

Oct. 28, 1958

W. F. COUSINO
PERFORATING MACHINE

2,857,968

Filed May 1, 1957

4 Sheets-Sheet 1

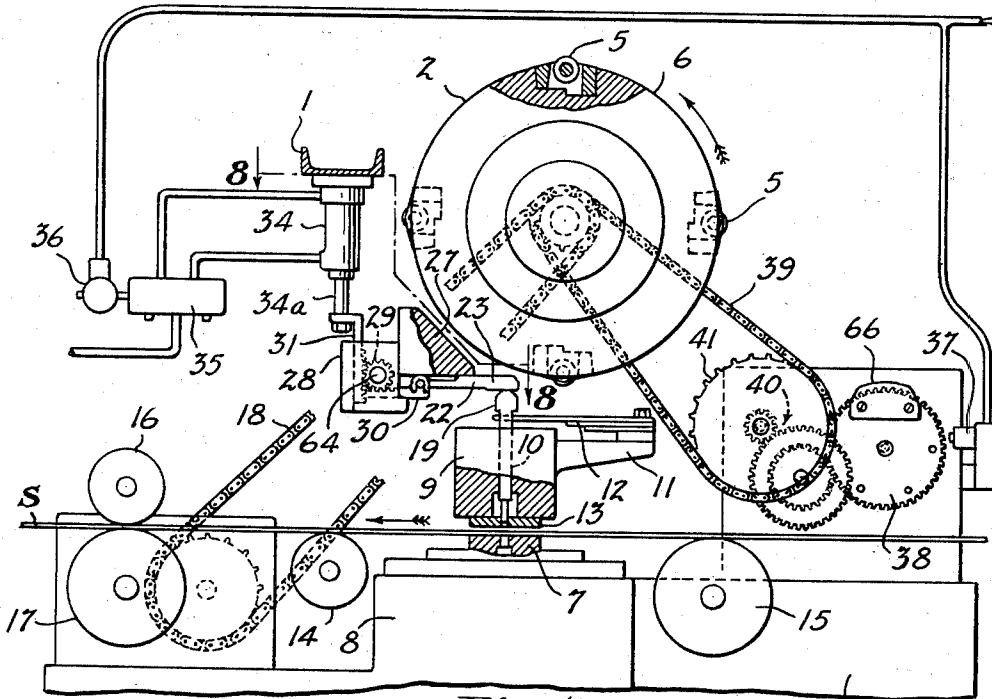


Fig. 1

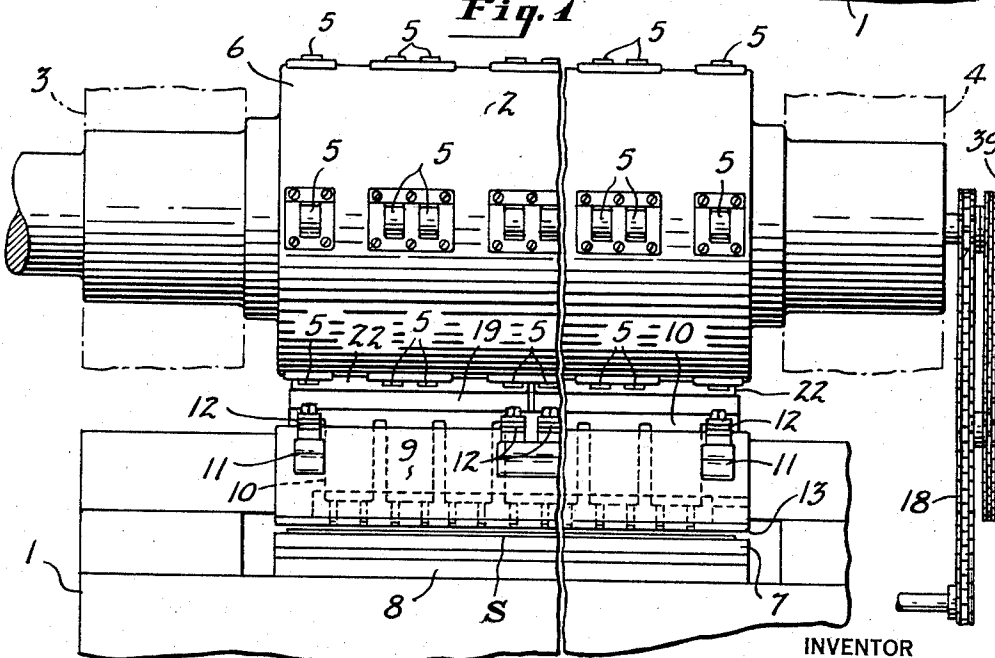


Fig. 2

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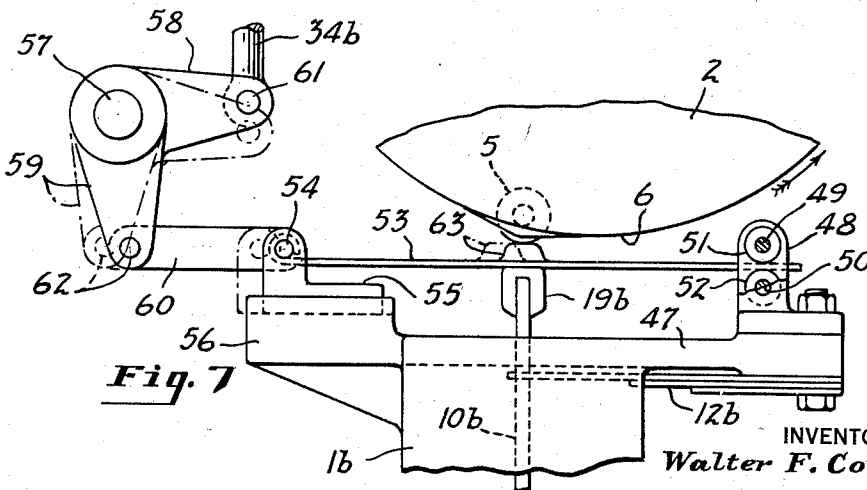
