June 11, 1963 H. J. LUEHRS 3,093,069

AUTOMATIC WEB TENSION CONTROL SYSTEM

Filed Sept. 16, 1960 7 Sheets-Sheet 1

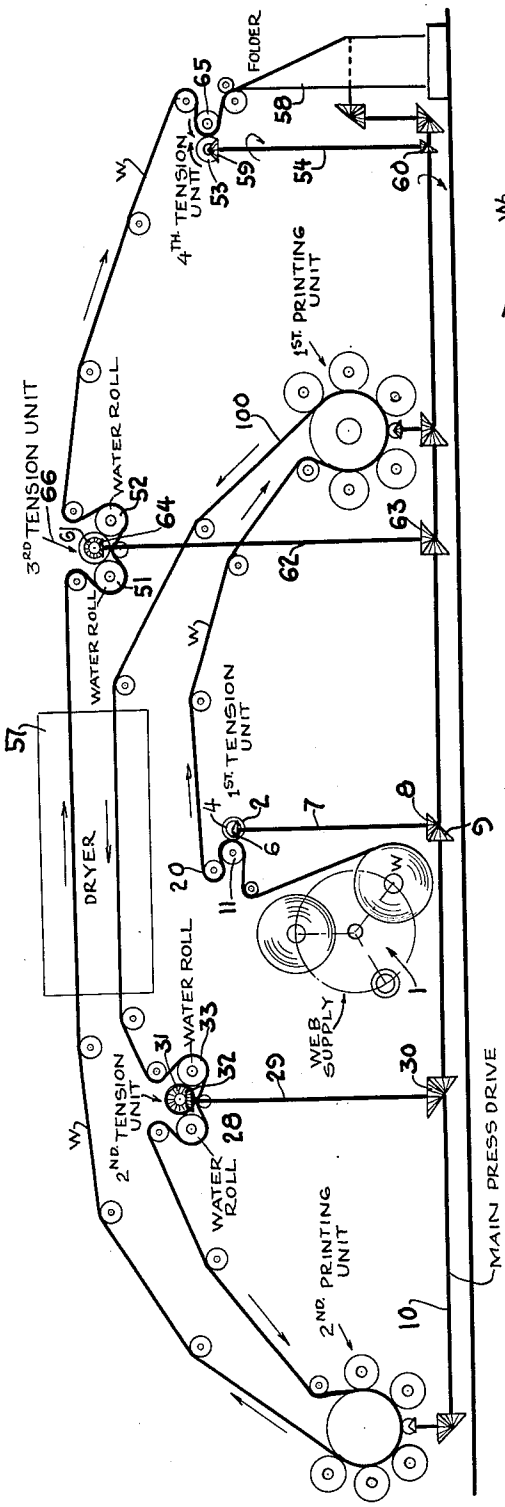

Fig. 1

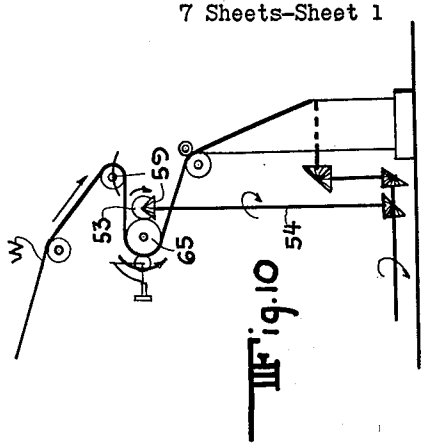

Fig. 10

INVENTOR
HANS J. LUEHRS
BY
Brown & Seward
his ATTORNEYS

June 11, 1963 H. J. LUEHRS 3,093,069

AUTOMATIC WEB TENSION CONTROL SYSTEM

Filed Sept. 16, 1960 7 Sheets-Sheet 2

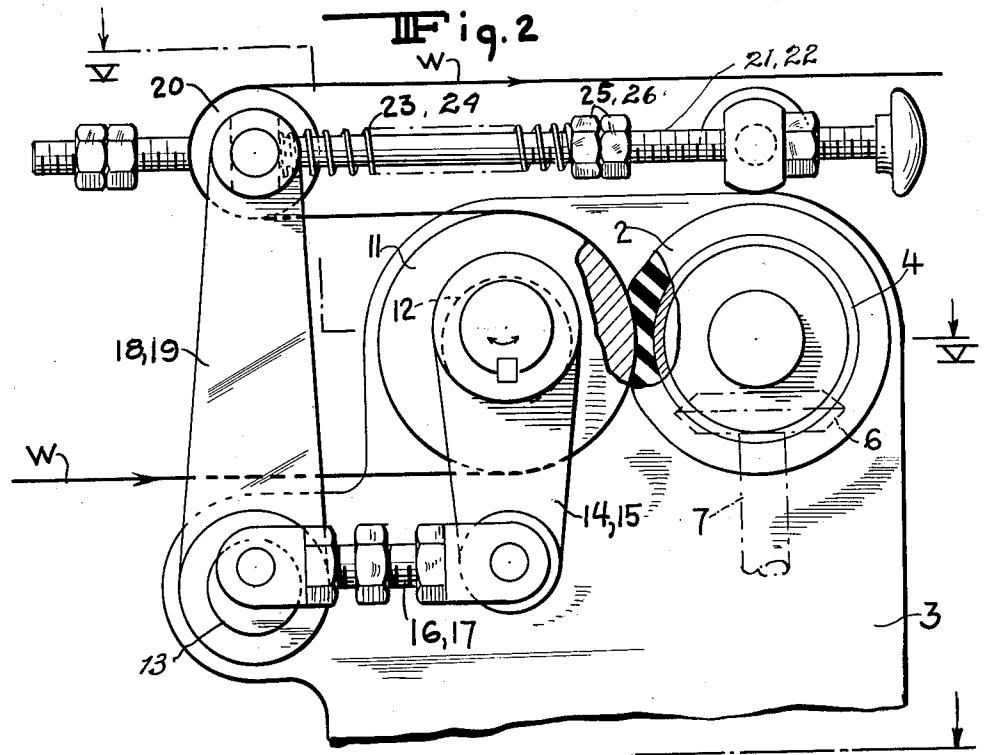

Fig. 2

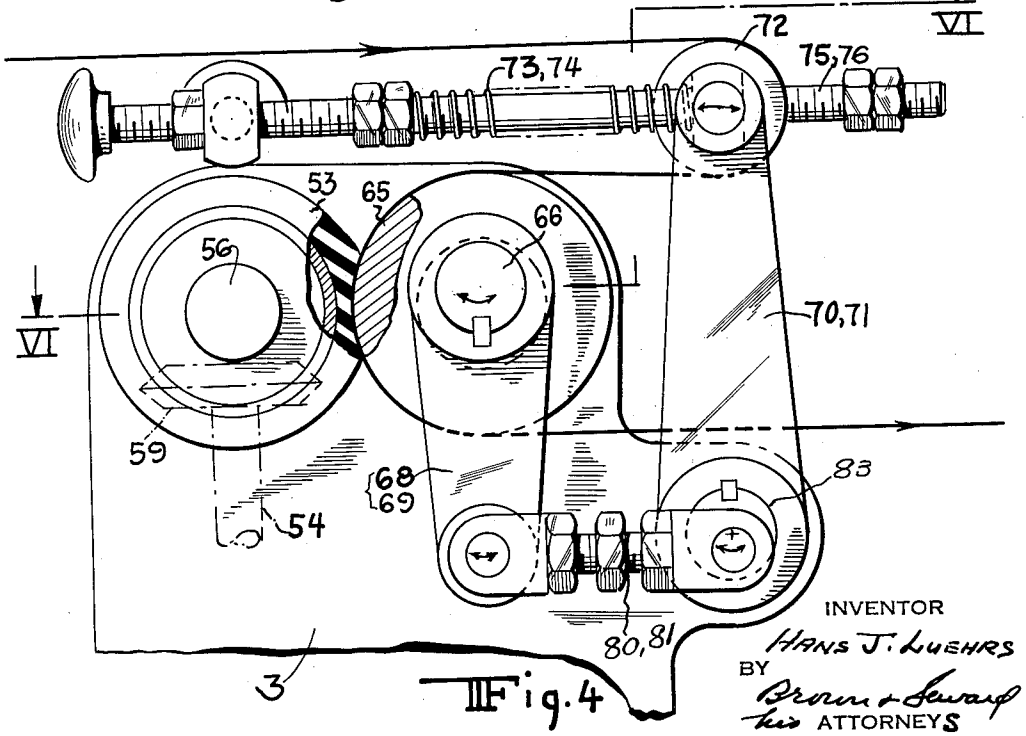

Fig. 4

INVENTOR
HANS J. LUEHRS
BY
Brown & Seward
his ATTORNEYS

June 11, 1963 H. J. LUEHRS 3,093,069

AUTOMATIC WEB TENSION CONTROL SYSTEM

Filed Sept. 16, 1960 7 Sheets-Sheet 3

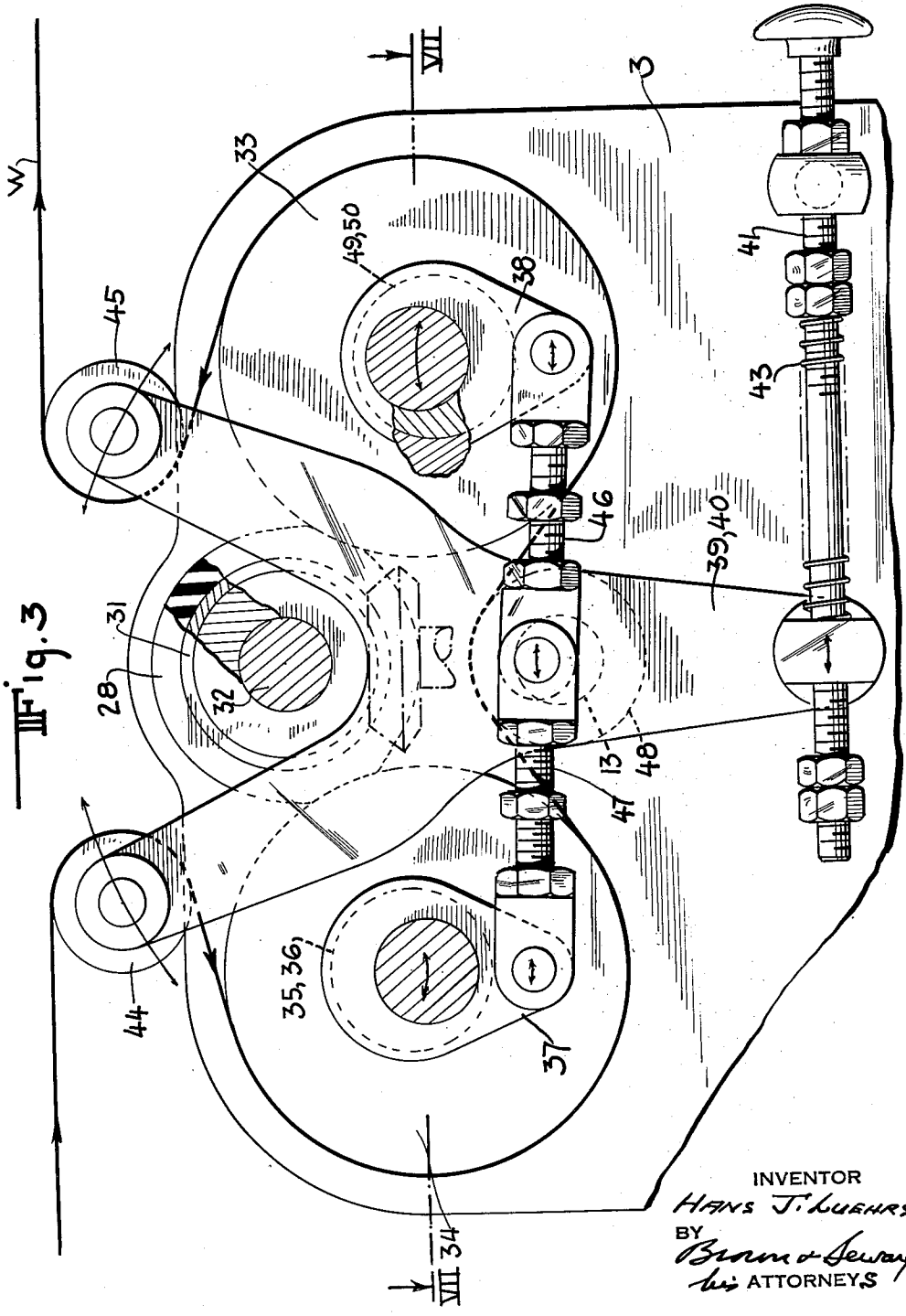

Fig. 3

INVENTOR
HANS J. LUEHRS
BY
Brumbaugh
his ATTORNEYS

