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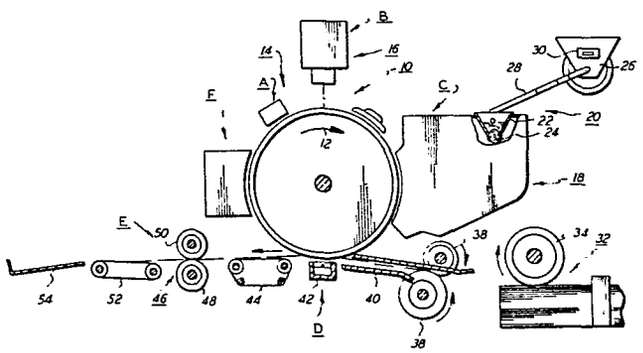
(54) Apparatus for dispensing particles into a housing.

(57) An apparatus (20) in which particles are dispensed from a first supply (22) thereof into a housing (18). Additional particles are advanced from a second supply (26), remote from the first supply (22), to the first supply (22). The second supply (26) is periodically vibrated to prevent bridging and caking of the particles.



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APPARATUS FOR DISPENSING PARTICLES INTO A HOUSING

This invention relates to apparatus for dispensing particles into a housing, and more particularly to a toner dispenser coupled to a development system of an electrostatographic printing machine for furnishing additional toner particles thereto.

In an electrophotographic printing machine, a photoconductive member is charged to a substantially uniform potential so as to sensitize the surface thereof. The charged portion of the photoconductive member is exposed to a light image of an original document being reproduced. Exposure of the charged photoconductive member selectively dissipates the charge thereon in the irradiated areas. This records an electrostatic latent image on the photoconductive member corresponding to the informational areas contained within an original document being reproduced. After the electrostatic latent image is recorded on the photoconductive member, the latent image is developed by bringing a developer mix into contact therewith. Generally, the developer mix comprises toner particles adhering triboelectrically to the carrier granules. The toner particles are attracted from the carrier granules to the latent image forming a toner powder image on the photoconductive member. Next, the toner powder image is transferred from the photoconductive member to a copy sheet. The copy sheet is then heated to permanently affix the toner particles thereto in image configuration. This general approach was disclosed by Carlson in U.S. Patent No. 2,297,691, and has been further amplified and described by many related patents in the art.

It is clear that as each copy is reproduced, toner particles are depleted from the developer mixture. Hence, the printing machine requires a device for furnishing additional toner particles to the developer mix. The toner particles maybe added to the developer mix

automatically or manually. In either case, the developer mix must have the concentration of toner particles maintained substantially constant. Hereinbefore, a toner dispenser was disposed adjacent to or just above the developer housing. A roller or vibrating screen was frequently employed to dispense toner particles from a hopper to the developer mixture. However, the size of the toner hopper was generally limited by the structural constraints of the printing machine. In order to minimize these constraints, it would be highly desirable to locate the toner supply housing remotely from the development system. However, it is also desirable to meter precise quantities of toner particles into the developer mixture so as to maintain the concentration thereof substantially constant. This may be more readily achieved by having the toner dispenser closely proximate to the development apparatus.

Various types of devices have hereinbefore been developed to discharge toner particles into the developer mix.

Thus, US Patent No 1855214 discloses a soap dispenser comprising a compartment storing soap powder. A soft rubber ball is mounted rotatably in the aperture of the compartment. The surface of the ball is roughened or has ribs formed therein. The roughened surface forms pockets for carrying the soap powder between the ball and compartment wall. As the ball rotates, it presses against the compartment wall forming a tight seal. The soap powder carried by the ball is dispensed from the compartment.

US Patent No 2892446 describes a hopper having a screen in the bottom portion thereof. The screen is vibrated to dispense toner particles from the hopper to the developer housing sump.

US Patent No 2910964 discloses a hopper housing a supply of developer powder. A vibratory mechanism controls the rate of discharge of the developer powder from the hopper.

US Patent No 3134849 describes a container having a supply of powder therein. The powder is dispensed from an opening in the bottom of the container only when a transducer is excited to vibrate the container.

