

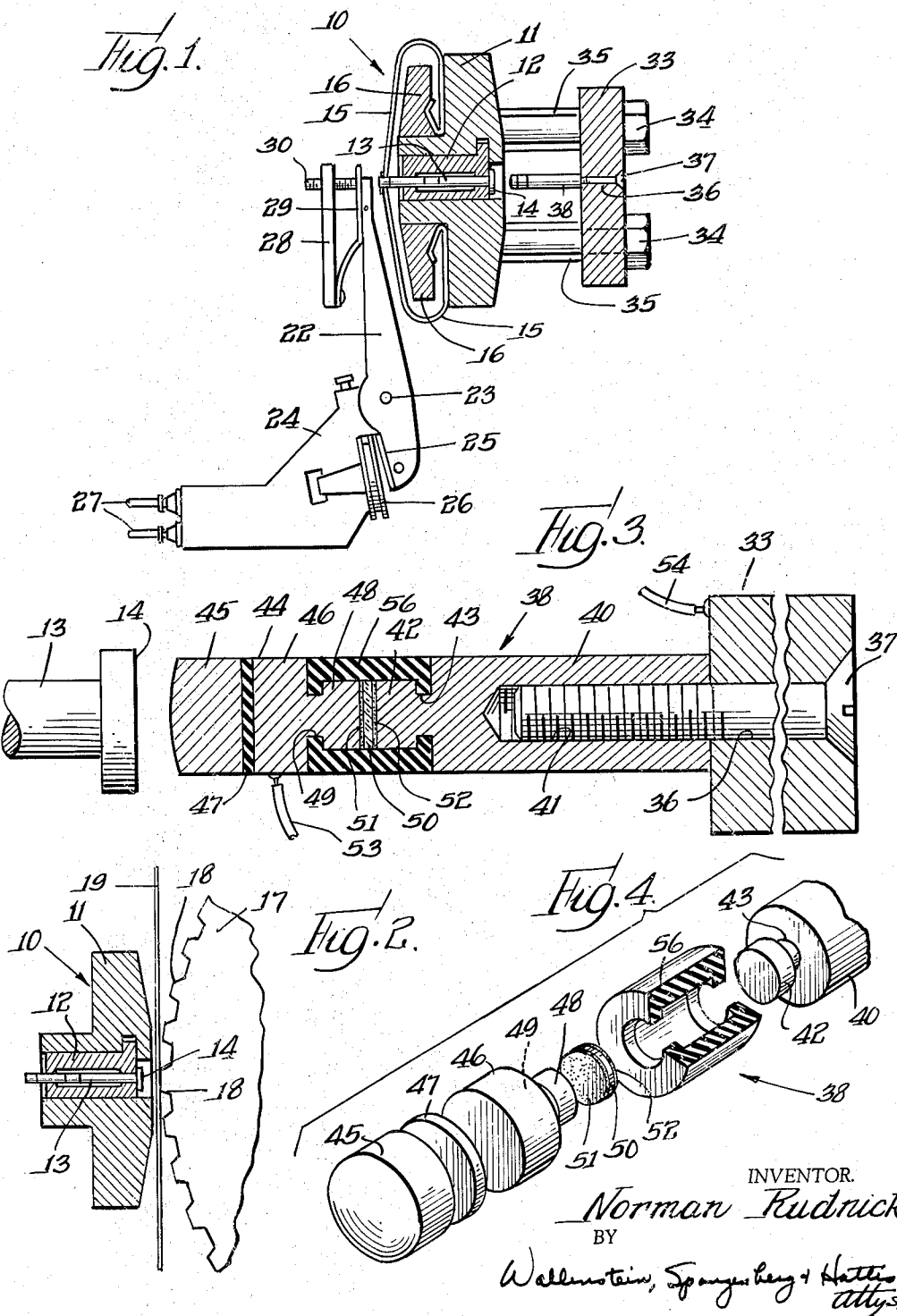
Oct. 26, 1965

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3,213,666

IMPACT SENSOR

Filed Nov. 29, 1962



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3,213,666

IMPACT SENSOR

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Filed Nov. 29, 1962, Ser. No. 240,826

17 Claims. (Cl. 73-11)

The principal object of this invention is to provide an impact sensor which produces electrical signals in accordance with impact forces applied thereto, which is generally usable in a variety of applications for sensing impacts, which is particularly adaptable for use in testing impact actions of printing hammers in a multiple rapid printer or the like, which may be compact and small in size, which is sturdy and simple in construction, and which may be inexpensively, readily and accurately constructed on a mass production basis.