June 11, 1963 H. J. LUEHRS 3,093,069

AUTOMATIC WEB TENSION CONTROL SYSTEM

Filed Sept. 16, 1960 7 Sheets-Sheet 4

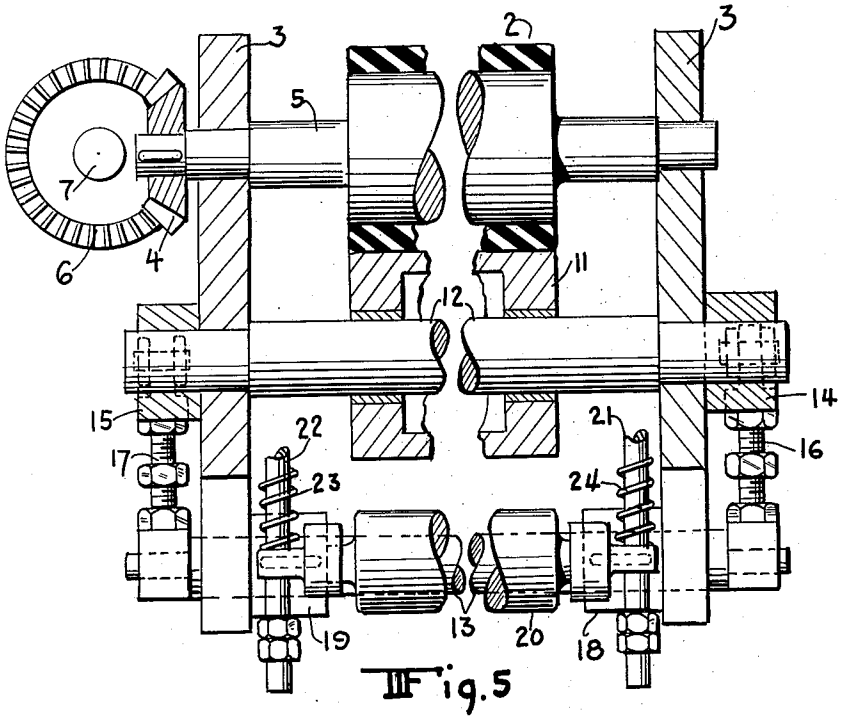

Fig. 5

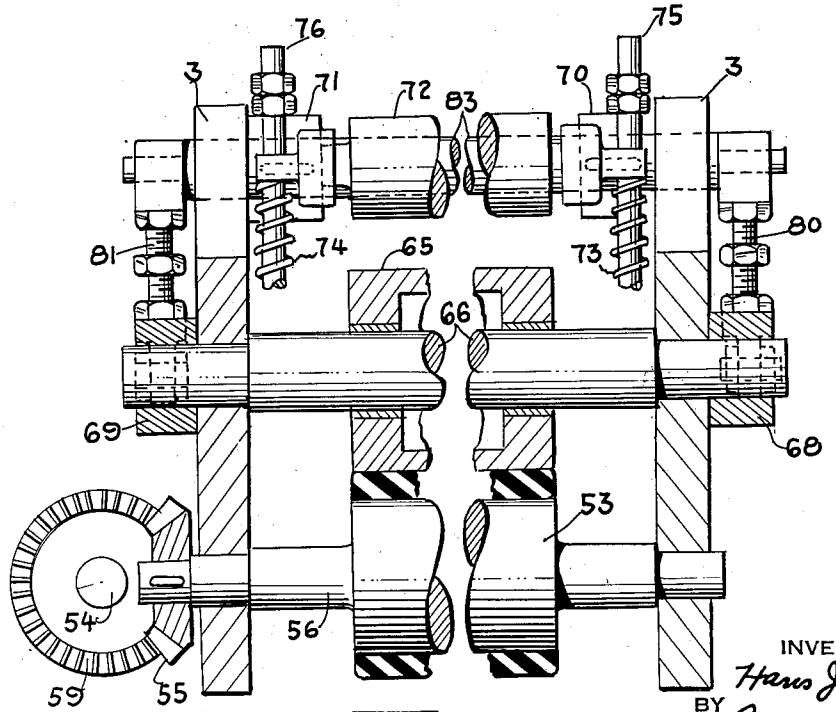

Fig. 6

INVENTOR
Hans J. Luehrs
BY Brown & Seward
his ATTORNEYS

June 11, 1963 H. J. LUEHRS 3,093,069

AUTOMATIC WEB TENSION CONTROL SYSTEM

Filed Sept. 16, 1960 7 Sheets-Sheet 5

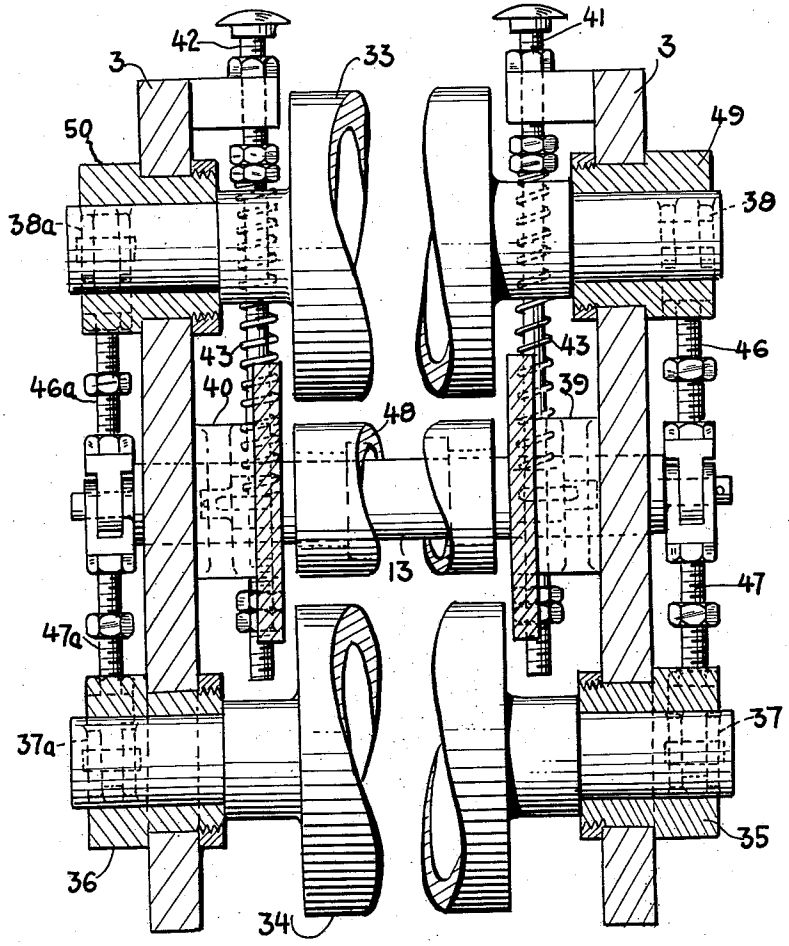

Fig. 7

INVENTOR
Hans J. Luehrs
BY
Brown & Seward
his ATTORNEYS

June 11, 1963 H. J. LUEHRS 3,093,069

AUTOMATIC WEB TENSION CONTROL SYSTEM

Filed Sept. 16, 1960 7 Sheets-Sheet 6

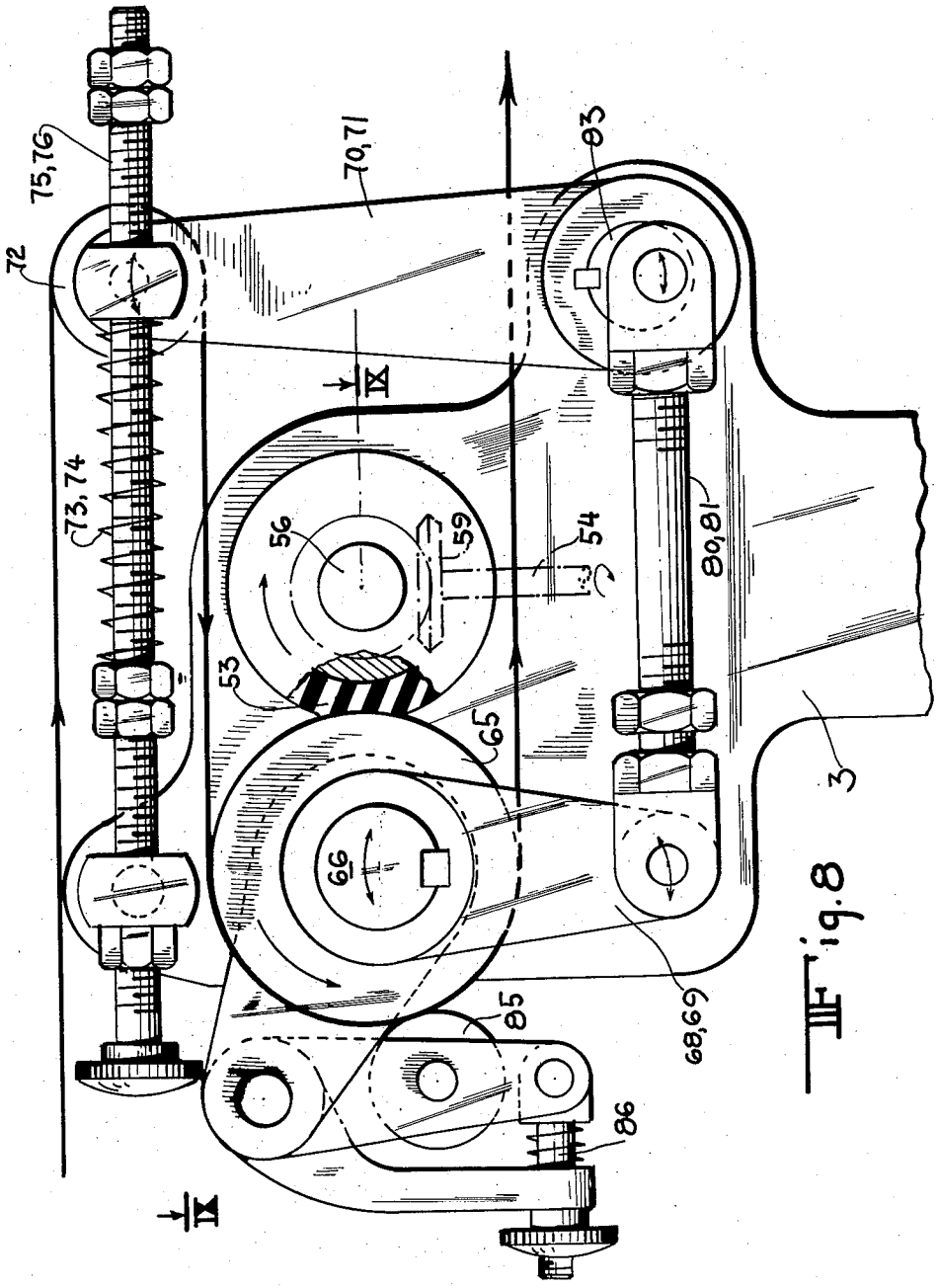

Fig. 8

INVENTOR
HANS J. LUEHRS
BY
Brown & Ward
HIS ATTORNEYS

June 11, 1963 H. J. LUEHRS 3,093,069

AUTOMATIC WEB TENSION CONTROL SYSTEM