US Patent No 3954331 discloses a toner dispenser having a removable reservoir which mates with the collar on pivotably mounted hopper having a dispensing roll. The reservoir is slid into the collar when upright and then rotated to invert the reservoir so that the toner flows onto the dispensing roll. The dispensing roll maybe covered with a polyeurthane foam.

US Patent No 4142655 describes a toner dispenser coupled to a remote toner container. Flexible augers, e.g. coil springs positioned in flexible tubes move toner from the remote toner container to the dispenser. The toner is moved into the dispenser at a greater rate than it is dispensed therefrom. Excess toner is returned from the dispenser to the remote toner container. A rotatable foam roll is located in the opening of the dispenser to discharge toner particles therefrom into the development system of the xerographic printing machine.

Finally, IBM Technical Disclosure Bulletin, Volume 15, Number 4, discloses a flexible auger located within a flexible tube for transporting toner particles from a toner bin to a developer bin.

In accordance with the features of the present invention, there is provided an apparatus for dispensing particles into a housing. The apparatus includes first means for storing a supply of particles therein. Second means, positioned remotely from the first storing means, also store a supply of particles therein. Means advance the particles from the second storing means to the first

storing means. Means, operatively associated with the first storing means, discharge the particles from the first storing means into the housing. Means vibrate the second storing means to prevent the bridging and caking of the particles stored therein.

Other aspects of the invention will become apparent as the following description proceeds and upon reference to the drawings in which:

Figure 1 is a schematic elevational view depicting an electrophotographic printing machine incorporating a toner dispenser according to the present invention therein;

Figure 2 is one embodiment of toner dispenser employed in the Figure 1 printing machine; and

Figure 3 is another embodiment of a toner dispenser employed in the Figure 1 printing machine.

As shown in Figure 1, the electrophotographic printing machine employs a photoconductor drum 10 which rotates in the direction of arrow 12 to pass through the various processing stations disposed thereabout, as follows.

A charging station A at which a corona generatin device 14, charges the photoconductive surface of drum 10 to a relatively high, substantially uniform potential.

An exposure station B at which an original document positioned face down on a transparent platen is exposed by exposure system 16 and an image thereof projected onto the charged portion of the photoconductive surface to form an electrostatic latent image of the original thereon.

A development station C at which a magnetic brush development system 18 advances a developer mix into contact with the electrostatic latent image recorded on the photoconductive surface of drum 10. Preferably,

the developer mix comprises carrier granules having toner particles adhering triboelectrically thereto. The development system forms a brush having a chain-like array of developer mix extending outwardly therefrom. This mix contacts the electrostatic latent image recorded on the photoconductive surface of drum 10. The latent image attracts the toner particles from the carrier granules forming a toner powder image on the photoconductive surface of drum 10. As the toner particles are depleted from the developer mixture, additional toner particles are furnished thereto by toner dispenser 20. Toner dispenser 20 includes a first hopper 22 having an elongated foam roller 24 disposed in the aperture thereof. As foam roller 24 rotates, toner particles are dispensed from hopper 22 into the sump of development system 18. Additional toner particles are furnished to hopper 22 from hopper 26 located remotely thereof. Toner transport 28 advances toner particles from hopper 26 to hopper 22. A vibrator 30 periodically vibrates hopper 26 to prevent the bridging and caking of the toner particles therein. Hopper 26 is much larger than hopper 22 and may be located in any convenient position within the printing machine. In this manner, the space configuration of the printing machine may be optimized since there is no need to position a large toner dispenser within or adjacent the development system. The detailed structure of toner dispensing apparatus 20 will be described hereinafter with reference to Figures 2 and 3.

A transfer station D, at which a sheet of support material is positioned in contact with the toner powder image formed on the photoconductive surface of drum 10.

A sheet of support material is advanced to the transfer station by a sheet feeding apparatus, indicated generally by the reference numeral 32. Preferably, sheet feeding apparatus 32 includes a feed roll 34 contacting the upper most sheet of the stack 36 of sheets of support material. Feed roll 34 rotates so as to advance the uppermost sheet from stack 36. Registration rollers 38 align and forward the advancing sheet of support material into chute 40. Chute 40 directs the advancing sheet of support material into contact with the photoconductive surface of drum 10 in a timed sequence so that the powder image thereon contacts the advancing sheet of support material at transfer station D.