A multiple rapid printer, with which the impact sensor of this invention is particularly adaptable for use, may include an elongated rotatable drum provided with embossed indicia thereon, a plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clapper for selectively engaging and operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes. For satisfactory operation of such a multiple rapid printer it is necessary that the impact force of the hammers and the timing of the operation of the hammers be maintained within predetermined limits and adjustment means are usually provided for so doing.

In accordance with this aspect of the invention, means are provided for testing the impact actions of the hammers. In this respect, the drum is removed from the printer and a support bar is mounted along the striking faces of the longitudinally arranged hammers, the support bar being provided with a plurality of impact sensors in alignment with the striking faces of the hammers. The impact sensors produce electrical signals in accordance with the impacts applied thereto by the striking faces of the hammers, and these electrical signals are transmitted to suitable gauges and/or oscilloscopes for indicating the impact actions, including the impact forces, the nature of the impact forces and the timing of the impact forces. By utilizing such indications suitable adjustments may be readily and quickly performed to bring the impact actions of the hammers within the required predetermined limits.

Briefly, the impact sensor of this invention includes an elongated base section supported at one end, as by securing the same to the support bar, and an elongated impact section in longitudinal alignment with the base section and adapted to be impacted at one end with an impact force, as by the striking face of a hammer. A thin piezoelectric ceramic plate having electrodes on opposite sides thereof is interposed between the other ends of the base section and impact section and, preferably, the electrodes thereof are mechanically and electrically secured respectively to the base section and impact section. The piezoelectric ceramic plate is stressed in accordance with the impacting of the impact section, as by the impact of the striking face of the hammer thereon, for producing electrical signals at the electrodes in accordance with said impacting. Means are provided for making electrical connections to the electrodes for transmitting said electrical signals to gauges, oscilloscopes or the like for indicating the impact actions applied to the impact sensor.

Preferably, the impact section is made of two portions, an anvil portion which is impacted and an operating portion which stresses the piezoelectric ceramic plate, the two portions being secured together by electrical insulating

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means. Electrical connections to the electrodes of the piezoelectric ceramic plate preferably extend through the base section and the impact section to which the electrodes are mechanically and electrically secured, and because the impact section is formed of two electrically insulated portions, the striking of the anvil portion of the impact section has no grounding or adverse effect on the electrical connections. Also, preferably, the base section and the impact section are secured together by electrical insulating means to provide a unitary rugged construction and protect the joints between the piezoelectric ceramic element and the base and impact sections.

Further objects of this invention reside in the details of construction of the impact sensor, the relationships between the component parts thereof and the relationships between the impact sensor and the multiple rapid printer.

Other objects and advantages of this invention will become apparent to those skilled in the art upon reference to the accompanying specification, claims and drawing in which:

FIG. 1 is a sectional view, partly in elevation, diagrammatically illustrating a multiple rapid printer having impact sensors of this invention applied thereto;

FIG. 2 is a view similar to FIG. 1 but showing the impact sensors removed and the rotatable drum in place for multiple rapid printing;

FIG. 3 is an enlarged sectional view of the impact sensor of this invention; and

FIG. 4 is an exploded perspective view of the impact sensor.

Referring first to FIGS. 1 and 2, a multiple rapid printer is generally designated at 10. It includes an elongated frame 11 having a plurality of inserts 12 therein, the inserts 12 slidably receiving hammers 13 having striking faces 14. The hammers 13 are arranged longitudinally along the frame 11 and any desired number of hammers 13 may be utilized. For example, in one form of a multiple rapid printer 132 hammers are utilized and they are arranged on centers of .100 inch. The longitudinally arranged hammers 13 cooperate with a rotatable drum 17 having embossed indicia 18 thereon (FIG. 2). The hammers 13 are normally retracted by springs 15 held in place by supports 16 and when the hammers 13 are impacted forwardly, the striking faces 14 thereof impact a sheet of paper 19 against the indicia 18 on the drum 17 for printing desired information on the paper sheet 19.

The hammers 13 are selectively struck forwardly against the action of the retracting springs 15 by clappers 22 pivotally mounted at 23 to base members 24. The clappers 22 are normally held retracted by springs (not shown) and they are provided with armature portions 25 which are attracted by electromagnetic coils 26 when energized. Electrical connections are made to the coils 26 through pins 27 so that the coils 26 may be selectively energized to advance the clapper 22 and hence strike forwardly the hammers 13. The retracted position of the clappers 22 is determined by stops 29 carried by an elongated frame 28 and positioned by adjusting screws 30.

As expressed above, for satisfactory operation of such a multiple rapid printer 10, it is necessary that the impact force of the hammers 13 and the timing of the operation of the hammers 13 be maintained within predetermined limits and this is obtained by suitable adjustments including the adjusting screw 30. To facilitate such adjustments, means are provided for testing the impact actions of the hammers 13. In this respect, the drum 17 (FIG. 2) is removed and a support bar 33 is mounted along the longitudinally arranged hammers 13. In this connection, the support bar 33 may be secured by screws 34 and spacers 35 to the frame 11 (FIG. 1). The sup-

port bar 33 is provided with a plurality of longitudinally arranged holes 36 which are in alignment with the hammers 13. Screws 37 extending through the holes 36 operate to secure a plurality of impact sensors 38 in alignment with the hammers 13, the outer ends of the impact sensors 38 having a position corresponding to the position of the indicia 18 on the drum 17 so as to be struck or impacted by the striking faces 14 of the hammers 13. The impact sensors 38 produce electrical signals in accordance with the impacts applied thereto by the striking faces 14 of the hammers 13 and these electrical signals are transmitted to suitable gauges, oscilloscopes or the like for indicating the impact actions of the hammers 13, including the impact forces, the nature of the impact forces and the timing of the impact forces. By utilizing such indications suitable adjustments may be readily and quickly performed to bring the impact actions of the hammer 13 within the required predetermined limits. When this is accomplished, the support bar 33 is removed and replaced by the drum 17 so as to provide subsequent accurate multiple rapid printing. The plurality of impact sensors 38 may include one impact sensor for each hammer 13 so that the impact actions of all hammers may be tested in one sequence. On the other hand, the plurality of impact sensors 38 may include a lesser number of impact sensors and, in this connection, one or more impact sensors may be selectively positioned along the support bar 33 for testing the impact actions of selected hammers 13.

The impact sensors 38 are illustrated in detail on a greatly enlarged scale in FIGS. 3 and 4. Each impact sensor 38 includes a base section 40 which is provided at one end with a tapped hole 41 for securing the base section at said one end to the support bar 33 by the screw 37 extending into the tapped hole 41. Thus, the base section 40 and hence the impact sensor 38 may be readily accurately removably mounted on the support bar 33. The other end of the base section 40 is reduced in diameter as indicated at 42 and this reduced portion is preferably provided with an annular groove 43. The impact sensor 38 also includes an impact section 44 formed of two portions, an anvil portion 45 and an operating portion 46 secured together by electrical insulating means 47 such as a suitable electrical insulating epoxy resin material. The two portions 45 and 46, which are so electrically insulated from each other, form a unitary impact section 44. The anvil portion end 45 of the impact section is adapted to be impacted or struck by the striking face 14 of the hammer 13, and to assure longitudinal impacting without bending or the like, the outer end of the impact section 44 is made substantially spherical where it is struck by the striking face 14. The inner end of the operating portion 46 of the impact section 44 is also of reduced diameter as indicated at 48 and this reduced diameter portion is also preferably provided with an annular groove 49.

Interposed between the ends 42 and 48 of the base section 40 and the impact section 44 of the impact sensor 38 is a thin piezoelectric ceramic plate 50 having electrodes 51 and 52. This piezoelectric ceramic plate may be formed of any suitable ferroelectric material, such as barium titanate, lead zirconium titanate or the like which has been permanently polarized by the application of a polarizing voltage thereto to make the same piezoelectric. When the piezoelectric ceramic plate 50 is stressed in the compression direction, electrical signals are produced at the electrodes 51 and 52 in accordance with the stressing thereof. The electrodes 51 and 52 of the piezoelectric ceramic element 50 are mechanically and electrically secured respectively to the impact section 44 and the base section 40 by means of suitable electrically conducting epoxy resin materials or the like. Thus, electrical connections may be made to the electrodes 51 and 52 by a lead 53 connected to the operating portion 46 of the impact section and by a lead 54 connected to the support

bar 33, the operating portion 46 of the impact section 44, the base section 40 and the support bar 33 being formed of electrically conducting metal. When the impact section 44 of the impact sensor 38 is struck or impacted by the striking face 14 of the hammer 13, the piezoelectric ceramic plate 50 is stressed in accordance with the impact for producing electrical signals at the electrodes 51 and 52 in accordance with said impacting, the electrical signals being transmitted by the leads 53 and 54 to gauges, oscilloscopes or the like for indicating the impact actions applied to the impact sensor. Since the anvil portion 45, which is impacted or struck by the striking face 14 of the hammer 13, is electrically insulated from the operating portion 46 of the impact section, the striking of the anvil portion 45 has no grounding or adverse effect on the electrical connections.

In addition to being secured together by the electrodes 51 and 52 of the piezoelectric ceramic plate 50, the base section 40 and the impact section 44 are also preferably secured together by electrical insulating means 56 extending over the ends 42 and 48 thereof and the interposed piezoelectric ceramic plate 50 into the annular grooves 43 and 49. This electrical insulating means preferably includes an electrical insulating epoxy resin material which is potted in place. This electrical insulating material 56 operates to hold together the base section and impact section and provide a unitary rugged construction which eliminates undue strain on the joints between the piezoelectric ceramic element 50 and the base and impact sections 40 and 44.

The impact sensor may be made in various sizes depending upon the amount of impact applied thereto and upon space requirements. In the particular embodiment of the impact sensor which is utilized in the above-described multiple rapid printer the outside diameter of the impact sensor may be substantially .095 inch and may have an over-all length of substantially .475 inch so as to be readily utilized therein. The piezoelectric ceramic plate 50 may be circular in configuration or it may have a square or other configurations and it is preferably made quite thin, having a thickness of substantially .010 inch to provide maximum capacitance with moderate voltage output. By making the length of the impact sensor relatively short whipping or bending or production of tensile stresses are minimized when the impact applied thereto is not purely axial. The base section 40 and the impact section 44 may be made of any suitable metal and preferably they are made of steel so that they provide maximum strength and provide a good bond with the epoxy resin material utilized. To soften the impact and, therefore, reduce the stresses on the piezoelectric ceramic plate without essentially changing the fundamental nature of the impact, softer materials, such as copper or aluminum or the like, may be utilized. The impact sensor has a high resonant frequency so that the details of the impact as indicated by the electrical signals produced may be readily indicated and observed.

While for purposes of illustration one form of this invention has been disclosed, other forms thereof may become apparent to those skilled in the art upon reference to this disclosure and, therefore, this invention is to be limited only by the scope of the appended claims.

I claim as my invention:

1. In a multiple rapid printer having an elongated rotatable drum provided with embossed indicia thereon, a plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clappers for selectively operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes, means for testing the impact actions of the hammers comprising, a support bar mounted along the striking faces of the longitudinally arranged hammers when the drum is removed and provided with a plurality of impact sensors in alignment with the striking

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faces of the hammers, each impact sensor including a base section secured to the bar, an impact section to be impacted by the striking face of a hammer, a thin piezoelectric ceramic plate having electrodes on the opposite faces thereof and interposed between the base section and impact section to be stressed in accordance with the impacting of the impact section by the striking face of the hammer for producing electrical signals at said electrodes in accordance with said impacting, and means for making electrical connections to said electrodes for transmitting said electrical signals.

2. In a multiple rapid printer having an elongated rotatable drum provided with embossed indicia thereon, a plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clappers for selectively operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes, means for testing the impact actions of the hammers comprising, a support bar mounted along the striking faces of the longitudinally arranged hammers when the drum is removed and provided with a plurality of impact sensors in alignment with the striking faces of the hammers, each impact sensor including a base section secured to the bar, an impact section to be impacted by the striking face of a hammer, a thin piezoelectric ceramic plate having electrodes on the opposite faces thereof, said electroded piezoelectric ceramic plate being interposed between the base section and impact section with the electrodes thereof mechanically and electrically secured respectively to the base section and impact section and being stressed in accordance with the impacting of the impact section by the striking face of the hammer for producing electrical signals at said electrodes in accordance with said impacting, and means for making electrical connections to said base section and impact section and hence to said electrodes for transmitting said electrical signals.

3. In a multiple rapid printer having an elongated rotatable drum provided with embossed indicia thereon, a plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clappers for selectively operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes, means for testing the impact actions of the hammers comprising, a support bar mounted along the striking faces of the longitudinally arranged hammers when the drum is removed and provided with a plurality of impact sensors in alignment with the striking faces of the hammers, each impact sensor including a base section secured at one end to the bar, an impact section having an operating portion, an anvil portion and electrical insulating means securing said portions together and adapted to be impacted by the striking face of a hammer striking the anvil portion thereof, a thin piezoelectric ceramic plate having electrodes on the opposite faces thereof and interposed between the other end of the base section and the operating portion of the impact section to be stressed in accordance with the impacting of the impact section by the striking face of the hammer for producing electrical signals at said electrodes in accordance with said impacting, and means for making electrical connections to said electrodes for transmitting said electrical signals.

4. In a multiple rapid printer having an elongated rotatable drum provided with embossed indicia thereon, a plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clappers for selectively operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes, means for testing the impact actions of the hammers comprising, a support bar mounted along the striking faces of the longitudinally arranged hammers

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when the drum is removed and provided with a plurality of impact sensors in alignment with the striking faces of the hammers, each impact sensor including a base section secured at one end to the bar, an impact section having an operating portion, an anvil portion and electrical insulating means securing said portions together and adapted to be impacted by the striking face of a hammer striking the anvil portion thereof, a thin piezoelectric ceramic plate having electrodes on the opposite faces thereof, said electroded piezoelectric ceramic plate being interposed between the other end of the base section and the operating portion of the impact section with the electrodes thereof mechanically and electrically secured respectively to the base section and the operating portion of the impact section and being stressed in accordance with the impacting of the impact section by the striking face of the hammer for producing electrical signals at said electrodes in accordance with said impacting, and means for making electrical connections to said base section and said operating portion of the impact section and hence to said electrodes for transmitting said electrical signals.

5. In a multiple rapid printer having an elongated rotatable drum provided with embossed indicia thereon, a plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clappers for selectively operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes, means for testing the impact actions of the hammers comprising, a support bar mounted along the striking faces of the longitudinally arranged hammers when the drum is removed and provided with a plurality of impact sensors in alignment with the striking faces of the hammers, each impact sensor including a base section secured to the bar, an impact section to be impacted by the striking face of a hammer, a thin piezoelectric ceramic plate having electrodes on the opposite faces thereof and interposed between the base section and impact section to be stressed in accordance with the impacting of the impact section by the striking face of the hammer for producing electrical signals at said electrodes in accordance with said impacting, electrical insulating means securing together said base section and impact section, and means for making electrical connections to said electrodes for transmitting said electrical signals.

6. In a multiple rapid printer having an elongated rotatable drum provided with embossed indicia thereon, a plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clappers for selectively operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes, means for testing the impact actions of the hammers comprising, a support bar mounted along the striking faces of the longitudinally arranged hammers when the drum is removed and provided with a plurality of impact sensors in alignment with the striking faces of the hammers, each impact sensor including a base section secured to the bar, an impact section to be impacted by the striking face of a hammer, a thin piezoelectric ceramic plate having electrodes on the opposite faces thereof, said electroded piezoelectric ceramic plate being interposed between the base section and impact section with the electrodes thereof mechanically and electrically secured respectively to the base section and impact section and being stressed in accordance with the impacting of the impact section by the striking face of the hammer for producing electrical signals at said electrodes in accordance with said impacting, electrical insulating means securing together said base section and impact section, and means for making electrical connections to said base section and impact section and hence to said electrodes for transmitting said electrical signals.

