

June 29, 1965

W. G. WADEY ETAL

3,191,527

FLUID PRESSURE WAVE PRINTER

Filed Aug. 16, 1961

5 Sheets-Sheet 1

FIG. 1a

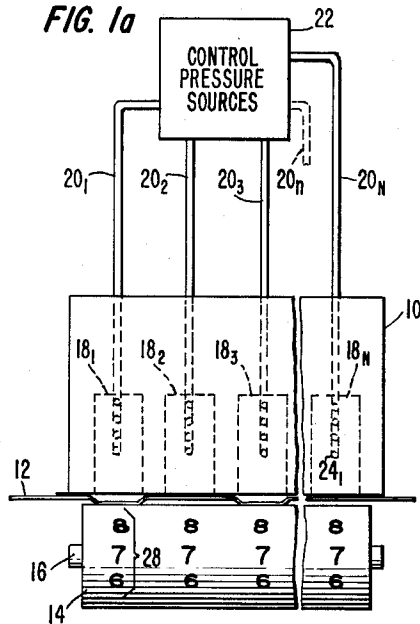


FIG. 1b

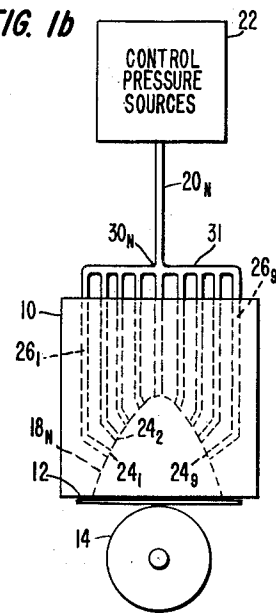


FIG. 2a

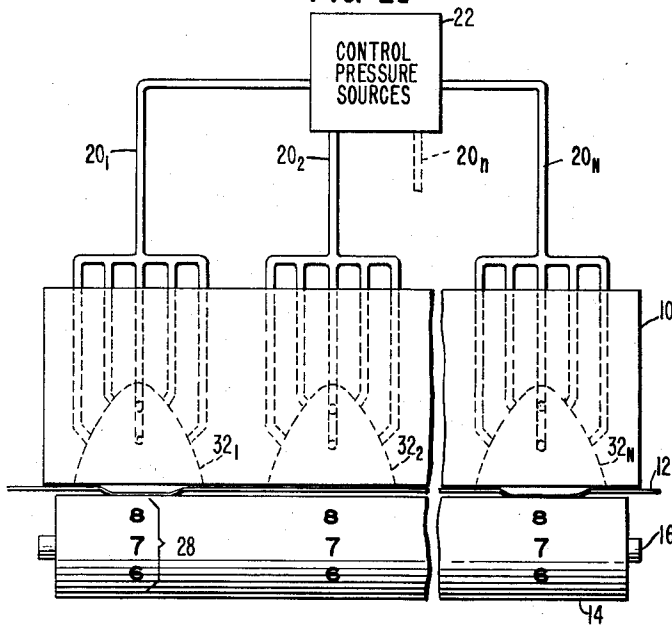
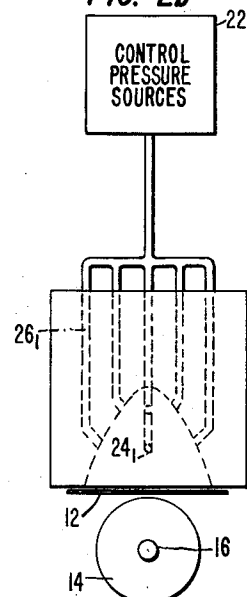


FIG. 2b



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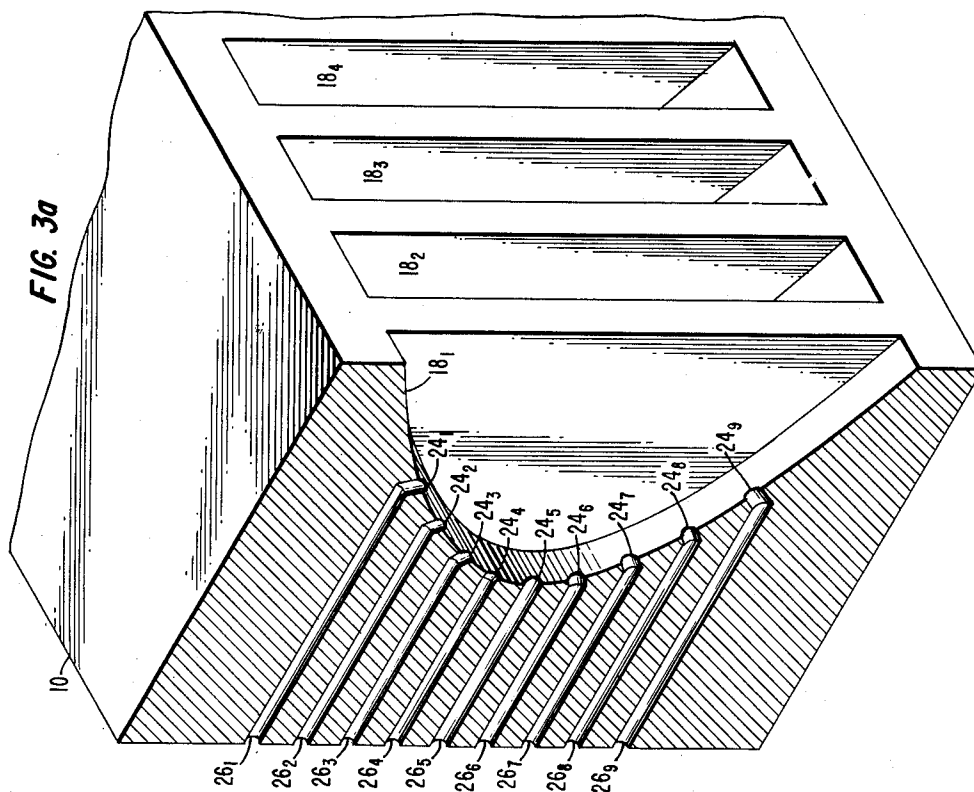
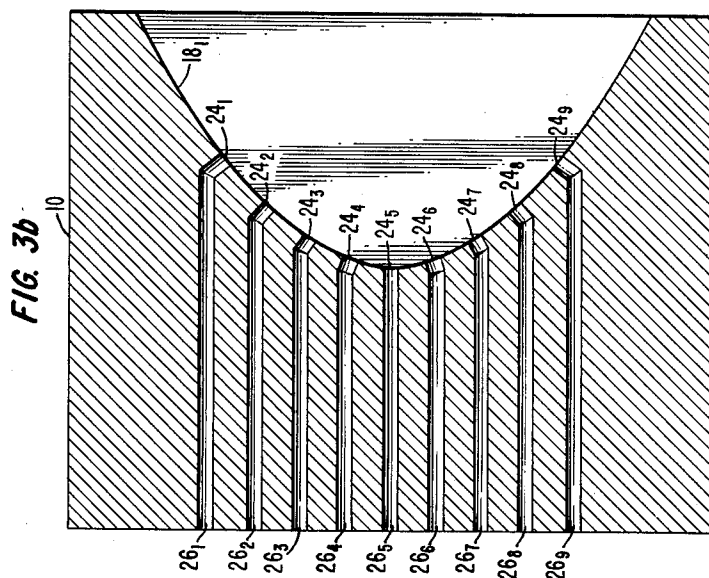
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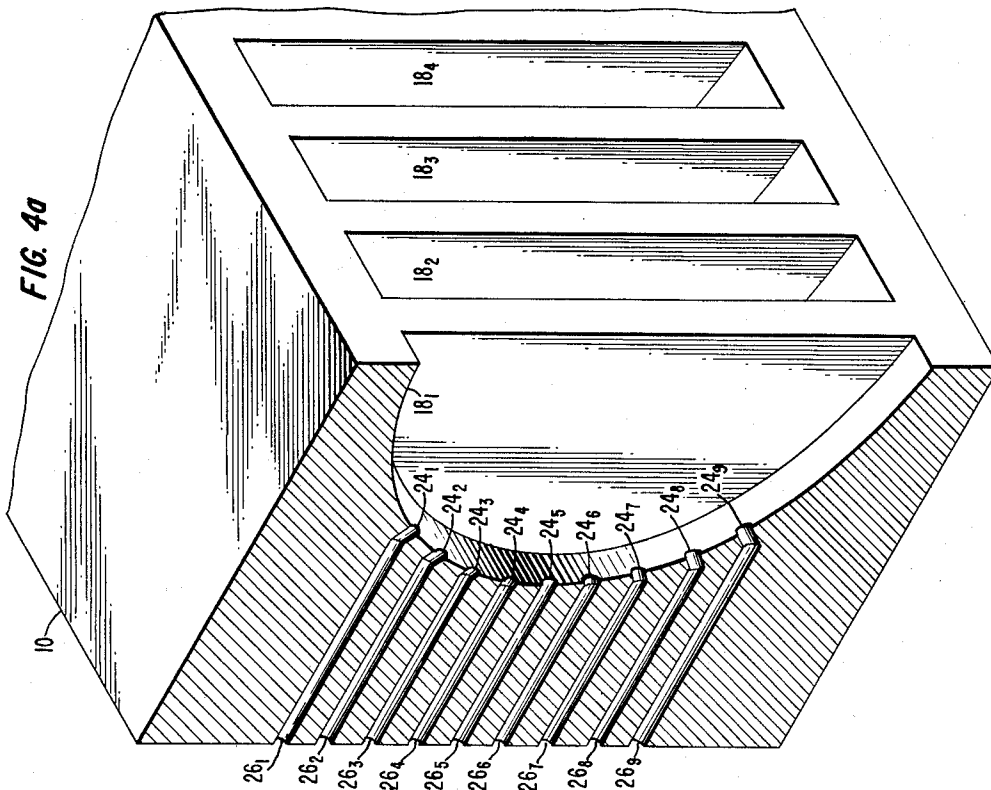
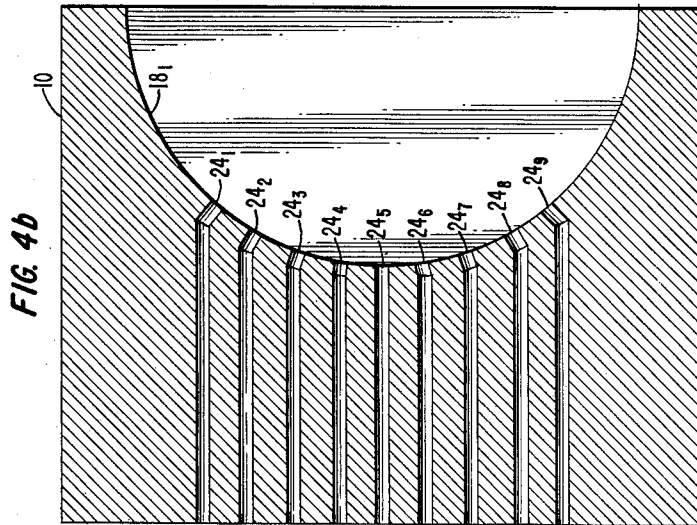
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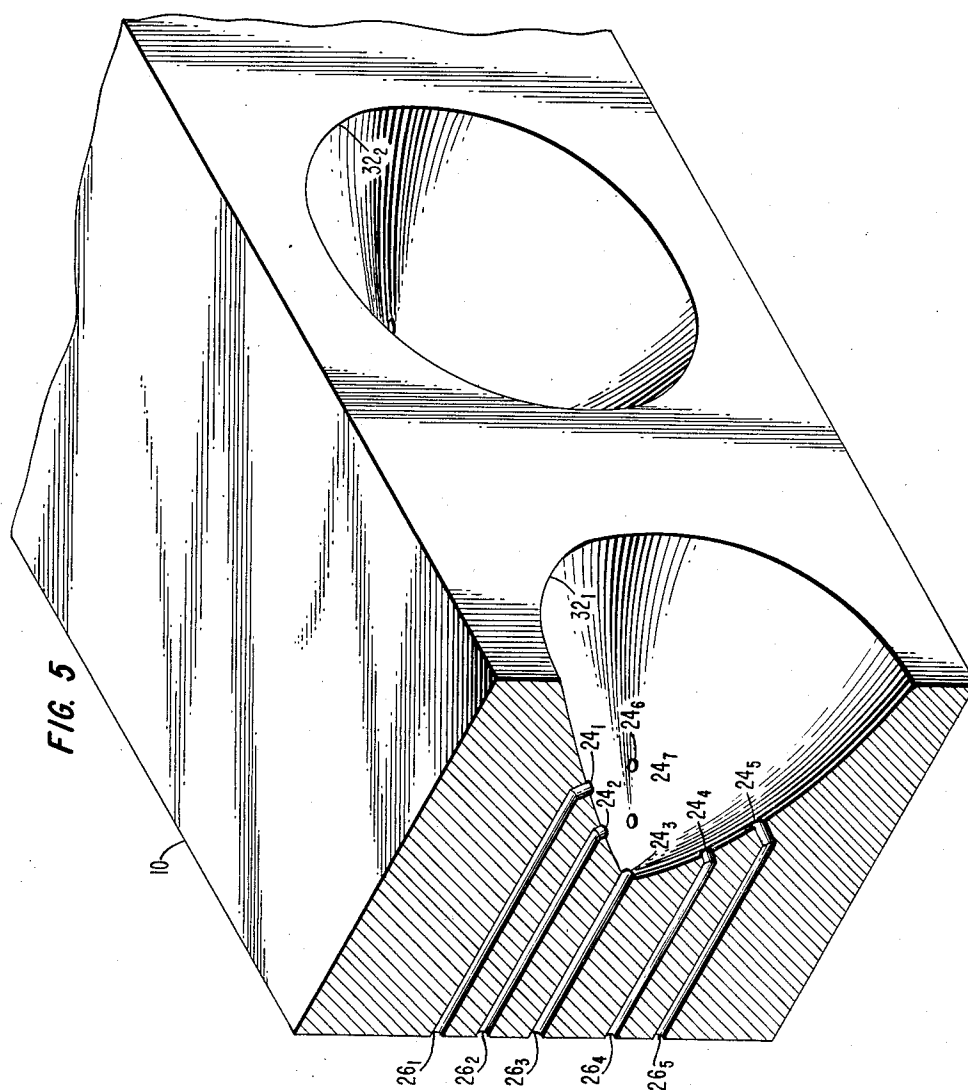
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FIG. 6

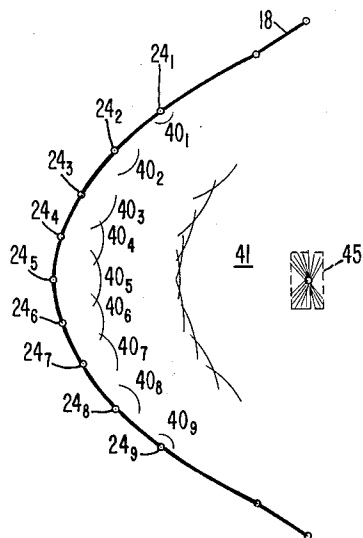


FIG. 7

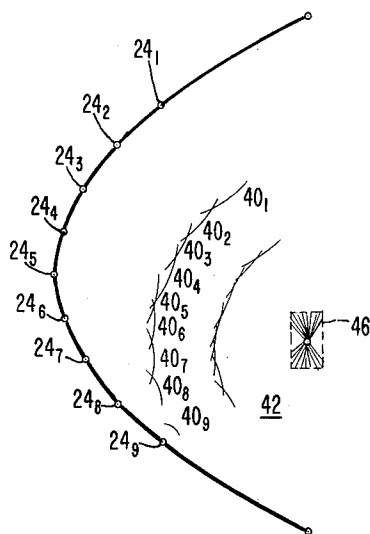


FIG. 8

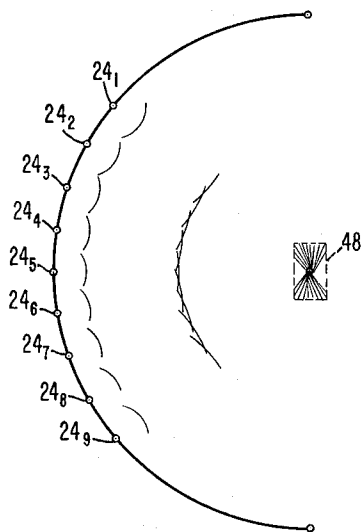
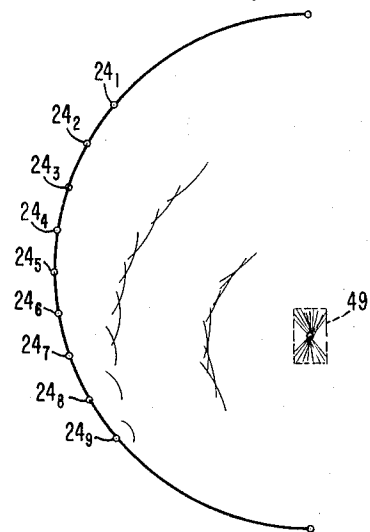


FIG. 9



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FLUID PRESSURE WAVE PRINTER

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Filed Aug. 16, 1961, Ser. No. 131,808
10 Claims. (Cl. 101-93)

This invention relates to means for developing a concentrated wave of fluid energy for applying a force to a pressure responsive means, and more particularly, to means in a printer apparatus for forcing a print receiving member against a type face which does not involve the use of a mechanical print hammer.

In printer mechanisms of the prior art, the print receiving member, such as a card or paper sheet, is commonly forced against the type face by means of a mechanical print hammer arrangement, wherein momentum is imparted to the print hammer head such that upon its striking the print receiving member, said member is pressed against the type face. In some mechanisms, an ink bearing member is interposed between the type face and the print receiving member, while in other apparatus the ink is spread upon the type face and transferred therefrom onto the print receiving member during the time of contact. The use of a mechanical print hammer together with its actuating mechanical linkage results in a fairly complicated and complex structure. Such mechanism from time to time may require certain adjustments so as to maintain a required minimum force upon the print receiving member, and furthermore, it is subject to wear and tear of the component members due to friction and impact forces.

The present invention eliminates the need for the above described mechanical mechanism. Instead, a controlled force is applied against the print receiving member or the like by means of a converging composite fluid pressure wave front developed within a body of fluid by a plurality of fluid pulses applied thereto at certain discrete times. By merely changing these pulse times, the point of application and direction of said force may be varied. The invention is especially useful in the output of data processing systems which employ fluid amplifiers. These systems generally manipulate and transmit data by means of fluid, rather than electrical, pulses. Control signals are also developed in the same fluid medium, and may be utilized as the actuating pulses for the present invention. Fluid amplifiers are mechanically rugged, adaptable to miniaturization, and operable at medium repetition rates.

It is therefore an object of the present invention to provide means for forcing a print receiving member against a type face which requires no moving mechanical parts or complex linkages.

Another object of the present invention is to provide means for forcing a print receiving member against a type face wherein a composite fluid pressure wave is generated within a body of fluid such that the maximum concentration of energy in said composite wave impinges against a print receiving member.

A correlative feature of this invention is the kind of print or type face that may be used with the printer mechanism. Presently, printing is accomplished by striking the print receiving member with a mechanical hammer and forcing same into the raised type of a type wheel in order to receive the character impression. This is commonly referred to as "letter press" printing. The consequent embossing of a print receiving member is an inherent disadvantage of this type of structure. However, with the present invention, a form of printing known as "intaglio" may be performed. In intaglio printing, the

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paper is pressed against a surface into which the type face is engraved and into which printing ink is wiped. For this application, the type is incised in shallow relief with relatively incompressible ink filling all of the recesses. Under these circumstances, no appreciable embossing will occur.

It is therefore a further object of the present invention to provide printer mechanism wherein intaglio printing rather than letter press printing is accomplished.

The force producing means of the present invention may also find use in applications other than printing wherever a controlled force is desired. By varying the number and/or timing of fluid pulses used in developing the composite pressure wave, varying forces may be generated at different locations within the body of fluid which impinge upon pressure responsive means there found. Thus, the invention is not to be limited to printing applications.

Consequently, it is yet a further object of the present invention to provide apparatus for generating a controlled force which avoids the use of mechanical linkage mechanism and a moving hammer head. A yet further object of the present invention is to provide means for producing a force in the form of a composite fluid pressure wave which is developed by a plurality of individual pressure waves acting to reinforce one another at the desired point of application.

These and other objects of the present invention will become apparent during the course of the following description wherein preferred embodiments of the invention are described, and which should be read in conjunction with the following drawings, in which:

FIGURES 1a and 1b respectively show the plan and side elevation views of one embodiment of the invention;

FIGURES 2a and 2b respectively show the plan and side elevation views of another embodiment of the present invention;

FIGURES 3a and 3b show different cross sectional views of the force producing means of FIGURE 1;

FIGURES 4a and 4b show a variation of FIGURE 3a; FIGURE 5 shows another embodiment of the invention;

FIGURES 6 and 7 illustrate how different composite pressure waves may be generated by the apparatus of FIGURE 3; and

FIGURES 8 and 9 illustrate how different composite pressure waves are generated by the apparatus shown in FIGURE 4.

FIGURES 1a and 1b respectively show the plan and side elevation views of one embodiment of the present invention as used in a printer mechanism. A housing 10 has contained therein a plurality of chambers 18₁ through 18_n which are coplanarly arranged and whose number corresponds to the number of columns to be printed on a print receiving member 12. As is more clearly shown in FIGURE 3, subsequently to be described, each of these chambers 18_n opens from housing 10 on the side thereof which is adjacent the print receiving member 12, and each has a shape in its vertical dimension which may be approximately parabolic. The width of a chamber may be quite narrow in order to allow more of them to be placed side by side for a given width of member 12. A series of fluid orifices 24 are positioned about the surface of a chamber 18_n in a vertical plane, with each orifice connecting with the environment outside of housing 10 by means of a fluid conduit 26. Each conduit 26 associated with a particular chamber 18_n is connected to an individual conduit 20_n which emanates from a control unit 22. The lengths of fluid conduits 26 associated with a chamber may vary as shown in FIGURE 1b, or they

may all be equal depending upon various considerations which will subsequently be discussed.

On the side of print member 12 opposite the openings to chambers 18 are located a plurality of type fonts 28 associated one with each column to be printed. Each font 28 may be located on an individual print wheel, or they may all be located on a single print drum 14 such as is shown in FIGURE 1a. As the drum 14 rotates on its spindle 16, each type character of a font is brought adjacent the surface of the print receiving member. If it is desired to print a particular character in a column n on the print receiving member, it is necessary to first wait until that character is moved adjacent the print receiving member 12. At this time, a pulse is applied via the respective conduit 20_n from control unit 22 which divides at junction 30_n and is applied via all of the conduits 26 to the fluid orifices in the selected chamber 18_n. The emergence of fluid pulses from the orifices 24 within the selected chamber 18 causes the development of a composite fluid pressure wave which converges and has its point of a maximum energy in a region next to the print receiving member 12 which is thereby forced against the type character face. The fluid contained within a chamber 18 must be one in which a pressure wave can be developed.

FIGURES 2a and 2b respectively illustrate plan and side elevation views of a second embodiment of the present invention wherein the fluid orifices in a chamber 32 are arranged in a three dimensional relationship with respect to each other. Like parts in FIGURE 2 and FIGURE 1 are correspondingly numbered. The advantage of utilizing three dimensionally disposed orifices within each chamber lies in that a greater number of orifices may be included so as to generate a larger force upon the print receiving member 12. However, this advantage is somewhat offset inasmuch as a chamber occupies a greater volume than does a chamber in FIGURE 1. Therefore, in a printing application, the use of three dimensional chambers requires that the type fonts be spaced further apart from each other on the type drum 14.

As mentioned in the foregoing objects, a correlative feature of the present invention is the nature of the type face that may be used when the invention is employed in a printer mechanism. The type face is incised or engraved in shallow relief within the type wheel or drum, with relatively incompressible printing ink being introduced thereto which fills all of the recesses. This is commonly known as "intaglio" printing. Although not shown, any readily adaptable well-known method of introducing the ink and wiping the type wheel surface may be employed in the present application. Since print receiving material such as paper, card, or the like is normally flexible to some extent, the application of the composite fluid pressure wave forces the print area of the card against the entire surface of the ink which fills the incised type character. This is because the nature of the fluid pressure wave medium is such that it applies substantially equal pressure to the entire print area of the print receiving member, thus causing said member to flex inwardly of the character outline and insuring that the printed character is continuous. In the prior art, intaglio printing when using a mechanical hammer head has not proved too satisfactory, inasmuch as the rigid impact surface of the hammer is at times unable to force the print receiving member to exactly conform to and make contact with the entire surface of the ink contained within the engraved character. Therefore, raised type is most often used with the printers of the class described, with the consequent and sometimes undesirable embossing of the print receiving member. Since no appreciable embossing occurs with intaglio printing, it is seen that the use of the present invention as the impact force producing medium in printer mechanism leads to novel and unexpected results. It should, however, be noted in passing that raised type may also be em-

ployed with the present invention if embossing is acceptable.

FIGURES 3a and 3b respectively illustrate a cross sectional pictorial view and a cross sectional elevation view of one of the parabolic chambers 18 of FIGURE 1. Fluid orifices 24₁ through 24₄ and 24₆ through 24₉ are symmetrically disposed about the axis of chamber 18, with all of these orifices lying in the same vertical plane, i.e., the plane of the parabola. Fluid conduits 26₁ through 26₉ are respectively associated with each of the orifices 24₁ through 24₉. Although the conduits are shown in FIGURE 3 to be normal to the surface of the chamber as they enter, this is not absolutely necessary in view of the description to follow.

Referring now to FIGURES 6 and 7, the generation of a converging composite pressure wave front at a particular portion of chamber 18 will now be described. In FIGURE 6, it is desired that the point of maximum energy concentration of the composite wave be produced in a region 45 of the fluid body contained within chamber 18. In FIGURE 3, each of the conduits 26 contains the same fluid as that in chamber 18, such that a pressure pulse applied at the input thereto travels through a conduit 26_n and emerges at its respective orifice 24_n. Upon emerging into chamber 18, the pulse continues its travel through the fluid body until it eventually reaches region 45 therein. Thus each of the fluid orifices in the wall of chamber 18 may be considered as a source of disturbance within the body of fluid for generating an individual pressure wave therefrom having a direction of propagation towards region 45.

A pressure wave thus created by a source of disturbance 24 transmits energy along its direction of propagation. Inasmuch as the fluid used in conduits 26 and within chamber 18 is a compressible one, the wave produced by the sources 24 are longitudinal in that the compression and rarefaction takes place in a direction parallel to the direction of travel. The energy density of longitudinal pressure wave (energy per unit volume) is generally proportional to the square of the maximum wave amplitude, and varies inversely as the square of the distance from the wave source. Thus, a pressure wave within the fluid body, whose source of origin is at an orifice on the wall of chamber 18, transfers its energy in a direction towards the region 45 with this energy becoming progressively smaller as the wave retreats from its source of origin 24.

Where there are two or more waves moving simultaneously through the same region, such as is the case when each of the sources 24 is actuated, each wave produces the same disturbance of the medium as though it were alone. The combined action of all of the waves at any particular location within the body may then be determined by summing together all of the instantaneous wave amplitudes, with each having either a positive or negative sign. This phenomenon is known as interference. Where two waves, both having positive amplitudes, interfere with one another, then reinforcement of the waves occur such that the resulting composite wave has an amplitude greater than that of its individual components. Thus, the energy content of the composite wave is greater than the energy content of either of its component waves. In like fashion, three or more waves interfere with one another to produce reinforcement if their amplitudes have the same polarity. Where two waves of opposite polarity interfere with each other, destructive interference is caused which may result in complete annulment, such that the composite wave produced thereby has little or no energy content.

With the foregoing principles in mind, the operation of the composite wave producing means of the present invention may be readily understood. Initially, with reference to FIGURE 6, a pulse is applied to chamber 18 via conduit 26₅ and orifice 24₅ such that a single pressure wave is produced in the fluid body which begins to travel toward the desired region 45. Inasmuch as orifice 24₅ does have a finite diameter, the pressure wave generated by this

source normally has a spherical wave front so that energy is propagated in more than just one direction. This wave front may be denoted as 405₁ and it represents the particles of the fluid body which are momentarily at their greatest distances in a positive direction from their undisturbed positions. In other words, the wave front 405 represents the points of greatest positive amplitude (maximum compression or pressure) of the pressure wave generated by source 24₅ at any particular time. Subsequent to the production of wave 405, fluid pressure pulses are applied simultaneously to sources 24₄ and 24₆ which thereby produce individual pressure waves having a direction of propagation toward region 45. These individual pressure waves have wave fronts 404 and 406 which respectively represent the location of their greatest positive wave amplitudes at different times during the course of their travel through the fluid body. The velocity of a pressure wave in chamber 18 is the same no matter where or what its source of origin. Therefore, when once produced, each pressure wave travels the same distance within the fluid body during a unit time interval as that traveled by any other.

Subsequent to the production of waves 404 and 406, fluid pressure pulses are applied to actuate sources 24₃ and 24₇ and in turn respectively generate pressure waves 403 and 407 each having at least a portion of their wavefronts travelling toward the desired location 45. Subsequent to their generation, sources 24₂ and 24₈ are simultaneously energized to respectively generate pressure waves 402 and 408. Sources 24₁ and 24₉ are thereafter simultaneously actuated to generate pressure waves 401 and 409, respectively.

As can be seen from FIGURE 6, immediately after waves 401 and 409 have been produced by their respective sources, they begin to travel toward region 45. In the meantime, the previously produced pressure waves 402 through 408 have been travelling through the fluid body and thus are further away from their respective sources than are the last two produced waves. However, the time at which each of the pressure waves have been generated from its respective source is such that all of the waves 401 through 409 are approximately the same distance from region 45. Inasmuch as each wave travels at the same velocity, the wave front of each will arrive at region 45 at substantially the same time. The propagation of these waves through the fluid body therefore results in a composite converging wave front such as is generally indicated by 41. As each individual wave approaches region 45, it interferes with the next adjacent wave so as to produce points of maximum energy at the intersections of the positive amplitude wave fronts. When all of the waves arrive at region 45, they substantially reinforce one another to produce a composite wave front at this location quite high in positive amplitude or pressure. Therefore, a concentration of energy is available to apply force and thus perform work on a pressure responsive means positioned adjacent region 45. Such a pressure responsive means may be the print receiving member 12 shown in FIGURE 1, or it may be other means responsive in some manner by the application of force thereupon.

It may thus be seen that in FIGURE 6, the sources of disturbance 24₁ through 24₉ are selectively actuated at times which are inversely proportional to the distance of a source from desired region 45 of maximum energy concentration. This principle is more clearly appreciated from FIGURE 7, wherein it is desired, by using the same number of orifices and the same chamber 18, to develop a composite wave having its maximum concentration of energy at a region 46 not found on the axis of symmetry. In this case, region 46 in the fluid body is approximately the same distance from sources 24₁ through 24₄. However, the distances from sources 24₅ through 24₉ become progressively shorter. Therefore, sources 24₁ through 24₄ must be actuated approximately simultaneously, but before actuation of the remaining sources, in order to generate fluid pressure waves 40₁ through 40₄ which will

arrive at region 46 at the same time that the remaining pressure waves 40₅ through 40₉ also arrive. After generation of waves 40₁ to 40₄, sources 24₅ through 24₉ are actuated in this sequence such that a converging wave front 42 is created which eventually reaches region 46. Here, all of the pressure waves substantially reinforce one another to generate a point of maximum concentration of energy within the fluid body. Thus, one important feature of the present invention is to provide a region of maximum fluid energy at any desired location in the chamber in accordance with the times at which fluid pulses are applied via the orifices in the surface of the chamber. The desired region of maximum energy concentration may be changed merely by adjusting these times, without need for changing the number or placement of orifices.

Since, as noted above, the wave front of an individual pressure wave from a source 24 is spherical in shape, it is not necessary that the axis of an orifice be parallel to the direction in which the desired region 45 or 46 is found from the source. In other words, by virtue of the expanding wave front of an individual pressure wave, a portion thereof propagates towards and eventually reaches region 46 even though said region is not on the axis of the orifice from which the wave originated. Furthermore, although FIGURE 6 and FIGURE 7 both show all of the pressure waves intersecting at a point within regions 45 or 46, it is to be understood that the desired region can have finite volume, with the waves only substantially reinforcing one another therein. In other words, the maximum amplitudes of the waves as represented by the indicated wave fronts need not arrive simultaneously at the very same point, but can arrive in the general locality of a point. In this way, positive portions of the waves, although they may vary in amplitude, will still be summed together to result in a composite wave having maximum energy concentration within the desired region of the fluid body.