Filed Sept. 16, 1960 7 Sheets-Sheet 7

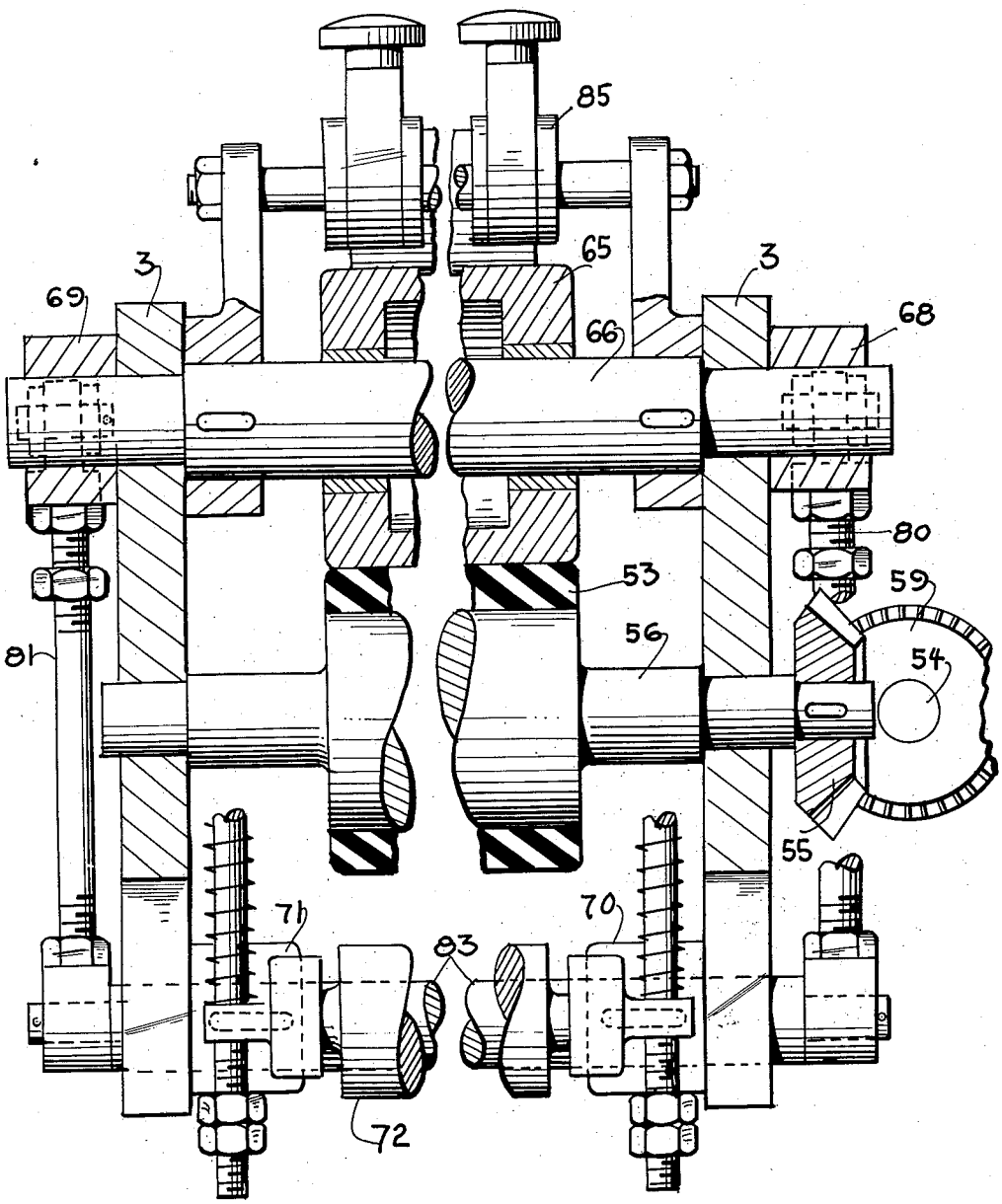

Fig. 9

INVENTOR
HANS J. LUEHRS
BY
Brown & Swald
HIS ATTORNEYS

United States Patent Office 3,093,069 Patented June 11, 1963

3,093,069

AUTOMATIC WEB TENSION CONTROL SYSTEM

Hans J. Luehrs, Westerly, R.I., assignor to The Cottrell Company, Westerly, R.I., a corporation of Delaware

Filed Sept. 16, 1960, Ser. No. 56,428
11 Claims. (Cl. 101—179)

Heretofore web tension has been controlled by complicated mechanisms involving movable carriages for compensating web rolls, V-belt variable speed drives in combination with differential drives, fluid pressure actuated systems and other compensating devices responsive to change in web tension on predetermined parts of the apparatus. Due to delay in response inherent in present systems and structure, correction of any web tension variation is often unsatisfactory and results in color misregister of the printing on the web or, in some instances, causes the web to break.

The object of my invention is to provide a means for controlling web tension which is capable of automatic and instant response to and correction of any changes in web tension which means is relatively simple in design when compared with web tension controls now in use.

Another object is to provide an automatic web tension device in which a driven resiliently surfaced roll of a given outside diameter and running at a constant rotative speed is adapted to drive a non-resiliently surfaced roll at a variable speed proportional to the deformation of the driving roll surface caused by the pressure between the driving and driven roll surfaces.

Another object is to provide an automatic web tension control system in which tension control units are interposed in the path of the web at predetermined points to maintain a desired or predetermined web tension between the web supply and other press units as the web is forwarded from the supply to and through the press to undergo the printing and/or drying and subsequent operations thereon.

Another object is to provide web tension control means in which the driven web roll or rolls are moved to control the pressure of same against their driving roll or rolls whereby the speed of the driven rolls is varied in proportion to the deformation of the driving roll or rolls.