7. In a multiple rapid printer having an elongated rotatable drum provided with embossed indicia thereon, a

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plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clappers for selectively operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes, means for testing the impact actions of the hammers comprising, a support bar mounted along the striking faces of the longitudinally arranged hammers when the drum is removed and provided with a plurality of impact sensors in alignment with the striking faces of the hammers, each impact sensor including a base section secured at one end to the bar, an impact section having an operating portion, an anvil portion and electrical insulating means securing said portions together and adapted to be impacted by the striking face of a hammer striking the anvil portion thereof, a thin piezoelectric ceramic plate having electrodes on the opposite faces thereof and interposed between the other end of the base section and the operating portion of the impact section to be stressed in accordance with the impacting of the impact section by the striking face of the hammer for producing electrical signals at said electrodes in accordance with said impacting, electrical insulating means securing together said base section and impact section, and means for making electrical connections to said electrodes for transmitting said electrical signals.

8. In a multiple rapid printer having an elongated rotatable drum provided with embossed indicia thereon, a plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clappers for selectively operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes, means for testing the impact actions of the hammers comprising, a support bar mounted along the striking faces of the longitudinally arranged hammers when the drum is removed and provided with a plurality of impact sensors in alignment with the striking faces of the hammers, each impact sensor including a base section secured at one end to the bar, an impact section having an operating portion, an anvil portion and electrical insulating means securing said portions together and adapted to be impacted by the striking face of a hammer striking the anvil portion thereof, a thin piezoelectric ceramic plate having electrodes on the opposite faces thereof, said electroded piezoelectric ceramic plate being interposed between the other end of the base section and the operating portion of the impact section with the electrodes thereof mechanically and electrically secured respectively to the base section and the operating portion of the impact section and being stressed in accordance with the impacting of the impact section by the striking face of the hammer for producing electrical signals at said electrodes in accordance with said impacting, electrical insulating means securing together said base section and impact section, and means for making electrical connections to said base section and said operating portion of the impact section and hence to said electrodes for transmitting said electrical signals.

9. In a multiple rapid printer having an elongated rotatable drum provided with embossed indicia thereon, a plurality of closely spaced hammers having striking faces arranged longitudinally along the drum, and a plurality of selectively operated clappers for selectively operating the hammers to cause the striking faces thereof to impact a sheet of paper against the indicia on the drum for rapid printing purposes, means for testing the impact actions of the hammers comprising, a support bar mounted along the striking faces of the longitudinally arranged hammers when the drum is removed and provided with a plurality of holes in alignment with the striking faces of the hammers, a plurality of impact sensors carried by the bar in alignment with the striking faces of the hammers, each impact sensor including a base section having a tapped hole at one end and secured to the bar by a screw extending

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through a hole in the bar into the tapped hole in the base section, an impact section to be impacted by the striking face of a hammer, a thin piezoelectric ceramic plate having electrodes on the opposite faces thereof and interposed between the base section and impact sections to be stressed in accordance with the impacting of the impact section by the striking face of the hammer for producing electrical signals at said electrodes in accordance with said impacting, and means for making electrical connections to said electrodes for transmitting said electrical signals.

10. An impact sensor comprising an elongated base section supported at one end, an elongated impact section in longitudinal alignment with the base section having an operating portion, an anvil portion and electrical insulating means securing said portions together and adapted to be impacted with an impact force applied to the anvil portion thereof, a thin piezoelectric ceramic plate having electrodes on opposite sides thereof and interposed between the other end of the base section and the operating portion of the impact section to be stressed in accordance with the impacting of the impact section for producing electrical signals at said electrodes in accordance with said impacting, and means for making electrical connections to said electrodes for transmitting said electrical signals.

11. An impact sensor comprising an elongated base section supported at one end, an elongated impact section in longitudinal alignment with the base section having an operating portion, an anvil portion and electrical insulating means securing said portions together and adapted to be impacted with an impact force applied to the anvil portion thereof, a thin piezoelectric ceramic plate having electrodes on opposite sides thereof, said electroded piezoelectric ceramic plate being interposed between the other end of the base section and the operating portion of the impact section with the electrodes thereof mechanically and electrically secured respectively to the base section and impact section and being stressed in accordance with the impacting of the impact section for producing electrical signals at said electrodes in accordance with said impacting, and means for making electrical connections to said base section and said operating portion of the impact section and hence to said electrodes for transmitting said electrical signals.