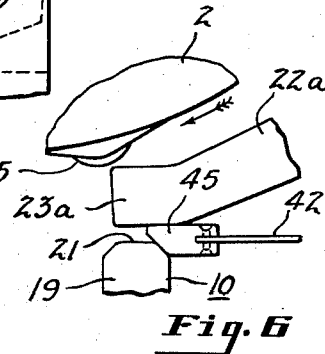
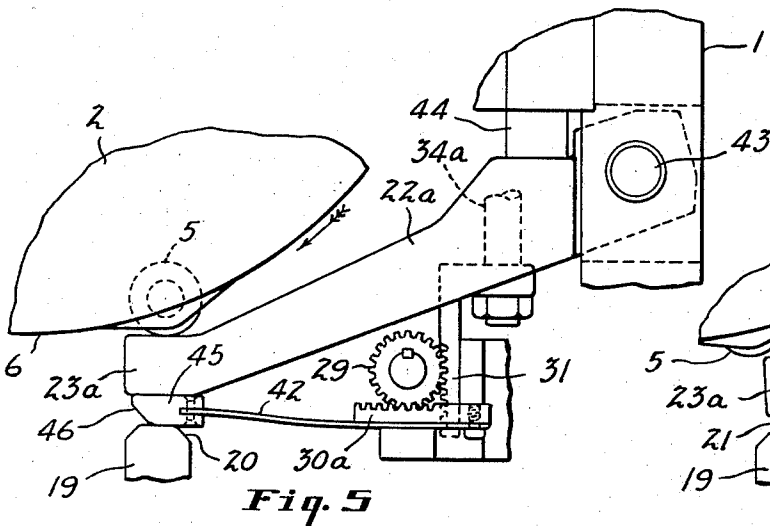
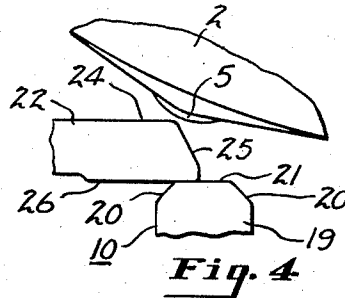
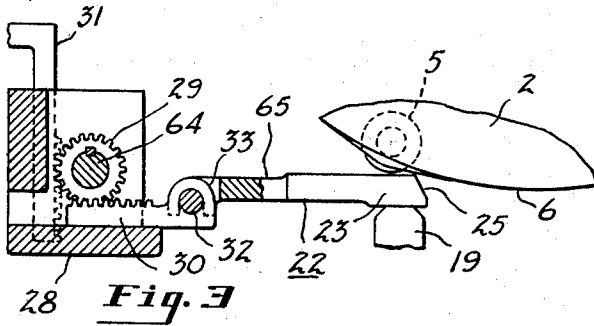
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

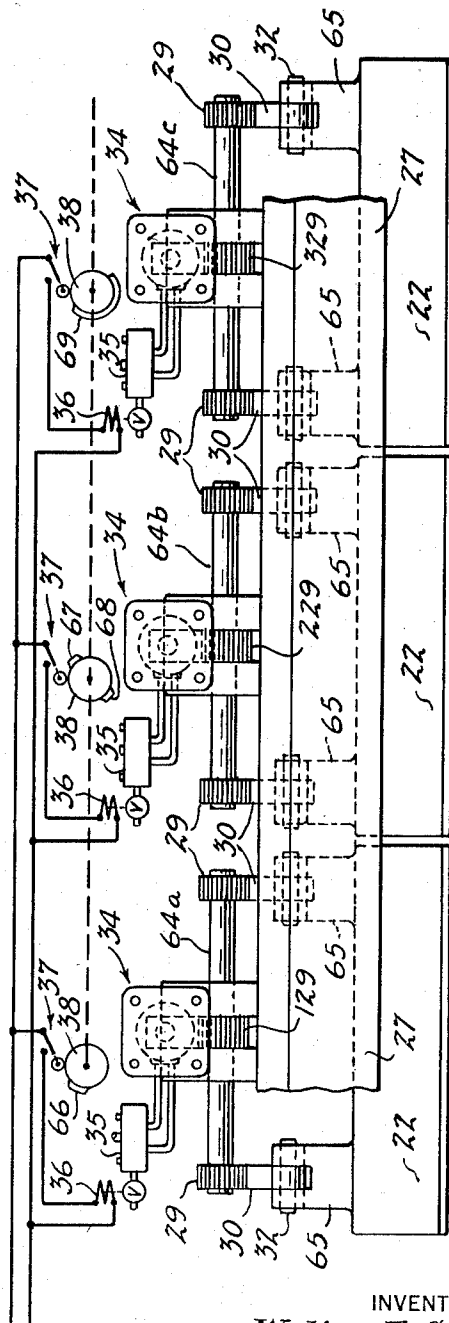
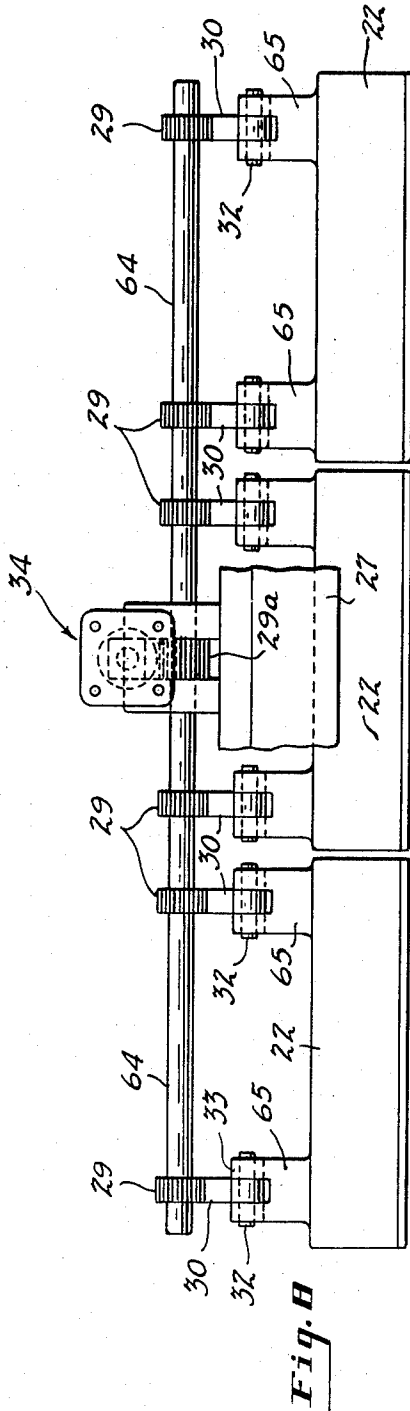


Fig. 9

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4 Sheets-Sheet 4

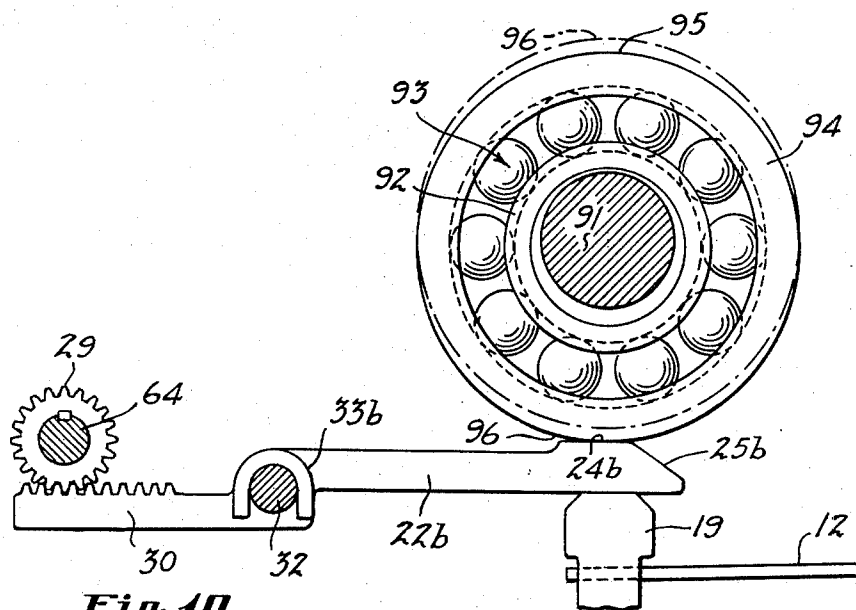


Fig. 10

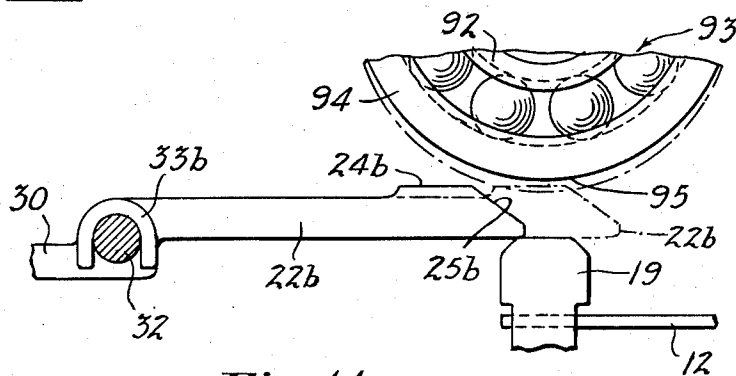


Fig. 11

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2,857,968

PERFORATING MACHINE

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Application May 1, 1957, Serial No. 657,472

10 Claims. (Cl. 164—89)

The present invention relates to a new and improved perforating machine and more particularly to a punching machine having means for starting and stopping operation of the punches during rotation of the punch-actuating means.

This application is a continuation-in-part of my copending application, Serial No. 533,611, filed September 12, 1955, "now abandoned," which contains subject matter disclosed in my abandoned applications, Serial No. 273,215, filed February 25, 1952, and Serial No. 307,479, filed September 2, 1952. Said subject matter is now disclosed in my copending application, Serial No. 581,862, filed May 1, 1956, which is a continuation-in-part of said abandoned applications.

According to the present invention, a bar or finger is mounted between a cam, impact wheel, or other suitable punch-actuating member, and a reciprocable punch of a perforating machine or the like, to engage the rotating punch-actuating member and to transmit movement from said rotating member to said punch. The bar is moved into and out of the path of movement of said rotating member so as to start and stop reciprocation of the punch. Movement of the bar may be controlled manually or may be controlled automatically through a rotary cam or any other suitable control mechanism in accordance with the rotation of the strip feeding means and said rotating members so that the punches are operated in a predetermined manner.

Where a plurality of punches are employed, separate means may be provided for controlling different groups of punches so that some punches are in operation while other punches are stationary. With such a construction, various patterns may be punched which cannot be handled with conventional equipment.

An object of the present invention is to provide a punching machine which can be set to form predetermined patterns.

A further object of the invention is to provide an effective means for starting and stopping operation of the punches in a punching machine.

Another object of the invention is to provide a perforating machine which may readily be adjusted to form different patterns with different spacing between rows of perforations.

Other objects, uses, and advantages of the invention will become apparent to those skilled in the art from the following description and claims, and from the drawings, in which:

Figure 1 is an end elevational view on a reduced scale with parts omitted and with parts broken away and shown in section, showing a perforating machine made according to the present invention;

Figure 2 is a fragmentary side elevational view with parts broken away and parts shown in section of the machine shown in Fig. 1, and on the same scale;

Figure 3 is a fragmentary end elevational view similar to Fig. 1 but on a larger scale, showing the position of

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the parts when the bar is in its impact transmitting position in the path of movement of the impact rollers;

Figure 4 is a fragmentary view similar to Fig. 3 showing the position of the parts when the bar is retracted out of the path of movement of the impact rollers;

Figure 5 is a fragmentary end elevational view with parts omitted and parts shown in section, illustrating a modified form of the invention, the bar being shown in its uppermost position in the path of movement of the impact rollers;

Figure 6 is a fragmentary view similar to Fig. 5 showing the position of the parts when the bar is out of the path of movement of the impact rollers;

Figure 7 is a fragmentary end elevational view with parts omitted showing another modified form of the invention, the position of the parts when the anvil is out of the path of movement of the impact rollers being shown in dot-dash lines;

Figure 8 is a top plan view on a reduced scale with parts omitted, taken substantially on the line 8—8 of Fig. 1;

Figure 9 is a top plan view similar to Fig. 8 showing a modified form of the invention, the automatic control means being shown schematically;

Figure 10 is a fragmentary end elevational view similar to Fig. 3, with parts omitted, of a modified form of the invention showing the position of the parts when the bar is in the path of movement of the rotating punch-actuating member; and

Figure 11 is a fragmentary view similar to Fig. 10 showing the position of the parts when the bar is retracted out of the path of movement of the rotating punch-actuating member.

Referring more particularly to the drawings, in which like parts are identified by the same numerals throughout the several views, Figs. 1 to 4 show a high-speed perforating machine that is adapted to handle relatively wide strips of metal, plastic, or other sheet material. The machine has a rigid metal frame 1 and a relatively long cylindrical metal impact wheel or flywheel journaled in aligned bearings 3 and 4 carried by the frame for rotation about a horizontal axis. Punch-actuating means are provided including a series of regularly circumferentially spaced cylindrical impact rollers 5 mounted in spaced parallel planes along the length of the flywheel for rotation about axes parallel to the axis of the flywheel. Each impact roller has its axis the same distance from the flywheel axis and projects beyond the external cylindrical surface 6 of the flywheel a distance less than its radius. The diameter of each impact roller is preferably less than one-tenth the diameter of the flywheel and the portions of the four rollers 5 extending beyond said cylindrical surface 6 preferably extend circumferentially a total distance no greater than about one-tenth the circumference of the flywheel so that the rollers are effective for only a small portion of the rotation of the flywheel. Each roller may be adjustably mounted and may be mounted so as to be easily removed from the flywheel without disturbing the mounting of the flywheel.

A row of regularly spaced dies 7 are rigidly mounted on a horizontal table 8 formed by a portion of the frame with their axes located substantially in a vertical plane parallel to and spaced from the horizontal axis of the flywheel 2. A rigid punch guide or block 9 is carried by the frame above the dies 7 for slidably supporting one or more punch holders 10. A row of punches are mounted on each punch holder for reciprocation vertically into and out of the dies 7. The punch guide has an outwardly extending portion 11 that is rigidly connected to one end of each resilient leaf spring 12. Each spring is supported in cantilever fashion by the portion 11 and has a top leaf that engages the punch holder 10.

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As shown in Fig. 2, two resilient leaf springs 12 are provided for each punch holder 10 near the opposite ends of said holder. The springs normally hold the punches above the dies to permit movement of sheet material between the punches and dies.

The upper surfaces of the dies 7 are located generally in a horizontal plane to support a flat sheet as it passes below the punches. As herein shown, a horizontal stripper plate 13 is rigidly mounted on the bottom of the guide block 9 with its smooth flat bottom surface parallel to and spaced from the flat upper surfaces of the dies 7.

Means is provided for feeding a strip of sheet material of uniform width and thickness horizontally over the upper surfaces of the dies and in a direction perpendicular to the vertical plane through the axes of the punches and dies. Such means includes conventional horizontal cylindrical guide rolls 14 and 15 for supporting the strip in a horizontal position and a pair of conventional feed rolls 16 and 17 for moving the strip in synchronism with rotation of the flywheel 2. The lower feed roll 17 is driven continuously through suitable gears and an endless chain 18 which is mounted on a sprocket carried by the shaft of the flywheel 2 as shown in Fig. 1. The upper roll 16 is an idler which holds the strip against the driven roll 17 and rotates in unison with said roll. Since the flywheel is operatively connected to the feed rolls, the strip is fed a predetermined distance during each revolution of the flywheel whereby the perforations made by the punches are spaced in a predetermined manner while the punches are in operation.

According to the present invention means are provided to start and stop operation of the punches during rotation of the flywheel so that the perforating may be interrupted at intervals to provide for special patterns. Such means preferably takes the form of a bar or anvil that is moved between the flywheel or other punch actuating member and the punch holder to transmit movement from the rotating punch-actuating member to the punches. The bar or anvil is mounted for movement into and out of an impact-transmitting position wherein it can effect movement of the punches, the punch-actuating member being ineffective when the anvil is moved out of said position. Movement of the anvil may be effected manually or automatically and preferably is effected in accordance with the rotation of the punch-actuating member.

As herein shown, each punch holder 10 has an enlarged head portion 19 with flat beveled surfaces 20 and a flat horizontal top surface 21 for receiving hammer blows from the impact rollers 5. A substantially horizontal bar 22 is mounted for movement perpendicular to the punch holders 10 into and out of the path of movement of the impact rollers 5 as shown in Figs. 1 to 4. The bar has an enlarged anvil portion 23 which is shown herein with a substantially flat upper surface 24, an inclined side face 25, and a smooth flat bottom surface 26. When the bar is in its advanced position as shown in Fig. 3, the anvil portion 23 will be struck by the impact rollers 5 and will transmit the hammer blows to the punch holder 10 so as to effect movement of the punches into the dies at bullet-like speeds. The high frequency springs 12 move the punches upwardly at high speed so that the punches remain in the strip material for extremely small periods of time. When the bar 22 is retracted out of the path of movement of the impact rollers as shown in Fig. 4, the bottom surface 26 of the bar rests on the top surface 21 of the punch holder and the punches do not move.

Any suitable mechanism may be provided for supporting and moving the bar 22. As herein shown, the frame 1 has a rigid longitudinal portion 27 substantially parallel to the flywheel axis and one or more guide blocks 28 rigidly connected to the portion 27. Each guide block contains a portion of a horizontal shaft 64, a pinion gear 29 rigidly mounted on said shaft, and a horizontal rack

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30 as best shown in Fig. 3. Each rack 30 has teeth which mesh with the pinion gear 29 and has a pin 32 which supports the end of the bar 22, said bar having an inverted U-shaped portion 33 which fits on said pin to provide an operative connection between the rack and the bar. A vertically movable rack 31, having teeth which mesh with the teeth of a pinion gear carried by the shaft 64, is connected to the piston rod 34a of a double-acting pneumatic motor 34 that is rigidly mounted on the frame. The motor 34 acts through the racks and the pinion to move the bar 22 between its foremost impact-transmitting position shown in Fig. 3 and its rearmost retracted position shown in Fig. 4. It will be noted that the portion 27 engages the bar 22 to limit its upward movement so that the bar will not move into the path of movement of the impact rollers when it is retracted as shown in Fig. 4. A reversing valve 35 controls the supply of air to the opposite sides of the piston of the motor 34, the valve in one position supplying air to the top face of the piston and exhausting air from below the piston, and in its other position supplying air below and exhausting air from above the piston.

The valve 35 may be controlled manually but is preferably controlled automatically through suitable electrical controls including a solenoid 36. As herein shown, the solenoid is operated at a predetermined time during the rotation of the flywheel through a microswitch 37 and a cam 38 that is driven in timed relation to rotation of the flywheel. The switch 37 is opened and closed by means including a follower that engages the lobe of the cam 38, said lobe moving into and out of contact with the follower to effect energization and deenergization of the solenoid 36. As herein shown, the lobe is removable and can be mounted in various adjusted positions. If desired, different numbers and shapes of lobes may be mounted on the cam wheel.

Any suitable drive mechanism may be provided for driving the cam 38 at a speed less than that of the flywheel. As herein shown, an endless chain 39 and change-speed gearing 40 are provided for driving the cam in synchronism with the flywheel, the chain passing over a small sprocket mounted on the flywheel shaft and a larger sprocket 41 that is connected to the speed reduction gearing 40. By changing the sizes of the gears at 40, the ratio of the speed of rotation of the cam 38 relative to the speed of the flywheel 2 may be varied to any desired amount.

The perforating machine functions automatically to start and stop movement of the punches during rotation of the flywheel. The cam 38, for example, may be readily adjusted so that the punches will cut ninety regularly spaced rows of perforations and will skip six rows during twenty-four revolutions of the flywheel. By changing the speed of the cam relative to the flywheel or the size and shape of the cam, the number of rows skipped in a predetermined time may be varied. Where the motor for the bar 22 is of a fast-acting type, the number of rows skipped at any one time may be very small, and the cam 38 may have several small sharply curved lobes so that the spacing of the perforations may vary considerably. It will be apparent from Figs. 3 and 4 that the distance moved by the bar 22 is small so that the piston of the motor 34 need move only a very small distance to start and stop movement of the punches. Such distance preferably is in the neighborhood of about one-half to one inch where the flywheel has a diameter of about one-half to two feet.

It will be noted from the drawings that the motor 34 moves the anvil portion 23 of the bar only a short distance into the path of movement of the impact rollers 5 and that the frame portion 27 has a flat horizontal lower surface that engages the top of the bar 22 to limit upward movement of the bar into said path. The bar is unobstructed below the portion 27 so that it may swing and remain substantially in engagement with the punch holder

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10 as the holder is lowered. The springs 12 normally hold the bar in a horizontal position in engagement with the frame portion 27 and yieldably resist downward movement of the bar out of that position.

The distance from the uppermost to the lowermost positions of the punches need not be substantially greater than about one-eighth of an inch or so for ordinary material and is usually less than one-quarter of an inch. In the perforating operation the punches travel downwardly through the strip and into the die and upwardly above the strip. The lowermost position of the lower end of the punch is usually not substantially greater than about $\frac{1}{2}$ of an inch or so below the strip after perforation. Since the punches move at extremely high velocity and move very short distances, the punches are in the work only a very short period of time and do not substantially interfere with feeding of the work.

Movement of the punches at high speed is important not only with regard to the movement of the strip material, but also with regard to the quality of the perforations. When the punches are moved into the dies at bullet-like speeds, there is very little bending and deformation of the strip in the neighborhood of each cut and very little tendency to tear or crumple the strip material.

In order to impart the desired high speed to the punches, it is necessary to strike hammer blows, to provide reciprocating parts with relatively low inertia, and to provide springs with a high frequency of vibration which can move the punches upwardly at high velocity. The leaf springs disclosed herein provide excellent means for retracting the punches at high velocity and can function effectively when the punches are reciprocated over 2000 times per minute.

The axes of the impact rollers 5 are moved at a velocity of at least about 15 feet per second and preferably at a speed in the neighborhood of about 20 to 30 feet per second so as to impart hammer blows to the punches. As herein shown, the cylindrical surface 6 of the flywheel 2 has a diameter of about sixteen inches and each roller 5 has a diameter that is a little over one inch and less than three percent of the circumference of said flywheel. The flywheel is preferably operated at a speed in the neighborhood of about three to four hundred revolutions per minute so as to reciprocate the punches about twenty to twenty-seven times per second while the bar 22 is in its impact-transmitting position shown in Fig. 3. It will be noted that the bar 22 is moved a distance in the neighborhood of about one to two centimeters by the motor 34 from the foremost advanced position shown in Fig. 3 to the rearmost retracted position shown in Fig. 4 and is moved into the path of movement of the impact rollers 5 a distance not substantially greater than one-half inch so that each impact roller is in contact with the bar 22 for a period of time during one revolution of the flywheel 2 not in excess of about one percent of the time required for said revolution. Each embodiment of the invention disclosed herein may be constructed to operate in such manner.

Figures 5 and 6 illustrate a modified form of the invention wherein each bar or anvil is detached from the motor 34 and falls by gravity out of the path of the impact rollers 5. The perforating machine shown in these figures is substantially the same as that shown in Figs. 1 to 4 and operates in the same manner except that each bar 22 is replaced by a bar 22a and each rack 30 is replaced by a rack 30a and a resilient spring finger 42 that is rigidly connected to said rack. The bar 22 is pivoted at one end on a pin 43 carried by the frame and moves into engagement with a rigid stop 44 carried by the frame when it is swung to its uppermost impact-transmitting position as shown in Fig. 5. The anvil portion 23a of the bar has a substantially horizontal position almost the same as the position of the anvil portion 23 described above when the bar is in its uppermost position.

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The bar 22a is moved to its uppermost position by the enlarged end portion 45 of the finger 42. Said end portion has flat parallel upper and lower surfaces for engaging the flat lower surface of the anvil portion 23a and the flat upper surface of punch holder 10, respectively, to transmit impacts from the bar 22a to the punch holder and the punches carried thereby. The end portion 45 also has an inclined face 46 substantially parallel to the inclined face 20 of the head 19 that moves into engagement with said face 20 when the finger is moved by the motor 34 to its rearmost retracted position shown in Fig. 6. As the finger 42 is retracted, the weight of the bar 22a moves the end portion 45 downwardly and the anvil portion 23a of the bar moves out of the path of movement of the impact rollers 5.

When the lobe of the cam 38 moves out of contact with the follower of the switch 37, the motor 34 is energized in a downward direction to advance the finger 42. As the finger advances, the inclined surface 46 rides up the surface 20 of the punch holder and the bar 22a is swung upwardly into the path of movement of the impact rollers as shown in Fig. 5. As long as the lobe of the cam is out of contact with the follower of the switch, the finger 42 remains in its advanced position and the impact rollers strike hammer blows on the anvil 23a. Such hammer blows are transmitted through the anvil and the finger portion 45 to the punch holder 10 and the punches carried thereby to lower the punches, the punches and the bar 22a being returned by the springs 12 to the uppermost position shown in Fig. 5 between successive impacts.

Figure 7 illustrates another modified form of the invention. The flywheel 2 and the impact rollers 5 function in the same manner described above to impart hammer blows to the punch and the pneumatic motor is controlled by the cam in timed relation to rotation of the flywheel in the same manner as described above. The perforating machine shown in Fig. 7 includes a rigid metal frame 1b that supports a vertical punch holder 10b for reciprocation toward and away from the strip material. The punch holder is biased upwardly by at least one leaf spring 12b which is bolted to the underside of a horizontally projecting portion 47 of the frame. Mounted on the top of said projecting portion is a bracket 48 having vertically aligned horizontal pins 49 and 50 mounted thereon parallel to the axis of the flywheel 2. Said pins rotatably support a pair of rollers 51 and 52 which engage the top and bottom surfaces, respectively, of a flat resilient bar or leaf spring 53 near the end thereof.

The opposite end of the single leaf spring 53 is pivotally mounted on a horizontal pin 54 that is carried by an L-shaped metal slide 55. The frame 1b has an outwardly projecting portion 56 with ways that slidably engage the opposite sides of the slide 55 to guide the slide horizontally in a direction perpendicular to the vertical plane through the axis of the flywheel. The spring 53 is normally supported in a horizontal position as shown in Fig. 7 and is mounted for reciprocation with the slide 55 from the position shown in solid lines in Fig. 7 to the position shown in dot-dash lines in that figure.

The slide 55 is operatively connected to the piston rod 34b of the cam-controlled pneumatic motor through a suitable linkage so that the spring 53 may be moved by the motor from its advanced impact-transmitting position to its inoperative retracted position. Such linkage includes a horizontal shaft 57 parallel to the axis of the flywheel 2, arms 58 and 59 rigidly connected to said shaft, and a link 60 between the arm 59 and the slide 55. The arm 58 is pivotally connected at its outer end to the lower end of the piston rod 34b by means including a pin 61. The link 60 is pivotally connected to the lower end of the arm 59 by means including a pin 62 parallel to the pin 54. The forward end of the link

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60 is pivotally mounted on the pin 54 so that the slide 55 is caused to move horizontally whenever the arm 59 swings with its shaft 57. The shaft 57 is pivotally mounted on the frame so that the force imparted to the piston rod 34b by the pneumatic motor 34 is transmitted through the arms 58 and 59 and the link 60 to the slide 55 and the spring 53. It will be apparent that cams, eccentrics, rack and pinion mechanisms, and other suitable mechanisms may be employed between the pneumatic motor and the slide 55 to convert vertical movement of the piston rod 34b to horizontal movement of the spring 53. The rollers 51 and 52 permit such horizontal movement of the spring while supporting the end of the spring. Where a cantilever spring is employed, however, the rollers 51 and 52 may be omitted.

The central portion of the spring 53 has a smooth flat bottom surface which slidably engages the smooth top horizontal surface of the head portion 19b of the punch holder. An anvil 63 is welded to the central portion of the spring 53 between the head portion 19b of the punch holder and the flywheel 2 for receiving hammer blows from the impact rollers 5 and for transmitting said blows to the punch holder and the punches carried thereby. The anvil 63 may be located in various positions on the spring 53, but is preferably located directly above the punch holder 10b as shown in Fig. 7. When the anvil 63 is advanced to its impact-transmitting position nearest the rollers 51 and 52, it is in the path of movement of the impact rollers 5 as shown in solid lines in Fig. 7, and the hammer blows received by the anvil will be transmitted to the punches to reciprocate the same at high velocity, the punches being retracted by the spring 12b between successive impacts. The spring 12b also assists the spring 53 to return the anvil 63 to the path of movement of the impact rollers between successive impacts.

When the pneumatic motor 34 is actuated so as to move the anvil 63 to its rearmost retracted position shown in dot-dash lines in Fig. 7, the anvil is out of the path of movement of the impact rollers and the punch holder 10b ceases to move. It is, therefore, possible to start and stop the operation of the punches automatically at predetermined intervals during rotation of the flywheel in a manner substantially equivalent to that described above.

It will be apparent to those skilled in the art that various mechanisms may be employed for moving a bar or anvil into and out of the path of movement of the impact members in addition to the mechanisms disclosed herein and that a perforating machine may take many forms different from that shown herein which employ the teachings of the present invention.

Figure 8 illustrates one form which the perforating machine may take. It will be noted from Fig. 2 that the perforating machine may be designed to perforate strips with a width of several feet. Where the perforations extend several feet in the direction of the flywheel axis, each punch holder 10 preferably has a substantial width and carries a plurality of punches. As shown in Fig. 2, each punch holder 10 and each bar 22 has a length in the neighborhood of about one foot in the direction of the flywheel axis, each bar 22 engaging the punch holder throughout its length. Figure 8 shows how the machine might appear where there are three punch holders, each with a length in the neighborhood of about one foot. In such a case, there would be three horizontally aligned bars that rest on the top surfaces of the punch holders 10 as indicated in Fig. 2. The bars 22 may be operated in unison by one or more motors so that all the punches operate simultaneously or the bars may be operated by separate independently controlled motors as indicated in Fig. 9.