Another object is to provide travelling web tension control means wherein web speed is determined by the pressure thereagainst as it is pinched between the resiliently covered driving roll and the non-resilient surface of the driven roll.

Advantages over the prior art of web control according to my invention are:

(1) Simple design at correspondingly low cost.

(2) Practically instantaneous correct orientation at quick stops, normal press accelerations or decelerations and any other rapid web tension fluctuations to provide a degree of responsiveness lacking on present devices.

(3) Increasingly positive web feeding action proportional to the amount of pinch between the driving and driven roll and/or the magnitude of the initial web tension control setting.

(4) In cases of non-drying presses, at speeds where heat, due to internal friction or thermal expansion is negligible, the system may be operated by manual adjustment.

(5) The structure of particular units may be reversed to properly control the incoming or outgoing web as may be required.

(6) For initial tension and correcting tension variation on the incoming and outgoing web, as on driven cooling rolls between printing units wherein the interconnected float rolls maintain and equalize incoming and outgoing web tension for such driven cooling rolls.

(7) With two or more non-resilient web feeding or water rolls, the cumulative metering differences as for instance on positively gear driven rolls are eliminated when all pinches between driving and driven rolls are identically pre-adjusted.

Broadly, my invention comprises the combination of web supply and web tension control mechanisms including driven rolls, driving rolls therefor, said rolls being adapted to advance the web and means connected to the driven rolls and responsive to web tension to govern the position of the driven rolls with respect to their driving rolls and thereby the speed of travel and tension of the web.

Practical embodiments of my invention are shown in the accompanying drawings in which

FIG. 1 represents diagrammatically in side elevation a double five color web perfecting rotary printing press, including a web supply, printing units, dryers, folder and the novel web tension control units constructed and located according to my invention.

FIG. 2 represents in detail side elevation a web tension control unit constructed according to my invention and suitable for tension control of the ingoing web into a press unit such as, in the present instance, from the web supply.

FIG. 3 represents in detail side elevation a web tension control unit sensitive to drive the water rolls at a required surface speed and to suit the inherent web tension of the entire web lead entering and leaving these water roll drive units.

FIG. 4 represents in detail side elevation a web tension control unit sensitive to and for regulating web tension at the folder.

FIG. 5 represents a sectional plan view of the web tension units as shown in FIG. 2.

FIG. 6 represents a sectional plan view of the web tension unit as shown in FIG. 4.

FIG. 7 represents a sectional view of the web tension unit as shown in FIG. 3.

FIG. 8 represents in end elevation the unit of FIG. 4 reversed to eliminate web pinch between the driving and driven rolls.

FIG. 9 represents a partial section of the unit of FIG. 8 taken on the line 9—9 of FIG. 8 and looking in the direction of the arrows and

FIG. 10 represents in diagram the drive for the unit of FIG. 8.

Referring to FIG. 1 the web W is led from the supply roll on the usual web roll stand 1 into and through the first tension control unit, into the first printing unit where it is printed on one side, to and through a dryer; to and through the second web control unit driving the water rolls; to and through the second printing unit where it is perfected by printing its blank side, back through the dryer; to and through the third web control unit, driving the water rolls, to and through the fourth web control unit and into the folder.

The location and functions of the respective web control units, the structures and operations of which will be detailed below, are as follows:

The first tension control unit is located between the web supply and the first printing unit and there functions to prevent reactions of the web roll stand tension fluctuations in the first printing unit and to maintain a selected tension of the web entering the first printing unit.

The second tension control unit is located at and includes the cooling rolls of the drying unit and there functions to drive the cooling or water rolls at a surface speed which maintains the desired tension of the entire web lead between the first printing unit, including its drying operation and the second printing unit.

The third web tension control unit is located at and

includes the second set of cooling rolls located between the dryer and the folder and serves to drive the said second set of cooling rolls at a proper surface speed to maintain a selected web tension throughout the entire web lead between the second printing unit including its dryer and the fourth web tension control.

The fourth web tension control unit is located in the web path just prior to the folder and is so located and functions to eliminate undesirable fluctuation in the web tension between the second printing unit and the folder which may be caused by the web cut-off operation of the latter.

Referring to the drawings FIGS. 2 and 5 the first web control unit comprises a driving roll **2** having a resilient deformable exterior of rubber, or other suitable material, rotatably mounted in the press frame **3**. This roll **2** obtains its drive through the bevel gear **4** mounted on the driving roll shaft **5** and meshed with the bevel gear **6** carried on the upper end of a vertical shaft **7**, said vertical shaft **7** being provided at its lower end with a bevel gear **8** operatively engaged with a bevel gear **9** interconnected with the main press drive **10** so that the said driving roll **2** is driven at a constant rotative speed from the main press drive as is indicated in the diagrammatic representation of FIG. 1.

In adjustable surface contact with said driving roll **2** is a driven web carrying roll **11** of steel, or other suitable hard surface material, which is driven at a speed determined by the pressure thereagainst of the above described driving roll **2**. The said driven roll **11** is rotatably mounted on a shaft **12**. This shaft **12** is also provided with eccentric ends, serving as rockable journals for it in the frames **3**. Levers **14**, **15**, keyed to both ends of shaft **12**, are connected by means of adjustable links **16**, **17** to eccentric pins at the ends of shaft **13**. This shaft **13** is rockably mounted in the frames **3** and carries the floating roll **20** on a pair of levers **18**, **19**, keyed to shaft **13**. Spindles **21**, **22** are rockably anchored in the frames **3**, and springs **23**, **24** mounted thereon provide a load against the levers **18**, **19**, adjustable by nuts **25**, **26** to counteract a given tension of the web and the force of the pinch between rolls **2** and **11**. With initial adjustment for the desired web tension, the system is in equilibrium with the forces of the springs **23**, **24** balancing the combined forces of the web tension, and the pinch between rolls **2**, **11**.

