July 8, 1969 G. L. WIEDERHOLD 3,453,681

CLEANING APPARATUS

Filed Aug. 14, 1967

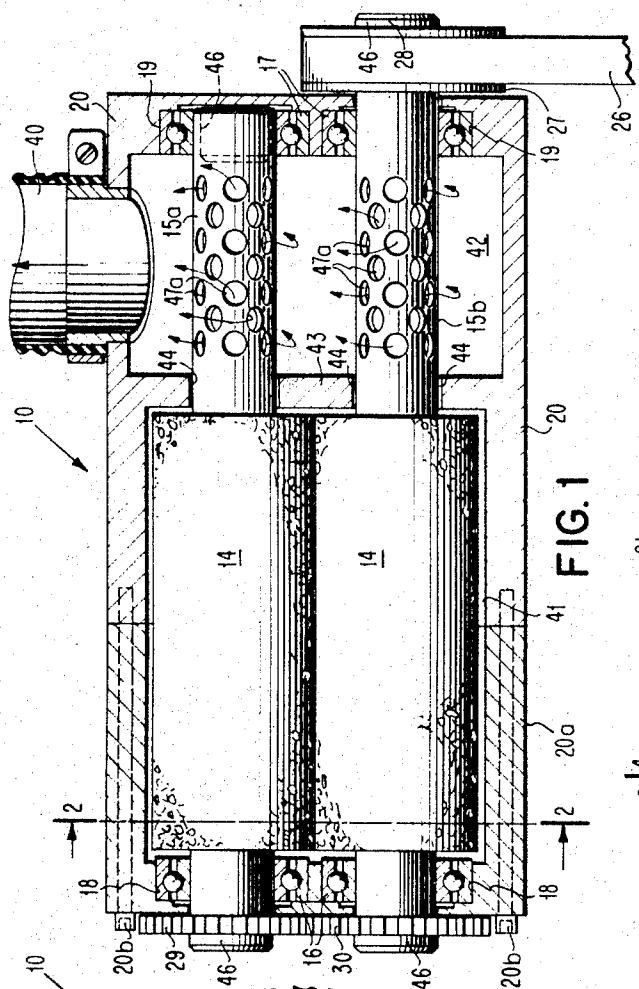


FIG. 1

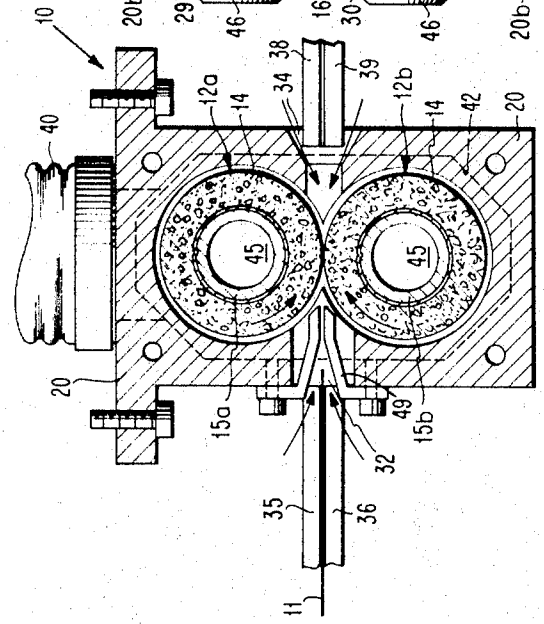


FIG. 2

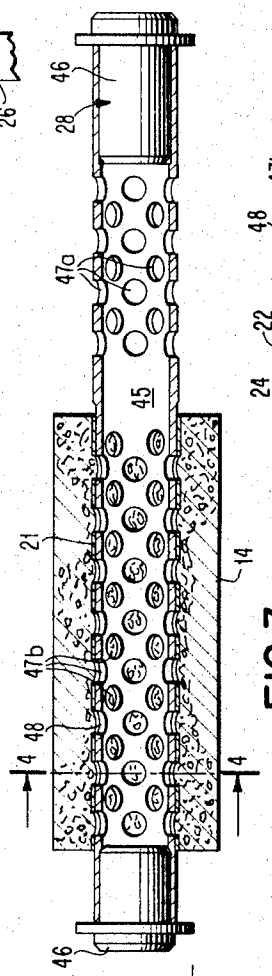


FIG. 3

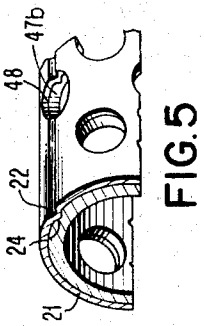


FIG. 5

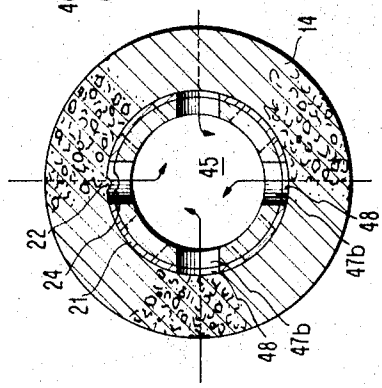


FIG. 4

*INVENTOR*

GERALD L. WIEDERHOLD

BY Gerald L Moore

ATTORNEY

United States Patent Office

3,453,681
Patented July 8, 1969



3,453,681

# CLEANING APPARATUS

Gerald L. Wiederhold, San Jose, Calif., assignor to International Business Machines Corporation, Armonk, N.Y., a corporation of New York

Filed Aug. 14, 1967, Ser. No. 660,401
Int. Cl. A47l 7/02; G03d 13/00
U.S. Cl. 15—306 3 Claims

## ABSTRACT OF THE DISCLOSURE

Apparatus for cleaning strip material including a power rotated roller positioned to contact the material when relative movement is effected therebetween with the roller having a porous exterior surface and means for drawing fluid radially through the roller surface to carry away any foreign matter dislodged from the strip surface.

## BACKGROUND OF THE INVENTION

### *Field of the invention*

This invention relates generally to surface cleaning apparatus and more particularly to such specialized cleaning apparatus for cleaning photographic film or other materials to remove dust, fluid or other such foreign matter.

### *Description of the prior art*

In such fields as data recording where coded information is stored at very high densities on photographic film, it is imperative that the film surface be clean and free of foreign matter during both the recording and readout operations. During recording, the information is stored by the use of scanning radiant energy beams such as electron beams which are modulated in accordance with a digital data signal. Naturally, any foreign material on the surface of the film can disrupt the recording process by intercepting or otherwise adversely affecting the operation of the beam. At the densities which the data is recorded, even small particles of dust can blot out a significant amount of data.

