for sensing a property of the sheet as the heads are shifted relative to the sheet.

In general, it is an object of the present invention to provide a sheet-gauging apparatus having gauging heads which are precisely positioned with respect to each other as they are shifted relative to the sheet being gauged.

Another object of the invention is to provide sheet-gauging apparatus of the above character in which track means is provided on which the gauging heads travel.

Another object of the invention is to provide a sheet-gauging apparatus of the above character in which means is provided for maintaining a substantially uniform temperature along the track means.

Another object of the invention is to provide sheet-gauging apparatus of the above character in which means is provided for protecting the track means from dust, dirt and the like.

Another object of the invention is to provide sheet-gauging apparatus of the above character in which precision stepping means is utilized for driving timing means for shifting the gauging heads longitudinally of the track means.

BRIEF DESCRIPTION OF THE DRAWING

FIGS. 1A and 1B are side elevation views with certain parts broken away of a sheet-gauging apparatus incorporating the present invention.

FIG. 2 is an end elevational view of the left-hand end of the apparatus shown in FIGS. 1A and 1B with certain parts broken away.

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 1B.

FIG. 4 is an end elevational view of the left-hand end of the apparatus shown in FIGS. 1A and 1B.

FIG. 5 is a side elevational view of the apparatus shown in FIG. 1B but showing the opposite side with certain portions broken away.

FIG. 6 is a side elevational view of the gauging head assembly apparatus shown in FIGS. 1A and 1B.

FIG. 7 is a cross-sectional view taken along the line 7—7 of FIG. 6.

FIG. 8 is an end elevational view of the gauging head assembly shown in FIG. 6.

FIG. 9 is a top plan view of the head assembly shown in FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The sheet-gauging apparatus consists of a main frame 11. The main frame 11 consists of a pair of spaced end supports 12 and 13 which extend generally in a vertical direction and a pair of spaced substantially parallel I-beams 14 and 16 which extend generally in a horizontal direction and are secured to the end supports 12 and 13.

For reasons hereinafter described, the end support 12 can be considered as a drive-in support and consists of a flat vertical plate 17 which has a vertical reinforcing web 18 secured thereto so that the end support is substantially T shaped in cross section. A bottom pad 19 is secured to the lower extremities of the plates 17 and 18. The end support 13 is formed of a vertical plate 21 and is provided with a pair of spaced vertical reinforcing webs 22 so that in cross section the end support 13 is generally in the form of a double "T." A horizontally disposed pad 23 is secured to the lower extremities of the plates 21 and the webs 22. The pad 23 is provided with an elongate recess 24 which is adapted to receive a large roller 26. The recess 24 has a width which is substantially greater than the diameter of the roller 26, as can be seen from FIG. 1B. The roller also seats in a similar recess 27 provided in a lower pad 28 which is adapted to be secured to the foundation for the apparatus by bolts 29. The pad 19 of the end support 12 is secured to a lower pad (not shown) provided by the customer by bolts 31.

The end supports 12 and 13 include parallel spaced vertical flanges 32 provided on the inner surface of the plates 17 and 21. The I-beams 14 and 16 are secured to the flanges 32 by bolts 33. In order to assure exact alignment, pins 34 are provided on the end of the I-beams and are adapted to be inserted in the flanges to precisely position the I-beams prior to tightening of the bolts 33. This arrangement permits the apparatus to be disassembled and then reassembled while still retaining the same exact alignment.

Upper and lower track means 36 and 37 are provided and which are secured by the I-beams 14 and 16. They are generally similar in construction as shown in the drawings and each consists of a flat plate 38 disposed below the I-beam and supported therefrom by a plurality of pairs of bolts 39 which are spaced longitudinally of the plate 38 and which are secured opposite flanges (see FIG. 3) of the associated I-beam. Nuts 41 on the bolts 39 are provided for retaining the plate in the desired adjusted position. For the apparatus to operate satisfactorily, it is desirable to have the plates 38 be as exactly level as possible and also that they are exactly straight in a sidewise direction for the entire length of the main frame. Thus, it is desirable that the tolerance in a vertical direction and also in a sideways direction be within 0.0020 of an inch.

