Aug. 18, 1964 J. E. DREJZA 3,144,821

PRINTER APPARATUS HAVING PRINT FORCE CONTROL

Filed Oct. 6, 1960 3 Sheets-Sheet 1

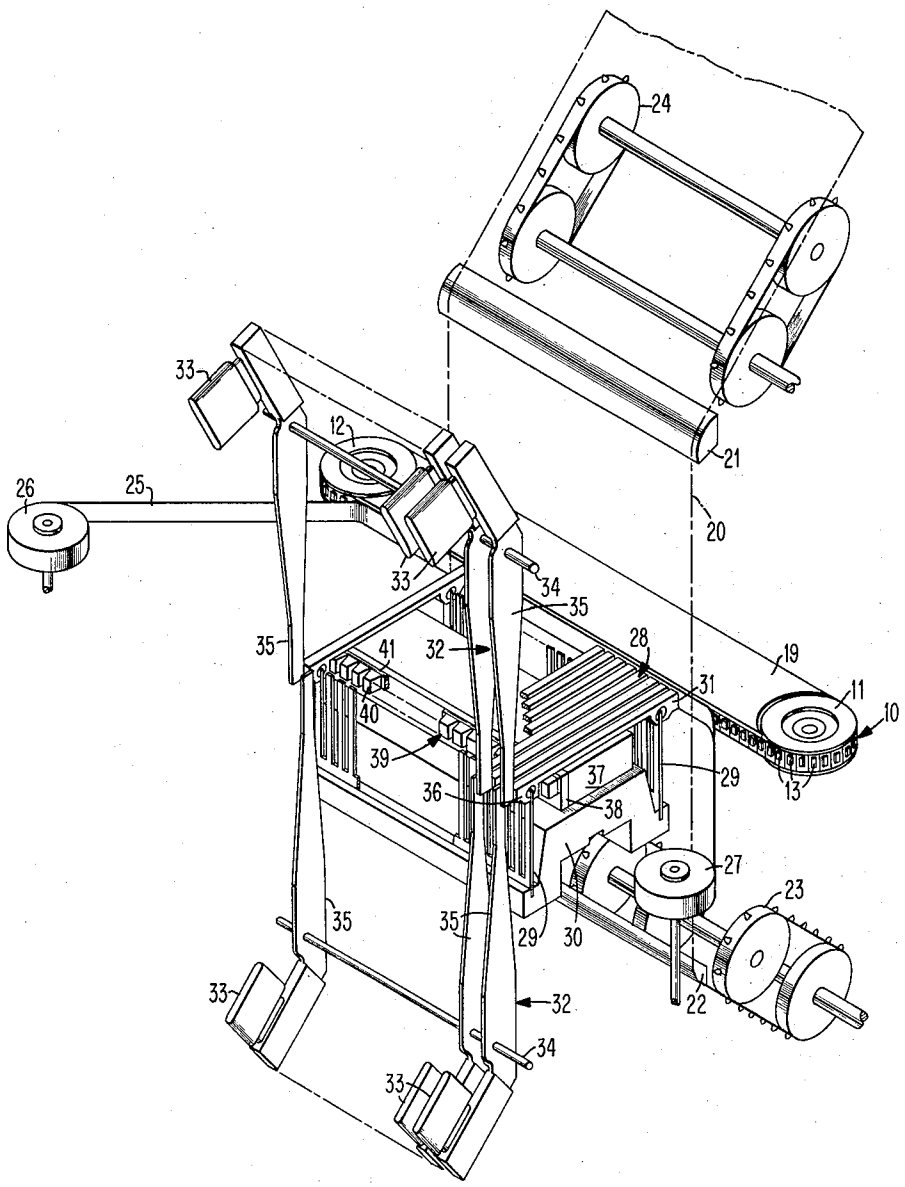

FIG. 1

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PRINTER APPARATUS HAVING PRINT FORCE CONTROL

