Feb. 9, 1971 F. D. HAUCK 3,561,133

THERMAL PROCESSOR

Filed March 21, 1969 2 Sheets-Sheet 1

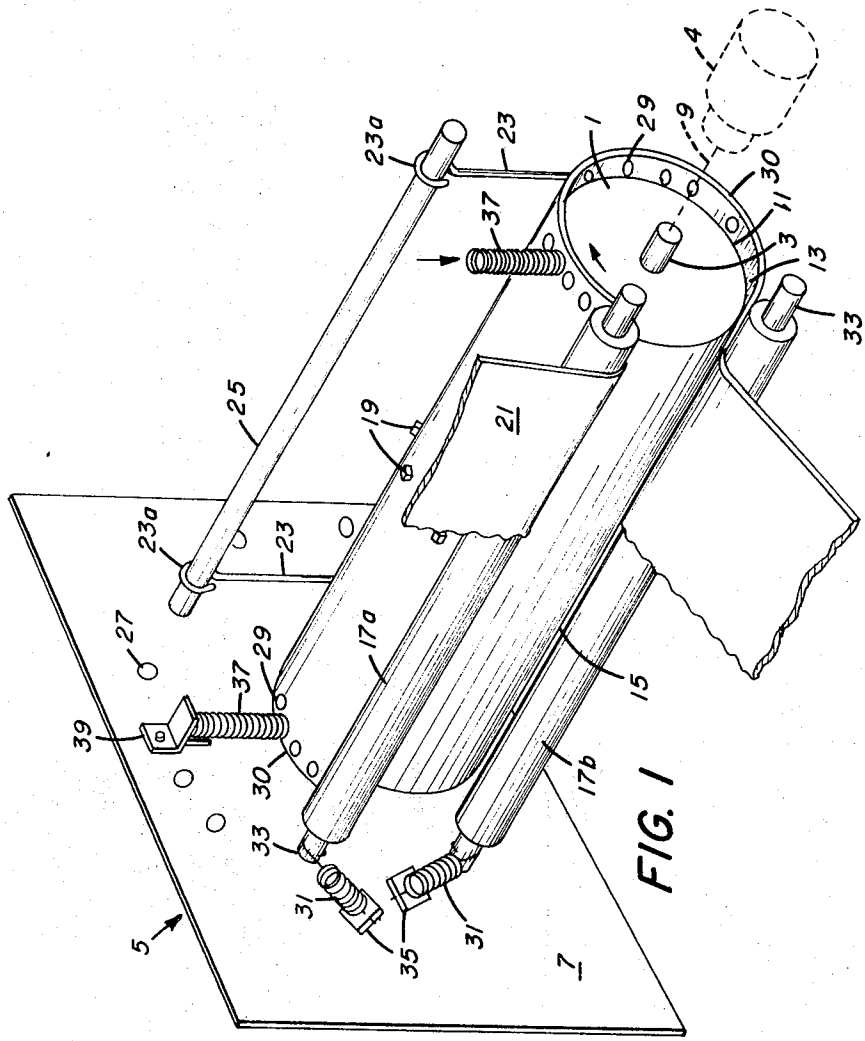



FIG. 1

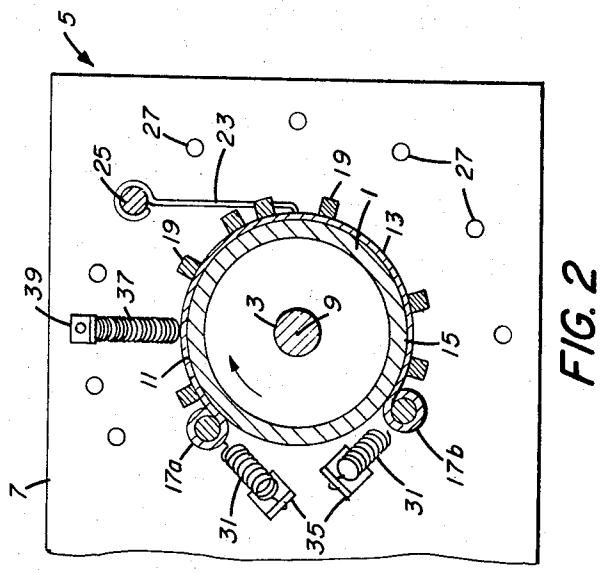



FIG. 2

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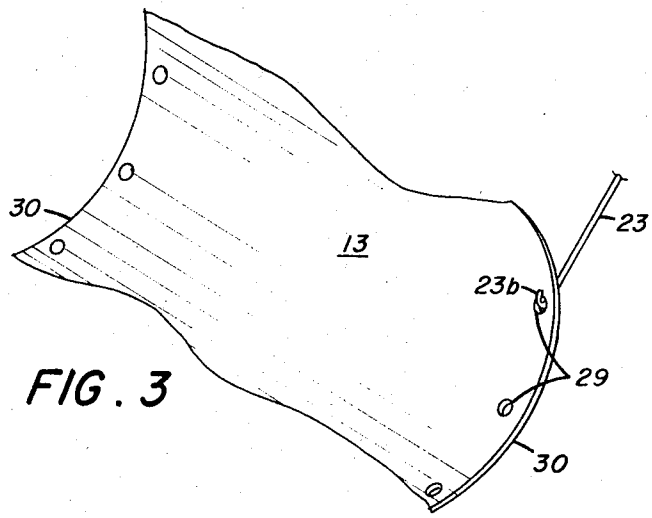



FIG. 3

FIG. 4

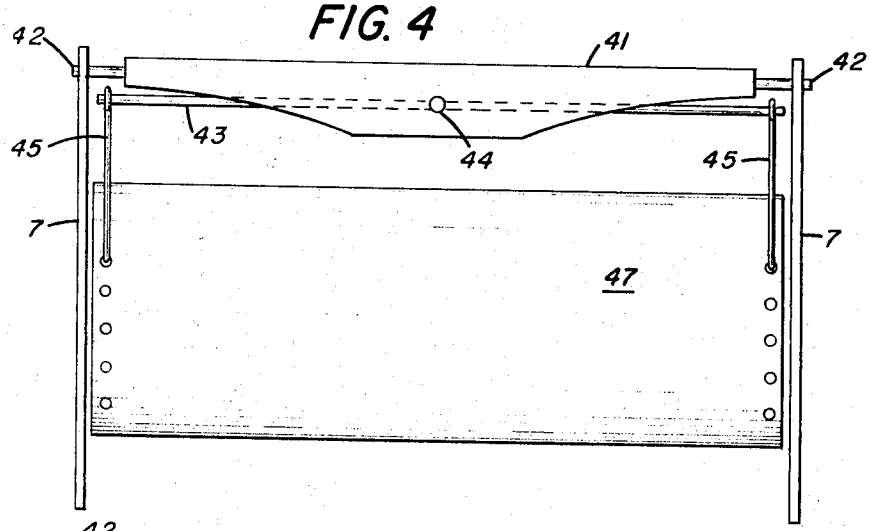
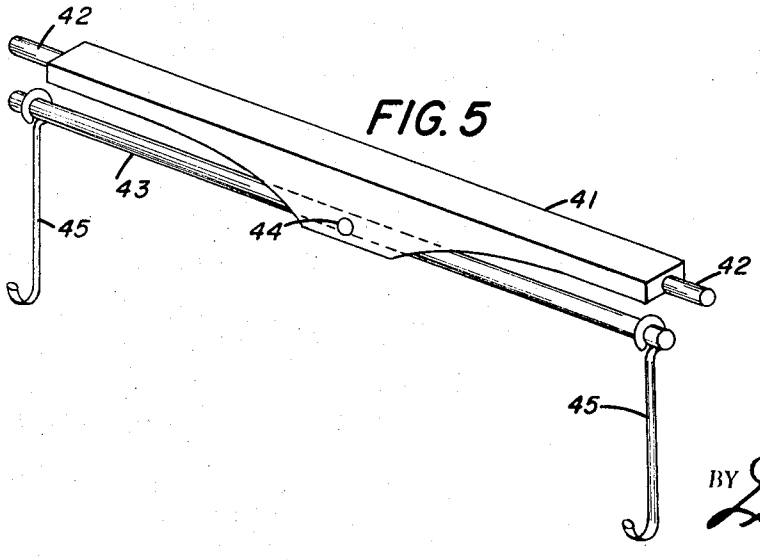