12. An impact sensor comprising an elongated base section supported at one end, an elongated impact section in longitudinal alignment with the base section and adapted to be impacted at one end with an impact force, a thin piezoelectric ceramic plate having electrodes on opposite sides thereof interposed between the other ends of the base section and impact section to be stressed in accordance with the impacting of the impact section for producing electrical signals at said electrodes in accordance with said impacting, electrical insulating means securing together said base section and impact section, and means for making electrical connections to said electrodes for transmitting said electrical signals.

13. An impact sensor comprising an elongated base section supported at one end, an elongated impact section in longitudinal alignment with the base section and adapted to be impacted at one end with an impact force, a thin piezoelectric ceramic plate having electrodes on opposite sides thereof, said electroded piezoelectric ceramic plate being interposed between the other ends of the base section and impact section with the electrodes thereof mechanically and electrically secured respectively to the base section and impact section and being stressed in accordance with the impacting of the impact section for producing electrical signals at said electrodes in accordance with said impacting, electrical insulating means securing together said base section and impact section, and means for making electrical connections to said base section and impact section and hence to said electrodes for transmitting said electrical signals.

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14. An impact sensor comprising an elongated base section supported at one end, an elongated impact section in longitudinal alignment with the base section having an operating portion, an anvil portion and electrical insulating means securing said portions together and adapted to be impacted with an impact force applied to the anvil portion thereof, a thin piezoelectric ceramic plate having electrodes on opposite sides thereof and interposed between the other end of the base section and the operating portion of the impact section to be stressed in accordance with the impacting of the impact section for producing electrical signals at said electrodes in accordance with said impacting, electrical insulating means securing together said base section and impact section, and means for making electrical connections to said electrodes for transmitting said electrical signals.

15. An impact sensor comprising an elongated base section supported at one end, an elongated impact section in longitudinal alignment with the base section having an operating portion, an anvil portion and electrical insulating means securing said portions together and adapted to be impacted with an impact force applied to the anvil portion thereof, a thin piezoelectric ceramic plate having electrodes on opposite sides thereof said electroded piezoelectric ceramic plate being interposed between the other end of the base section and the operating portions of the impact section with the electrodes thereof mechanically and electrically secured respectively to the base section and impact section and being stressed in accordance with the impacting of the impact section for producing electrical signals at said electrodes in accordance with said impacting, electrical insulating means securing together said base section and impact section, and means for making electrical connections to said base section and said operating portion of the impact section and hence to said electrodes for transmitting said electrical signals.

16. An impact sensor comprising an elongated base section supported at one end and provided with an annular groove adjacent its other end, an elongated impact section in longitudinal alignment with the base section and adapted to be impacted at one end with an impact force and provided with an annular groove adjacent its other end, a thin piezoelectric ceramic plate having electrodes on opposite sides thereof and interposed between said other ends of the base section and impact section to be

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stressed in accordance with the impacting of the impact section for producing electrical signals at said electrodes in accordance with said impacting electrical insulating means encompassing said other ends of the base section and impact section and the interposed piezoelectric ceramic plate and received in the annular grooves in the base section and impact section for securing the base section and impact section together, and means for making electrical connections to said electrodes for transmitting said electrical signals.

17. An impact sensor comprising an elongated base section supported at one end and provided with an annular groove adjacent its other end, an elongated impact section in longitudinal alignment with the base section and adapted to be impacted at one end with an impact force and provided with an annular groove adjacent its other end, a thin piezoelectric ceramic plate having electrodes on opposite sides thereof, said electroded piezoelectric ceramic plate being interposed between said other ends of the base section and impact section with the electrodes thereof mechanically and electrically secured respectively to the base section and impact section and being stressed in accordance with the impacting of the impact section for producing electrical signals at said electrodes in accordance with said impacting, electrical insulating means encompassing said other ends of the base section and impact section and the interposed piezoelectric ceramic plate and received in the annular grooves in the base section and impact section for securing the base section and impact section together, and means for making electrical connections to said base section and impact section and hence to said electrodes for transmitting said electrical signals.

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