An upper gauging head assembly 46 is carried by the upper track means 36 and a lower gauging head assembly 47 is carried by the lower track means 37. The head assemblies 46 and 47 are very similar and include a head housing or casting 48 formed of suitable material, such as aluminum, and which is provided with a pair of spaced generally parallel ears 49. A head pivot plate 51 is secured to each of the ears 49 by bolts 52 which extend through arcuate slots 53 and 54 provided in the head pivot plates 51. A pair of spaced generally parallel platelike lever arms 55 are pivotally secured to the head pivot plate 51 by bolts 56 and to a lever support plate 57 by bolts 58. The lever support plate 57 is secured to head support castings 59 by screws 60 for the lower gauging head assembly 47. The head castings 59 are mounted upon a pad support casting 61 by screws 62. For the upper gauging head assembly, the platelike lever arms 55 are directly secured to the pad support casting 61 by screws 62. Removable pins 63 are provided which extend through the platelike lever arms 55 and into one of the holes 70 in the head support member 57 and are utilized for retaining the gauging head assemblies in a predetermined angular position with respect to the sheet of paper as shown by the broken lines in FIG. 3. The pins 63 can be shifted between the upper and lower holes 70 in the support member 57 to

position the lever arms **55** between the solid line position shown in FIG. **3** and the broken line position also shown in FIG. **3** to adjust the position of the gauging head assemblies **46** and **47** as hereinafter described.

As can be seen particularly from FIG. **7**, the pad support casting **61** is provided with four padlike portions **61***a* provided on the four corners of the casting. A U-shaped member **64** is secured to each of the padlike portions **51***a* by bolts **65**. A pair of side support wheels or rollers **66** are rotatably mounted upon Teflon bearings (not shown) between each of the U-shaped members **64** and the pad portion **61***a* associated therewith and are adapted to engage the sides of the plate **38** which forms a part of the upper track means **36**. Each of the U-shaped members **64** also carries a pair of spaced top support wheels or rollers **67** rotatably mounted thereon by suitable means such as ball bearings. It has been found desirable to provide rubber-tired wheels for the side support wheels **66** and the top support wheels **67** because it may be necessary to mount the sheet-gauging apparatus in corrosive atmospheres. When such is the case, it also is desirable to coat the upper and lower track means with a suitable protective covering such as an epoxy resin. The rubber-tired wheels or rollers prevent the wheels or rollers from chipping the epoxy resin off of the track means.

The lower head assembly **47** is mounted in a somewhat similar manner upon a pad support casting **61** on the lower track means with the use of the head support castings **59**. The pad portions **61***a* carry side support wheels **66** and top support wheels **67** in the same manner as for the upper head assembly so that the lower head assembly also is secured by and is guided by lower track means **37**. The pad support castings **61** with their side support rollers **66** and top support rollers **67** serve as carriage means for the associated head assembly for travel on the associated track means.

The castings **48** are provided with passages **68** through which a cooling fluid such as water can be introduced for cooling the casting. A sheet guide plate **69** formed of suitable material such as aluminum is secured to each of the head castings **48** by suitable means such as countersunk screws **70**. As can be seen and particularly from FIG. **6**, the sheet guide plate **69** is provided with upturned outer side margins **69***a*.

The head castings **48** have certain devices mounted thereon as hereinafter described. In addition, each of the head assemblies has a water-in connector **71**, a water-out connector **72**, a compressed air connector **73** and a pair of electrical connectors **74** and **76**.

A cover **81** formed of a suitable material such as fiberglass is provided for each of the head assemblies **46** and **47** and is provided with a rubber molding **82** on its outer edge which is adapted to engage the casting **48**. The cover is held in place by a suitable means such as clamps **83**.