FIG. 5




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# THERMAL PROCESSOR

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Int. Cl. F26b 1/02
U.S. Cl. 34—110 8 Claims

## ABSTRACT OF THE DISCLOSURE

A thermal processor for heating web material in a well-known manner between a rotating drum and a mating, non-rotating, semi-rigid resilient shell. A pivotally connected support means holds the shell in "floating" relationship with the drum. Such relationship is achieved by the use of links which pivotally connect the support means and shell which permit limited movement of any portion of the shell in a generally radial direction relative to the drum while preventing the shell, as a whole, from rotating with the drum.

## FIELD OF THE INVENTION

This invention generally pertains to an improvement in a thermal photographic processor utilizing a rotating drum and a cooperating, non-rotating, semi-rigid, resilient shell. More particularly, the invention pertains to means for supporting the shell relative to the drum.

## DESCRIPTION OF THE PRIOR ART

Thermal photographic processors of the type disclosed herein are used to apply heat to web materials in the form of paper, film or the like. Generally, such processors include a motor-driven, frame-mounted drum that is rotatable about a fixed axis, and a semi-rigid, resilient, non-rotating shell having a structure complementary to that of the drum such that the shell is biased into contact with and wrapped partially around the periphery of the drum. The limit of the shell's peripheral contact with the drum is established by the ends of the shell which are transverse to the direction of the drum's rotation and which leave a portion of the drum uncovered to provide access to the facing surfaces of the drum and shell. Typically, a material having a relatively high coefficient of friction, e.g., silicone rubber, is used to form the facing or peripheral surface of the drum, while a material having a relatively low coefficient of friction, e.g., tetrafluoroethylene (sold under the trademark "Teflon"), is generally used for the facing surface of the shell.

In the processing cycle of this type of apparatus, the web material to be processed is inserted into the apparatus between the facing surfaces of a shell and a drum so it can be moved with the drum beneath the shell that partially surrounds the drum and is resiliently urged thereagainst. During this movement, heat is applied to the web either through the shell or the drum, as well as pressure which results from the coaction of the shell and drum to cause the desired processing action to take place. When the web material reaches the trialing transverse edge of the shell, it is removed from the apparatus.

Preferably, predetermined amounts of heat and pressure are applied to the web material for a predetermined time period to carry out the processing cycle. To provide optimal thermal processing with such apparatus, the web should be held against the heated element (drum or shell) with a fairly constant pressure so as to have uniform contact with both the drum and shell. A shell used in apparatus of the above type is partially wrapped around and biased into contact with the rotating drum in an attempt to maintain the desired uniform contact throughout the entire area of contact. Consequently, the shell is made somewhat resiliently flexible to maintain such uniform contact. Further, in order to provide a certain amount of shell resiliency, while preventing rotation of the shell with the drum, one end of the shell is pivotally connected above a fixed axis which maintains that end of the shell in a fixed position relative to the drum. Spring means, acting between the other transverse end of the shell and the frame of the apparatus, urge the shell into contact with the drum.