Transfer station D includes a corona generating device 42 which applies a spray of ions to the backside of the sheet. This attracts the toner powder image from the photoconductive surface of drum 10 to the sheet. After transfer, the sheet continues to move with drum 10 and is separated therefrom a detack corona generating device which neutralizes the charge causing the sheet to adhere to the drum. Conveyor 44 advances the sheet from transfer station D to fusing station E.

Fusing station E, indicated generally by the reference numeral 46, includes a back-up roller 48 and a heated fuser roller 50. The sheet of support material with the toner powder image thereon passes between back-up roller 48 and fuser roller 50. Toner particles contact fuser roller 50 and the heat and pressure applied thereto permanently affix them to the sheet of support material. After fusing, conveyor 52 advances the finished copy sheet to catch tray 54. Once the copy sheet is positioned in catch tray 54, it may be removed therefrom by the machine operator.

Invariably, after the sheet of support material is separated from the photoconductive surface of drum 10, some residual toner particles remain adhering thereto. These residual toner particles are cleaned from

drum 10 at cleaning station F. Preferably, cleaning station F includes a rotatably mounted fibrous brush in contact with the photoconductive surface of drum 10. The particles are cleaned from the photoconductive surface by the rotation of the brush in contact therewith. Subsequent to cleaning, a discharge lamp floods the photoconductive surface with light to dissipate any residual electrostatic charge remaining thereon prior to the charging thereof for the next successive imaging cycle.

Referring now to Figure 2, there is shown one embodiment of toner dispensing apparatus 20. Toner dispensing apparatus 20 includes a hopper 26 located remotely from development apparatus 18 (Figure 1). A flexible helical auger 56, e.g. a coil spring extends through the lowermost portion of hopper 26 and is arranged to advance toner particles therefrom. Auger 56 is rotated by motor 58. Flexible tube 60 extends between the lower most portion of hopper 26 and the uppermost portion of hopper 22. Auger 56 is disposed interiorly of tube 60. As motor 58 rotates auger 56, toner particles are advanced through tube 60 into the uppermost portion of hopper 22. Foam roll 24 is located in the aperture of hopper 22. As motor 62 rotates foam roller 24, toner particles are dispensed from hopper 22 to development system 18. As shown in Figure 1, hopper 22 is mounted in development system 18.

A level detector may be located in hopper 22. When the toner level within the hopper is beneath a predetermined level, the level detector actuates motor 58. As motor 58 rotates auger 56, toner particles are

advanced through flexible tube 60 into hopper 22. One type of suitable level detector would a light source generating light rays at a specified height in hopper 22. The light rays from the light source, e.g. a tungston lamp, would be detected by a photodiode which, in turn, developes an electrical signal. This signal may be amplified and processed by suitable logic circuitry to energize motor 58. When the toner particle level blocks the light rays, the photodiode does not develop an electrical output signal and motor 58 remains de-energized. In this latter mode, i.e. when motor 58 is de-energized, toner particles are not transported from hopper 26 to hopper 22. Alternatively, motor 58 may be energized at prescribed time intervals, or after a predetermined number of copies have been reproduced in the printing machine.

Motor 62 rotates foam roller 24. Preferably, foam roller 54 is made from a rigid core of plastic or metal having a polyurethane coating thereover. The side walls of hopper 22 engage the peripheral surface foam roller 24. Toner particles are prevented from being dispensed from hopper 22 when foam roller 24 is stationary. However, when motor 52 is energized, foam roller 24 rotates and toner particles are dispensed from hopper 22 into development system 18. An automatic developability and control system may be employed to energize motor 62. One suitable type of automatic developability and control system employs a transparent electrode mounted in the non-image area of drum 10. The transparent electrode has an electrically conductive coating thereon. As drum 10 rotates, the electrode is biased to a suitable D.C. voltage to attract toner particles thereto as it passes through development station C. A light source, disposed interiorly of drum 10, illuminates the transparent electrode and a photodiode detects the light rays transmitted therethrough. Suitable

logic circuitry processes the electrical output signal to energize motor 62 when the photodiode output signal is above a predetermined level. The foregoing type of system is more clearly described in U.S. Patent application No. 3,778,146 issued to Knapp in 1973, the relevant portion thereof being hereby incorporated into the present application. Alternatively, motor 62 maybe actuated automatically by the machine logic after a predetermined number of copies have been reproduced. In either case, energization of motor 62 rotates roller 24 causing toner particles to be dispensed into development system 18 so as to maintain the concentration of toner particles within the developer mixture substantially constant.

