May 19, 1959 K. A. BARSTROM ET AL 2,887,353

REPRODUCING APPARATUS

Filed July 3, 1956 2 Sheets-Sheet 1

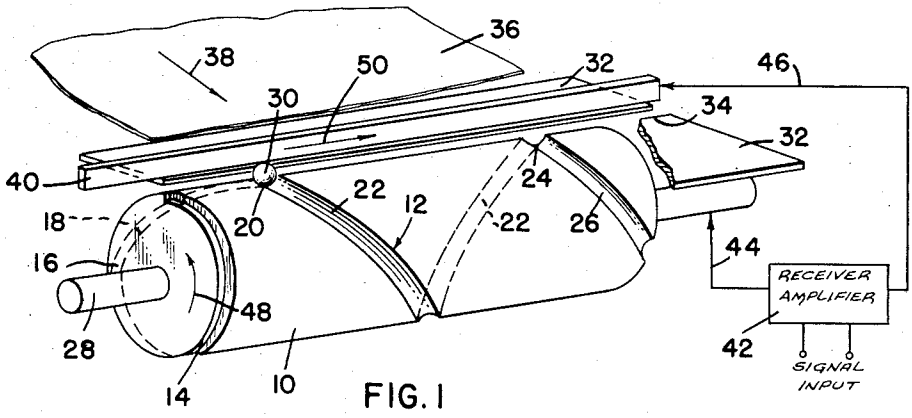


FIG. 1

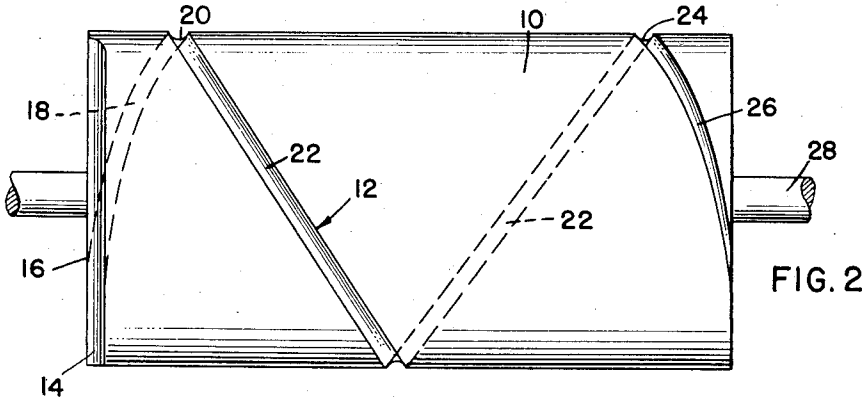


FIG. 2

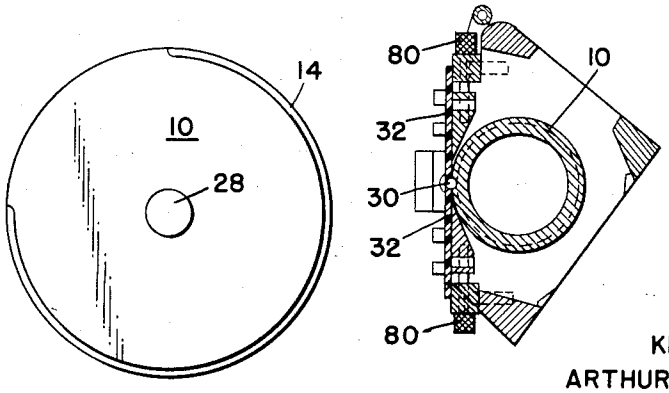


FIG. 3

FIG. 6

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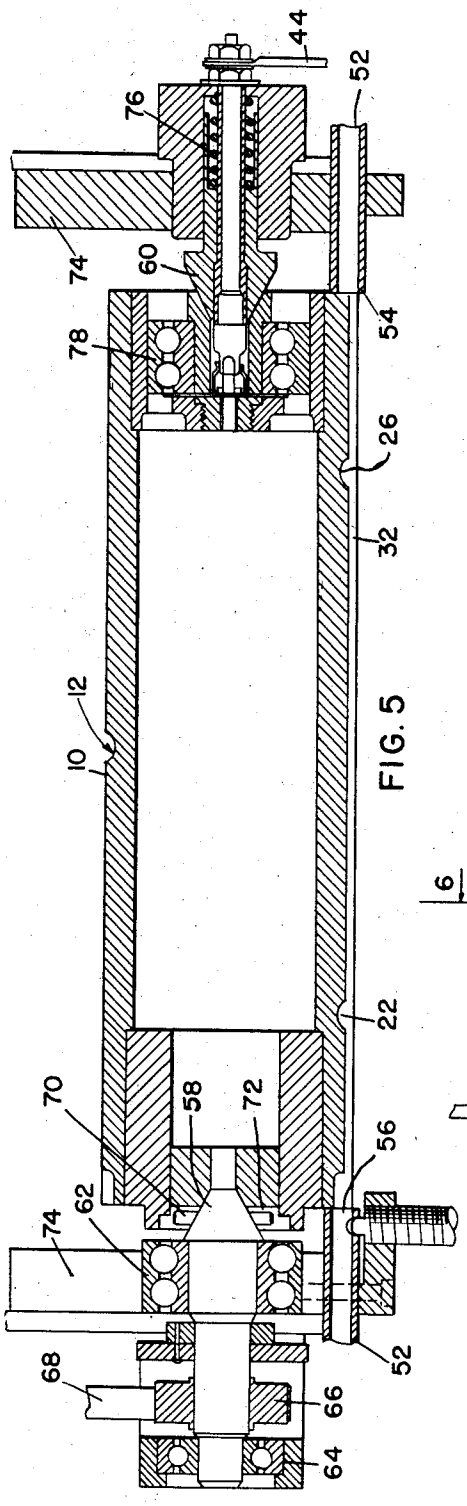


FIG. 5

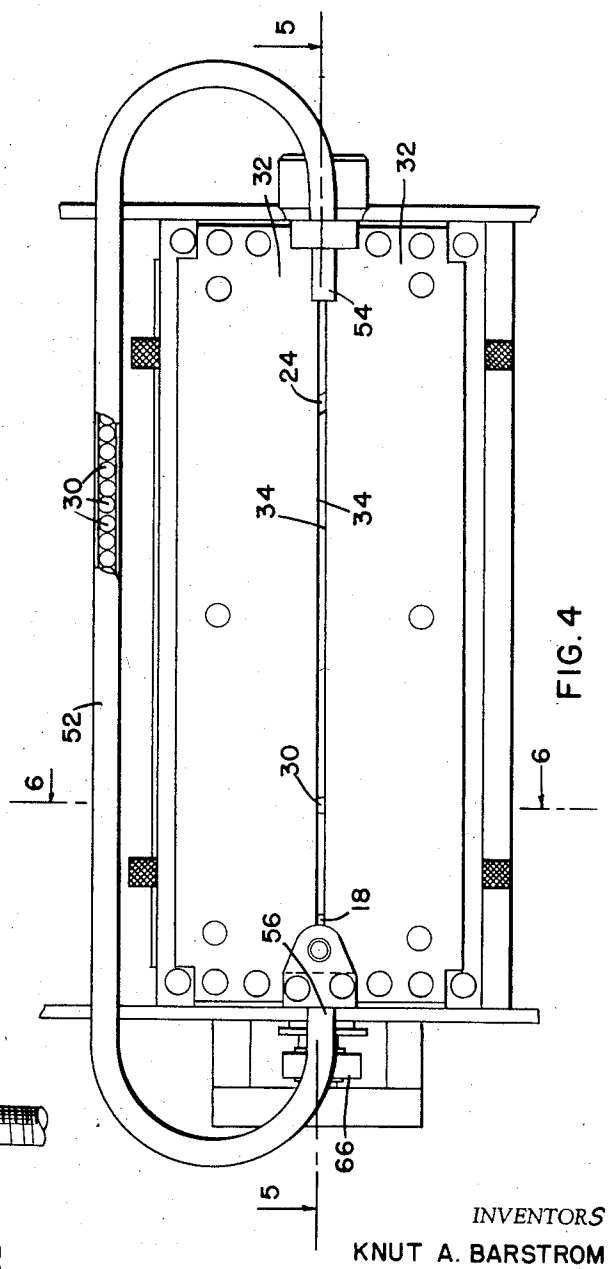


FIG. 4

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2,887,353

REPRODUCING APPARATUS

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Application July 3, 1956, Serial No. 595,676

12 Claims. (Cl. 346—74)

This invention relates to reproducing apparatus eminently suited for facsimile scanning systems and particularly to those systems employing chemically treated paper at the receiver. However, the apparatus is also well suited in conjunction with reproducing systems of other types.

Conventional facsimile apparatus as exemplified by the disclosures of the patents to Finch 2,413,962, dated January 7, 1947, and Young 2,415,229, dated February 4, 1947, have employed drums bearing helical wires or bars for producing point by point contacts through the paper upon which the record is to be produced with conductive blades. Experience has shown that such helical wires or strips are highly susceptible to non-uniform erosion due to the composition of the paper and the passage of current. Moreover, the conventional apparatus as exemplified by these patents has severely limited the speed of operation in order to prevent undesirable damage to the paper itself.

By virtue of the present invention, in addition to solving these problems, inertia forces have been reduced, wear diminished and registration improved. Consequently, in accordance with this invention much higher writing speeds and higher resolution have been achieved than has been possible with conventional apparatus.

The reproducing apparatus constituting the subject matter of this invention comprises a rotary drum containing a peripheral helical groove adapted to receive a ball, the groove having ball inlet and discharge portions adjacent the ends respectively of the drum, means defining a raceway adjacent the drum constraining the ball to traverse the groove, and ball directing means adjacent the inlet portion for introducing the ball into the groove and raceway. The groove preferably has an intermediate portion of constant pitch, an inlet portion increasing in pitch in the direction of movement of the ball, and a discharge portion decreasing in pitch in the direction of movement of the ball. By employing a ball in this manner, erosion is distributed over its entire spherical surface, greatly extending the life of the apparatus as compared with equipment employing helical wires or strips.

The groove is preferably a circular arc in cross section of less than 180° and the raceway defined by strips having opposed straight edges of relatively low coefficient of friction such as nylon or Teflon. The ball directing means preferably contains a plurality of balls and assumes the form of a conveying tube interconnecting the inlet and discharge portions of the groove. Such tube is preferably maintained full of balls advanced towards the inlet portion of the groove by each ball delivered from the discharge portion of the groove. Thus, it will follow, that such use of multiple balls even further distributes erosion and wear and assures a long life to the apparatus.

A more complete understanding of the invention will follow from a description of the accompanying drawings wherein:

Fig. 1 is a schematic perspective showing, partially broken away, of portions of a system incorporating the present invention;

Fig. 2 is an elevation of a drum produced in accordance with the present invention;

Fig. 3 is an end elevation of the drum shown in Fig. 2;

Fig. 4 is a plan view, partially broken away, of a practical structure incorporating the present invention;

Fig. 5 is a section taken along line 5—5 of Fig. 4 on a slightly enlarged scale; and

Fig. 6 is a section taken along line 6—6 of Fig. 4.

The drum **10** as shown in Fig. 1 contains a helical groove **12** whose cross-section is a circular arc less than 180°. At the left end of the drum **10** as shown in Fig. 1, there is an undercut portion **14** of slightly increasing width extending approximately 270° about the periphery of the drum to a point **16** at which it communicates with an inlet portion **18** of the groove **12** having an increasing pitch to provide uniform acceleration to a ball introduced thereinto until it reaches a point **20** at which it joins the intermediate portion **22** of the groove **12** of constant pitch. This intermediate portion of the groove extends to a point **24** at which it joins a discharge portion **26** of the groove of decreasing pitch so as to impart constant deceleration to a ball received therein. As the drum **10** is rotated about the axis of its shaft **28**, a ball **30** received in the groove **12** is retained therein by a raceway defined by strips **32** of material such as nylon or Teflon having a low coefficient of friction and tending to lubricate the ball, the strips **32** having straight edges **34** defining a raceway. By virtue of this arrangement, it will follow that when a ball **30** is introduced at the left end of the drum, its initial horizontal movement will be very slight, whereupon it will receive a constant acceleration in the inlet portion **18** of the groove until it enters the intermediate portion **22** of constant pitch whereupon its horizontal travel will be uniform until it enters the discharge portion **26** of the groove in which it will be uniformly decelerated so as to receive a progressively decreasing horizontal movement. Suitably treated paper **36** fed as shown in the direction of the arrow **38** will ride over the strips **32** for engagement with the balls **30** and under a blade **40** of conducting material. As depicted in Fig. 1, a signal to be translated will be supplied to a receiver amplifier **42** having output leads **44** and **46** connected to the shaft **28** and blade **40** respectively. Since the shaft, drum and balls are conducting, the desired electrolytic action will be produced by the passage of current through this circuit.