In one known process, the film is developed by a standard wet developing process and is read by passing a light beam through the film to be modulated by the light and dark portions of the film. If it is desired to reread the film immediately to check the recording process, the film must be wiped clean of any fluid which may remain as the result of the developing process because such fluid can affect the transparency of the film and interrupt the reading process.

Naturally, it can also be appreciated how dust on the film surface can cause an erroneous reading of the data recorded. Experience has shown that the application of pressured air or mechanical wiping alone usually will not clean the film sufficiently for the purpose heretofore described. Various attempts have been made in the past to provide satisfactory cleaning apparatus. However, the problems are greatly complicated when it is necessary to remove foreign matter having dimensions of twenty-



five microns or less since such particles must not only be physically dislodged from the surface, but must also be carried away before they can settle back onto the surface. Particles this size lie within the boundary layer of circulating air and thus are difficult, if not impossible, to dislodge from the surface without some form of mechanical wiping. Also in the case of removing liquids from films, the liquids adhere to the surface and are not removable by air except by utilizing the relatively slow evaporating processes. To complicate the cleaning task even further, static charges frequently work to hold or attract the matter onto the film surface.

Therefore, the primary object of this invention is to provide in improved cleaning apparatus to remove foreign matter from the surface of photographic film or the like.

A further object of this invention is to provide a cleaning apparatus incorporating both a mechanical wiping and pressured fluid scouring of the surface to dislodge and carry away any foreign matter on the surface.

## SUMMARY OF THE INVENTION

Apparatus for cleaning strip material comprising a rotatable roller positioned to contact a surface of the strip, drive means for rotating the roller at a peripheral speed exceeding the linear speed of the strip surface, and suction means for creating a flow of environmental fluid into the roller to carry away any foreign matter dislodged from the strip.

The forgoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the acompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a cross-sectional view of a preferred embodiment of the invention;

FIGURE 2 is a cross-sectional view along the line 2—2 of FIGURE 1;

FIGURE 3 is a cross-sectional view of the roller and shaft assembly;

FIGURE 4 is an enlarged cross-sectional view taken along the line 4—4 of FIGURE 3; and

FIGURE 5 is an enlarged view of a portion of the shaft sleeve assembly.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

In accordance with a preferred embodiment of the subject invention, an apparatus **10** is provided for cleaning a chip **11** by effecting relative motion between the chip and a roller **12***a* such that an exterior porous wear surface **14** of the roller contacts the chip with a wiping action to dislodge any foreign material on the chip surface. Concurrently with this wiping action, environmental air is drawn in through the porous outer layer of the roller at a velocity sufficient to pull any dislodged foreign material into the roller and exhaust it from the vicinity of the chip. In this manner, a mechanical wiping of the chip surface is effected while at the same time

a scrubbing action is achieved by the flow of air past the chip and radially in through the roller, to dislodge and carry directly away from the surface any foreign material. In the preferred embodiment, the environmental fluid is air, however, it is recognized that the cleaning apparatus could be used in an environment of other types of fluid such as water to effect a cleaning action with beneficial results in specific instances.

In the embodiment shown, it is desirable to clean both surfaces of the chip **11** and for this purpose two rollers **12***a* and **12***b* are mounted with the exterior of the layers **14** thereof in contact so that as the chip **11** is passed therebetween each surface is scrubbed. Frequently, it is necessary to clean only one surface if the film is opaque while both surfaces of transparent film need be cleaned. The rollers are mounted on rotatably supported shafts **15***a* and **15***b* respectively, held at the ends by bearings **16**, **17**. These bearings are positioned in openings **18**, **19** of a solid-walled housing **20** enclosing the cleaning apparatus. The resilient layer **14** of each roller is fixed to a removable sleeve **21** (FIGURES 2 and 4) which slides over the shaft and includes an indent **22** (FIGURE 5) which interfits with a complementary indent **24** in the shaft to align and prevent relative rotation between the sleeve and the shaft. The sleeves can be replaced by removing from the housing **20** a cover **20***a* held in place by screws **20***b* (FIGURE 1).

The lower shaft **15***b* is driven by a belt **26** cooperating with a pulley **27** fixed to an extension **28** thereon. On the opposite end of the shafts **15***a* and **15***b* respectively, are meshed gears **29** and **30** for transmitting rotational power between the shafts. Thus, as the belt **26** is power driven, the lower shaft **15***b* is rotated in the clockwise direction (FIGURE 2) while the upper shaft **15***a* is rotated in the counter-clockwise direction to rub the opposite surfaces of the chip **11** as it is passed therebetween.

The chip **11** is passed through openings **32** and **34** in the opposite sides of the housing **20** and in alignment with the juncture between the two rollers. Thus, by sliding the chip between the adjacent guides **35** and **36** positioned adjacent the inlet opening **32**, it is passed between the rollers where mechanical contact is made with each side of the chip to effect a wiping action on the surfaces of the chip for the cleaning thereof. The chip passes on between the rollers and through the opening **34** to be received by the guides **38** and **39**. In the present embodiment, the chip is passed through the rollers by a mechanism (not shown) which holds onto the trailing end of the chip such that the portion containing the data is passed completely between the rollers and then is withdrawn out through the opening **32** again after cleaning is accomplished. The brushes are turned at a speed sufficient to scour the film surface with the speed of the chip being determined so that each portion of the chip is contacted thoroughly by the scrubbing action of the rollers for effective cleaning. In the manner described, any foreign matter on the chips is brushed away by the wiping action of the roller portions **14**.

However, it has been found that merely dislodging this foreign matter is not sufficient and it is necessary in addition to carry this foreign matter away from the chip to prevent its coming to rest on the chip as it passes from the cleaning apparatus. For instance, frequently a static charge will attract the foreign material to the chip as it is withdrawn from between the rollers. Thus, according to the present invention, the foreign material dislodged by the rollers is carried away by a vacuum fluid which, in the present embodiment, is air being drawn radially into the rollers and out of the housing by an apparatus (not shown) acting to create a vacuum pressure at an outlet **40** in the housing **20**. To control the air flow, the housing forms a pair of internal cavities **41** and **42** separated by a partition **43** having openings **44** through which the shafts pass. These openings **44** closely fit about the shafts to prevent or limit air leakage lengthwise of the shaft. The shafts **15***a* and **15***b* are hollow (FIGURES 3 and 4) to form a center passage **45** therein extending the length of the shaft. The ends of each shaft are closed by plugs **46** with access to the center opening **45** being provided through a series of openings **47***a* extending through each shaft wall in a position of alignment with the chamber **42**. A second series of openings **47***b* extend through the shaft in alignment with openings **48** (FIGURE 3) in each sleeve **21** at the cleaning cavity **41**. The wear surface **14** of each roller preferably is a resilient material such as an open pore form so as to permit free passage of the foreign matter and air. The material also must be sufficiently hard to scour the film surface yet pliable enough so as not to scratch the surface being cleaned.