Vibrator 30 is periodically actuated by the machine logic to vibrate hopper 26 so as to prevent the bridging and caking of toner particles therein. Vibrator 18 may be any suitable electro-mechanical transducer which is driven from a signal source. The transducer may be attached to hopper 26 in a suitable manner to effectuate the required vibration. The transducer may be any of the types well known in the art, such as crystal of either the piezoelectrical or ferroelectric type or an electromagnetic transducer such as a voice coil or a loud speaker. The signal source actuating the transducer may be any suitable device which generates signals suitable for driving the type of electro-mechanical transducer employed.

Turning now to Figure 3, there is shown another embodiment of toner dispensing apparatus 20. As depicted thereat, remotely located hopper 26 is coupled to hopper 28 by a bead chain 64. A portion of bead chain 64 passes through the lowermost portion of hopper 26. While the other end portion thereof passes through the uppermost portion of hopper 22. In this manner, when motor 58 is actuated, bead chain 64 advances toner particles from hopper 26 to hopper 22. Once again, when motor 62 is

energized, roller 24 rotates to dispense toner particles from hopper 22 to development system 18. Vibrator 30 periodically vibrates hopper 26 to prevent the caking and bridging of toner particles therein. It is clear that the difference between the embodiment of toner dispensing apparatus 20 depicted in Figure 2 and that depicted in Figure 3 merely resides in the utilization of different toner transports 28. In the embodiment depicted in Figure 2, the toner transport is a flexible auger disposed within a flexible tube. While in the embodiment depicited in Figure 3, the toner transport is a bead chain. In either of the foregoing cases, toner particles are advanced from a hopper located remotely from the development apparatus to a hopper located within the development apparatus. The toner particles are dispensed from the hopper located within the development apparatus by the rotation of a foam roller.

In recapitulation, it is event that the toner dispensing apparatus of the present invention includes two toner hoppers. One of the toner hoppers is fairly large and contains a great deal of toner particles therein. This large toner dispenser is located remotely from the development system and may be positioned anywhere within or without the printing machine. The remotely located toner hopper is coupled to a toner hopper positioned in the development apparatus of the printing machine. A toner transport advances toner particles from the remotely located hopper to the hopper positioned within the development apparatus. A foam roller rotates in the hopper to discharge toner particles into the sump of the development system. The remotely located toner hopper is periodically vibrated to prevent bridging and caking of the toner particles. This type of toner dispensing apparatus permits the optimum usage of space within the electrophotographic printing machine while providing maximum toner particle storage capability.

CLAIMS:

1. Apparatus (20) for dispensing particles into a housing (18), characterized by a first store (22) for storing a supply of particles therein; a second store (26), positioned remotely from said first store (22), for storing a supply of particles therein; means (28) for advancing the particles from said second store (26) to said first store (22); means (30) for vibrating said second store (26) to prevent bridging and caking of particles stored therein; and means (24), operatively associated with said first store, for discharging particles from said first store means (22) into the housing (18).

2. Apparatus (20) according to Claim 1, in which said discharging means (24) includes an elongated resilient roller (24) mounted rotatably in an aperture of said first store (22) for metering quantities of particles from said first store (22) to the housing (18).

3. Apparatus (20) according to Claim 1 or 2, in which said advancing means (28) includes: a flexible tube (60) coupling said first store (22) with said second store (26); an elongated flexible helical member (58) disposed interiorly of said flexible tube (60); and means (58) for rotating said helical member (56) to advance the particles from said second store (26) to said first store (22).

4. Apparatus (20) according to Claim 1 or 2, in which said advancing means (28) includes a bead chain (56) coupling said first store (22) with said second store (26); and means (58) for moving said bead chain (56) to advance the particles from said second storing means (26) to said first storing means (22).

5. Apparatus (20) according to any preceding Claim, in which said second store (26) is adapted to hold a greater supply of particles than said first store (22).

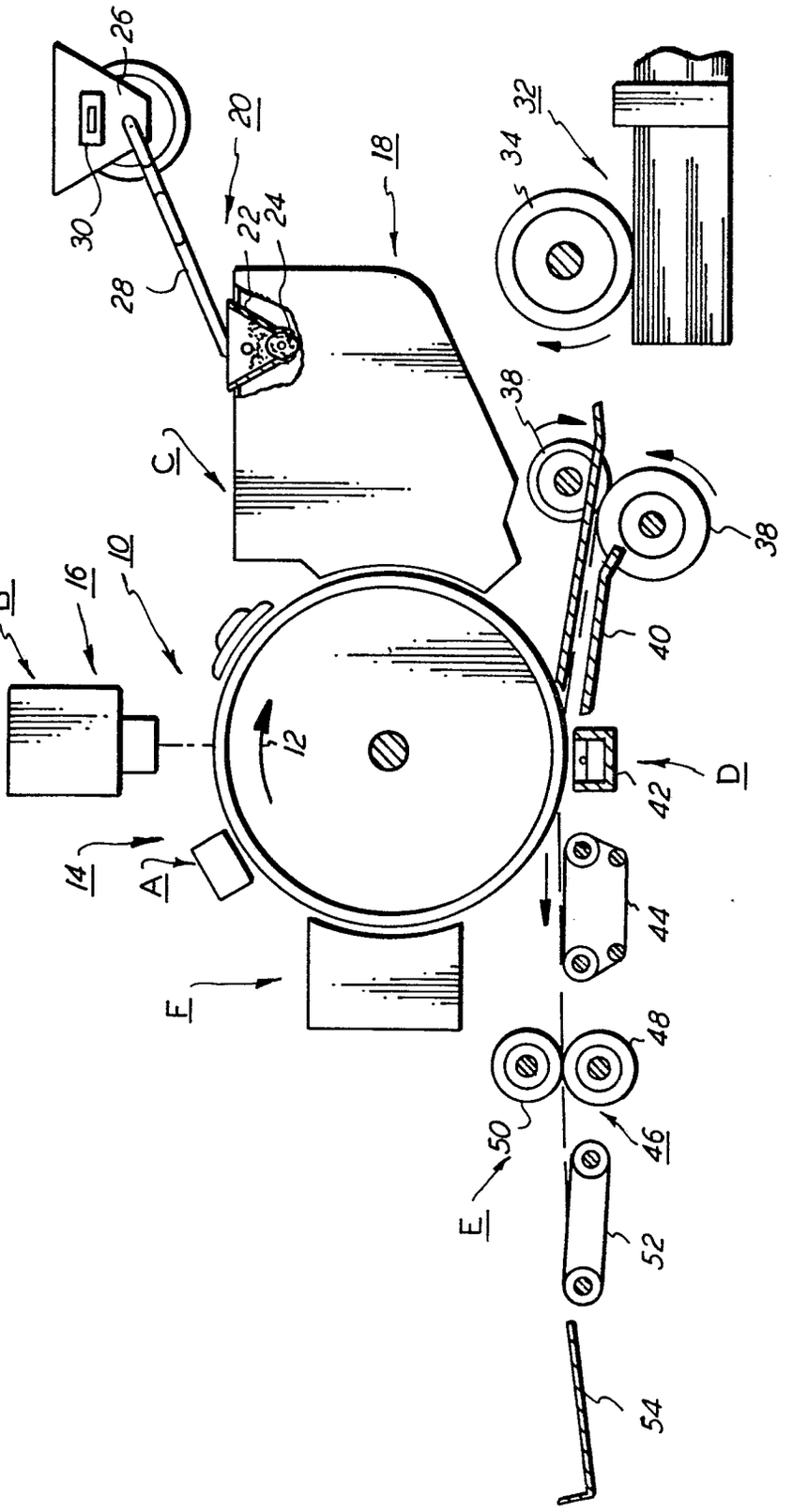
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FIG. 1

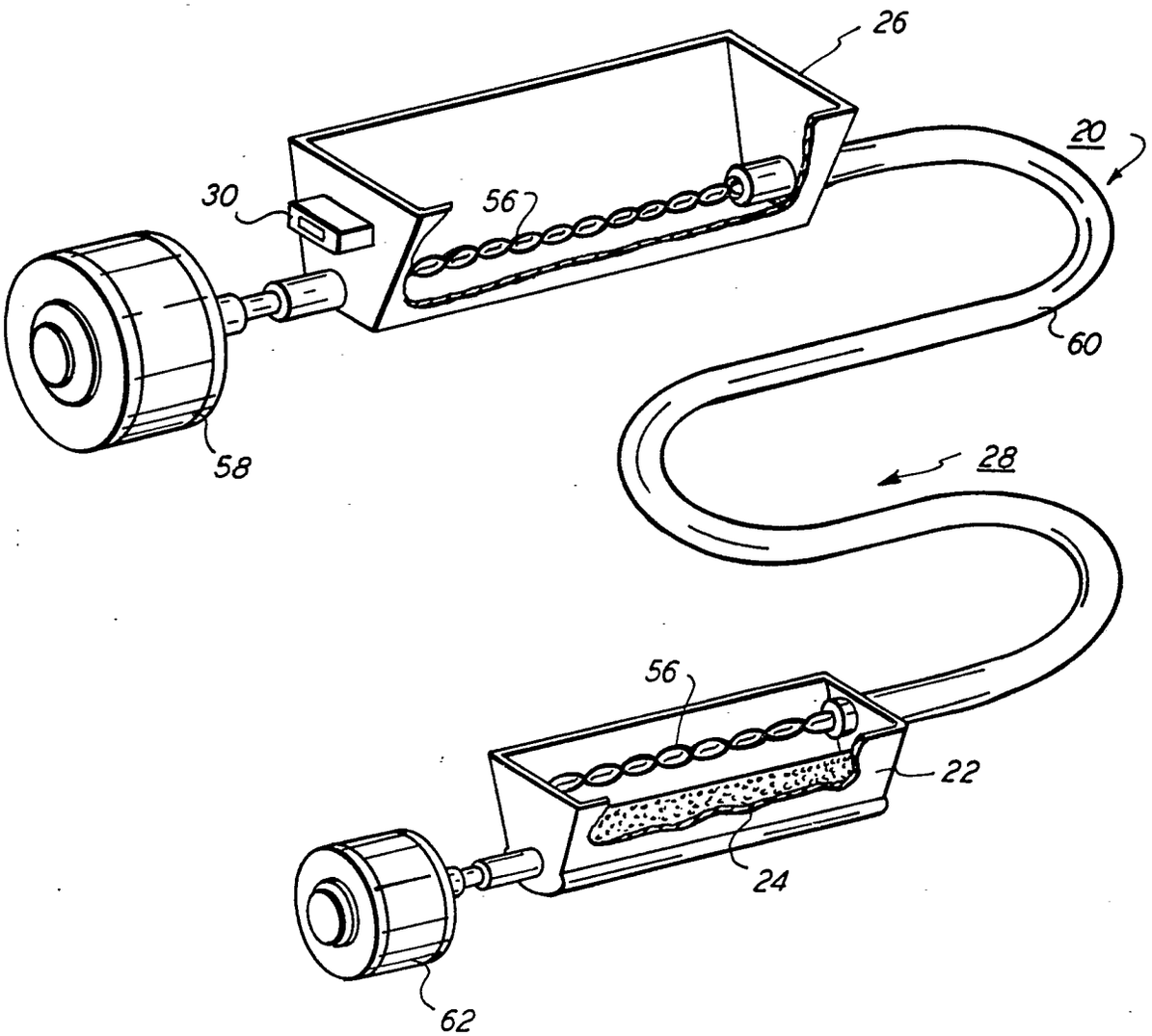

FIG. 2

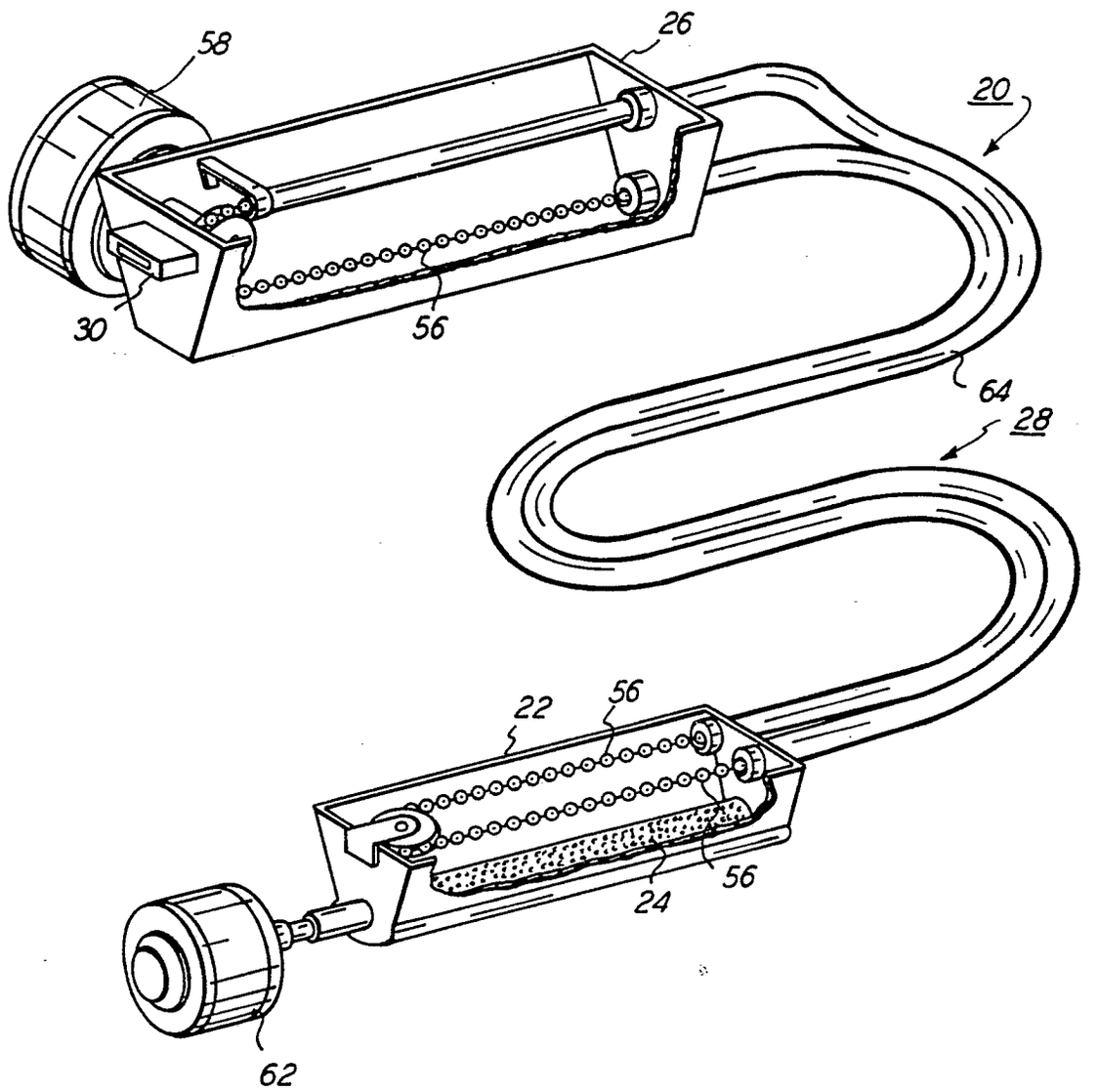

FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application number 0018141

EP 80 30 1077.6

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
D	US -A - 4 142 655 (J. FANTUZZO) * claim 1; fig. 1 *	1-3
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	DE - A1 - 2 813 556 (RICOH) * fig. 3 *	1
	--	
D	IBM TECHNICAL DISCLOSURE BULLETIN, Vol. 15, No. 4, September 1972 New York C.A. QUEENER "Flexible Auger Toner Transport" page 1262	1
	--	
D	US - A - 2 910 964 (A. STAVRAKIS et al.) * fig. 1, 3 *	1
	--	
	US - A - 3 724 020 (H.R. TILL) * fig. 2 *	4
	--	
D	US - A - 3 778 146 (L.W. KNAPP) * fig. 1, 2 *	

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

G 03 B 15/08

TECHNICAL FIELDS SEARCHED (Int.Cl.³)

G 03 G 15/00
G 03 G 21/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	08-08-1980	HOPPE

EPO Form 1503.1 06.78