Means is provided for advancing the upper gauging head assembly **46** and the lower gauging head assembly **47** in a precision manner with respect to each other and to the frame **11**. This means consists of a bracket **86** which is secured to the pad support casting **61** by suitable means such as screws **87**. A nonslip timing belt **88** having teeth **88***a* has its ends secured to a pair of spaced shafts **89** secured to the upper ends of the brackets **86** by capscrews **91**. The shafts **89** are provided with flats **92** and have the ends of the timing belt clamped thereto by a clamping plate **93** and capscrews **94**. The shafts **89** have hexagonal portions **89***a* to facilitate rotation of the shaft to tighten the timing belt **88**.

The two timing belts **88** are driven by a main toothed drive sprocket **96** (see FIG. **1A**) and are rotatably mounted upon a shaft **97** carried by the end support **12**. As can be seen from FIG. **2**, the main drive sprocket **96** is wide enough to accommodate three timing belts. Thus, it drives the two timing belts **88** and is driven by separate timing belt **99** that is driven by a drive sprocket **101** mounted upon the output shaft **102** of a suitable stepper motor **103** such as a Slosyn motor manufactured by the Superior Electric Company of Bristol, Conn. The motor **103** is mounted upon a bracket **104** by bolts **106** and the bracket **104** is secured to the end support **12** by the bolts **107**.

Both of the belts **88** travel over a pair of idler rollers **108** and **109**. The idler rollers **108** and **109** are rotatably mounted upon the shafts **111** mounted in shaft supports **112** secured to the end support **12** by capscrews **113**. The idler rollers **108** and **109** are positioned so as to guide the upper and lower runs of each of the timing belts **88** through openings **116** provided in the end support **12**. The openings **116** are substantially larger than that required for the timing belt for the admission of air as hereinafter described. The timing belts **88** travel longitudinally of the I-beams **14** and **16** as shown in FIGS. **1A** and **1B**. over small idler rollers **115** mounted on the I-beams **14** and **16**, and over large idler rollers **117** mounted upon shafts **118** carried by the I-beams adjacent end support **13**.

Means is provided for supporting the conduits and/or cables **121** which are utilized for supplying the water, air and electrical energy in signals to the connectors **71**, **72**, **73**, **74** and **76** for each of the upper and lower head assemblies **46** and **47** and consists of a bracket **122** which is mounted upon the pad portions **61***a* by capscrews **123**. The brackets **122** and **86** are mounted on opposite sides of the casting. The conduits are secured to the brackets **122** by clamps **124** and fastened thereto by capscrews **126**. The conduits **121** extend upwardly through the bracket **122** and then extend into a carrier **127** of a conventional type such as that disclosed in U.S. Pat. Nos. 2,864,907 and 2,975,807. As is well known to those skilled in the art, the carrier **127** is capable of supporting the conduits while accommodating the travel of the head assemblies **46** and **47**. Thus, the conduits extend through the upper run of the carrier **127** and down through the lower run to the end support **12** where they are connected to the appropriate exterior sources (not shown).

As shown particularly in FIG. **3**, the timing belts **88** are mounted on one side of the I-beams, whereas the carrier **127** is mounted on the other side of the I-beam. As also shown in FIG. **3**, a support channel **128** is provided for the lower run of the carrier **127** as it is laid down. The support channel **128** is carried by the lower portion of the associated I-beam as shown in FIG. **3**.

Means is provided for supplying energy to the stepper motor **103** and controlling its operation. Generally, the control is such that when the sheet-gauging apparatus is placed in operation, the stepper motor **103** rotates in small, precise, discrete steps to advance the timing belts. It accelerates gradually to drive the head assemblies **46** and **47** across the main frame **11** and then the stepper motor **103** decelerates but continues to move in the same direction until a vane **131** carried by the bracket **86** enters a vane oscillator switch **132** of conventional type mounted upon the I-beam **14** by bracket **133**. At the same time this is occurring, a vane **136** carried by the bracket **86** on the lower head assembly **47** enters a vane oscillator switch **137** carried by a bracket **138**. As soon as the vanes **131** and **136** enter the vane oscillator switches **132** and **137** which are adjacent the end support **13**, the control circuitry associated therewith reverses the movement of the head assemblies **46** and **47** by bringing the same to a stop and gradually accelerating them to move in an opposite direction across the main frame **11**. This movement continues until the vanes **131** and **136** enter similar vane oscillator switches **132** and **137** provided adjacent to the end support **12**. This, again, causes a reversal of the stepper motor **103** and reversal movement of the head assemblies **46** and **47** to cause them again to travel down the main frame in a direction towards the end support **13**. This repeated traversing of the main frame **11** continues during operation of the sheet-gauging apparatus.