It will thus be seen that when any change in web tension results, from any cause, at the floating roll **20** carrying the travelling web, such change will cause the levers **18**, **19** to move, and this movement will be instantly transmitted through the connections **16**, **17** between the lower ends of the levers **18**, **19** and the levers **14**, **15**, and in turn, to the eccentric shaft **12**, for the driven web roll **11**. Thus a shift of the shaft **12** will increase or decrease the pressure of the driven roll **11** against the resiliently surfaced driving roll **2** to cause a change in surface speed of the driven web carrying roll **11**. Obviously, any change in speed of the web carrying driven roll **11** will change the web speed of travel and thus maintain a predetermined web tension of the web as it enters the first printing unit. Any change in web tension is automatically and instantaneously compensated for or corrected by the action of the web transmitted by direct mechanical connection of same with its driven forwarding roll **11** the speed of which, as above described, is directly and quickly responsive to any tension variation in the web.

The second web control unit (FIGS. 3 and 7) comprises a driving roll **28** in all respects similar to the driving roll **2** of the first web control unit, said driving roll **28** being driven through its connection with the main press drive **10** at a constant speed. The said connection includes a vertical shaft **29** geared at one end **30** into the main press drive **10** and, at its upper end into a gear **31** on the driving roll shaft **32**.

In adjustable surface contact with the resiliently covered driving roll **28** are two driven water rolls **33**, **34** adapted to advance the web W fed therearound, said driven rolls having a harder surface than their said common driving roll **28**. These driven rolls are mounted in turnable mountings **35**, **36**, **49**, **50**, preferably eccentric boxes so that their surface contact with their driving roll **28** can be governed by moving said driven rolls toward and away from said driving roll as will be described below.

The eccentric boxes **35**, **36**, **49**, **50**, with their levers **37**, **37***a*, **38**, **38***a* are operatively connected by adjustable connections **46**, **47**, **46***a*, **47***a* to cranks at both ends of shaft **13**, mounted turnably in frames **3**. Y-shaped levers **39**, **40** are keyed to shaft **13**. Spindles **41**, **42** are rockably anchored in the frames **3**, and springs **43** mounted thereon provide an adjustable load against the levers **39**, **40** to counteract the forces of the pinch between driving roll **28** and the driven rolls **33** and **34**. With the initial adjustment for the desired surface speed of the roll, these opposing forces are normally in equilibrium.

Also carried on the Y-shaped levers **39**, **40** are floating rotatable web carrying rolls **44**, **45** around which the web passes prior to encountering one driven roll **34** and after having passed around a web lead roll **48** and the other roll **33** as is illustrated in FIGS. 3 and 7. Normally the tensions of the incoming and outgoing web are equalized. Any change in web tension at either of the said floating rolls **44** or **45** will cause the Y-shaped levers **39**, **40** to rock on their shaft **13** and change the surface pressure of the driven rolls **33**, **34** with respect to their driving roll **28**. The rockings of the levers **37**, **37***a*, **38**, **38***a* will be transmitted to the eccentric boxes **35**, **36**, **49**, **50** for the driven rolls **33**, **34** through the linkages described above so that both driven rolls will be driven faster or slower depending upon whether its surface pressure against the driving roll **28** is increased or decreased, thereby immediately compensating for the change in web tension.

It will be noted in the second web tension control unit just described that the driving roll **28**, which is driven at a constant speed from the main press drive **10**, drives both driven rolls **33** and **34** simultaneously at an initially adjusted identical speed and, when the pressure between driving and driven rolls changes, both driven rolls are rotated simultaneously at different yet identical speeds thereby equalizing the tension of the incoming and outgoing web and/or maintaining the inherent web tension of the entire web lead between the first and second printing units.

Located at the outgoing side of the heating unit **57** and between it and the folder **58** is a third web tension control unit which is, in all respects similar both as to structure and operation with the second web tension control unit hereinbefore described in FIGS. 3 and 7. Therefore, no further description of this third unit is deemed necessary, except to state it is so located and operated as to drive the rolls **51**, **52** (water rolls), as shown in FIG. 1 by means of rubber roll **61**, at a speed suitable to maintain a selected uniform tension throughout the web lead between the second printing unit and the folder. Roll **61** is driven from the main press drive **10** by vertical shaft **62** and its gears **63**, **64** (FIG. 1).

Located in the path of travel of the web just prior to its entry into the folder is a fourth web control unit (FIGS. 4 and 6). This unit is so located and constructed as will be described as to prevent the effects of web tension fluctuation due to web cut-offs in the folder affecting the balance of the third web tension control unit by maintaining the predetermined web tension between the second printing unit and the folder **58**.

This fourth web tension unit shown in FIGS. 4 and 6 is similar to the first tension unit described above and comprises a resilient surfaced (or rubber) driving roll **53** driven at a constant rotative speed from the main press

drive 10 by a vertical shaft 54 carrying bevel gears (59, 60) at both ends and geared into the main press drive (as shown in FIG. 1) at one end and into the driving gear 55 at the end of the rubber driving roll shaft 56.

This driving rubber covered roll 53 is in surface contact with and drives a roll 65 (harder surfaced than the rubber roll) the web W being pinched between said driving and driven rolls. Means actuated by web tension are provided to vary the pinch of these rolls by moving the driven roll 65, which is rotatably mounted on shaft 66. This shaft 66 is also provided with eccentric ends serving as rockable journals for it in the side frames 3. Levers 68, 69, keyed to both ends of shaft 66, are connected by means of adjustable links 80, 81 to eccentric pins at the ends of shaft 83. This shaft 83 is rockably mounted in the side frames 3 and carries the floating roll 72 on a pair of levers 70, 71 keyed to shaft 83. Spindles 75, 76 are rockably anchored in the frames 3, and springs 73, 74 mounted thereon provide a load against the levers 70, 71 to counteract the combined forces created by the tension of the web and the pinch between the rolls 53, 65.

It will be seen that the web is caused to travel from the third web tension control unit to and around said floating web roll 72, between the driving roll 53 and driven roll 65 and thence to the folder 58.

Normally, the forces of this fourth tension unit are in equilibrium. However, when for any reason a change in the web tension takes place, the position of the floating roll 72, the pinch between rolls 53, 65 and the web speed changes accordingly thus instantly correcting the web tension of the web lead from the third tension unit to its initial value.

