

Oct. 18, 1960

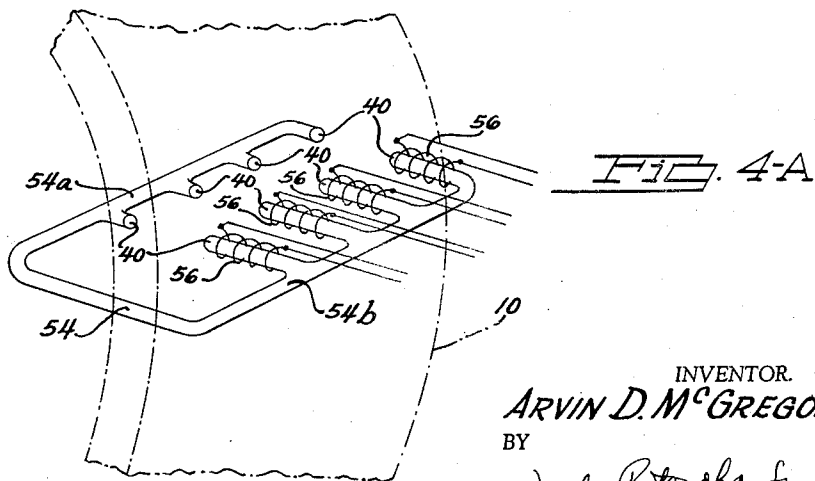
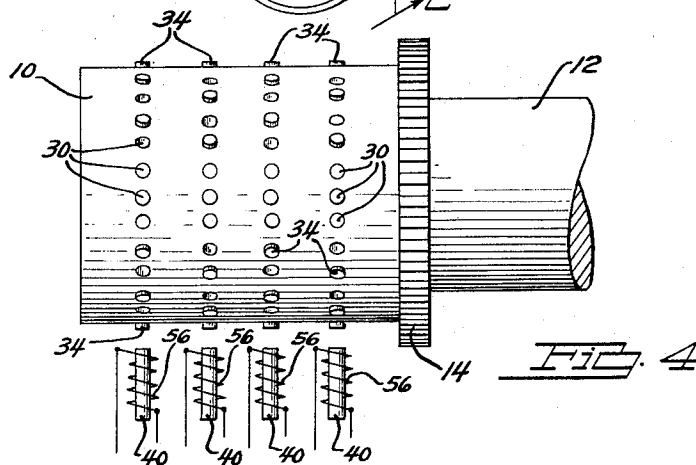
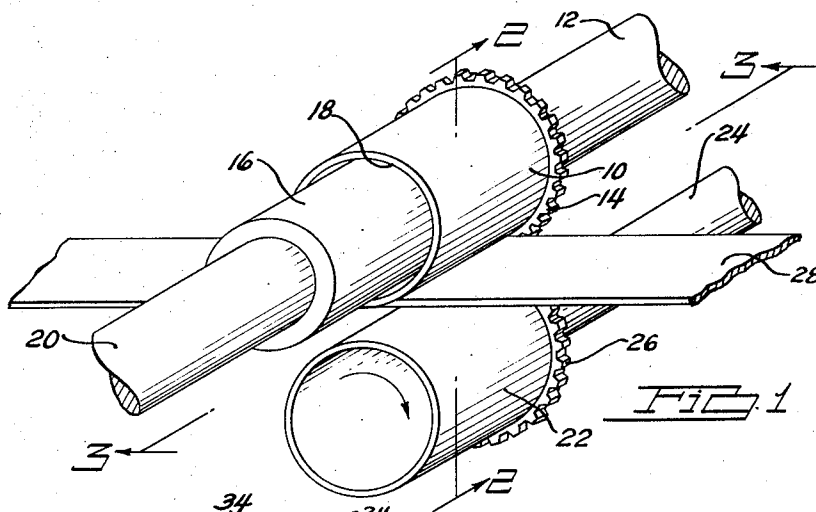
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2,956,740

ROTARY PERFORATOR

Filed Aug. 22, 1958

6 Sheets-Sheet 1



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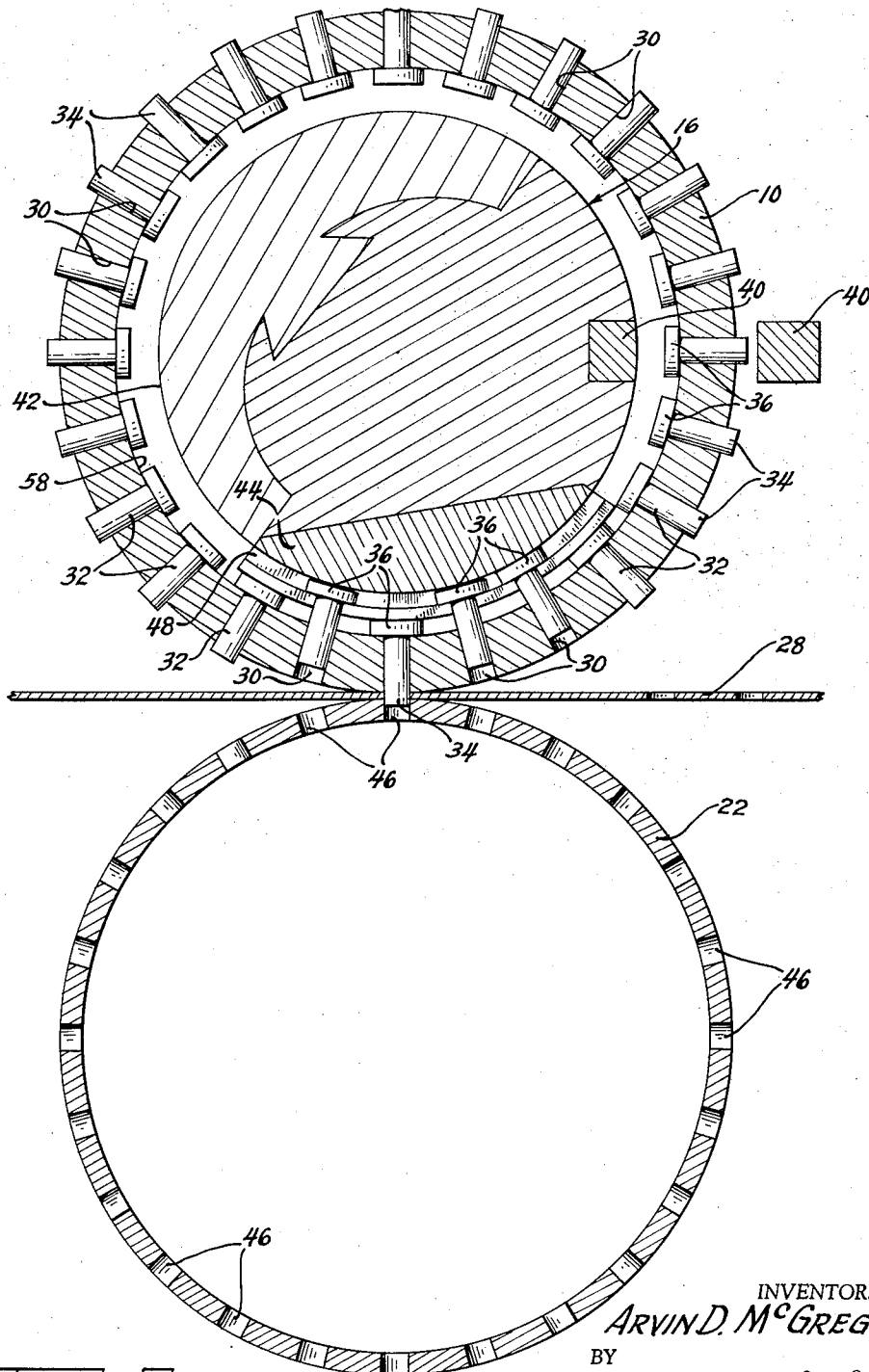
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ROTARY PERFORATOR

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6 Sheets-Sheet 2



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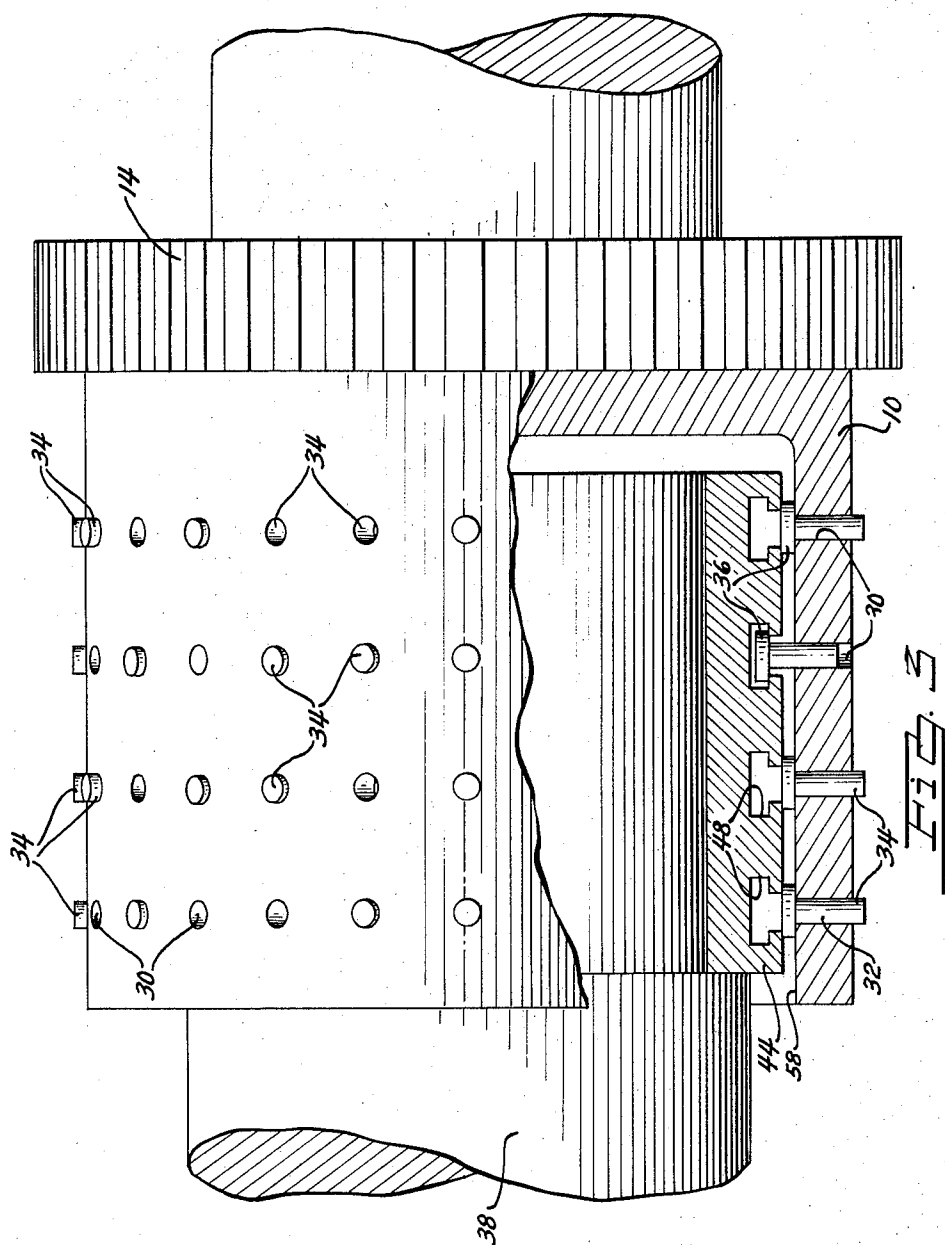
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6 Sheets-Sheet 3



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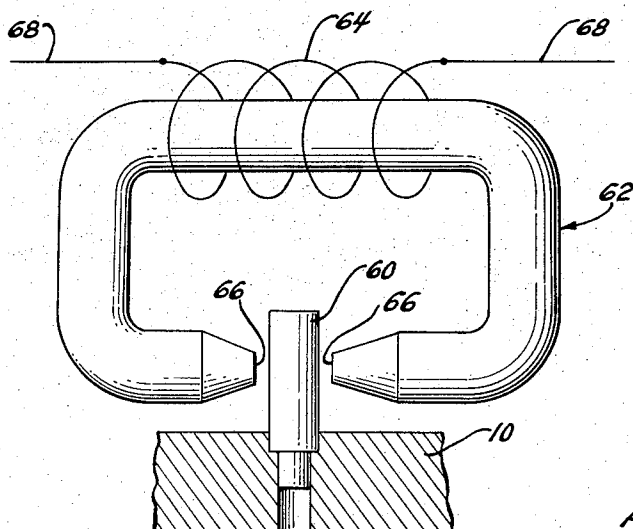
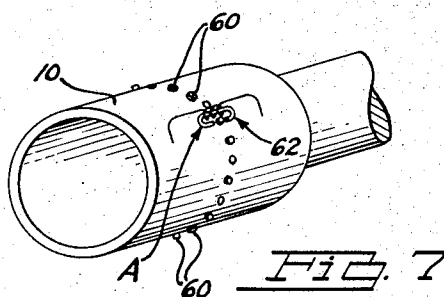
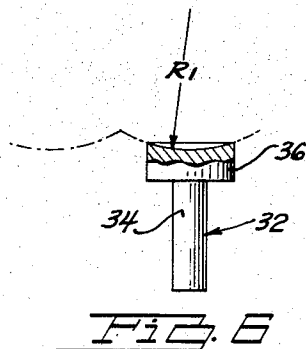
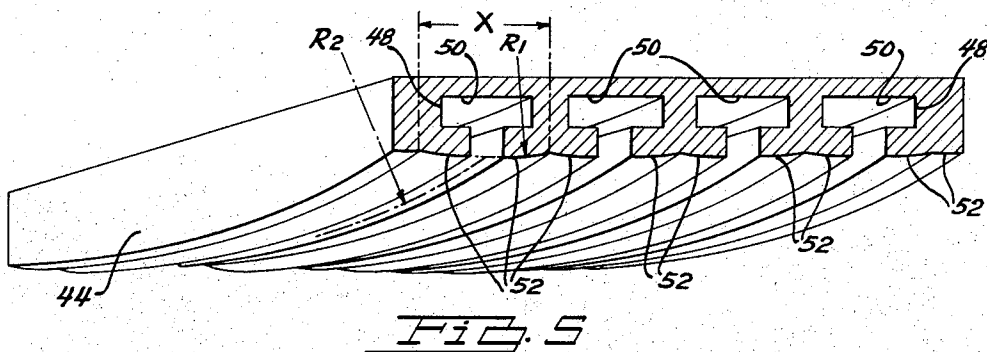
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6 Sheets-Sheet 4



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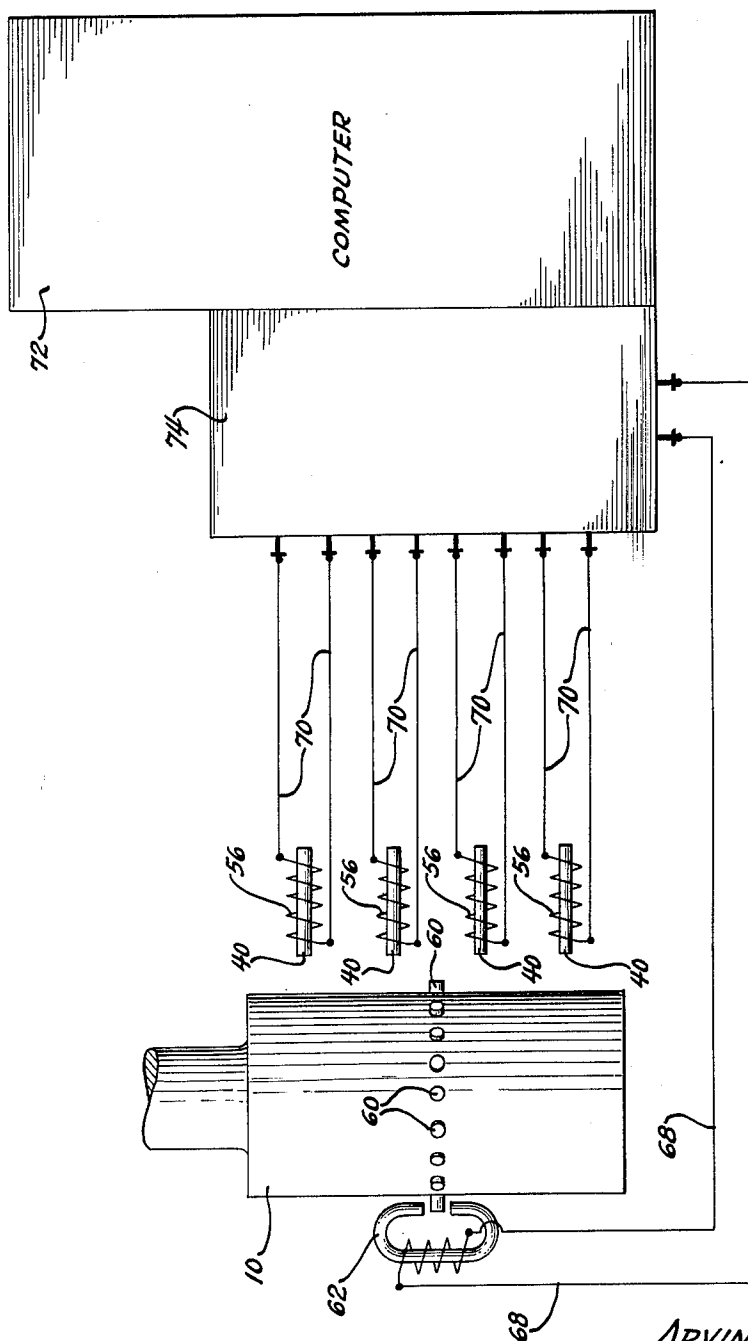
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6 Sheets-Sheet 5



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6 Sheets-Sheet 6

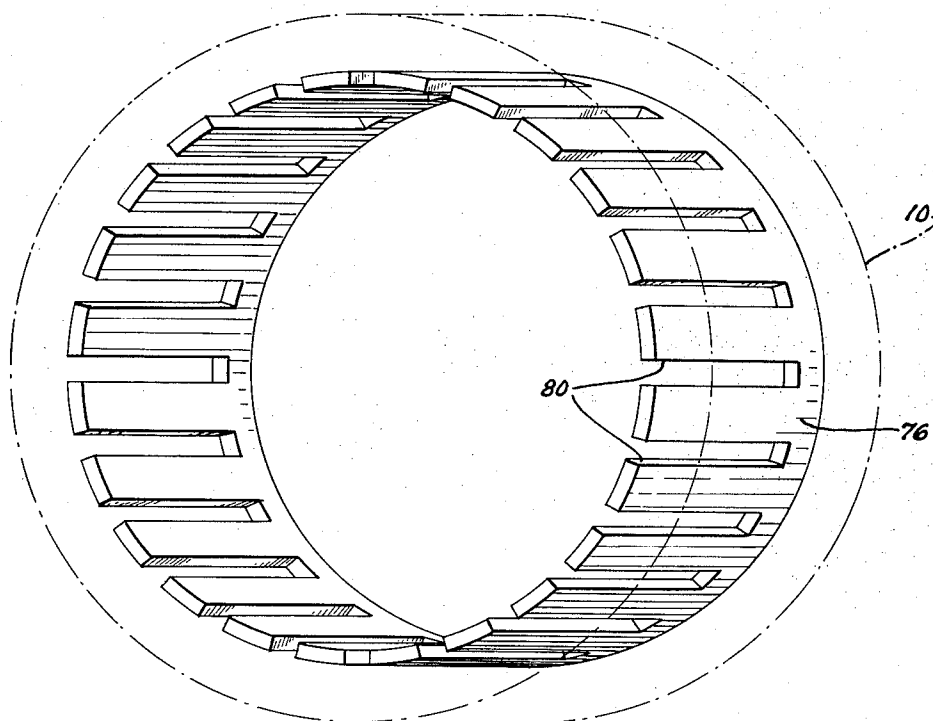


FIG. 10

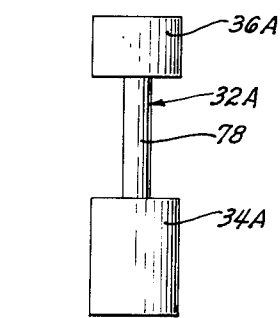


FIG. 9

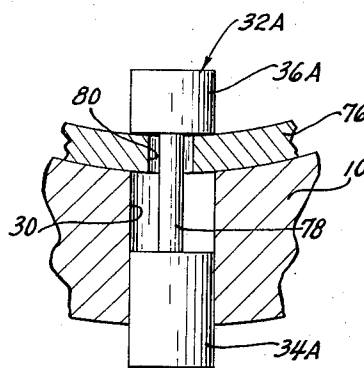


FIG. 11

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1

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ROTARY PERFORATOR

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8 Claims. (Cl. 234—49)

This invention relates generally to perforating mechanisms, and more specifically to rotary mechanisms having automatically positioned perforating members therein.

Electronic computers, for example, frequently accept information and supply answers by a code system comprised of holes selectively formed in a paper tape or cards, and a variety of machines have been designed to properly form these holes. However, most of these machines have been of the intermittent variety; that is, a punch carrying head will move down on a certain length of paper strip, perforate it according to predetermined requirements and return to its home position. The strip of paper is then indexed to its next position and the punch carrying head again completes its operation. With a perforator of this type, it is presently possible to obtain only about 300 characters per second. Since the computer can generate information for the tape much faster than the perforator can form the tape, the operation of the computer is limited by the speed of the perforator.

It is now proposed to provide a rotary perforating mechanism capable of forming or punching these characters much faster than the devices now available for this purpose.

Accordingly, an object of this invention is to present means for perforating tape in a continuous uninterrupted fashion. Devices embodying the invention may, for example, be capable of forming tape at a rate of 1000 or more characters per second.

More specifically, an object of this invention is to provide a device for continuously perforating a work piece, said device having automatically positioned punches on a rotary punch carrier.

Other objects and advantages will become apparent when reference is made to the following specification and illustrations wherein:

Figure 1 is a schematic illustration in perspective of a device embodying the invention, with certain elements thereof not shown.

Figure 2 is an elevational cross-sectional view taken substantially on line 2—2 of Figure 1 and looking in the direction of the arrows.

Figure 3 is a fragmentary side elevational view looking in the direction of the arrows 3—3 of Figure 1, with the lower portion thereof being cut away and in cross-section.

Figure 4 is a schematic illustration of the relationship of some of the elements of a device embodying the invention.

Figure 4A is a schematic illustration in perspective of one possible embodiment of the magnets illustrated in Figure 4.

Figure 5 is an enlarged perspective view of one of the elements shown by Figure 2.

Figure 6 is an enlarged view, partly in cross-section, of another element of the invention which at times cooperates with the element illustrated in Figure 5.

Figure 7 is a schematic illustration in perspective of

2

one embodiment of a central mechanism which may be employed in the invention.

Figure 7A is an enlarged view of the elements shown at "A" of Figure 7.

Figure 8 is a schematic illustration of one arrangement whereby an electronic computer may be electrically connected to a device embodying the invention.

Figure 9 is an elevational view of a punch which may be used in a modification of the invention.

Figure 10 is a perspective view of a retainer which may be used in conjunction with the punch shown by Figure 9.

Figure 11 is a fragmentary cross-sectional view illustrating the relationships between the elements shown by Figures 9 and 10.

Referring now in greater detail, Figure 1 illustrates in perspective a rotary punch carrier 10 having a bearing shaft 12 which may either be integrally formed with the carrier 10 or attached thereto. A gear 14 may be secured to the punch carrier 10 so as to act as either a driving or a driven member.

A punch setting assembly 16 located within the generally cylindrical cavity 18 formed within the punch carrier 10 has a supporting member 20 which may be a part of or secured to the assembly 16.

A rotary coacting die 22 has secured thereto a support member 24 and a gear 26, which mates with gear 14, secured to it. The work piece or paper strip 28 is sandwiched between the cooperating punch carrier 10 and die 22 in such a manner so as to be progressively fed therebetween as the members 10 and 22 rotate.

Figure 2, a cross-sectional view, illustrates in greater detail the general arrangement of the elements comprising the invention. The punch carrier 10 has formed therein (see also Figures 3 and 4) a series of rows of guide holes 30, which may be displaced angularly equidistantly about the circumference. Individual punches 32, which may be in the shape of a stem 34 with a head 36 formed thereon, are slidably received in the guide holes 30. The entire punch carrier 10 rotates counter-clockwise and in so doing, carries the individual punches 32 around with it.

The punch setting assembly 16, which does not rotate and is in substantial concentric alignment with punch carrier 10, is comprised of a main body portion 38 having secured thereto one end of a punch magnetizing magnet 40, a punch setting magnet 42 of a constant polarity and a punch guide 44.

The rotary die 22 is placed in close proximity to the punch carrier 10 so that the two are separated from each other by approximately the thickness of the work piece 28. The die 22 contains die holes 46, which may be equal in number to the number of punches 32 within the punch carrier 10 and necessarily arranged so as to be in juxtaposition with the punches 32 during perforation.

Figure 3 is a fragmentary side elevational view of the carrier 10 with portions thereof being cut away and in cross-section to better illustrate the relationship of some of the elements comprising the invention. The punch guide 44 is shown as being secured to the main body portion 38 and holding the individual punches 32 in different positions. That is, one of the center punches 32 is in a retracted position, while the other three punches are in an extended position and capable of perforating any work piece disposed between the punch carrier 10 and die 22.

The punch guide 44 is further illustrated in Figure 5 which shows the guide in enlarged perspective form. The punch guide may be comprised of a body formed to provide a series of parallel, circular T slots 48 and secured to the main body portion 38. The guide 44

may be placed within the body 38 in such a manner so as to have surfaces 50 of the T slots on the same diameter as the outer diameter of the main body 38. The T slots are of a width greater than that of the punch heads 36 thereby enabling the punches 32 to slide freely therethrough. The outer surfaces 52 of the guide 44 are used as the pressure surfaces; that is, the punch head 36 will abut against the surfaces 52 so as to be able to perforate the work piece 28.

The surfaces 52 are also circular and of equal radius; however, the radius is greater than that of the main body 38. While the surfaces 52 may be cylindrical, they are illustrated as being curved in two directions. It will be noted, therefore, that each segment of width X is a segment of a sphere. This is done intentionally by making the radius R_1 equal to the radius R_2 . It is then possible to have the heads 36 of the punches 32 formed concave with the same radius, thereby permitting total surface contact between heads 36 and surfaces 52.

Figure 4 illustrates schematically the position of the punch magnetizing magnets 40. As can be seen, there is one magnet 40 for each row of punch guide holes 30. It is of course, possible to have a magnet arrangement such as that illustrated in Figure 4A, in which the magnet cores 40 have a common body portion 54 secured within the punch setting assembly 16 by the portion 54a. The field windings 56 could, however, be disposed either internally or externally of the punch carrier 10.

Operation of invention

In order to better explain the invention, let it be first assumed that magnet 42 is the north pole of a permanent magnet, and that the carrier 10 is rotating counter-clockwise. Each punch 32 will pass between the poles of the magnetizing magnet 40 and at that precise instant, the windings 56 will be energized by any suitable means in a manner so as to produce a desired magnetic field. As the punch 32 passes through this field, it will be magnetized so that the head 36 becomes a south pole. As the carrier 10 continues to rotate, punch 32 is carried to an area which is influenced by the magnetic properties of magnet 42. Since, in this example, the head of punch 32 is of a south polarity and the magnet 42 is of a north polarity, the punch 32 will be attracted by and drawn to magnet 42. Once the punch contacts magnet 42, it will continue to ride on the diameter of the magnet, it being remembered that the punch setting assembly 16 is stationary and never rotates. As the carrier continues to move, the punch 32 will be pushed into the T slots 48 of punch guide 44 thereby being kept out of perforating position. It should be understood that the above explanation of operation applies to each individual punch 32 regardless of its particular position in the carrier 10. The carrier 10 will continue to rotate, and assuming that the field current through the appropriate winding 56 has been changed, punch 32 will have its polarity reversed and made north by the magnets 40. Thus, when punch 32 again comes into the area of magnet 42, it will be repelled by magnet 42 and consequently forced outwardly against the inner diameter 58 of carrier 10. As punch 32 is further moved by the carrier, it will be guided between the inner diameter 58 and surfaces 52 of guide member 44. In this position the punch is capable of perforating the work piece when it reaches the work station.

The principle of operation of the rotary perforator itself has been described. However, further explanation of the actuating mechanism and its associated controls is necessary in order to fully appreciate the operation of the invention.

It is evident from the foregoing description that synchronization of the elements comprising the perforator is required. Figure 7 illustrates one system by which this can be accomplished. In the embodiment illustrated, a series of fixed sprocket pins 60 are arranged

circumferentially about the punch carrier 10, this, is of course, in addition to the guide holes 30 which may have been provided for the punches 32. A permanent magnet 62 having a coil winding 64 about it is placed so that the pins 60 pass between the north and south poles 66 of the magnet 62. The ends 68 of coil 64 are connected to any suitable control mechanism such as an electronic computer for example.

As previously mentioned electronic computers receive their data in coded form; however, they also supply their answers in the same code. Figure 8 illustrates schematically the general arrangement of the invention with respect to an electronic computer 72 and a buffer storage or shift register unit 74. The buffer storage and shift register units are well known to those skilled in the art and accordingly do not need to be explained in detail. For purposes of further illustration, it can be assumed that the computer 72 has started giving a coded answer and that the present invention is being used as a perforating device for recording the answer on paper tape, which tape can later be used to supply information to the computer.

During operation, the computer 72 feeds information to the storage unit 74, which in turn properly determines the required polarities of magnets 40. As punch carrier 10 rotates, pins 60 will pass between ends 66 of permanent magnet 62 and increase the flux density thereby causing a current flow in circuit 68 which is used as a signal by storage unit 74. When this signal is received by the storage unit, it then determines the polarity of magnets 40 in accordance with the information which computer 72 has furnished. Of course, a storage unit as illustrated at 74 is not entirely necessary. That is, the rotation of the punch carrier 10 can be timed by the computer 72 and the lines 68 and 70 connected directly to the output of the computer.

It is apparent that various modifications are possible within the scope of the invention. For example, the punches 32 may be modified, as shown in Figure 9, and a retainer 76 may be provided, as in Figure 10.

Some modifications of the invention may be of such dimensions that the spaces between the punches are too small to provide for a head which is larger than the stem. Therefore, Figure 9 illustrates a punch 32A which has the same diameter head 36A and the stem 34A of equal diameter. The head and stem are connected by a portion 78 of reduced diameter in substantially concentric alignment therewith.

Figure 10 illustrates a retainer 76 which may be used in conjunction with the punch 32A. The retainer is substantially tubular, and it has slots 80 formed in the wall thereof. The slots 80, which are open at one end, are provided so as to accumulate all of the punches located in the punch carrier 10, with the stem 34A of each punch being positioned in its punch guide hole 30 in the carrier 10. The retainer 76 is positioned within the carrier 10 and is adapted to rotate therewith. Figure 11 illustrates in cross-section, a typical arrangement of the punch 32A, retainer 76, and punch carrier 10.

The drawings and the foregoing specification constitute a description of the invention in such full, clear and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. In a device for punching tape in accordance with code signals transmitted to said device, a rotary punch carrier, a plurality of variably positioned punches spaced radially about said carrier and being responsive to magnetic fields, a plurality of electro-magnets positioned in close proximity to said punch carrier for receiving said code signals and producing first magnetic fields in accordance with said signals, a rotary die member located in close proximity to said punch carrier and adapted to rotate in timed relation to said carrier and to said tape

as said tape passes between said carrier and said die member, magnetic means disposed within said carrier for maintaining a constant second magnetic field of a predetermined polarity, said magnetic means serving to position said punches radially within said carrier in accordance with said code signals, and additional means for maintaining said punches in the position determined by said code signals as said punches are brought into juxtaposition with said rotary die member.

2. In a device for punching tape in accordance with code signals transmitted to said device, a rotary punch carrier, a plurality of variably positioned punches spaced radially about said carrier, said punches being responsive to magnetic fields, a plurality of electro-magnets positioned in close proximity to said punch carrier for receiving said code signals and producing first magnetic fields in accordance with said signals, a die member located in close proximity to said punch carrier and adapted to move in timed relation to said carrier and to said tape as said tape passes between said carrier and said die member, magnetic means for maintaining a constant second magnetic field of a predetermined polarity, said magnetic means serving to position said punches radially within said carrier in accordance with said code signals, and additional means for maintaining said punches in the position determined by said code signals as said punches are brought into juxtaposition with said die member.

3. In a tape forming apparatus for punching tape in accordance with code signals transmitted to said apparatus, a rotary punch carrier provided with a plurality of radially formed holes adapted to slideably receive a plurality of punches, said punches being ferrous in nature and susceptible to polarity reversals when passed through a field of magnetic flux, a die member adapted to rotate in timed relation to said carrier and to said tape as said tape passes between said carrier and said die member, a plurality of electro-magnets positioned in relatively close proximity to said punch carrier for receiving said code signals and producing first magnetic fields of flux which envelope the individual punches as they are carried there-through by said carrier in such a manner so as to cause the said punches to assume a complementary magnetic property in accordance with said signals, magnetic means disposed within said carrier for maintaining a constant second predetermined magnetic field for positioning said punches in either punching or non-punching position in accordance with said code signal, and mechanical means disposed within said carrier for maintaining said punches in a punching or non-punching position after said carrier translates said punches beyond the area influenced by said magnetic means.

4. In a tape forming apparatus for punching tape in accordance with code signals transmitted to said apparatus, a rotary punch carrier provided with a plurality of radially formed holes adapted to slideably receive a plurality of punches, said punches being susceptible to polarity reversals when passed through a field of magnetic flux, a die member adapted to operate in timed relation to said carrier and to said tape as said tape passes between said carrier and said die member, an electromagnet located in close proximity to said carrier for receiving said code signals and producing a magnetic field of flux which envelopes the individual punches as they are carried there-through by said carrier in such a manner so as to cause the said punches to assume a complementary magnetic property in accordance with said signals, magnetic means for maintaining a constant predetermined magnetic field of one direction within said carrier for positioning said punches in either punching or non-punching position in accordance with said code signal, and means cooperating with said carrier for maintaining said punches in a punching or non-punching position after said carrier translates said punches beyond the area influenced by said magnetic means.

5. A rotary tape perforator for perforating tape in ac-

cordance with a coded signal, comprising a plurality of ferrous punches adapted to be selectively positioned in either a punching or a non-punching position, rotary carrier means adapted to slideably retain said punches in a manner so as to form a plurality of axially disposed rows, each row being radially disposed with respect to the next adjacent row, a rotary die member placed in close proximity to said carrier and adapted to rotate in timed relation to said carrier and said tape as said tape passes between said carrier and said die during the punching operation, electromagnetic means disposed axially along and in close proximity to said carrier for receiving said coded signal and creating in accordance with said signal magnetic fields of a predetermined direction so as to cause said punches to assume a complementary polarity as they are translated through said magnetic fields, magnetic means disposed within said carrier for creating a constant unidirectional magnetic field effective over an area which is substantially beyond the first mentioned magnetic field for causing said punches to be either attracted or repelled by said magnetic means in order to select a position which is proper either for punching or non-punching, and means disposed within the said carrier for positively maintaining said selected position of said punches during the period during which the said punches and said die member pass into and out of juxtaposition to each other.

6. A rotary tape perforator for perforating tape in accordance with a coded signal, comprising a plurality of punches susceptible to magnetism and being adapted to be selectively positioned in either a punching or a non-punching position, rotary carrier means adapted to slideably retain said punches in a manner so as to form a plurality of axially disposed rows, each row being radially disposed with respect to the next adjacent row, a die member placed in close proximity to said carrier and adapted to move in timed relation to said carrier and said tape as said tape passes between said carrier and said die during the punching operation, electromagnetic means disposed axially along and in close proximity to said carrier for receiving said coded signal and creating in accordance with said signal magnetic fields of a predetermined direction so as to cause said punches to assume a complementary polarity as they are translated through said magnetic fields, magnetic means cooperating with said carrier for creating a constant unidirectional magnetic field effective over an area which is substantially beyond the first mentioned magnetic field for causing said punches to be either attracted or repelled by said magnetic means in order to select a position which is proper either for punching or non-punching, and means cooperating with said carrier for positively maintaining said selected position of said punches during the period during which the said punches and said die member pass into and out of juxtaposition to each other.

7. A rotary perforator for perforating a work piece in accordance with a coded signal, comprising a plurality of punches susceptible to magnetism and being adapted to be selectively positioned in either a punching or a non-punching position, rotary carrier means adapted to slideably retain said punches in a manner so as to form a plurality of axially disposed rows, each row being radially disposed with respect to the next adjacent row, a die member placed in close proximity to said carrier and adapted to move in timed relation to said carrier and said work piece as said work piece passes between said carrier and said die during the punching operation, electromagnetic means disposed axially along and in close proximity to said carrier for receiving said coded signal and creating in accordance with said signal magnetic fields of a predetermined direction so as to cause said punches to assume a complementary polarity as they are translated through said magnetic fields, magnetic means for creating a constant unidirectional magnetic field effective over an area which is substantially beyond the first mentioned magnetic

field for causing said punches to be either attracted or repelled by said magnetic means in order to select a position which is proper for either punching or non-punching, and means cooperating with said carrier for positively maintaining said selected position of said punches during the period during which the said punches and said die member pass into and out of juxtaposition to each other.

8. In a device for punching tape in accordance with code signals transmitted to said device from an exterior source, a rotary punch carrier, a plurality of variably positioned punches spaced radially about said carrier and being responsive to magnetic fields, a plurality of electro-magnets positioned in close proximity to said punch carrier for receiving said code signals and producing first magnetic fields in accordance with said signals, a rotary die member located in close proximity to said punch carrier and adapted to rotate in timed relation to said carrier and to said tape as said tape passes between said carrier and said die member, magnetic means disposed within said carrier for maintaining a constant second magnetic field of a predetermined polarity, said magnetic means serving to position said punches radially within said carrier in accordance with said code signals, retaining means for maintaining said punches in the position determined by said code signals as said punches are brought

into juxtaposition with said rotary die member, and timing means for synchronizing the application of said code signals to said electro-magnets with respect to the rotation of said punch carrier, said timing means comprising a permanent magnet of a generally U-shaped form, an electrical coil surrounding a portion of said magnet and having its ends electrically connected to said exterior source of said code signals, a plurality of projections spaced radially about and carried by said punch carrier, said projections being composed of such a material as to result in said projections having a property providing a path for magnetic flux, said permanent magnet being positioned in such a manner so as to allow said projections to sequentially pass through the open end of the U-shape as said projections are rotated by said carrier thereby increasing the flux density through said permanent magnet, and causing a current flow through said electrical coil, said current flow being used as a signal to said exterior source for the transmission of said code signals to said electro-magnets.

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