During operation, the chip is passed between the rollers in the manner previously described while a vacuum is drawn at the air outlet **40**. This vacuum creates a high velocity air flow indicated by the arrows in FIGURES 1 and 2 coming in through openings **32** and **34** of the housing **20** and passing through the roller coverings **14**, the openings **47***b*, in the sleeve **48** in the shaft and flowing lengthwise along the shaft interior **45** and out through the openings **47***a* to the vacuum chamber **42** and the air outlet **40**. This air flow preferably is high velocity so as to carry away any foreign matter which is dislodged from the chip to maintain the fluid environment in the chamber **41** clean. The velocity of the air must be sufficient to draw the dislodged matter quickly through the rollers against the pull of the centrifugal force acting thereon. By drawing the air directly through the rollers, it is circulated across the area being scrubbed by the rollers to carry any foreign matter directly away from the surface from which it was dislodged. The guides **49** extend to a position near the line of contact between the roller and film to guide the incoming air to the film surfaces so that some foreign matter is dislodged without mechanical scrubbing action. Such a cleaning apparatus as heretofore described has proven suitable for removing solid matter such as dust from film chips as well as for removing liquids from the surface such as might be necessary for drying the film after it has been exposed to a wet developing process.

In the cleaning of opaque film only one roller as shown in FIGURE 4 is required. The air path in this case is from openings **32** and **34** through roller covering **14** (FIGURE 4), openings **47***b* in the sleeve **48** in the shaft and flowing lengthwise along the shaft interior **45** and out through one open shaft end to which the air outlet connects directly. Thus, if desirable, shaft openings **47***a* and one plug **46** can be omitted from this roller. Also vacuum chamber **42** and gears **29** and **30** may not be required.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

I claim as my invention:

**1.** An apparatus for cleaning a surface of a member comprising:

a pair of adjacently-positioned power rotated rollers having porous exterior surfaces,

means to effect relative movement between said rollers and member to bring said exterior roller surfaces in contact with the surfaces of said member as the rollers are rotated to perform a scrubbing action on said member for dislodging any foreign matter thereon,

means for drawing the environmental fluid surrounding said rollers through said porous exterior surfaces for carrying any such dislodged foreign matter away from said member, and

a housing having a cleaning chamber enclosing said rollers, with said housing having a second chamber through which said shafts extend and in fluid flow connection with said means for drawing fluid, said

shafts having radially extending fluid openings in said second chamber therein to permit fluid flow from the interior to the exterior thereof to draw the fluid through said rollers.

2. A cleaning apparatus as defined in claim 1 wherein said apparatus is enclosed in a solid walled housing with inlets therein for admitting said member, and said guide means are positioned within said inlets.

3. A cleaning apparatus as defined in claim 2 wherein said environmental fluid is drawn through said inlets before passing into said rollers, and said guide means serve to direct the flow of air past the line of contact between the rollers and member to pick up any dislodged foreign matter.



**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 1,176,990 | 3/1916 | Scherff et al. | 15—320 |
| 1,237,047 | 8/1917 | Howell. | |
| 2,501,875 | 3/1950 | Rayburn. | |

FOREIGN PATENTS

| | | |
|---|---|---|
| 1,206 | 2/1963 | Japan. |

ROBERT W. MICHELL, *Primary Examiner.*

U.S. Cl. X.R.

15—100

PO-1050
(5/69)

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,453,681 Dated July 8, 1969

Inventor(s) G. L. Wiederhold

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Column 4, line 60, after the word "exterior" and before the word "surfaces," should be inserted the word --wear--.

SIGNED AND
SEALED
NOV 4 1969

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents