

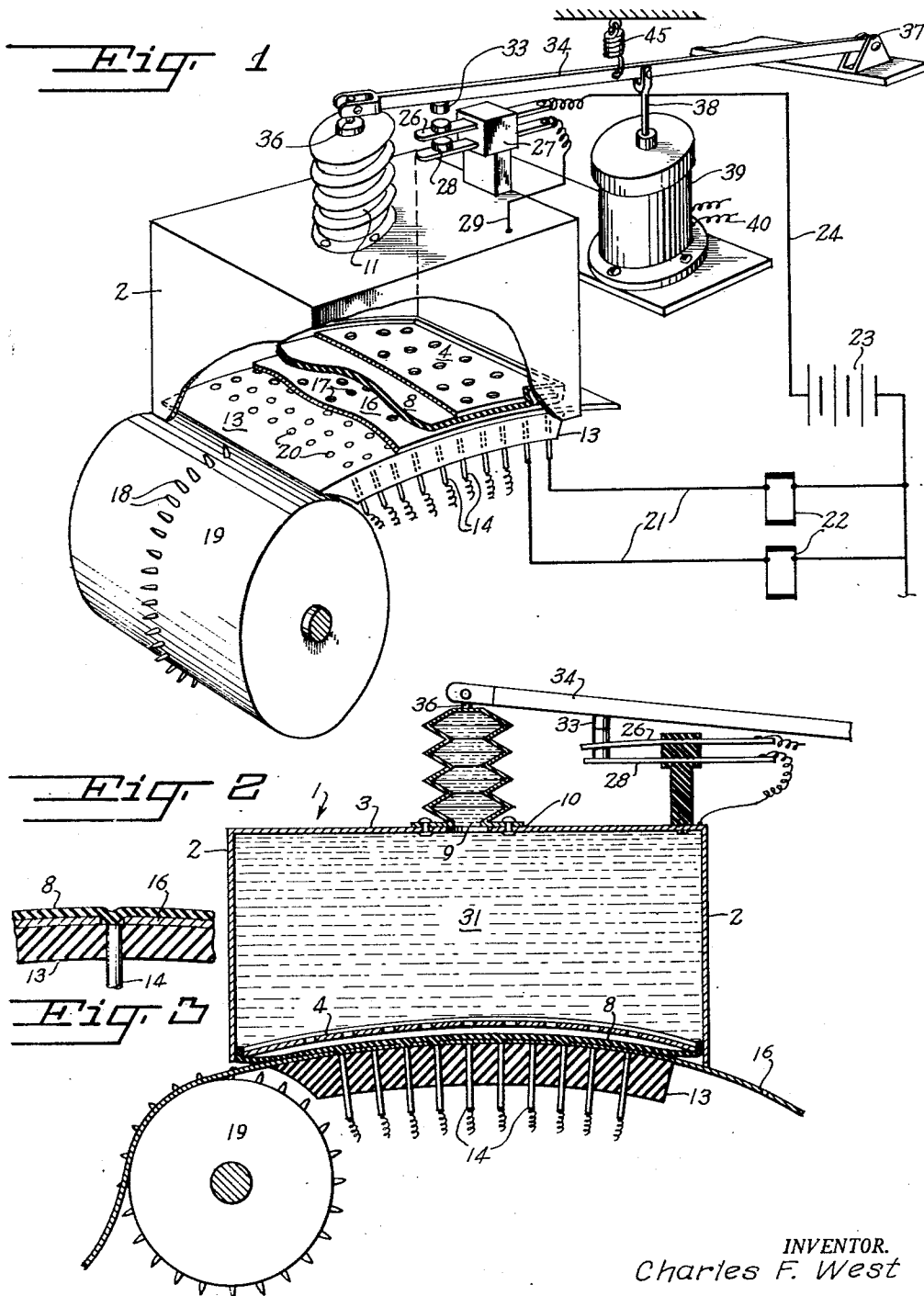
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PERFORATED MEMBER SENSING MECHANISMS

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PERFORATED MEMBER SENSING MECHANISMS

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The present invention relates to perforated card and perforated tape sensing mechanisms and more particularly to a perforated card and perforated tape sensing mechanism for sensing large areas of perforated tapes or perforated cards in a single sensing operation.

Apparatus has been provided in the prior art for sensing large areas of perforated cards in a single sensing operation. In one such mechanism twelve rows of brushes, each row containing 80 brushes, are moved into contact with twelve rows of stationary contact points through holes in the perforated card. Each of the twelve rows of contact points are insulated from one another and a stepping switch is employed to successively apply operating voltages to each of the rows, thereby providing differentially timed output signals. Such systems are complex and, therefore, expensive to manufacture. In addition, the large number of moving parts result in a high inertia relatively slow acting system.

It is, therefore, a broad object of the present invention to provide a perforated member sensing mechanism employing few moving parts for rapidly sensing large areas of a perforated member in a single sensing operation.

Another object of the present invention is to provide a perforated member sensing mechanism employing a flexible conductive diaphragm as the perforations sensing element.

It is another object of the present invention to provide a pressure operated flexible diaphragm as a sensing mechanism for perforated members, which diaphragm may smooth out the perforated member during a sensing operation.

Another object of the present invention is to provide a flexible conductive diaphragm positioned adjacent to a perforated member and to provide a mechanism for developing a pressure for forcing the flexible diaphragm through the perforations in the perforated member and into contact with conductive elements disposed adjacent to each information area on the perforated member to complete electrical circuits connected between the diaphragm and the conductive elements.

Yet another object of the present invention is to provide a flexible conductive diaphragm positioned adjacent to a perforated member and to provide a pressure system for applying a pressure to the diaphragm to force the diaphragm through perforations in the perforated member and into contact with conductive elements disposed adjacent to each information area on the perforated member. The contact pressure between the conductive diaphragm and the conductive elements is provided by the pressure system and, therefore, the contact pressure can be made extremely high.

It is another object of the present invention to provide a plurality of conductive elements molded in a die block with the edges of the conductive elements being flush with the upper surface of the die block. A perforated member to be sensed is supported by the upper surface

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of the die block during a sensing operation and is moved over this upper surface during movement of the perforated member. Movement of the member over the die block burnishes the edges of the conductive elements that are flush with the upper surface of the die block and, therefore, provides for self-cleaning of the contact surfaces.

A further object of the present invention is to provide an apparatus for sensing large areas of a perforated member in a single sensing operation, the sensing mechanism having few moving parts, providing high contact pressures and cooperating with the perforated member to be sensed to provide for self-cleaning of the contact surfaces.

Yet another object of the present invention is to provide a single movable member as the sensing medium for a large area of a perforated member.

Still another object of the present invention is to provide a pressure actuated conductive diaphragm as a perforations sensing mechanism and to provide a conductive fluid as a medium for applying pressure to the diaphragm.

The above and still further features, objects, and advantages of the invention will become apparent upon consideration of the following detailed description of two specific embodiments of the invention, especially when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a perspective view partly in section of an embodiment of the present invention;

Figure 2 is a vertical cross section drawing of a reading mechanism employing a conductive fluid as a pressure developing medium;

Figure 3 is a cross sectional drawing showing a portion of a flexible diaphragm and a perforated tape during a hole sensing operation.

Referring to Figures 1 and 2 of the accompanying drawings, there is provided an enclosure 1 having side walls 2, a top wall 3, and a bottom wall 4 which is curved concave outwardly of the enclosure 1 along only one of its dimensions. A flexible, deformable, conductive material, such as conductive natural or synthetic rubber or conductive flexible plastic may be utilized as the diaphragm 8. The edges of the diaphragm 8 are clamped between the edges of the bottom wall 4 and the inner surface of the walls 2, to provide a pressure-tight seal for the bottom of the enclosure 1. The clamping arrangement disclosed is merely exemplary and it is not intended that the invention should be limited thereto. The upper wall 3 of the enclosure 1 is provided with an aperture 9 which communicates with the interior of a bellows 11. The bellows 11 is secured to the top wall 3 of the enclosure 1, a pressure-tight seal 10 being provided between these two members. The enclosure 1, flexible diaphragm 8, and bellows 11 provide a variable volume, pressure-tight chamber, the volume of the chamber, and, therefore, the pressure in the chamber varying in response to movement of the bellows 11. When the bellows 11 is collapsed, the pressure developed in the enclosure 1 is applied to the diaphragm 8 through a plurality of apertures 12 in the end wall 4 and forces the diaphragm 7 away from the end wall 4, causing it to bulge outwardly of the enclosure 1. When the bellows 11 is expanded, the pressure in the enclosure 1 is reduced and the diaphragm 8 is forced upwardly by atmospheric pressure, upward movement of the diaphragm 8 being limited by the bottom wall 4. It is preferable to limit upward movement of the diaphragm so that it is not excessively stretched and, therefore, torn. Disposed below the diaphragm 8 and substantially co-extensive therewith is an insulated die block 13, the up-

per surface of which is curved convex upwardly along the same dimension that the bottom wall 4 is curved. The insulated die block 13 has a plurality of conductive rods 14 extending vertically upward through an insulating member 15, upper ends 20 of the conductive rods 14 being flush with the upper surface of the die block 13. The conductive rods 14 are arranged in rows and columns, the number of the rods 14 per column and the spacing between the rods corresponding respectively to the number of information areas per column and the spacing between the information areas on the perforated member to be sensed. The number of conductive rods 14 per row is determined by the number of rows of the perforated member to be sensed during each sensing operation and, therefore, the number is determined by the characteristics of the system in which the reader is employed.

A perforated tape 16 is disposed between the diaphragm 8 and the upper surface of the die block 13, and is provided with a row of holes 17 extending along its entire length. Sprocket teeth 18 of a sprocket wheel 19 extend through the holes 17 adjacent the sprocket wheel 19, and move the tape lengthwise when the sprocket wheel 19 is rotated. The holes 17 do not carry information, and therefore, rods 14 are not disposed adjacent to the area of the tape containing these holes 17. The sprocket wheel 19 is driven by a conventional driving mechanism, which is not illustrated since it forms no part of the present invention.

Each of the conductive bars 14 is connected over a separate lead 21 through a separate utilization device 22 to one end of a common source of operating voltage 23. The other end of the voltage source 23 is connected over lead 24 to a leaf spring contact 26 of a switch 27. The switch 27 is provided with a second leaf spring contact 28, the contacts 26 and 28 being normally open. To complete the electrical circuit, the contact 28 must be electrically connected to the diaphragm 8.

In the modification of the invention illustrated in Figure 1 the contact 28 is connected over a lead 29 to the top wall 3 of the enclosure 1. In this modification the top wall 3 and at least one and preferably all of the side walls 2 of the enclosure 1 must be electrically conductive so that the circuit may be completed from the lead 29 through the walls 2 and 3 to the diaphragm 8. Another possible arrangement is to have the lead 29 extend from the contact 28 directly to the diaphragm 8, in which case it would not be necessary for any of the walls of enclosure 1 to be conductive.

In a preferred embodiment of the invention illustrated in Figure 2, the enclosure 1 and the bellows 11 are filled with a conductive fluid 31. The lead 29 is connected to the top wall 3, which is electrically conductive in this modification, and through the conductive fluid 31 to the diaphragm 8. The conductive fluid 31 employed may be of any conductive liquid, such as a colloidal suspension of graphite in water. The reasons for employing the conductive fluid 31 in the preferred embodiment of the invention will be discussed subsequently. Except for the difference in construction described above, the embodiments of the invention illustrated in Figures 1 and 2 are identical.

The switch 27 is supported above the top wall 3 of the container 1 on an insulated support 32. The contacts 26 and 28 are arranged below an insulated stub 33 carried on an arm 34, which is pivotally supported at one end on a vertical rod 36 mounted on the top of the bellows 11. The other end of the arm 34 is pivoted at 37 to the frame of the machine. A vertically reciprocal shaft 38 of a solenoid 39 is pivotally secured to the arm 34 at a point between the two ends of the shaft. The arm 34 is biased upwardly by a spring 45 mounted between the arm 34 and a frame member 35 positioned above the arm. The solenoid 39 is supplied with elastic power over

leads 40 when it is desired to perform a reading operation.

When it is desired to read a portion of the tape 16, the tape is positioned by the drive sprocket 19 so that each of the information areas to be sensed is adjacent to an end 20 of a different one of the conductive bars 14. The solenoid 39 is then energized by a voltage applied over the leads 40 and the arm 34 is moved downwardly. Downward movement of the arm 34 compresses the bellows 11, thereby compressing the fluid in the enclosure 1 and producing a pressure inside of the enclosure 1. The pressure is transmitted through the apertures 12 in the bottom wall 4 of the enclosure 1 to the upper surface of the diaphragm 8, causing the diaphragm to bulge outwardly of the enclosure 1 and into engagement with the tape 16. The pressure applied to the upper surface of the diaphragm 8 is sufficient to force each segment of the diaphragm disposed adjacent to a hole in the tape 16 through the hole, and into contact with the conductive bar 14 disposed below the hole, this being illustrated in Figure 3. At the limit of downward movement of the arm 34, at which time the diaphragm is in contact with the conductive bars 14, the stub 33 closes the contacts 26 and 28 of the switch 27 and an electrical circuit is completed from one terminal of the source 23, over conductor 24, through switch contacts 26 and 28, over lead 29 to the top wall 3 of the enclosure 1, through the diaphragm 8 to the conductive bars 14 disposed below a hole in the tape 16, and over leads 21 through the output devices 22 to the other terminal of the source 23. The output devices 22 associated with conductive bars 14 contacted by the diaphragm 8, are energized and produce an output function. At those information areas where there is no hole in the tape, the tape material serves as an insulator between the diaphragm 8 and the conductive bars 14 and prevents current flow through and, therefore, energization of the output devices 21 associated with the conductive bars 14 adjacent unperforated information areas.

Perforated tapes are normally quite thin and, therefore, the conductive diaphragm 8 may be easily pressed through a hole in the tape and into contact with a conductive bar 14. However, when the mechanism of the present invention is employed to sense relatively thick perforated members it may be necessary to provide the diaphragm with a plurality of small raised areas on its lower surface. Each raised area is disposed adjacent to a conductive bar 14 and passes through a hole in the perforated member and into contact with a conductive bar 14 during a sensing operation.

In the embodiment of the invention illustrated in Figure 1 where contact is made with the diaphragm 8 only at its edges, relatively long lengths of the diaphragms 8, between its edges and the segments of the diaphragm adjacent conductive bars 14, are included in each of the circuits. The material from which the diaphragm 8 is fabricated has a coefficient of resistance which is large compared to the coefficient of resistance of a metallic conductor. As a result of the inclusion of relatively long lengths of the diaphragm 8 in each of the electrical circuits, the circuits have a relatively high internal impedance. The high internal impedance of the electrical circuits causes undesirable power losses in the circuits.

In the modification of Figure 2, as a result of the enclosure 1 being filled with conductive liquid 31, each incremental area on the upper surface of the diaphragm 8 is in direct electrical contact with the top wall 3 of the enclosure 1 and only a very short length of the diaphragm 8, between the conductive liquid and the conductive bars 14, is included in each electrical circuit. Even though the diaphragm 8 has a relatively high coefficient of resistance, the impedance of such short lengths of the diaphragm is very low and does not appreciably increase the impedance of the electrical circuits. Therefore, the power dissipated in the circuits of this embodiment of the invention is quite small.

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Systems employing a liquid 31, whether or not conductive, also are capable of higher operating speeds than systems employing gas as the fluid within the enclosure 1. The fluid in the enclosure 1 is primarily employed to transmit pressure to the diaphragm 8. Air, which is employed as the pressure transmitting fluid in the embodiment of Figure 1, is a highly compressible fluid, as are all gases, and, as a result, the movement of the bellows 11 necessary to develop sufficient pressure to actuate the reading mechanism must be considerable. If the enclosure 1 is filled with an incompressible liquid, such as water, the movement of the bellows 11 necessary to actuate the reading mechanism is very small. Obviously, a system actuated in response to a small movement of the bellows 11 can complete a read-out operation more rapidly than a system actuated only in response to a large movement of the bellows 11.

The switch 27 is incorporated in the circuit of the present invention to insure that voltage is not applied to the diaphragm 8 until it is in contact with the conductive bars 14. If voltage is maintained in the circuit at all times, arcing between the conductive bars and the conductive rubber may take place and cause rapid deterioration of the diaphragm. By employing the switch 27 voltage is not applied to the circuit until the arm 34 has reached its lowermost position, at which time the conductive rubber member 8 is in firm contact with the conductive bars 14. As a result, all possibility of arcing between the diaphragm 8 and bars 14 is eliminated.

The number of information areas of the tape 16 sensed in any given operation is determined by the number of conductive bars 14 disposed in each row of the die block 13. In the arrangement illustrated in Figures 1 and 2 of the accompanying drawings, there are ten such bars in each row of the die block. The perforated tape illustrated in the drawings is provided with seven information areas in each column and, therefore, in any given read-out operation the reading mechanism senses seventy information areas of the perforated tape. Perforated tapes are available having 5, 6, 7, and 8 information areas per column and the apparatus of the present invention may be adapted to sense any number of information areas per column by merely varying the number of conductive bars 14 per column.

During tape advance the spacing between the die block 13 and the diaphragm 8, which at this time is in its retracted position against the bottom wall 4 of the container 1, must be such that the tape does not contact the diaphragm 8 so that the tape may be rapidly advanced. However, this spacing should be no greater than absolutely necessary to allow advance of the tape, since it is desired to minimize movement of the diaphragm 8, in order to minimize the time required to complete a read-out operation. Movement of the tape 16 over the upper surface of the die block 13 during tape advance burnishes the edges 20 of the conductive bars 14 and thereby provides for self-cleaning of the surfaces of the conductive bars that come into contact with the diaphragm 8.

The utilization of a pressure actuated, flexible diaphragm results in a perforated member sensing mechanism employing relatively few moving parts. In addition, the moving parts may be maintained relatively small and, therefore, a low inertia high speed system is provided. Further, the diaphragm 8, when pressed against the tape as a result of pressure developed in the container 1, tends to smooth out wrinkles in the perforated member, and results in proper registry between the holes in the perforated member and the conductive bars 14.

In the modification of the invention illustrated in Figures 1 and 2 the pressure developing mechanism is described as a solenoid actuated bellows. However, other types of pressure systems may be employed without departing from the spirit of the present invention. Thus, there may be provided a pressure line connected to the

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enclosure 1, the pressure line having solenoid actuated feeder and bleeder valves.

Although the specific embodiments of the present invention have been described with respect to perforated tape mechanisms, it is apparent that the apparatus of the present invention may be employed in reading perforated cards or other perforated media. The only modification necessary to the apparatus of the present invention to convert it to a perforated card reading mechanism is to replace the sprocket wheel 19 by a conventional perforated card feed mechanism and to change the number of conductive bars 14 per column.

The mechanism of the present invention is particularly useful as apparatus for sensing large areas of a perforated member in a single sensing apparatus. Quite obviously the apparatus may be employed for sensing a single column of information during each sensing operation. The apparatus has further been described as transmitting simultaneously all of the electrical signals indicative of the information contained in the entire area of the perforated member sensed in each operation. However, in some instances it may be desirable to transmit the signals derived from each column of information sequentially. Sequential transmission may be accomplished by employing rotary switches as taught by the patent to George F. Daly, No. 2,514,031, issued July 4, 1950.

While I have described and illustrated two modifications of the present invention it will be clear that variations of the specific details of construction may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

What I claim is:

1. A mechanism for analyzing record members having a plurality of columns of perforated information areas, comprising at least one column of conductive members, a flexible, deformable, conductive diaphragm having a surface adjacent to and normally spaced from said conductive areas, and means to cause the surface of said diaphragm to contact said conductive members through perforations in said perforated member, said means comprising means for directly applying a pressure to said diaphragm.

2. A mechanism for analyzing perforated members having a plurality of columns of information areas, comprising at least one column of conductive members carried by a perforated member supporting means, a flexible, deformable, conductive diaphragm adapted to contact said conductive members through the perforated areas of the perforated member, and means to cause said diaphragm to contact said conductive members.

3. The combination according to claim 2, wherein said diaphragm is a conductive rubber diaphragm.

4. A mechanism for analyzing perforated members having a plurality of columns of information areas, comprising at least one column of conductive members, a flexible, deformable, conductive diaphragm adapted to contact said conductive members through the perforated areas of the perforated member, a plurality of electrical circuits, means connecting each of said electrical circuits between a different one of said conductive members and said diaphragm, and means to cause said diaphragm to contact said conductive members through the perforated areas.

5. A mechanism for analyzing perforated members having a plurality of columns of information areas comprising at least one column of conductive members, a pressure-tight enclosure, a flexible, deformable, conductive diaphragm forming one wall of said pressure-tight enclosure, said diaphragm adapted to contact said conductive members through the perforated areas of the perforated member and means for developing a pressure in said enclosure to cause said diaphragm to bulge outwardly from said enclosure and into contact with said conductive

members through the perforated areas on the perforated member.

6. The combination in accordance with claim 5, wherein said enclosure is filled with an incompressible liquid.

7. The combination according to claim 5, wherein said enclosure is filled with a conductive liquid, a plurality of electrical circuits, and means connecting each of said electrical circuits between a different one of said conductive members and said conductive liquid.

8. The combination according to claim 5 having a plurality of electrical circuits, each of said circuits connected between a different one of said conductive members and said diaphragm, normally open switch means connected in series with each of said electrical circuits, and means for closing said switch means when said diaphragm is in contact with said conductive members.

9. The combination in accordance with claim 5 further comprising means disposed adjacent said conductive diaphragm inwardly of said enclosure for limiting inward movement of said diaphragm.

10. The combination in accordance with claim 9 wherein said last mentioned means comprises an apertured plate disposed substantially parallel to said conductive diaphragm.

11. The combination in accordance with claim 5 further comprising a plurality of electrical circuits and means connecting each of said electric circuits between a different one of said conductive members and said conductive diaphragm.

12. A mechanism for analyzing perforated members having a plurality of columns of information areas comprising a plurality of columns of conductive members, a pressure-tight enclosure, a flexible, conductive rubber diaphragm forming one surface of said enclosure, said diaphragm adapted to contact said conductive members through the perforated areas of the perforated member, bellows means for selectively increasing and decreasing the pressure in said enclosure, said diaphragm bulging

outwardly from said enclosure and into contact with said conductive members through the perforated areas on said perforated member in response to an increase in pressure in said enclosure.

13. A mechanism for analyzing record members having a plurality of perforated information areas, comprising a plurality of conductive members arranged to correspond to predetermined patterns of perforations in the record member, a sheet of material having deformable areas at least opposite said conductive members, each of said deformable areas comprising means for conducting electric current, and means for moving said sheet of material and said conductive members one toward the other sufficiently to cause said deformable means to extend through the perforations in the record members to thereby effect contact between said means for conducting electricity and said conductive members.

14. The combination in accordance with claim 13 wherein said means includes means for developing and directly applying a pressure to said sheet of material.

15. The combination in accordance with claim 13 wherein said means for moving includes a conductive liquid in contact with said means for conducting electric current.

16. The combination in accordance with claim 13 having a body of insulating material with a surface opposite said sheet of material, said conductive members being supported in said body and each having a surface flush with said surface of said body and means for moving the perforated member over said surface of said body thereby to clean and burnish said surface of said conductive members.

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