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[54] **AUTOMATIC ASSEMBLY MACHINE FOR FILM CARTRIDGES**

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[52] **U.S. Cl.** ..... **29/211 D**, 29/208 D, 29/200 B

[51] **Int. Cl.** **B23q 7/10**, B23p 19/04

[58] **Field of Search** ..... 29/208 D, 200 B, 29/430, 211 R, 211 D

[56] **References Cited**

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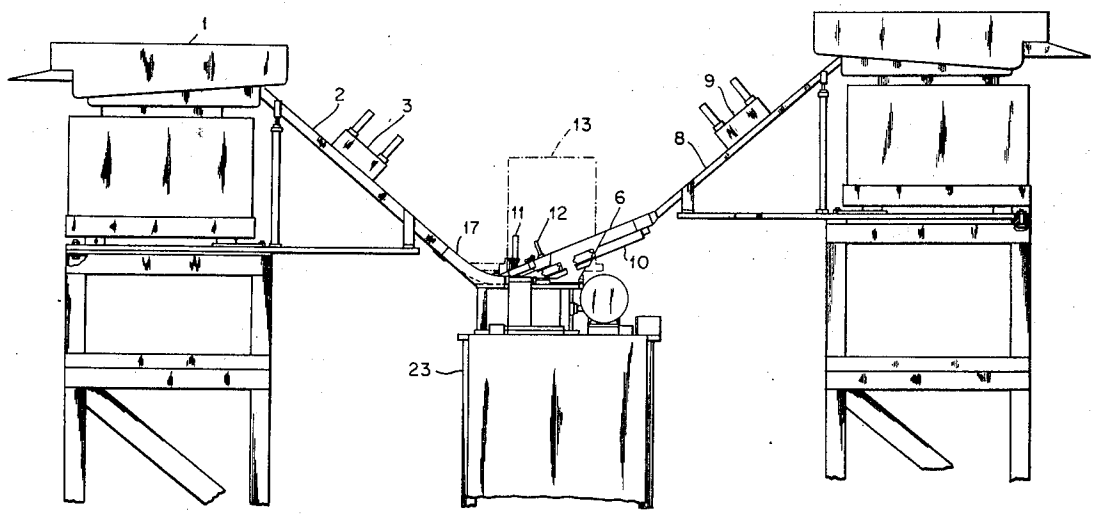
[57] **ABSTRACT**

A film cartridge assembly and loading apparatus in which a scroll of film and paper backing are automatically taped to a spool and fitted into a suitable cartridge body and cover unit. The apparatus includes two principal assembly units; the first for pre-assemblying the cartridge body and cover and the second for inserting a scrolled film and paper spool into the cartridge and ultrasonically sealing the cartridge. A notcher, labeler and torque-testing apparatus are included as part of the present invention.