The time at which a fluid pulse arrives at an orifice 24 via its conduit 26 may be adjusted by merely varying the length of said conduit between its orifice and junction 30 shown in FIGURE 1b. A single pulse is applied to junction 30 via conduit 20_n from the control source 22 for the particular chamber 18 in which a composite wave is desired to be generated. When the pulse from source 22 arrives at junction 30, it generates a fluid pulse in each of the conduits 26₁ through 26₉ with each of these fluid pulses leaving junction 30 at the same time. The time required for a pulse to travel from junction 30 to a particular orifice 24 depends upon the length of its associated conduit 26_n together with whatever common path 31 is required before the fluid pulse actually enters conduit 26. For example, in FIGURE 1b, a fluid pulse arriving at junction 30 from source 22 will essentially create a pulse in each of the two branches 31. The fluid pulse in the upper branch 31 successively creates fluid pulses in conduits 26₄, 26₃, 26₂, and 26₁. In like fashion, the fluid pulse in the lower branch 31 successively produces pulses in conduits 26₈, 26₇, 26₆, 26₅. The pulse at junction 30 immediately produces a pulse in conduit 26₉. Therefore, a pulse emerges from orifice 24₅ prior to the emergence of pulses from orifice 24₃ and 24₄. In like fashion, since the distance travelled by a pulse in conduit 26₁ is greater than the distance travelled by pulse in conduit 26₂, the pulse in the former arrives at chamber 18 subsequent to the pulse in the latter. In order to cause pulses to arrive at the orifices 24 at times indicated in FIGURE 7, it is only necessary to appropriately adjust the lengths of the conduits 26.

FIGURES 4a and 4b show cross sectional pictorial and elevation views, respectively, of a two dimensional chamber having a semi-circular shape rather than parabolic. FIGURES 8 and 9 illustrate the generation of a composite converging fluid pressure wave within the chamber of FIGURE 4, where the concentration of energy is to

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occur at a region in the fluid body which is on or away from the chamber axis of symmetry, respectively. In FIGURE 8, for example, the desired region 48 is directly at the center of the circle such that all of the sources 24 are equi-distant therefrom. Therefore, each of the sources 24 should be actuated at the same time, since all the pressure waves need to travel the same distance. However, in FIGURE 9, the desired region 49 is located away from the center of the circle such that all of the sources 24 are at different distances therefrom. In such a case, no two sources in FIGURE 9 emit a pulse at the same time. Of course, this statement may be modified in view of the preceding discussion wherein it was mentioned that it is not necessary that all of the individual pressure wave fronts intersect at the exact same point within the desired region. Generally, the fronts from sources 24₁ through 24₄ could intersect in the upper part of region 49, while the fronts from the remaining sources could intersect in the lower part. Even in this case, however, the waves will substantially reinforce one another such that a crest of maximum energy is concentrated in region 49.

As before indicated in connection with FIGURES 2a and 2b, the chambers 18 may be three dimensional in that orifices are located therein which do not all lie in the same vertical plane. This can be more readily seen in FIGURE 5 which shows a cross sectional pictorial view of a chamber which is a parabola in the plane of its axis of symmetry, and a circle in the plane normal thereto. As there shown, orifices 24 are symmetrically disposed about the axis of symmetry, but do not all lie in the vertical plane of the cross section. Orifices 24₁, 24₂, 24₃, 24₄, and 24₅ are positioned around the surface of chamber 32 in a manner similar to the orifices 24 shown in FIGURE 3. However, there are fewer orifices provided in the vertical plane since other orifices 26₆, 24₇, and 24₈ and 24₉ are positioned in a horizontal plane, of which only the first two are shown.

In operation, FIGURE 5 is similar to the two dimensional chambers disclosed in FIGURE 3 and FIGURE 4. Each orifice acts as a source of disturbance in the fluid body within chamber 32 such that an individual pressure wave is generated therefrom a portion of whose wave front has a direction towards some predetermined desired region. These pressure waves arrive in the desired region and substantially reinforce one another to produce maximum energy concentration which can do work upon a pressure responsive means adjacent thereto. By adding more orifices in either of the two planes shown in FIGURE 5, or in other planes, a larger number of pressure waves can be generated which increases the energy concentration at the desired location. Thus, a three dimensional chamber provides more surface area in which to place orifices such that the composite pressure wave is thereby comprised of a greater number of individual pressure waves.

Only chambers having parabolic and circular cross sections in the plane of the axis of symmetry have been shown for the preferred embodiments. These configurations are desirable inasmuch as the longitudinal axes of the orifices placed about the surface of the chamber will converge generally toward the desired region in the fluid body at which the concentration of energy must be applied. However, as before noted, an orifice acting as a source of disturbance in the fluid body normally produces a spherical wave front having more than one direction of propagation through the fluid body. Therefore, the orifices may be arranged in chamber surfaces different from those illustrated. Furthermore, it is not necessary that the sources of disturbance be at the surface of the chamber, since the orifice nozzles could extend into the fluid body and still produce pressure waves. It may also be pointed out that a transducer might be used as a source of disturbance to convert other than fluid pulse energy into a pressure wave travelling through the fluid body.

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Thus, the invention is not to be limited to source actuation means employing the use of fluid pulses in conduits 26.