Auxiliary safety stop means is provided to prevent further movement of the head assemblies **46** and **47** in the event that the vane oscillator switches **132** and **137** fail to operate. This stop means consists of limit switches **141** mounted upon the end supports **12** and **13** which are adapted to be engaged by the head assemblies **46** and **47** in the event their travel is not arrested by the vane oscillator switches **132** and **137** so as to

prevent damage to the entire apparatus and particularly to the head assemblies 46 and 47. Such limit switches consist of a plunger 142 which is mounted on a fitting 143 secured to the associated end support 12 or 13 by a nut 144. A rubber bumper 146 is mounted over the plunger 142. The plunger is adapted to engage a microswitch 147 carried by bracket 148. The bracket 148 and the switch 147 are protected by a dust cover 149.

Elongate covers 156 and 157, which are substantially U shaped in cross section as shown in FIG. 3, are mounted over the upper and lower I-beams 14 and 16 and extend the entire length of the I-beams between the end supports 12 and 13. The covers 156 and 157 also cover the upper track means 36 and the lower track means 37. As can be seen from FIG. 3, the lower extremities of the covers 156 and 157 are laterally spaced from the outer margins of the plates 38 which form a part of the upper track means 36 and the lower track means 37.

A large end cover 161 is mounted on the end support 12 and is provided with an upper section 161*a* and a lower section 161*b*. The lower section 161*b* is secured to the end support 12 by brackets 162 and the upper section 161*a* is removably secured to the end support 12 by clamps 163. The upper section 161*a* of the end cover 161 is provided with a large framed opening 166 which has mounted therein a large filter 168. A pair of spaced fans 171 are mounted within the upper section 161*a* immediately behind the filter 168 and draw air through the filter 168, forcing it through the openings 116 in the end support into the covers 156 and 157. The air introduced into the covers 156 and 157 travels longitudinally of the I-beams 14 and 16 and gradually discharges downwardly through the spaces provided between the lower ends of the covers 156 and 157 and the plates 38 forming parts of the upper track means 36 and lower track means 37.

A cover 176 also formed of a suitable material such as impregnated fiberglass is mounted upon the end support 13 so that the appearance of the end support 13 is similar to the end support 12.

As hereinbefore indicated, certain devices are mounted in the upper head assembly 46 and the lower head assembly 47 which are useful for sheet gauging. Thus, for example, the lower head assembly 46 can contain a radiation source 181 of the type described in copending application Ser. No. 792,088, filed Jan. 17, 1969 in the event that basis weight measurements are to be made. A power supply 182 of a conventional type is mounted within the head assembly. If moisture measurements are to be made, an infrared source 183 of a type described in copending application Ser. No. 799,784, filed Feb. 17, 1969 can be utilized.

When the above-identified measurements are to be made, a basis weight gauge detector assembly 186 of the type described in copending application Ser. No. 791,915, filed Jan. 17, 1969 is provided in the upper head assembly 46. A power supply of a conventional type 187 is also provided in the upper head assembly. A moisture detector 188 of a conventional type can also be provided in the upper head assembly. The radiation source 181 and the basis weight gauge detector assembly 186 are arranged so they are opposite each other and so that the radiation from the radiation source travels through the sheet of paper indicated at 191 to the basis weight gauge detector assembly. Similarly, the radiation from the infrared source 183 is positioned so the radiation therefrom travels through the sheet 191 to the moisture detector 188.

In operation of the sheet-gauging apparatus, the sheet travels through the large O-type frame 11 between the upper head assembly 46 and the lower head assembly 47. The sheet being gauged is normally advanced continuously, and during this time the head assemblies 46 and 47 travel transversely of the sheet. As explained previously, the head assemblies 46 and 47 reciprocate longitudinally of the frame 11 and, therefore, travel back and forth in a lateral direction across the sheet 191 which is travelling through the main frame. During this travel of the head assemblies 46 and 47, the desired measurements are being made by the devices within the head assemblies 46 and 47.

As explained previously, the main frame 11 and the upper and lower track means 36 and 37 are constructed in a very precise manner so that the head assemblies 46 and 47 travel in a fixed relationship with respect to each other as they move longitudinally of the main frame. As it can be seen, considerable effort has been made to maintain the upper track means 36 and lower track means 37 and the I-beams 14 and 16 which carry the same relatively stable in temperature so that there is no change in the relative positioning of the head assembly because of temperature changes. Thus, although the sheet 191 travelling through the apparatus and being gauged may be very hot, precise measurements are still made. The sheet guide plates 68 serve as radiant heat shields and the heat support castings 63 are water cooled so that the electronic devices mounted within the head assemblies 46 and 47 remain relatively cool.

At the same time that water cooling is being utilized for the head assemblies 46 and 47, the upper and lower track means 36 and 37 are being continuously cooled by the stream of air passing longitudinally of the I-beams from the fans 171 provided in the end support 12. This serves to stabilize the temperature of the I-beams and the upper track means 36 and the lower track means 37 along their entire length. This serves to retain the desired spacing between the head assemblies 46 and 47 as they traverse the main frame. The covers 156 and 157 covering the I-beams, in addition to providing channels for the passage of air for cooling of the I-beams, also serve to protect the upper and lower track means 36 and 37 by keeping dust, dirt and the like off of the tracks. In addition, the slight overpressure created in the covers 156 and 157 by introducing air into the covers 156 and 157 prevents corrosive vapors and the like from coming into contact with the upper and lower track means.

The covers 81 provided as a part of the head assemblies 46 and 47 have relatively smooth surfaces so that in the event the sheet travelling through the apparatus should strike the same, the sheet will not be torn. The covers 81 also serve as a shield against heat radiating from the sheet being gauged to protect the electronic devices within the head assemblies. In addition, the covers prevent the entrance of dust, dirt and the like into the head assemblies.

The upper and lower gauging head assemblies 46 and 47 are mounted upon the carriage means in such a manner so that any radiation introduced through the sheet by the devices carried by the head assemblies 46 and 47 passes through the sheet substantially perpendicular regardless of the inclination of the sheet relative to the main frame. It can be appreciated that this is important so that the measurements are made in the same position with respect to the sheet being gauged. As can be seen from FIG. 3, the head assemblies 46 and 47 can be adjusted through substantial angles. First, the positions of the lever arms 55 can be adjusted between two positions by shifting the pins 63 from the position shown in FIG. 3 to the upper holes 70 provided in the support member 57. Additional, more precise adjustment can be accomplished by shifting of the pivot plates 51 and then tightening the bolts 52. In this way, it is possible to accommodate the various paths of travel for the sheet through the main frame while still maintaining the head assemblies 46 and 47 and the radiation passing therebetween substantially perpendicular to the sheet passing through the main frame.

It is apparent from the foregoing that there has been provided a new and improved apparatus for the gauging of sheets. The apparatus is particularly of a precision type which can be utilized for making a plurality of precision measurements at many different positions on sheets of material which are moving continuously.

I claim:

1. In a sheet-gauging apparatus for gauging properties of a sheet of material, a frame having parallel-spaced, upper and

lower beams extending laterally of the sheet, spaced upper and lower track means carried by the upper and lower beams, upper and lower gauging head assemblies disposed on opposite sides of the sheet, upper and lower carriage means mounting said upper and lower gauging head assemblies on said upper and lower track means, motor drive means and nonslip timing belt means connected to said motor drive means and to said carriage means for shifting said gauging head assemblies longitudinally of the beams and laterally of the sheet, said nonslip timing belt means including a flexible belt having toothlike portions formed therein extending transversely of the belt and pulleys engaged by the belt and having recesses therein extending axially of the pulleys for receiving the toothlike portions and gauging means carried by said upper and lower gauging head assemblies for gauging a property of said sheet as the heads are shifted longitudinally of the beams.