8 Claims, 5 Drawing Figures



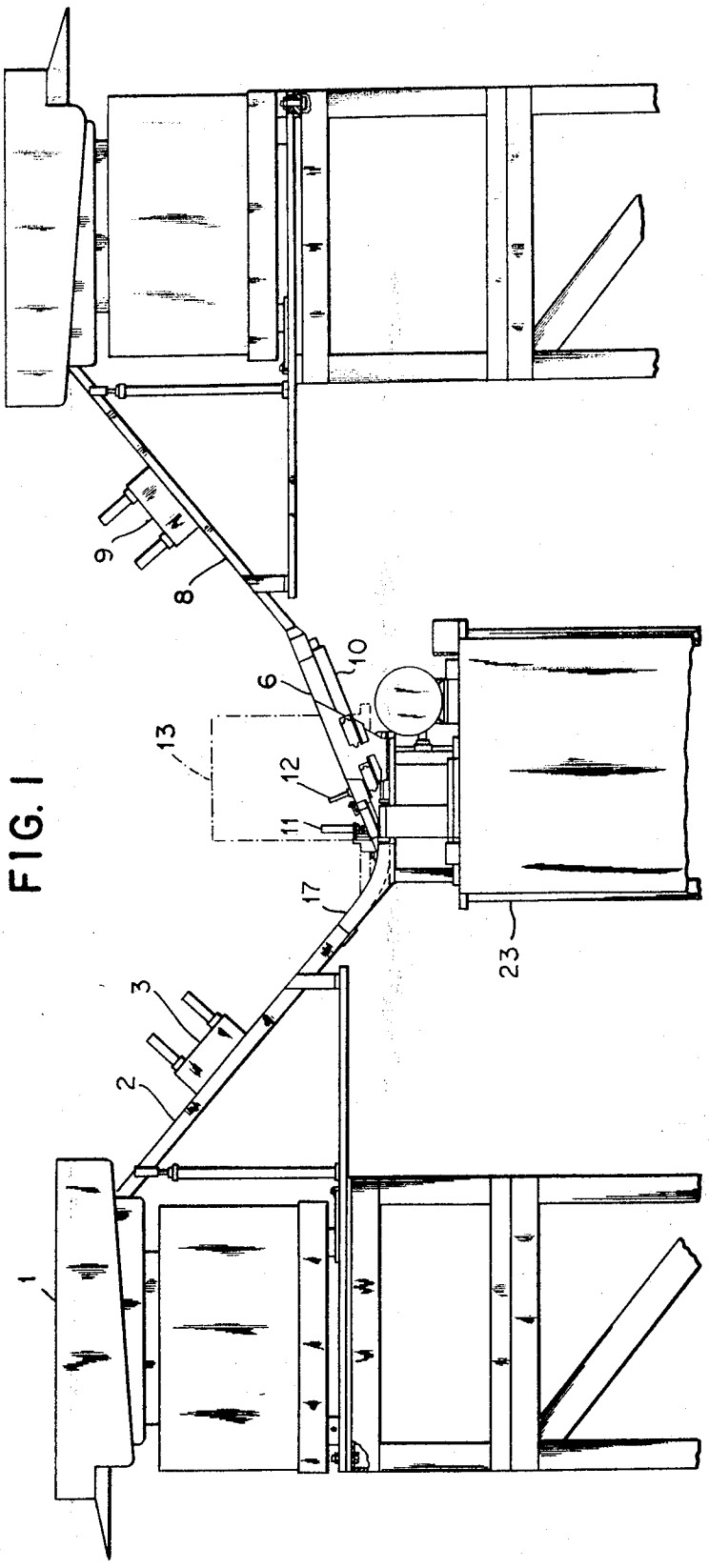
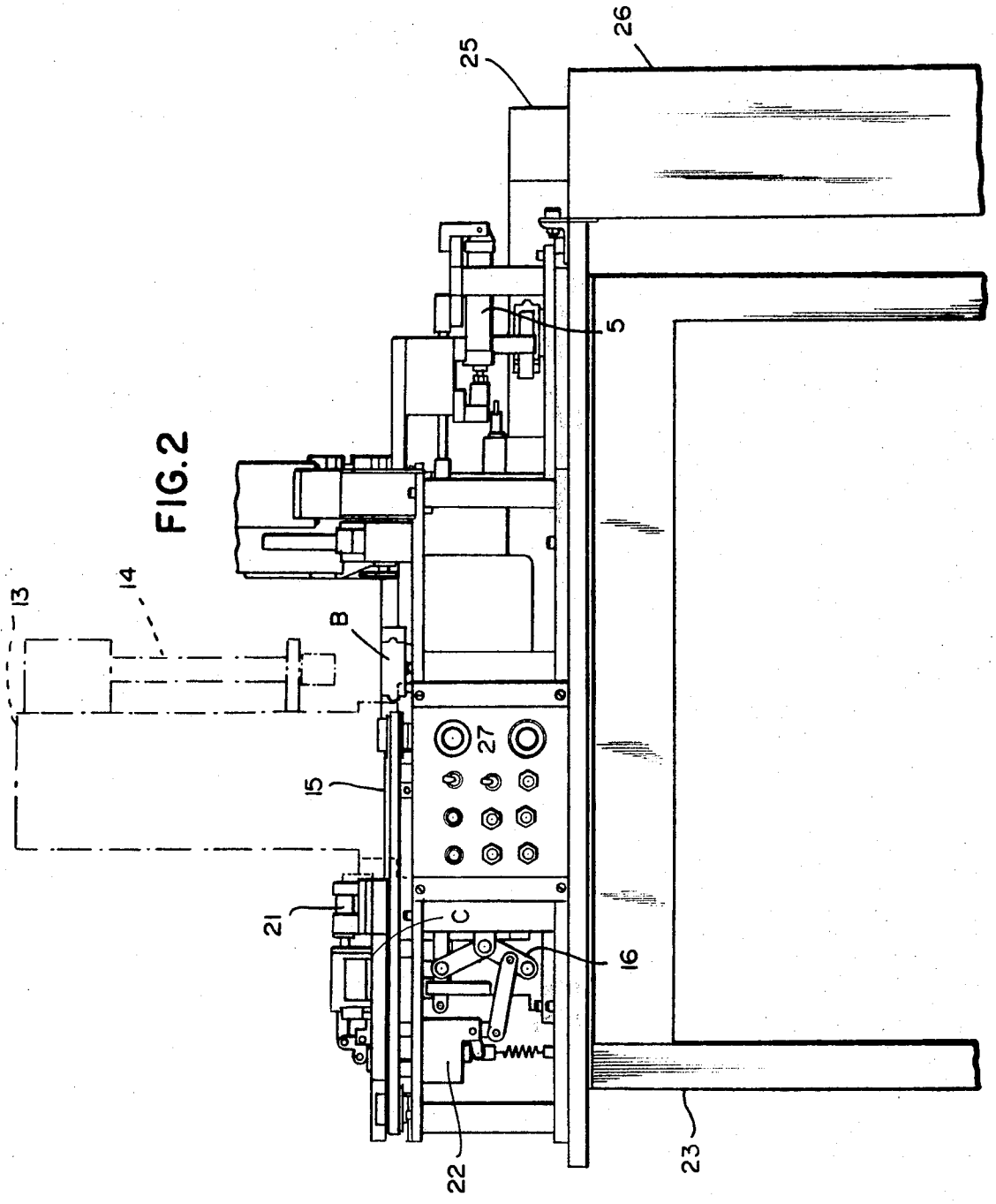


FIG. 1

FIG.2



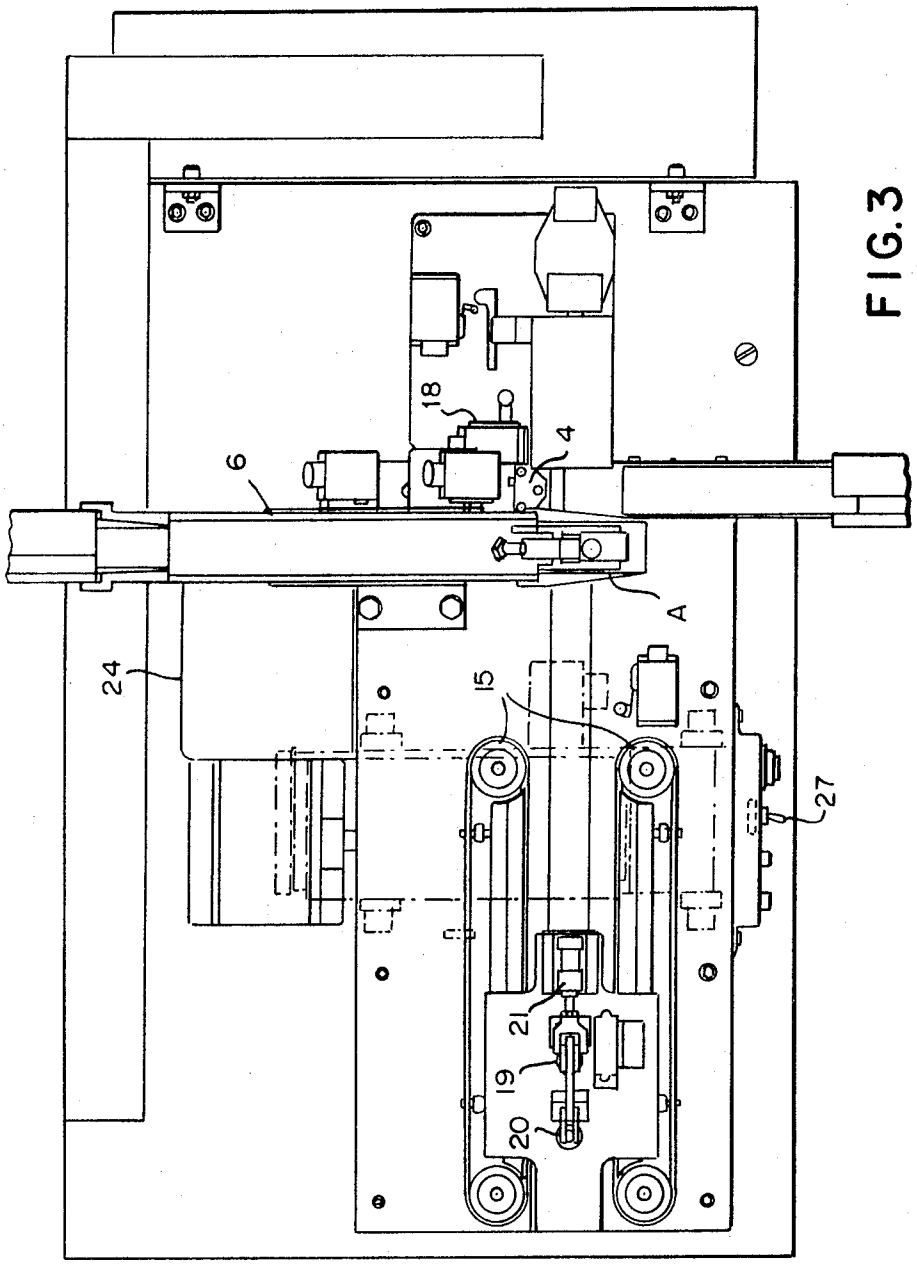


FIG. 3

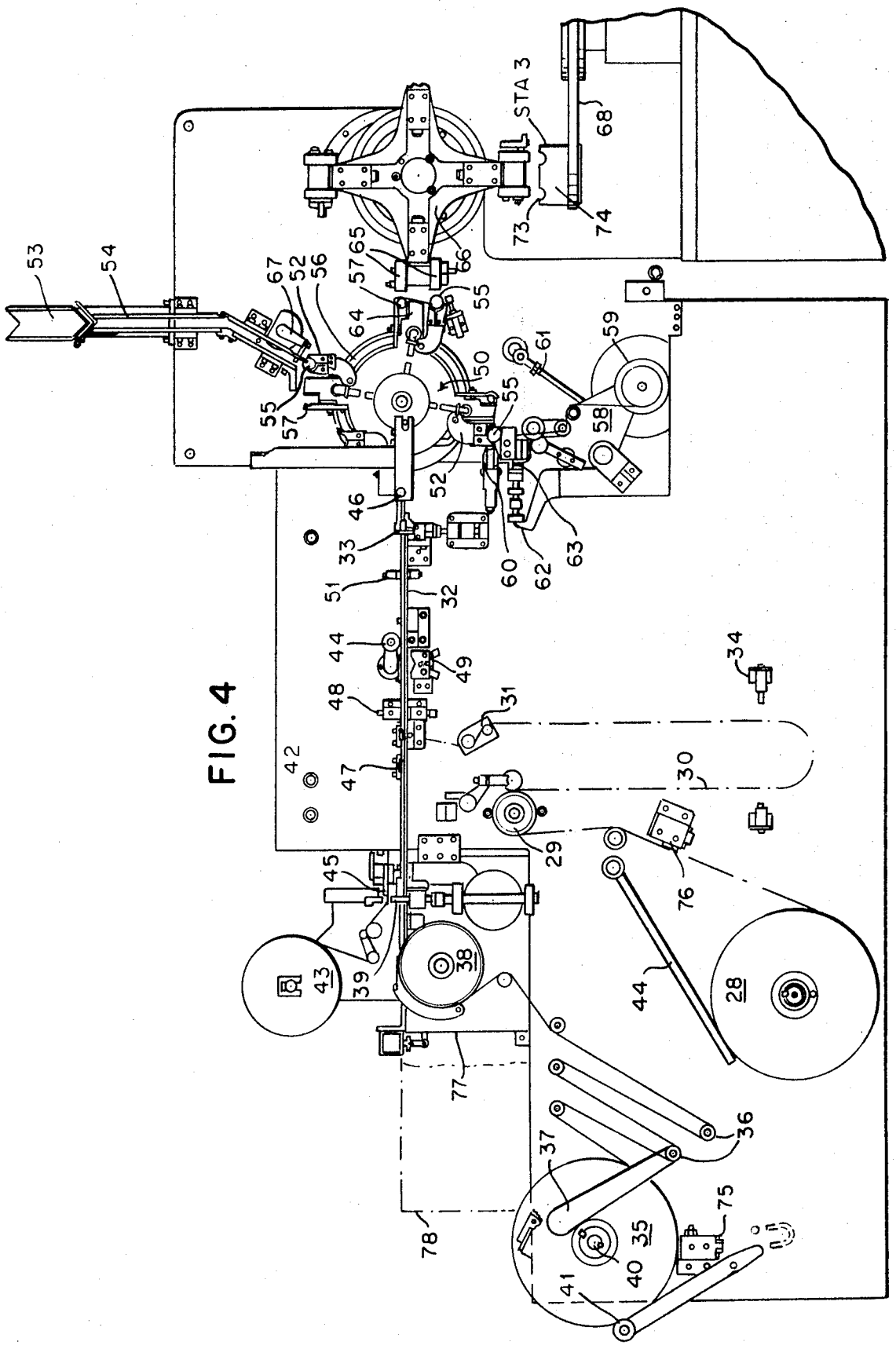

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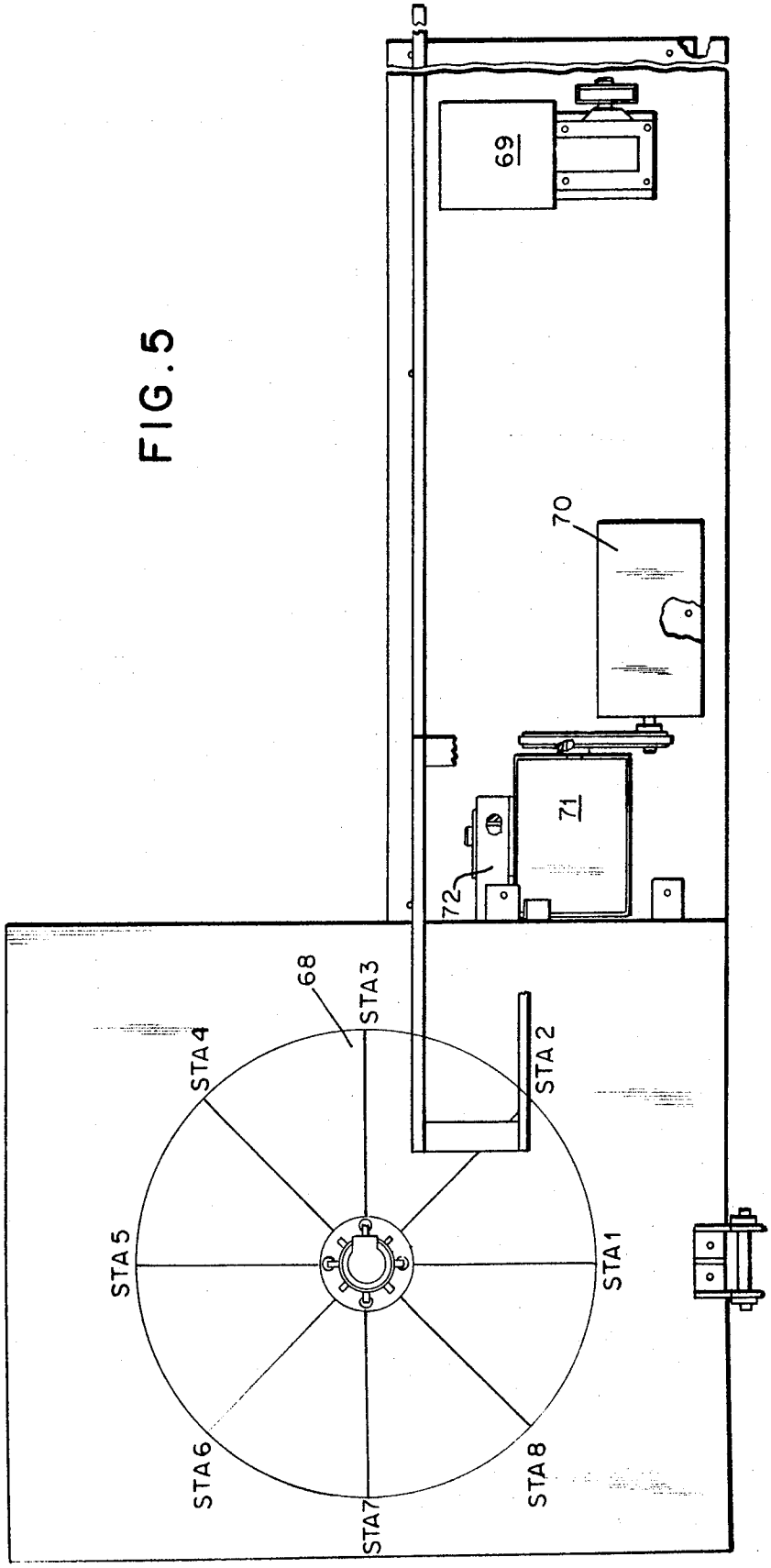
FIG. 4

FIG. 5



AUTOMATIC ASSEMBLY MACHINE FOR FILM CARTRIDGES

The present invention is directed to an improved apparatus for automatic manufacturing of photographic film cartridges.

The film cartridge as mentioned hereinafter is of a functional construction consisting of 3 parts which may be constructed preferably of plastic. Included in the cartridge assembly is a spool, a cover and a body encasing the spool and cooperating with the cover. A scroll of film and paper backing are taped to such spool. The present invention includes a first and second assembly unit which serve to automatically place the cover on the body of the cartridge after which a label is adhered to the cover. A conveyor system transports the cartridges in that condition through a light-lock conveyor to a second assembly unit which lifts the cover, inserts the scroll of paper, film and spool, replaces the cover and seals the cover to the body. At the same location, inspection of the cartridge takes place and rejects of defective cartridges are discharged.