In addition to the above modifications to the preferred embodiments, it is also evident that the orifices 24 need not be symmetrically arranged about the axis of symmetry of the chamber. This is obvious from an examination of FIGURE 9, for example, wherein all of the sources 24 are at different distances from the desired region 49. Therefore, the symmetrical shape of chamber 18 in this instance has no particular significance. The same may be true for a three dimensional chamber. Of course, where the sources are not symmetrical about some axis or on which the desired location is placed, it becomes necessary to adjust appropriately the timing of the pulses emitted from each of the orifices such that all arrive at the desired region at approximately the same time to result in reinforcement therein.

In the preferred embodiment of the invention, air may be used as the fluid within chamber 18, conduits 26, and conduit 20. In this case, chamber 18 is open to the outside environment and the print receiving member 12 need not make an air tight seal therewith. However, the composite pressure wave must have sufficient energy to move member 12 outwardly from chamber 18 against the existing environmental pressure. In like fashion, fluid other than air can be employed if it is contained in chamber 18 by means of a flexible sealing diaphragm member across the opening which stretches to force the print receiving member against the type face. Other arrangements may also be constructed, such as immersing the print receiving member 12 and type drum 14 in the body of fluid. Therefore, many modifications of the invention may be apparent to one skilled in the art without departing from the spirit of the invention as defined in the appended claims.

We claim:

1. Printer mechanism comprising: a type face engraved into a surface, and apparatus for forcing a print receiving member against said type face, with said apparatus including a body of fluid a region of which is adjacent to a print receiving member, a finite plurality of actuable discrete sources of disturbance arranged symmetrically about an axis in said fluid body, where said axis extends to said region with each said source producing, when actuated, an individual longitudinal pressure wave which travels through said fluid body toward said region, and means to actuate initially the said source farthest from said region and thereafter to actuate each of the remaining sources at a time, as measured from said initial actuation time, which is approximately inversely proportional to its distance from said region, such that all of said individual pressure waves substantially reinforce one another in said region to develop a concentration of fluid energy therein.

2. Printer mechanism according to claim 1 wherein said sources are parabolically arranged about said axis.

3. Printer mechanism according to claim 1 wherein each said source comprises an orifice through which a fluid pressure pulse can be introduced into said body of fluid by said actuating means.

4. Printer mechanism according to claim 3 which further includes a fluid impervious chamber surrounding said body of fluid except adjacent a print receiving member such that said region in said fluid body is in direct contact with a print receiving member.

5. Printer mechanism according to claim 4 wherein said fluid body is air.

6. Printer mechanism comprising: a type face, and apparatus for forcing a print receiving member against said type face, with said apparatus including a body of fluid a region of which is adjacent to a print receiving member, a finite plurality of actuable discrete sources of disturbance arranged symmetrically and parabolically about an axis in said fluid body, where said axis extends

to said region, with each said source producing, when actuated, an individual longitudinal pressure wave which travels through said fluid body towards said region, and means to actuate each of said sources of disturbance at an appropriate time such that all of said individual pressure waves substantially reinforce one another in said region to develop a concentration of fluid energy therein.

7. Printer mechanism comprising: a type face, and apparatus for forcing a print receiving member against said type face, with said apparatus including a body of fluid a region of which is adjacent to a print receiving member, a finite plurality of actuable discrete sources of disturbance arranged symmetrically and circularly about an axis in said fluid body, where said axis extends to said region, with each said source producing, when actuated, an individual longitudinal pressure wave which travels through said fluid body towards said region, and means to actuate each of said sources of disturbance at an appropriate time such that all of said individual pressure waves substantially reinforce one another in said region to develop a concentration of fluid energy therein.

8. Printer mechanism comprising: a type face, and apparatus for forcing a print receiving member against said type face, with said apparatus including a body of fluid a region of which is adjacent to a print receiving member, a finite plurality of actuable discrete sources of disturbance each located at a different position in said fluid body and producing, when actuated an individual longitudinal pressure wave which travels through said fluid body towards said region, and means to actuate each of said sources of disturbance at an appropriate time such that all of said individual pressure waves substantially reinforce one another in said region to develop a concentration of fluid energy therein, wherein said source actuating means comprises means to actuate initially the source farthest from said region, and thereafter to actuate each of the remaining sources at a time, as measured from said initial actuation time, which is approximately inversely proportional to its distance from said region, and each said source of disturbance comprises an orifice through which a fluid pressure pulse can be introduced into said body of fluid by said actuating means.

9. Printer mechanism comprising: a type face, and apparatus for forcing a print receiving member against said type face, with said apparatus including a body of fluid a region of which is adjacent to a print receiving member, a finite plurality of actuable discrete sources of disturbance each located at a different position in said fluid body and producing, when actuated an individual

longitudinal pressure wave which travels through said fluid body towards said region, and means to actuate each of said sources of disturbance at an appropriate time such that all of said individual pressure waves substantially reinforce one another in said region to develop a concentration of fluid energy therein, wherein each said source of disturbance comprises an orifice through which a fluid pressure pulse can be introduced into said body of fluid by said actuating means.

10. Printer mechanism comprising: a type face, and apparatus for forcing a print receiving member against said type face, with said apparatus including a body of fluid a region of which is adjacent to a print receiving member, a finite plurality of actuable discrete sources of disturbance arranged symmetrically about an axis in said fluid body, where said axis extends to said region, with each said source producing, when actuated, an individual longitudinal pressure wave which travels through said fluid body towards said region, and means to actuate each of said sources of disturbance at an appropriate time such that all of said individual pressure waves substantially reinforce one another in said region to develop a concentration of fluid energy therein, wherein each said source of disturbance comprises an orifice through which a fluid pressure pulse can be introduced into said body of fluid by said actuating means.

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