2. Apparatus as in claim 1 together with means for mounting said frame on a foundation and means carried by at least one end of said frame permitting shifting of one end of the frame with respect to the foundation to accommodate expansion and contraction of the frame.

3. Apparatus as in claim 1 wherein said upper and lower track means each includes a plate extending the length of the frame and having at least one flat surface extending the length of the frame and wherein said carriage means includes roller means travelling on said surface.

4. In a sheet-gauging apparatus for gauging properties of a sheet of material, a frame having parallel-spaced, upper and lower beams extending laterally of the sheet, spaced upper and lower track means carried by the upper and lower beams, cover means for protecting said upper and lower track means, means for introducing cooling air into the cover means to maintain said upper and lower track means at a substantially uniform temperature, upper and lower gauging head assemblies disposed on opposite sides of the sheet, upper and lower carriage means mounting said upper and lower gauging head assemblies on said upper and lower track means, motor drive means connected to said carriage means for shifting said gauging head assemblies longitudinally of the beams and laterally of the sheet, and gauging means carried by said upper and lower head assemblies for gauging a property of said sheet as the heads are shifted longitudinally of the beam.

5. Apparatus as in claim 4 wherein said covers are mounted on said upper and lower beams and cover the upper and lower track means, said cover means having lower extremities spaced from the track means, and means for introducing cooling air into the cover and for causing it to discharge downwardly through the space between the track means and the lower extremities of the cover along the entire length of the track means to thereby maintain said track means at a substantially uniform temperature throughout their lengths.

6. Apparatus as in claim 5 wherein said means for preventing movement of said gauging head assemblies beyond predetermined spaced points on said beams includes a conducting vane and a vane-type oscillator adapted to receive said vane.

7. In a sheet-gauging apparatus for gauging properties of a sheet of material, a frame having parallel-spaced, upper and lower beams extending laterally of the sheet, spaced upper and lower elongated platelike track means carried by the upper and lower beams, adjustable means for mounting said upper and lower elongated platelike track means upon said upper and lower beams whereby each of said track means can be adjusted laterally and longitudinally so that they are level throughout their entire length, upper and lower gauging head assemblies disposed on opposite sides of the sheet, upper and lower carriage means mounting said upper and lower gauging head assemblies on said upper and lower track means, motor drive means connected to said carriage means for shifting said gauging head assemblies longitudinally of the beams and laterally of the sheet, and gauging means carried by said upper and lower gauging head assemblies for gauging a property of said sheet as the heads are shifted longitudinally of the beams.

8. In a sheet-gauging apparatus for gauging properties of a sheet of material, a frame having parallel-spaced, upper and lower beams extending laterally of the sheet, spaced upper and lower track means carried by the upper and lower beams, upper and lower gauging head assemblies disposed on opposite sides of the sheet, upper and lower carriage means mounting said upper and lower gauging head assemblies on said upper and lower track means, motor drive means connected to said carriage means for shifting said gauging head assemblies longitudinally of the beams and laterally of the sheet, gauging means carried by said upper and lower gauging head assemblies for gauging a property of said sheet as the heads are shifted longitudinally of the beams, said upper and lower gauging head assemblies including a housing, said housing having a passage therein for the travel of a cooling fluid therethrough, and a sheet guide mounted on said housing, said sheet guide having inclined outer side margins which are inclined away from the sheet travelling between the gauging head assemblies.