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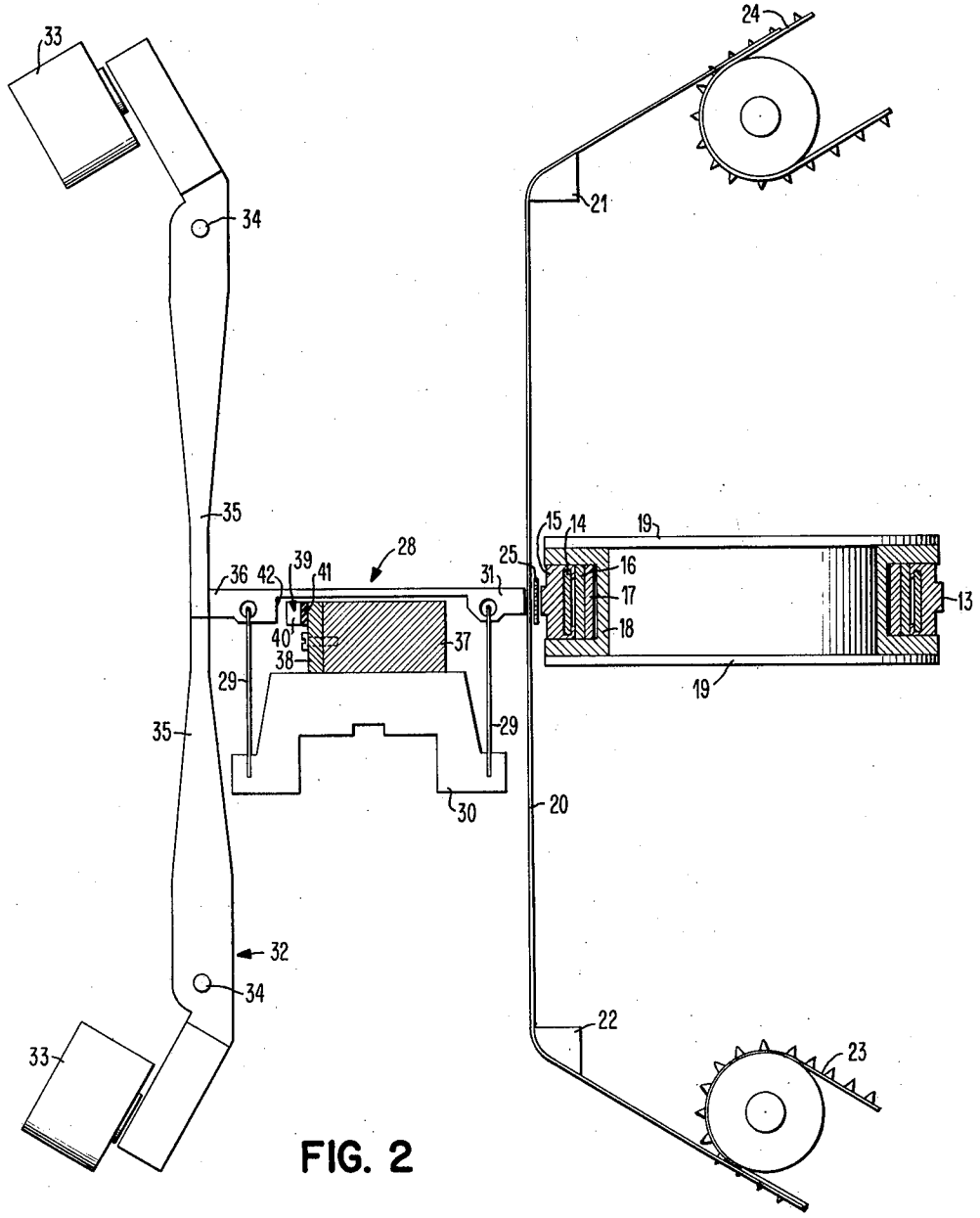

FIG. 2

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PRINTER APPARATUS HAVING PRINT FORCE CONTROL

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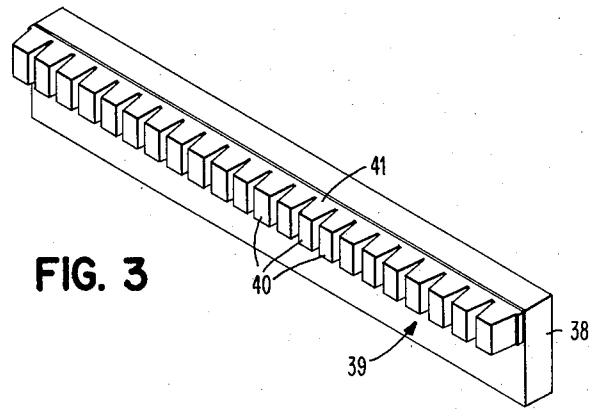