By way of background, prior known apparatuses to manufacture film cartridges have had several inherent defects. In particular, they have been quite complicated to operate necessitating a number of operators with a high level of competence. In addition, such prior machines have been expensive to construct and maintain and were slow in their overall operation.

For an example, it is known that some cartridge assembly apparatuses require 8 film tracks, 8 paper tracks, 8 sealing nests and at least three skilled operators to control manufacturing operations.

Another prior art apparatus requires a first operator to manually place the scroll and spool combination into the body and still a second operator to manually place the cover on the body and a third operator to label, notch and torque test the cartridge.

A technical shortcoming in prior art cartridge assembly apparatuses is related to the inability of the assembly machine to seal the cartridge while simultaneously being able to maintain a proper focal plane so as to produce a sharp picture when the cartridge is used in a camera.

Accordingly, it is a main object of the present invention to provide an apparatus for film cartridge manufacture which overcomes the disadvantages of the prior art.

Another object of the present invention is to provide an improved and simple way to operate apparatuses for loading film cartridges.

A further object of the present invention is to provide an improved apparatus for assembling cartridges having a supply of film and paper and take-up spools which are mounted on opposite sides of the cartridge.

Still another object of the present invention is to provide a high-capacity, automatic film cartridge loading apparatus.

Another object of the present invention is to provide an improved arrangement for combining the manufacture of cartridges together with film loading and sealing of a final film cartridge.

Other and further objects of the invention will be obvious upon understanding of the illustrative embodiment about to be described or will be illustrated in the appended claims and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings forming part of the specification wherein:

FIG. 1 is an end elevational view of the body and cover feeders coupled into the First Assembly Unit of the apparatus.

FIG. 2 illustrates a front view of the First Assembly Unit of the apparatus.

FIG. 3 shows a plan view of the First Assembly Unit.

FIG. 4 is the front view of the Second Assembly Unit.

FIG. 5 illustrates a top view of a section of the Second Assembly Unit.

The entire apparatus of the present invention consists of two units. A First Assembly Unit and A Second Assembly Unit. The primary function of the First Assembly Unit (FIGS. 1–3) is to provide a pre-assembled cartridge ready for film loading on the Second Assembly Unit (FIGS. 4–5), the latter unit being located in dark light. Once the cartridges are pre-assembled, on the First Assembly Unit, they are transported to the Second Assembly Unit by a conveyor belt system moving through a light lock.

The light-lock system is installed in a partition separating both units of the apparatus and allows the empty pre-assembled cartridges to be transported to the Second Assembly Unit.

The entire apparatus is designed to function in a continuous and sequential manner, that is, the pre-assembled cartridges flow into a conveyor system and are received at a pre-selected rate commensurate with the rate of the Second Assembly Unit in the adjacent dark room.

The principal features of the present invention are directed to a film cartridge assembly and loading apparatus including, a first unit adapted to position a film cartridge body and a cover thereon; a second unit including a film and paper feeding means; a cutting means, a scrolling means adapted to scroll a predetermined length of photographic film and paper, means for inserting said spool-scroll assembly into said cartridge and means for ultrasonically welding a cartridge cover and body while still maintaining the proper focal plane.

More specifically, the film cartridge assembly and loading apparatus includes a first unit storage means for storing said cartridge bodies in a manner permitting such bodies to enter one at a time by gravity onto a feed track means including a table, said table having a locating nest for positioning said cartridge body at a designated location, circuit means to detect the presence of a cartridge body in said nest, a first air cylinder means responsive to the presence of said nested cartridge body for transferring said cartridge body to a cover loading station, cover loading means for guiding said cartridge cover onto said body, slide means to receive said cover in a detented position as it moves to the forward area of said track, a second air cylinder means adapted to direct said slide and cover down said track into a position above the nested cartridge body, a third air cylinder means above said cartridge cover adapted to retain said cover on said cartridge body to form a cover-cartridge body combination until said slide is in the full retracted position, and electrical circuit means for energizing a conveyor means to direct said cover-cartridge-body combination to another area for further work.

FIRST ASSEMBLY UNIT

According to FIG. 1, cartridge bodies are placed at random into the cartridge body feeder 1 by an operator and are automatically oriented and guided into a gravity feed track 2. Several bodies proceed to move into the upper portion of the feed track 2, above the escapement 3, until a sensing unit (not shown) deactivates escapement 3. The bodies are released into the lower portion of the feed track 2, one at a time. A maximum number of five bodies in the lower portion of the feed track has been found to be quite satisfactory for production runs. Every time a cartridge body has been delivered for pre-assembly a signal is sent to escapement 3 to release another body.

Cartridge covers are placed at random into the cartridge cover feeder 7 by an operator and are automatically oriented and guided into a feed track 8. As several covers proceed to move into the upper portion of the feed track 8, above the escapement 9, another sensing unit (not shown) deactivates escapement 9.

A maximum number of four covers in the lower portion of the feed track has been found to be quite satisfactory for production runs. A signal is sent to the escapement 9 to release another cover everytime a cartridge cover has been put on a body.

Once the cartridge body leaves the lower track 17, it travels into a nested position directly under a photocell 4, FIG. 3, which signals indexing air cylinder 5, FIG. 2. Next, the cartridge body is transported via a pusher unit (activated by the air cylinder 5) to a cover loading station A (shown in FIG. 3). The cartridge bodies in the lower portion of feed track 17 are held back by the pusher unit until such pusher is retracted. Up until that time, additional cartridge bodies cannot be fed into the machine to be worked upon.

At the cover loading station A, the cartridge body is underneath the cover loader 6. A limit switch 18 actuated when the pusher unit is fully extended signals that a cartridge body has arrived at the cover loading station A and also signals the pusher unit to retract When a second signal is received by still another air cylinder 10 on the l loading mechanism 6, a cover is transported into position over the top of the cartridge body at Station A. A slide mechanism (not shown) moves the cover into position directly over the nested cartridge body and and air cylinder 11 positioned over the cover is extended. The cover is now held in position on the body until the slide is fully retracted. After the slide is retracted, other cartridge covers in the loading mechanism 6 are prevented from moving by a spring-loaded detent (not shown). Air cylinder 12 on top of the cartridge cover loading mechanism 6 acts in combination with a hole in the cartridge cover to prevent movement of the other covers in the track when the slide retracts. When the next cartridge body is pushed forward the now-assembled body and cover is moved to the labeling Station B, which includes a labeling apparatus 13 for dispensing pressure-sensitive labels received from a continuous reel. Such labels are fed out individually and held in position by a vacuum. The label is directly underneath the labeling placing head 14.

This labeling head reciprocates on demand and places a label in position with a light downward force and the label adheres to the cartridge top at the moment the vacuum is released. The head 14 completes its cycle and returns ready for the next cycle. When the next cartridge body is pushed forward the now-labeled cartridge is transferred into a pair of constant speed escape belts 15. These belts 15 serve the dual purpose of transferring the cartridge to a notching mechanism 16 and also allows time for the notching mechanism 16 to complete its cycle before another cartridge reaches the notching mechanism.

The notches are for identification purposes. Such notches are on each side of the cartridge, one is a speed notch used in conjunction with certain cameras for setting the speed of the camera in cooperation with the type of film being used.

When the cartridge-cover assembly reaches the notching Station C, a limit switch is actuated which activates a single revolution clutch to drive the notching mechanism 16. One revolution of the clutch causes the notching mechanism 16 to notch the cartridge and return to its starting position. During the notching cycle, the cartridge slips on the belts. After the cartridge leaves the notcher it moves to a second pin 20 which is already lowered. A parallel linkage arrangement activated by air cylinder 21 allows the two pins 19 and 20 to lower at the same time. The signal from a limit switch actuated near the end of the notching cycle causes the air cylinder 21 to retract the pins 19 and 20 and release the cartridge that has been notched so that it moves until it contacts the second pin. The interval of time it takes the cartridge to reach the second pin is sufficient to allow the air cylinder 21 to lower the pins 19 and 20 and entrap one cartridge between the two pins. The same linkage that operates the notching mechanism 16 also functions in conjunction with a probe 22. The notching mechanism 16 is actually performing two independent operations simultaneously, that is notching at one location and probing for a notch at the second. The probe 22 checks to determine whether or not a notch exists, i.e., it senses the presence or lack of a notch. In the event such probe fails to detect a notch, the pre-assembly unit stops until the operator corrects this condition. The probe is a miniature limit switch that is able to sense in a straight line and make contact in the area of the notch. The switch cannot be depressed if a notch is present.

If the cartridge is notched properly, pins 19 and 20 retract and allow the belt 15 to discharge the notched cartridge onto a conveyor. As the cartridge moves from the belts 15 to the conveyor (not shown) a fixed guide causes the cartridge to shift 90° from a side to side position to an end to end position.

The entire apparatus as is described above, is supported on a frame 23 and a motor 24 is employed to drive the belts and the notching mechanism 16.

The electrical circuitry is all within a control box and rectangular duct sections 25 terminate in the control panel 26 for convenience and compactness. The unit is automatically stopped and the appropriate alarm light is lit on Control Station 27 whenever a cover or a notch is missing. An on-off power switch with a toggle switch to deactivate the pusher are also located on Station 27.

SECOND ASSEMBLY UNIT

The scroll of paper and film is wound at position 46 shown in FIG. 4.

First the paper from roll 28 is threaded over a drive roll 29 into a free loop 30, and thence over snubber 31 and into the film-paper track 32 to the paper cut off knife 33. A photocell and light source 34 control the

paper loop **30**. When the paper is being scrolled, the loop becomes shorter until it fails to break the light beam. At this time, the photocell energizes an electric clutch which drives roll **29** to feed out paper until the light beam is broken again.

Film **35** is threaded over rollers, **36** on loop arm **37** and over the film feed sprocket **38** to the film cut-off knife **39**. The loop arm **37** in cooperation with a mechanical brake and an electrical brake, neither shown, on spindle **40** controls the film tension during starting, running and stopping of the drive sprocket **38**.

When the sprocket **38** is started arm **37** moves up, gradually releasing the mechanical brake on spindle **40** to maintain constant film tension. When the sprocket **38** is stopped the momentum of the roll of film **35** continues to feed film causing the film tension to decrease and arm **37** to lower increasing the mechanical braking on spindle **40**. If arm **37** reaches the bottom of its mechanical travel, which happens only occasionally, a limit switch is actuated which applies the electric brake. A follower roller **41** keeps the outer convolutions of film from falling off the supply roll.

Feeding the first strip of film is initiated by pressing pushbutton **42**. This energizes a one revolution clutch which drives the sprocket **38** to advance the film and at the same time feeds a length of pressure sensitive tape from roll **43** through the knife **39**. The end of the film is advanced just past the open pinch rollers **44**. After the sprocket makes one revolution, another one revolution clutch is energized which through cams causes the knife to (1) rise, (2) cut the tape, (3) lower with one end of the tape adhering to the top of the knife, (4) cut the film, and (5) deposit the loose end of the tape on the film. A pressure pad **45** following the knife presses the loose end of the top onto the film and strips the other end from the knife as the knife returns to its normal position. After stripping the tape, the pressure pad returns to its normal position. After the film knife and pressure pad complete their cycle, the pinch rollers **44** are closed on the film and paper.