9. In a sheet-gauging apparatus for gauging properties of a sheet of material, a frame having parallel-spaced, upper and lower beams extending laterally of the sheet, spaced upper and lower track means carried by the upper and lower beams, upper and lower gauging head assemblies disposed on opposite sides of the sheet, upper and lower carriage means mounting said upper and lower gauging head assemblies on said upper and lower track means, motor drive means and nonslip timing belt means connected to said drive means and to said carriage means for shifting said gauging head assemblies longitudinally of the beams and laterally of the sheet, and gauging means carried by said upper and lower gauging head assemblies for gauging a property of said sheet as the heads are shifted longitudinally of the beams, said gauging means carried by said upper and lower gauging head assemblies including means for introducing radiation through said sheet and means for adjusting the positions of the upper and lower gauging head assemblies so that the radiation passing through the sheet is maintained perpendicular to the sheet regardless of the inclination of the sheet relative to the upper and lower track means of the frame.

10. In a sheet-gauging apparatus for gauging properties of a sheet of material, a frame having parallel-spaced, upper and lower beams extending laterally of the sheet, spaced upper and lower track means carried by the upper and lower beams, upper and lower gauging head assemblies disposed on opposite sides of the sheet, upper and lower carriage means mounting said upper and lower gauging head assemblies on said upper and lower track means, motor drive means connected to said carriage means for shifting said gauging head assemblies longitudinally of the beams and laterally of the sheet, gauging means carried by said upper and lower gauging head assemblies for gauging a property of said sheet as the heads are shifted longitudinally of the beams, said gauging means including means for introducing radiation through said sheet and means for adjusting the positions of the upper and lower gauging head assemblies so that the radiation passing through the sheet is maintained perpendicular to the sheet regardless of the inclination of the sheet relative to the upper and lower track means of the frame, said means for adjusting the positions of the upper and lower gauging head assemblies including a housing, a pair of pivot plates, cooperative means carried by the pivot plates and the housing for mounting said pivot plates on said housing and permitting movement of said pivot plates through a predetermined angle, a pair of lever arms pivotally secured to each of said pivot plates, means pivotally connecting said lever arms to said carriage means, and means for adjusting the position of said lever arms on said carriage means whereby the position of said gauging head assemblies can be adjusted.

11. In a sheet-gauging apparatus for gauging properties of a sheet of material, a frame having parallel-spaced upper and lower beams extending laterally of the sheet, spaced upper and lower track means carried by the upper and lower beams, upper and lower carriage means mounted on said upper and

lower track means, upper and lower gauging head assemblies disposed on opposite sides of the sheet, and means for mounting said upper and lower gauging head assemblies on said upper and lower carriage means, said gauging head assemblies including means for introducing radiation through the sheet of material, said adjustable means for mounting each of said upper and lower gauging head assemblies on said upper and lower carriage means including a pair of pivot plates, cooperative means carried by the pivot plates and by the gauging head assembly for mounting said pivot plates on the gauging head assembly and permitting limited pivotal movement of the pivot plate with respect to the gauging head assembly, a pair of pivot arms pivotally connected to said pivot plate, and means pivotally connecting said pivot arms to said carriage means and means for adjusting the angular position of said pivot arms on said carriage means whereby said gauging head assemblies can be adjusted so that the radiation extending through the sheet of material is substantially perpendicular to the sheet regardless of the inclination of the sheet.

12. In a sheet-gauging apparatus for gauging properties of a sheet of material, a frame having parallel-spaced upper and lower beams extending laterally of the sheet, spaced upper and lower track means carried by the upper and lower beams, upper and lower gauging head assemblies disposed on opposite sides of the sheet, upper and lower carriage means mounting said upper and lower gauging head assemblies on said upper and lower track means, and drive means for moving said carriage means and said gauging head assemblies longitudinally of the beams and laterally of the sheet, covers mounted on said beams and covering said upper and lower track means, and means for introducing air into the cover means and to cause the same to pass over the entire length of the upper and lower track means whereby the upper and lower track means are maintained at a substantially uniform temperature throughout their lengths.

13. Apparatus as in claim 12 wherein said covers have lower extremities and wherein the lower extremities of the covers are spaced from the track means whereby air introduced into the covers can discharge downwardly between the track means and the lower extremities of the covers.

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