The assumed direction of rotation of the drum is indicated by the arrow **48** and the corresponding direction of movement of the ball **30** by the arrow **50**.

As shown in Fig. 4, a tube **52** having a substantially C-shaped configuration, provides one open end **54** for the reception of the balls as they are delivered from the discharge portion **26** of the groove **12** and its other end **56** in communication with the inlet portion **18** of the groove **12** for supplying balls thereto. The tube **52** is maintained full of these balls so that upon the discharge of each ball from the groove **12**, it will force those before it towards the inlet portion of the groove until the leading ball actually enters the undercut portion **14**. The parts are preferably designed so that a ball enters the undercut portion after approximately 90° of such portion have passed the end **56** of the tube, thus avoiding any possibility of jamming.

One of a number of ways in which the assembly can be produced is depicted in Fig. 5 wherein the drum **10** is supported between a driving center **58** and a supporting center **60**. The driving center is supported in suitable bearings **62** and **64** and carries a pulley **66** driven by a belt **68**. The driving connection between the center

58 and the drum 10 is produced by a pin 70 received in a complementary slot 72. The supporting frame 74 also carries the center 60 which is biased towards its end of the drum 10 by means of a helical spring 76. At this end of the drum, a suitable bearing 78 is received internally of the drum.

Adjustment of the strips 32 defining the raceway can be effected by screws 80 or in some other equally suitable manner.

As depicted and described for purposes of illustration, the intermediate portion of the groove occupies an angle of 360°. Departure from this detail and from others shown and described will suggest themselves to those skilled in the art as modifications of the present invention. Accordingly, the examples set forth herein should not be construed as limiting beyond the scope of the appended claims.

We claim:

1. In reproducing apparatus a rotary drum containing a peripheral helical groove adapted to receive a ball, a ball in said groove, said groove having ball inlet and discharge portions opening at the ends respectively of said drum, means defining a raceway adjacent said drum constraining said ball to traverse said groove, ball directing means adjacent said inlet portion for introducing said ball into said groove and raceway, a blade extending axially of said drum and radially spaced therefrom to define a gap with said ball, said groove having a portion of uniform pitch adjacent said blade, and means for applying signal voltages across said gap.

2. In reproducing apparatus as set forth in claim 1 wherein said groove has an intermediate portion of constant pitch.

3. In reproducing apparatus as set forth in claim 1 wherein said inlet portion increases in pitch in the direction of movement of said ball.

4. In reproducing apparatus as set forth in claim 1 wherein said discharge portion decreases in pitch in the direction of movement of said ball.

5. In reproducing apparatus as set forth in claim 1 wherein said groove has an intermediate portion of substantially constant pitch, said inlet portion increases in pitch in the direction of movement of said ball, and said discharge portion decreases in pitch in the direction of movement of said ball.

6. In reproducing apparatus as set forth in claim 1 wherein said groove has a circular arcuate cross section.

7. In reproducing apparatus as set forth in claim 1 wherein said groove has a circular arcuate cross section of less than 180°.

8. In reproducing apparatus as set forth in claim 1 wherein said ball directing means contains a plurality of balls.

9. In reproducing apparatus as set forth in claim 1 wherein said inlet and discharge portions are interconnected by a ball conveying tube.

10. In reproducing apparatus as set forth in claim 9 wherein said tube is maintained full of balls advanced towards said inlet portion by each ball received from said discharge portion.

11. In reproducing apparatus as set forth in claim 1 wherein strips having opposed straight edges define said raceway.

12. In reproducing apparatus as set forth in claim 11 wherein said strips have a relatively low coefficient of friction.

References Cited in the file of this patent

UNITED STATES PATENTS

2,733,116	Fantham et al.	Jan. 31, 1956
2,760,840	Gordon	Aug. 28, 1956
2,776,336	Clauer	Jan. 1, 1957