A major problem arises with such prior art apparatus because, when the shell's leading end is thus fixed and its trailing end is spring-biased, operation of the apparatus produces frictional forces which tend to cause the shell to wrap tightly around the drum, thereby increasing its pressure thereagainst and introducing fractional forces which will depend on the relative coefficients of friction of the shell surface and drum surface. To avoid this tighening effect, the prior art discloses that the shell's ends can be connected in an opposite manner, i.e., with the trailing edge of the shell pivotally fixed and the leading edge spring-biased. However, with this arrangement the frictional forces that are produced tend to cause the shell to move away from the drum, thereby obtaining an effect that is converse to the desired uniform contact. With the aforementioned arrangements, an excessive pressure tends to cause the shell to bind with the drum and insufficient pressure results in wrinkling of the web material and/or inefficient heating thereof.

Further, with both of the prior art arrangements described above, one end of the shell is always in a fixed relation to the drum and, hence, it is not possible to compensate for any variations in web thickness. In addition, thermal processing apparatus is subject to relatively high temperatures, as well as temperature variation, so that further problems are generally created by corresponding thermal expansion and contraction effects. These effects result in changes in the dimensions of the apparatus components and cause them to assume a modified orientation relative to each other. This problem is particularly critical with respect to the fixed, hinged end of the shell, since relatively small movements of this hinged end toward or away from the drum result in relatively large changes in the pressure to which the web is subjected as it passes therebetween.

Still another problem is prevalent in that a heavy load is placed on the drive motor when the drum is driven with no web material between the drum and the shell due to the frictional force generated between the facing surfaces. However, insertion of web material between the drum and the shell generally reduces the aforementioned frictional force because of the much lower coefficient of friction which exists between the web material and the shell and drum so that the load on the motor is reduced. Such variations in load frequently result in large enough changes in the speed of the motor to have detrimental effects on processing cycle time peroids.

## SUMMARY OF THE INVENTION

A primary object of the invention is to provide a thermal processor of the above type wherein a shell mounting arrangement for use in such processor that will minimize the above-described problems, while still retaining the advantages inherent in such apparatus.

Another object of the invention is to provide a "floating" shell-mounting arrangement for use in a thermal processor which permits radial movement of all parts of the shell relative to the drum and providing automatic compensation for variations in web thickness, for variations in the expansion and contraction of component parts

of the web and shell assembly, and for variation in the load on the drive motor.

These objects and others, which will become apparent on reading the following detailed description, are achieved in accordance with the invention disclosed herein by supporting the shell so that it is in "floating" contact with the rotating drum. Such floating contact is achieved by the use of links which pivotally connect the shell to the frame of the apparatus to provide for limited movement of any portion of the shell in a generally radial direction relative to the drum while holding the shell against rotational movement with the drum. These links are preferably attached to the shell at points intermediate its leading and trailing transverse ends, thereby dividing the shell into essentially two zones. Under the effect of friction occurring during operation of the apparatus, in one zone, the shell will tend to more tightly wrap around the drum, while in the second zone, the shell tends to unwrap or loosen. At the same time, the shell is continually urged toward and into contact with the drum by resilient means, e.g., springs, acting between the shell and frame.

## DESCRIPTION OF THE DRAWINGS

The invention will now be described in greater detail with reference being made to the accompanying drawings wherein:

FIG. 1 is a fragmentary perspective view of the web heating apparatus showing a drum and shield arrangement in accordance with the invention;

FIG. 2 is a partial cross-sectional view of the embodiment shown in FIG. 1, including a web of material passing between the drum and shell;

FIG. 3 is a fragmentary perspective view of the shield shown in FIG. 1 and showing the manner in which a link can be pivotally connected to the shield;

FIG. 4 is a rear view of an alternative embodiment of the invention; and

FIG. 5 is a fragmentary perspective view showing the pivotal arrangement for mounting the shield shown in FIG. 4.

## DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, the apparatus comprises a drum **1** mounted on a shaft **3** which is driven by a motor **4** through a suitable coupling designated by the dotted line between said shaft and motor. The ends of shaft **3** are journaled in a frame **5** which comprises a pair of end plates **7** (only one of which is shown). The drum **1** rotates about the axis **9** of the shaft **3** and the peripheral surface **11** of drum **1** is coated with a material having a relatively high coefficient of friction, such as silicone rubber. A resilient, semi-rigid, non-rotatable shell **13** has an interior surface **15** that is coated with a material having a relatively low coefficient of friction, such as tetrafluoroethylene, which is marketed under the trademark "Teflon." The shell **13** is arranged to partially surround the drum **1** with the surfaces **11** and **15** being in facing and contacting relationship, as shown in FIG. 2. Access to the drum **1** and the surfaces **11** and **15** is provided by extending the transverse ends **17***a* and **17***b* of the shell **13** beyond the full width of drum **1** in an axial direction. The exterior surface of the shell **13** can be coated with a material in which heating elements **19** can be disposed to provide a source of heat for a web material **21** which is to be processed by the apparatus.

The web material **21** is inserted between the surfaces **11** and **15** adjacent the leading end **17***a* of the shell **13**. Since the coefficient of friction between the web material **21** and the drum surface **11** is greater than that between the web material **21** and the shell surface **15**, the web material **21** adheres to the surface of the drum **1** and moves therewith subsequently exiting from the apparatus at the trailing end **17***b* of the shell **13**.



In accordance with the invention, the shell **13** is mounted for floating contact relative to the drum **1** in order that the apparatus will operate smoothly when web material **21** is inserted and moved therebetween. Such a mounting means provides more uniform and less extreme pressures and contact than were previously attainable. This mode of obtaining a floating contact is achieved by pivotally connecting the shell **13** to the frame **5** to prevent rotation of the shell **13** with the drum **1** and at the same time permitting limited and generally radial movement of the shell **13** relative to drum **1** throughout its axial length. The mounting means utilized for this purpose comprises a pair of links **23** interconnecting the shell **13** and frame **5**. The links **23** are connected to the frame **5** by means of a rod **25** which is oriented parallel to the axis **9** of the shaft **3** and is attached to the end plates **7** by inserting its opposed ends in a pair of directly opposed holes **27** in the end plates. Each of the links **23** has a looped end **23***a* and is pivotally connected to the rod **25** adjacent its opposed ends, so that the links **23** can swing in a generally vertical plane. The links **23** are attached to the shell **13** by inserting each of their hooked ends **23***b* (FIG. 2, 3) into one of the opposed pair of holes **29** in the shell **13** adjacent each of the side edges **30**. Such attachment of the shell **13** limits its twisting, tilting and pivotal movement relative to the drum **1**.

Biasing means are preferably provided to urge the shell **13** toward and into contact with the drum **1**. Such biasing means comprises tensile springs **31** which are interconnected between rods **33** to which the leading and trailing ends of shell **13** are secured and adjustable anchors **35** located on the end plates **7**. The biasing means can also include compression springs **37** which are arranged between adjustable anchors **39** on the end plates **7** and the shell **13**. While the springs **37** can be located at various selected points relative to the shell **13**, such point should, preferably, be between the leading end **17***a* and the point of attachment of the link **23** to the shell **13**. Accordingly, the shell **13** is then biased into contact with the drum **1** at such selected points.

The shell suspension described above provides automatic compensation for the variable expansion and contraction of parts due to temperature changes occurring during the thermal photographic process as well as for the presence or absence of the web material in the apparatus. Such automatic compensation is smoothly achieved in view of the self-adjusting radial movement, the limited twisting movement, the tilting movement and/or the pivotal movement of the shell **13** relative to the drum **1**. Moreover, the floating connection permits a greater range of web thicknesses to be readily processed than was previously possible.

As noted above, insertion of the web material **21** into the apparatus can result in a considerable variation in the load on the drive-motor **4**. The magnitude of this variation in load is a function of the position of the point of attachment of the links **23** to the shell **13**. Therefore, a plurality of the pairs of holes **27** and the pairs of holes **29** is provided so that alternative points of attachment are available, thereby obtaining optimal operation of the apparatus under various operating conditions. The optimum position of the links **23** for achieving minimum variation in the load does not necessarily coincide with that position at which optimum shell pressures can be achieved. A compromise can be reached by selecting, from the various pairs of available holes, those which will yield, in combination, acceptable pressures and range in variation of load.

In a second embodiment of this invention (FIGS. 4 and 5), the mounting means comprises a fixed member and a pivotal member. A channel member **41**, comprising the fixed member, has a projection **42** extending from each of its opposed ends for insertion in the holes **27** of the end plates **7**. A rod **43**, comprising the pivotal member, is pivotally mounted within the confines of the

channel member **41** by means of a pin **44**, the rod **43** being movable about an axis that is generally perpendicular to that of member **45**. A pair of links **46** are then pivotally mounted adjacent the ends of rod **43**. The complemental structure of this embodiment is similar to that of the first embodiment except that the shell **47** is of a more rigid nature. The second embodiment thereby provides specific means for dividing those forces which are tending to cause rotation of the shell, generally equally between the links. Also, the second embodiment is more appropriately used with a rigid shell than a semi-rigid shell. The semi-rigid shell, as used in the first embodiment of this invention, can divide the rotational forces between the links because of its flexibility. However, a rigid shell is much less flexible and therefore cannot do so. Thus, auxiliary means, as shown in the second embodiment, are desirable to provide this equalizing action.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

**1.** In a thermal processor of the type having a drum mounted on a frame for rotation in a predetermined direction for moving a web of material positioned between said drum and a complementary shaped, non-rotatable, resilient, semi-rigid shell partially surrounding said drum, said shell being heated for subjecting said web material to said heat while being moved between said drum and said shell, the improvement comprising:

connecting means between said frame and said shell for maintaining the latter in floating contact with said drum and web of material;

said connecting means comprising a pair of spaced links pivotally mounted on said frame and engaging said shell for substantially maintaining said shell against rotation in the direction of rotation of said drum while permitting generally radial movement of said shell, toward and away from said drum, throughout its peripheral extent.

**2.** The processor in accordance with claim **1** including resilient means located between said frame and said shell for biasing the latter toward said drum.

**3.** The processor in accordance with claim **1** wherein said frame comprises a pair of spaced, substantially parallel plates and mounting means arranged therebetween and spaced from said shell with each end of said mounting means engaging one of said plates and wherein each of said links is pivotally mounted on said mounting means adjacent one of said plates.



**4.** The processor in accordance with claim **3** wherein said mounting means comprises a fixed member which is disposed between said plates in spaced and parallel relation to said drum and a pivotal member which is pivotally connected intermediate its ends to said fixed member for movement in the generally vertical axial plane of said fixed member, said links being pivotally mounted in said pivotal member.

**5.** The processor in accordance with claim **3** wherein said shell has a leading and a trailing end both of which extend transverse to the direction of rotation of said drum, one end of each said links being selectively connectable to said shell at any one of a plurality of positions about its periphery and intermediate said leading and trailing ends, and each end of said mounting means selectively engages one of said plates at any one of a plurality of positions.

**6.** The processor in accordance with claim **5** including resilient means arranged between said frame and the leading and trailing ends of said shell for radially biasing said shell into contact with said drum.

**7.** The processor in accordance with claim **6** wherein said resilient biasing means includes spring means arranged between said frame and said shell and engaging the latter between its leading end and its point of attachment with said links for radially urging said shell toward said drum.

**8.** The processor in accordance with claim **3** wherein each of said plates is provided with a plurality of serially disposed holes for receiving a respective end of said mounting means, whereby said mounting means can be positioned selectively relative to said holes and to said shell.


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