As illustrated in FIGS. 8, 9, and 10 it may be desired to forward the web at the folder without pinching same across its surface by the driving and driven rolls.

In this instance the web is held against the steel roll 65 which is driven by roll 53, by idler 85, yieldingly urged thereagainst by spring 86, and, as illustrated in FIG. 10, the drive has been reversed to obtain the desired direction of rotation of rolls 53 and 65.

For operation of the complete system throughout the press, the initial adjustments and the resulting functions are as follows.

The second tension unit, driving its water rolls, is initially adjusted to the inherent surface speed of the web and adapted by the action of its floating rolls to automatically maintain the basic web tension between the first and second printing units, which is created by the drying shrinkage of the web between said units.

The first tension unit, forwarding the web from the web supply roll, is initially adjusted to the required web speed and is adapted by the action of its floating roll to maintain a web tension between first tension unit and first printing unit equal to the web tension between first and second printing units, independent of any web tension fluctuation which may occur at the web supply roll for any reason.

The fourth tension unit, forwarding the web into the folder, is initially adjusted to create a web tension between it and the second printing unit equal to the web tension between the first and second printing unit and by the action of its floating roll to automatically maintain said tension, independent of any web tension fluctuation which may occur in the folder for any reason.

The third tension unit, driving its water rolls, is initially adjusted to the surface speed of the web and adapted by the action of its floating rolls to automatically maintain the web tension created by the fourth tension unit between the second printing unit and the fourth tension unit.

It will be understood that variations in the operating speed of the press and/or the heat of the dryer affects the amount of shrinkage of the web and, therefore, the tensions of the incoming and outgoing webs, respectively.

The combined action of the floating rolls of all units instantly corrects this variation, thus maintaining a uniform web tension throughout the press.

Since it is evident that various changes may be resorted to in the construction, form and arrangement of the several parts, without departing from the spirit and scope of my invention, I do not intend to be limited to the particular embodiments herein shown and described except as set forth in the appended claims.

What I claim is:

1. In a rotary web printing press or other web handling machinery, the combination which includes a web supply, means for taking a web therefrom under tension, web processing means, and web tension control mechanism, each said mechanism comprising a driven web forwarding roll, a deformable surfaced driving roll therefor operable against said driven roll, web engaging means movable by said web according to change in web tension, and connections between said web engaging means and each driven roll whereby such motion of said web engaging means due to changes in web tension alters the pressure of the driven roll against the driving roll and thereby its speed for maintaining web tension.

2. The combination according to claim 1 in which the driving roll is operable against the web and said driven roll, and the web is pinched therebetween.

3. The combination according to claim 1 which includes a plurality of driven web forwarding rolls driven by the deformable surfaced driving roll whereby the motion of the web engaging means due to changes in web tension alters the pressure of the driven rolls against the driving roll and thereby their speed for maintaining web tension.

4. The combination according to claim 1 which includes a plurality of web tension control units, at least one of said units including opposed web pinching rolls and web engaging means connected to at least one of said rolls in each said control unit and wherein at least one of said web control units is interposed between web supply and a web processing unit.

5. In a rotary web printing press, the combination according to claim 1 in which the driving roll is provided with a resilient deformable surface and the driven roll with a hard surface.

6. In a rotary web printing press, the combination according to claim 1 in which the driving roll is a resilient rubber roll and the driven roll is a steel roll.

7. In a rotary web printing press, the combination according to claim 1 in which the driving roll is driven at a constant rotative speed from the main press drive.

8. In a rotary web printing press, the combination according to claim 1 in which the web engaging means connected with the driven roll and responsive to web tension include a floating web carrying roll, its rockable support, movable mountings for said driven roll and levers connecting said support with said movable mountings.

9. In a rotary printing press, a web supply and means for forwarding the web therefrom under tension through the press, said forwarding means comprising a plurality of web tension control units, at least one of said units including opposed web pinching rolls, and web engaging means movable by said web according to change in web tension connected to at least one of said rolls in each control unit and responsive to changes in web tension for moving said roll toward and away from its opposed roll, at least one of said rolls having a resilient deformable periphery, and means for driving said last named roll at a constant rotative speed in which at least one of the means responsive to web tension includes a common rockable support, a plurality of floating web engaging rolls mounted thereon and means connecting said support to a plurality of driven web advancing rolls for moving same toward and away from their opposed roll, said interconnected plurality of web advancing rolls being driven by said last named opposed roll.

10. In a rotary web printing press, a web supply, means

for advancing a web therefrom and forwarding same through the press at a desired tension, comprising a plurality of web tension control units, means at each unit for setting initial web tension, each tension control unit including at least one hard surface web carrying roll, its driving roll, said driving roll having a resilient deformable surface, means for driving the last named roll at a constant rotative speed, eccentric mountings for each driven roll, at least one floating web engaging roll, its mounting, means interconnecting each floating web roll mounting with a driven roll eccentric mounting whereby change in web tension at a floating web roll causes said eccentric mounting to be moved and thereby change the surface contact pressure of the hard surfaced roll against the driving roll surface and the speed of said hard surfaced web carrying roll to compensate for changes in web tension.

11. In a rotary web printing press, a web supply, means for advancing a web therefrom and forwarding same through the press at a desired tension, comprising a plurality of web engaging tension control units, means at each unit for setting initial web tension, each tension control unit including at least one hard surface web carrying roll, its driving roll, said driving roll having a resilient deformable surface, means for driving the last named roll at a constant rotative speed, the web being pinched between said driven and driving rolls, eccentric mountings for each driven engaging roll, at least one floating web roll, its mounting, means interconnecting each such floating web roll mounting with a driven roll eccentric mounting whereby change in web tension at a floating web engaging roll causes said eccentric mounting to be moved and thereby change the surface contact pressure of the hard surfaced roll against the web and driving roll surface and the speed of said hard surfaced web carrying roll to compensate for changes in web tension.

References Cited in the file of this patent

UNITED STATES PATENTS

2,723,620	Huck	Nov. 15, 1955
2,911,908	Johnson	Nov. 10, 1959
2,972,297	Auerbacher	Feb. 21, 1961