FIG. 3

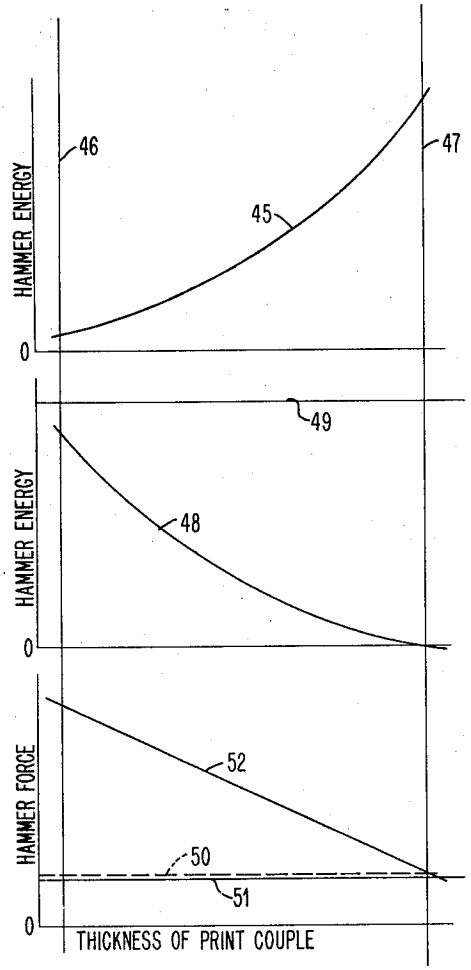

FIG. 4

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PRINTER APPARATUS HAVING PRINT FORCE CONTROL

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4 Claims. (Cl. 101—93)

This invention relates to printer apparatus and particularly to a printer apparatus in which printing impressions are formed by a hammer element striking a print medium.

While not necessarily limited thereto the present invention has particular utility in on-the-fly back printers.

In general, a mechanical back printer involves the driving of a print medium and ink ribbon against an engraved type character on a type carrier. In an on-the-fly printer, the type characters are struck when they are in motion. In certain types of print apparatus, the energy for impacting is delivered by an inertial hammer mechanism. An inertial hammer mechanism is one which is thrown much in the manner of a projectile by a hammer operator such as an electromagnet or the like. At the time of impact the hammer is moving under the momentum supplied to it by the operator but is not under control thereof.

In modern printer applications there is a demand for versatility in the number of copies to be printed. Some applications require only one copy whereas others will require as much as six or more copies. It is well known in printing to supply multiple copies in a single printing by interleaving several sheets with several carbon papers. This multiple copy document as well as the single copy document is generally inserted into a print apparatus between the print hammer and the type characters and ink ribbon in the case of a back printer, or between the hammer and type ribbon and an anvil or platen in the case of a front printer to form a print couple. Whatever the type of printer, it will be appreciated that the amount of impact energy needed to print six or more legible copies is considerably greater than to print a single copy. On the one hand, energy for printing one copy is insufficient for printing six copies while energy for six copies would likely result in cutting of ribbon and/or document in the case of printing a single copy.

Present printer apparatus do not provide for variation in the amount of energy delivered by the operator to the print hammer element. Indeed, a mechanism for accomplishing this would be extremely complex. The present method of compensating for the difference of energy level requirements for the hammers as the number of copies is varied is to adjust the relative spacing of hammer and type elements. This is generally accomplished manually. In addition to being time consuming, it is not particularly accurate since such adjustments continually involve the human error factor.

It is the principal object of the present invention to provide a printer apparatus having means for automatically adjusting print force control as the number of document copies to be printed is varied.

It is a particular object to provide such control for an on-the-fly back printer.

It is a further object of the present invention to provide such controls in a manner which is simple, economical, and involves a minimum of elements to accomplish the results.

These and other objects are attained in accordance with the practice of the present invention by providing in a print apparatus a print mechanism comprising an inertial hammer element and a hammer operator adapted to hurl said hammer to impact a print couple against a type character carrier a hammer impression control means mounted in the path of the inertial print hammer. To accomplish automatic adjustment of the energy level of the hammer as the energy absorption characteristic of the document is varied, the hammer impression control means is made of an energy absorbing material having an energy absorption characteristic substantially equal to that of the documents.

In a print apparatus comprising a plurality of inertial hammer elements arranged in a row for impacting a print couple at a plurality of print positions along a print line extending across a document and a plurality of operators for hurling said hammers individually against said document, the hammer impression control means in a preferred embodiment comprises a continuous force control member having a plurality of integral energy absorbing land portions, each adapted to coact with a separate hammer element.

In the preferred form of the invention, the force control bar is formed of rubber material, preferably a synthetic rubber such as chloroprene more commonly known as Neoprene rubber. In a multiple hammer print apparatus the force control member comprises a continuous multi-landed block of synthetic rubber such as chloroprene bonded to a metal support plate.

In this manner, the energy of the hammer will be corrected to a level which will not be excessive for any particular thickness of the print couple, i.e., the document being printed upon. Thus improved printing results, and the amount of wear on the printing system is also diminished. It will be appreciated that these and other advantages have been achieved by a mechanism which is simple, economical, and easily serviced. Manual adjustments are substantially eliminated and automatic adjustment of impact forces are accomplished.

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

In the drawings:

FIG. 1 is a perspective view of a print apparatus incorporating the principles of the present invention.

FIG. 2 is a side view with partial cross section of the print apparatus of FIG. 1.

FIG. 3 is a perspective of one embodiment of the energy absorbing stop device of a type having particular utility in multiple hammer print apparatus.

FIG. 4 is a graph illustrating principles of energy distribution in connection with various thickness print couples.

Referring to the drawings, FIG. 1 shows a simplified printer comprising an endless chain belt **10** supported on spaced-apart rollers **11** and **12** carrying a plurality of equally spaced type members **13** thereon. The chain belt **10** may be of any well-known type but preferably comprises a steel band **14** (see FIG. 2) coated with an energy-absorbing plastic as taught by co-pending U.S. application of V. R. Simpson and T. W. Thompson filed January 11, 1960, S.N. 1,761 now U.S. Patent 3,041,964 issued on July 3, 1962. As disclosed in said application, the type members are comprised of block portions **15** and **16** which are clamped by suitable means such as screws to the steel band **14**. The block portion **16** has the rear side thereof provided with gear teeth **17** so as to be engageable with corresponding gear teeth in roller **11**. The chain belt is preferably located in a track or guide member **17** supported by upper and lower plate members **19**. In addition to guiding the chain belt, guide member **17** may also back up the type belt on impact. The roller **11** may be adapted to be driven by motive means (not shown) in any well-known manner.

A record strip 20 is adapted to pass over guide members 21 and 22, respectively, and to be advanced step by step by conventional means, including lower sprocket wheels 23 and upper sprocket wheels 24. An ink ribbon 25 which forms a print couple with record strip 20 extends along a print line formed by the chain belt 10 and between record strip 20 and type members 13. Ribbon 25 is fed from supply reel 26 to take-up reel 27 in any well-known manner which may include reversing the direction of feeding as is well known in the art.

Printing of the characters represented by type members 13 on record strip 20 is accomplished by a plurality of hammers 28 individually movable under their own inertia. Hammers 28 which are preferably arranged in a row along the print line are mounted horizontally to be supported individually on leaf springs 29 which in turn have their bottom end portions attached to a support block 30. The leaf springs 29, in addition to supporting the hammers 28 for inertial motion also biases them away from record strip 20 and type members 13. Thus the hammers are uniformly spaced from the type members at a distance such that documents of various thickness may be inserted between the hammers and the type members so that one or more copies may be printed at a time. An impression is formed with or without copies on record strip 20 of the print couple when the front end portion 31 of hammers 28 strike the record strip 20 and ink ribbon 25 against type members 13.

The energy to effect the impacting of the head portions 31 of hammers 28 against record strip 20 is obtained by operation of hammer operators comprising armatures 32 and electromagnets 33. Armatures 32 which may be pivoted on a common pivot member 34 have an arm portion 35 adapted to strike the rear end portion 36 of hammers 28 in such a way that hammers 28 are moving at the time of impact under their own inertia. For this purpose, means (not shown) is provided for limiting the stroke of armatures 32.

In accordance with this invention, the hammers 28 are engaged while in inertial motion by impression control means designed to automatically adjust for varying thicknesses of the record strip 20. The impression control means in preferred form comprises a resilient shock absorbing force control member 39 bonded to a mounting member 38 which may be attached to a support member 37 which is made stationary preferably by attachment to hammer support block 30. Various configurations of the force control member may be had for accomplishing the purpose of the invention. A preferred form having particular utility for a multiple hammer print apparatus is shown in FIGS. 1 and 3. As there illustrated the resilient energy absorbing member 39 is comprised of a plurality of individual energy absorbing land portions 40 which protrude outwardly from a common base portion 41. The rear end portion 36 of hammer 28 is adapted to have an abutment 42 which engages the face of the land portion 40. With this construction, each hammer 28 is individually engaged without substantially effecting the energy absorption characteristics of adjacent portions of the force control member. Thus uniformity is more readily obtained.