The winding of the first scroll is initiated by pressing a pushbutton, not shown, which energizes a one revolution clutch to drive the pinch rollers **44**. The pinch rollers advance the paper from the knife **33** to the scrolling position **46**. Just before the pinch rollers complete one revolution, a limit switch is actuated which inserts the vacuum spindle at scrolling position **46**. When the spindle is fully inserted, another limit switch is actuated to start the D.C. scrolling motor that drives the spindle to scroll the paper and film. When the tape, sitting at right angles on the film, passes between the photocell and light source **47**, the pinch rollers **44** are opened and the next film feed cycle is initiated by energizing the one revolution clutch which drives sprocket **38**. The tape must not be fastened to the paper until it is in the scroll. If the pinch rollers were not opened they would press the tape to paper and the tape would wrinkle when it entered the scroll.

Both the film **35** and the paper **28** have been perforated along one edge on other equipment. In addition, a hole has been pre-punched in the middle of each paper strip. When this round hole is detected by photocell and light source **48** the scrolling motor and spindle go from a fast to a slow speed. When the first paper perforation after the round hole is detected by photocell and light source **49** the scrolling motor and spindle are stopped, the spindle is retracted and the paper knife **33** is actuated. The next scrolling cycle is initiated by a limit switch actuated as soon as turret **50** completes its next 90° index.

Proper registration between the perforations in the paper and the perforations in the film is determined by the physical location of photocell **49** and maintained by the repetitive operation of the aforementioned controls.

Photocell and light source **51** check the registration of the perforations in the paper and the film. If they are not in registration, photocell **51** will stop the Second Assembly Unit and illuminate a legend called "Registration." The operator then throws this scroll away and restarts the machine.

Spools are fed to the spool fingers **52** on turret **50** from a vibratory bowl feeder by an inclined trough **53** and a vertical trough **54** and released one at a time by escapement **67**. When turret **50** indexes, the spool **55** is forced into spring-loaded fingers **52**. Movements of the spool fingers relative to turret **50** are controlled by cam **56**. The scrolls are wound in scroll fingers **57** on tureet **50** at position **46**. While turret **50** is indexing spool tape unit **58** is triggered and feeds out approximately 2½ inches of pressure sensitive tape from roll **59** in front of the taping fingers **60**. When turret **50** has completed its index, the spool tape applicator is pulled up by eccentric arm **61** so that the fingers **60** slide over the tape and the spool held in fingers **52**. Before the fingers press the tape to the paper tail a fixed cam plate **62** pulls the tape knife **63** down to cut the tape. This insures that the tape is not severed before the tape is partially applied. The tape unit **58** is cycled by arm **61** and returns to its normal position before turret **50** indexes.

All the mechanical motions described so far for the Second Assembly Unit except turret **50** and the D.C. scrolling motor are driven by motor **69**, FIG. **5**.

Turret **50**, turret **66**, and the final assembly table **68** are driven in synchronism by the same motor **70**, gear box **71**, belt **72** (FIG. **5**) and a commercially available indexing mechanism not shown.

After turret **50** indexes, the spool-scroll **55** and **64** are transferred from fingers **52** and **57** to jaws **65** on turret **66**.

After turret **66** indexes, the jaws **65** are lowered and then opened after the spool-scroll has been inserted into the cartridge body **73** at Station **3** on the final assembly table.

The sequence of operation of the final assembly table as it indexes from one station to the next (FIG. **5**) is as follows:

Station **1**

Cartridges assembled, labeled and notched on the First Assembly Unit and arriving on the dark light conveyor from the light lock, not shown, are loaded into nest **74** one at a time.

Station **2**

The cover is lifted by vacuum.

Station **3**

The spool-scroll is inserted into the cartridge body.

Station **4**

The cover is placed on the body.

Station 5

The cover and body are ultrasonically sealed together. At this station, a welding nest rises through an opening in plate **68** and cartridge nest **74** and lifts the cartridge against a spring-loaded ultrasonic welding horn. After the welding cycle is completed the sealed cartridge is lowered until it is again resting in nest **74.** By using one welding nest, the focal plane for each cartridge is more precisely held than if eight nests were used as would be the case if each cartridge was welded in nest **74.**

Station 6

The cartridge is torque tested. The maximum amount of torque desired is set by adjusting the current to a magnetic particle clutch driven by a small A.C. gear motor. When the cartridge arrives at this Station the torque tester is lowered and a drive shaft extended to engage and rotate the spool. A photocell is mounted above the hole in the cartridge cover and a light source is mounted below the cartridge. If the photocell at first does not see light because the paper is between the photocell and light source and then sees light as the hole in the paper (previously described in conjunction with photocell **48** in FIG. **4**) passes the hole in the cartridge, the cartridge is accepted by the torque test. Passing the torque tests indicates three things: (1) the torque required to advance the paper and film is less than the torque available in cameras to advance the film and paper, (2) the cartridge is not empty and (3) the paper is taped to the spool.

Station 7

Cartridges not accepted by the torque tester at Station **6** are rejected.

Station 8

Acceptable cartridges are unloaded by vacuum into storage boxes.

The majority of the mechanical motions on the final assembly table are operated by cams driven from the indexing mechanism. The other motions required are obtained from a bank of cam switches operating solenoid valves which in turn operate air cylinders. The cam switches are driven by the indexing mechanism to maintain synchronism with the rest of the Second Assembly Unit.

To help the operator run the Second Assembly Unit or to prevent damage to the Unit, controls have been added to automatically stop the machine and illuminate legend plates whenever undesirable conditions occur. These conditions are: (1) film supply used up — initiated by limit switch **75,** (2) paper supply used up — initiated by limit switch **76** (3) film tape used up — initiated by photocell **47.** Photocell **47** will also stop the unit if for any reason there isn't a piece of tape on the end of the film, (4) spool tape used up — initiated by a photocell not shown, (5) no spool — initiated by photocell not shown, (6) no registration initiated by photocell **51,** (8) no vacuum — initiated by a vacuum switch in the supply line, (9) no cartridge or cover at Station **2** — initiated by a limit switch not shown, (10) spindle not retracted before turret **50** indexes — initiated by a cam switch, not shown, (11) no unload initiated by a photocell, not shown and (12) no compressed air initiated by a pressure switch in the supply line.

The Second Assembly Unit can be converted from assembling 12-exposure film cartridges to 20-exposure cartridges by replacing the 12-exposure film feed unit **77** with a 20-exposure film feed unit **78,** and lengthening track **32.** No other change is required in the Second Assembly Unit and no change is required in the First Assembly Unit to convert from 12 to 20-exposure cartridges except the roll of labels.

The apparatus of the present invention provides an automatic and highly-efficient arrangement for the assembly of film cartridges per se, as well as a film-loading phase which enables the entire assembly and loading step to be performed by only two operators. This present apparatus provides for efficient, rapid and accurate loading of film into cartridges with minimum of personnel and minimum of skills required to perform the operation successfully.

It will be apparent to those skilled in the art from the preceding description, that certain changes may be made in the above apparatus without departing from the scope of the invention. It is intended that the descriptive matter above shall be interpreted as illustrative and in no way limiting, since all equivalents within the scope of the disclosure may be substituted and such substitution is intended.

What is claimed is:

1. A film cartridge assembly and loading apparatus including:

a first unit adapted to position a film cartridge body and a cover thereon;

a second unit including a film and paper feeding means; a cutting means, a scrolling means adapted to scroll a pre-determined length of photographic film and paper, means for inserting said spool-scroll assembly into said cartridge and means for ultrasonically sealing a cartridge cover and body while still maintaining the proper focal plane.

2. A film cartridge assembly and loading apparatus as claimed in claim **1,** wherein;

said first unit includes storage means for storing said cartridge bodies in a manner permitting such bodies to enter one at a time by gravity onto a feed track means including a table, said table having a locating nest for positioning said cartridge body at a designated location, circuit means to detect the presence of a cartridge body in said nest, a first air cylinder means responsive to the presence of said nested cartridge body for transferring said cartridge body to a cover loading station, cover loading means for guiding said cartridge cover onto said body, slide means to receive said cover in a detented position as it moves to the forward area of said track, a second air cylinder means adapted to direct said slide and cover down said track into a position above the nested cartridge body, a third air cylinder means above said cartridge cover adapted to retain said cover on said cartridge body to form a cover-cartridge body combination until said slide is in the full retracted position, and electrical circuit means for energizing a conveyor means to direct said cover-cartridge-body combination to another area for further work.

3. A film cartridge assembly and loading apparatus as claimed in claim **2** wherein said cover is held in position by a slide arrangement until such slide is fully retracted to prevent further advance of additional slide covers

through the action of an air cylinder entering a hole in said cartridge cover.

4. An apparatus as claimed in claim **3** including:

A labeling means for placing a label on said cartridge assembly, constant speed escape belt having an indexing air cylinder means for receiving said cover-cartridge body assembly, said belts being adapted to transfer said cartridge assembly to a notching means where said cartridge is notched in a pre-designated manner and immediately thereafter tested for the presence or absence of said notches, and transport means for transporting said notched cartridge assembly into a light-lock chamber for insertion therein of a scroll of film and paper.

5. An apparatus as claimed in claim **4** wherein the presence of a notch in said cartridge assembly is detected by a limit switch.

6. An apparatus as claimed in claim **1,** including:

means for controlling a pre-determined amount of film and backing paper, an arm control assembly for controlling the tension of said film being drawn from a roll, a tape dispenser means for dispensing tape to attach said film to said paper backing; a scrolling means for combining said film and paper combination into a coreless scroll; a spool feeding means adapted to advance an empty film spool to a position where a pre-selected length of tape is automatically applied to said paper scroll and spool to form a scroll-spool combination; a track means for maintaining registration between said film and paper, means for inserting said scroll-spool combination into a cartridge body, a sealing means for ultra-sonically sealing said loaded cartridge cover and body, and torque-testing means for applying a pre-established torque on the film paper and tape-spool combination.

7. An apparatus as claimed in claim **1,** wherein film tension is governed by a mechanical brake in cooperation with a loop arm controlled by a spindle such that a decrease in film tension causes said arm to lower its position of travel resulting in added film feed out.

8. An apparatus as claimed in claim **7** including photoelectric light-sensing means for sensing the presence of film and paper registration.

* * * * *

Disclaimer

3,748,715.—*James E. Hoover,* Binghamton, *Robert W. Houser,* Vestal, and *Bernard C. Sheffer,* Binghamton, N.Y. AUTOMATIC ASSEMBLY MACHINE FOR FILM CARTRIDGES. Patent dated July 31, 1973. Disclaimer filed Sept. 30, 1982, by the assignee, *Eastman Kodak Co.*

Hereby enters this disclaimer to all claims of said patent.

[*Official Gazette March 22, 1983.*]