The energy absorbing member 39 may be of any suitable resilient material, but is preferably made of synthetic rubbers because of their resistance to lubricants and/or other substances used in other parts of the printer which are harmful to natural rubber. One suitable material is chloroprene, more commonly referred to as Neoprene rubber. In a particular embodiment, an impression control means of the type shown in FIG. 3 was made of 50 durometer Neoprene rubber. The land portion and base configuration was obtained by molding. Satisfactory results were obtained with record strips 20 composed of 11–13 and 15 lb. #4 sulfide bond papers interleaved with one to five carbon papers commercially known as Kraft

5½, 7½–9 lb. Ink ribbons such as Keelox nylon, silk, or cotton .0024"–.004" thickness were used.

FIG. 4 illustrates graphically the principles of the subject invention. In the upper portion of the graph, line 45 shows the energy required by an inertial print hammer such as hammer 28 to obtain legible copy without damage to record strip 20 and/or ink ribbon 25. Vertical lines 46 and 47 indicate practical minimum and maximum print couple thicknesses which include one print copy to six or eight print copies, respectively, with an ink ribbon.

In the middle portion of FIG. 4, line 48 shows the energy removed by the energy absorbing member 39, while line 49 shows the maximum hammer energy available. As is shown, the total energy of hammer 28 is absorbed at the maximum practical limit for a particular design.

The bottom portion of the graph of FIG. 4 shows the results of the automatic control of hammer force from the aspect of impact force on the type members 13. Line 50 shows the impact force as experienced by type members 13 with print force control. Line 51 indicates the minimum force on type members 13 for good printing which is the standard at the upper level of print couple thickness. Line 52 shows the force on the type member 13 in a print mechanism of FIG. 1 without an impression control means. It was found that where single copy printing was desired, the force at lower practical limit was sufficient when print control was not used to cause cutting of the print couple.

Thus, it will be seen that an improved printing operation is assured with the present invention. Versatility in the number of legible copies which can be produced without damage thereto is enhanced without complexities in structure.

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

What is claimed is:

1. In a print apparatus, a print mechanism comprising in combination, a movable striking member, a struck member, said striking and struck members coacting to form print impressions on a print medium therebetween and being spaced apart a predetermined distance to accommodate print media of various thicknesses, means for imparting inertial motion to said striking member, and impression control means for automatically varying the impact force level of said striking member in accordance with variations of the thickness of said print media within a predetermined range of thicknesses thereof including a resilient force control means located in the path of travel of said striking member for engaging said striking member coincidentally with the impact thereof on said print media, said force control means having an energy absorbing characteristic whereby print media in the range of said thicknesses are struck with force proportional to the thickness thereof and said struck member is struck at a substantially constant force throughout said range of print media.

2. In a print apparatus, a print mechanism comprising in combination, a plurality of striking members located at plural print positions along a print line, and struck means locatable at said print positions along said print line, said striking and said struck members coacting at each print position for producing print impressions on a print medium interposable therebetween, said striking and struck members being spaced apart a predetermined distance to accommodate various layers of a multi-layer print medium to be printed upon, means for imparting inertial motion individually to said striking members, and impression control means for varying the impact force level of each of said striking members in accordance with variations in the number of layers in said print medium includ-

ing a force control member co-extensive with said print line, said force control member having individually operable resilient force control portions located in the path of travel of each of said striking members, said control portions having an energy absorbing characteristic for a predetermined range of layers of said print medium whereby print media in said range of layers are struck by each striking member with a force proportional to the thickness thereof and said struck member is struck at each print position at a substantially constant impact force throughout said range of layers.

3. In a print apparatus, a print mechanism in accordance with claim 4, in which said resilient force control means is a compression member having a plurality of separate resiliently compressible energy absorbing portions engageable by said hammer means at various print positions along said print line.

4. In a print apparatus, a print mechanism comprising a type carrier adapted to present engraved type elements at a plurality of print positions along a print line, a plurality of print hammers located at said print positions along said print line, said hammers and said type elements being spaced apart to accommodate various layers of a multi-layer print medium to be printed upon and said hammers being movable individually under their own energy to a point of impact with said type elements, means for imparting inertial motion to said hammers, and impression control means for automatically varying the impact force level of said hammers in a manner proportional to variations in the number of layers in said print medium including a resilient force control means located along said print line in the path of travel of each of said hammers and in position for engaging said hammers coincidentally with the impact thereof on said print medium, said force control means having an energy absorbing characteristic whereby print media in a predetermined range of layers thereof are impacted by each of said hammers with a force proportional to the number of layers thereof and said type elements are struck at said print positions at a substantially constant force throughout said range.

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