As shown in Fig. 8, there is only one motor 34 for operating all the bars 22. The motor 34 acts through the rack 31 to rotate a pinion 29a mounted at the cen-

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ter of the horizontal shaft 64 carried by the frame parallel to the flywheel axis, the teeth of the rack 31 meshing with the teeth of the pinion gear 29a. Six pinions 29 are mounted along the length of the shaft 64 and are rigidly connected to said shaft for rotation in unison therewith. Each pinion 29 has teeth which mesh with the teeth of a rack 30 which is pivotally connected to one projecting end portion 65 of a bar 22. The racks 30 are located at the opposite ends of each bar 22 substantially as shown in Fig. 8 so that the bars 22 move substantially in unison when actuated by the motor 34 between their impact-transmitting positions and their inoperative retracted positions.

Figure 9 shows how the perforating machine may be constructed so that the bars 22 are controlled independently. As shown in that figure, a separate motor 34 and separate control means are provided for each bar 22. The pinions 29 and the racks 30 are arranged with respect to the bars 22 in the same manner as in Fig. 8; however, the pinions 29 are mounted on three separate aligned shafts 64a, 64b, 64c, the pinions being mounted at the opposite ends of each shaft. Pinions 129, 229 and 329 are mounted at the center of the shafts 64a, 64b, and 64c, respectively, each of said pinions engaging the rack 31 connected to the adjacent motor 34 to rotate the shaft when the piston of the motor is reciprocated.

The motors 34 and the rack and pinion means 29 and 30 connecting the motors to the bars 22 are shown as they might actually appear in the perforating machine so that Fig. 9 is consistent with Figs. 1 to 4 of the drawings and so that the construction of the machine is apparent. However, the automatic controls for the motors 34 are shown diagrammatically in Fig. 9 to facilitate a ready understanding of the invention in a minimum number of drawings.

As shown in Fig. 9, each bar 22 is actuated by a separate motor 34 and each motor 34 is controlled automatically in response to rotation of the flywheel by a separate control mechanism including a cam wheel 38, a switch 37 that is adapted to be closed by a follower in the path of the lobe of the cam, a solenoid 36 that is energized whenever the switch is closed, and a valve 35 that is operated by the solenoid. The control mechanism for each motor 34 functions in the manner described above with respect to Figs. 1 to 4. Each time the lobe of the cam wheel 38 strikes the follower of the switch 37, the switch is closed to energize the solenoid 36 and to move the valve 35, whereby the motor 34 is supplied with motive fluid to move the piston in a direction to retract one of the bars 22 and to stop operation of the punches controlled by that bar. When the lobe moves out of contact with the follower, the switch opens to effect operation of said punches.

As shown in Fig. 9, the cam wheels 38 are provided with lobes 66 to 69, the lobes on each cam wheel being arranged differently than on the other cam wheels so that each of the bars 22 is moved at different times. The lobes 67 and 68 of the intermediate cam 38 are shown out of phase with the cam 66 of the end cam so that the punches controlled by the intermediate bar 22 will cut holes in the strip S while the other punches are inoperative or stationary. The lobe 69 of the end cam extends almost half the circumference of the cam so that the punches controlled by that cam are inoperative almost half of the time. Of course, it will be obvious that any suitable cam lobes may be provided on the cam wheels 38 and that such lobes may be mounted in any suitable position to obtain the desired pattern of holes in the strips.

Figures 10 and 11 illustrate another form of the invention which is the same as the machine illustrated in Figs. 1 to 4, and 9, except that the flywheel and the associated impact rollers are replaced by a punch-actuating means in the form of an eccentric. In the machine shown in these figures, the bar is replaced by a similar

bar 22b having a flat upper surface 24b and a flat inclined surface 25b. The bar 22b has a U-shaped portion 33b which fits on the pin 32 to connect the bar to the rack 30 whereby the bar may be moved by the motor 34. The bar 22b normally rests on the head portion 19 of the punch holder and is adapted to be moved horizontally by the motor 34 between the position shown in dot-dash lines in Fig. 11 and the position shown in solid lines in that figure.

The bar 22b is moved toward the punch by punch actuating means including a crank shaft 91 mounted for rotation about a horizontal axis parallel to the pin 32, an inner sleeve 92 having a tight fit on the eccentric portion of the crank shaft, a ball bearing 93, and an outer sleeve 94 concentric to the sleeve 92. The cylindrical sleeves 92 and 94 form the inner and outer races of the bearing 93 as is apparent from the drawings. In any position of the crankshaft 91, the outer cylindrical surface of the sleeve 94 has a portion 95 closest to the axis of rotation of the crank shaft 91 and a portion 96 on the opposite side of the crank shaft located farthest from said axis so that during rotation of the crankshaft the sleeve 94 serves as a punch-actuating member.

The bar 22b is moved to a first position in the path of movement of the sleeve 94 as shown in Fig. 10 to transmit movement from said sleeve to the punches, the spring 12 retracting the punches each time the center of the sleeve 94 moves away from the punches. Whenever it is desired to stop the reciprocation of the punches without stopping rotation of the shaft 91, the bar 22b is moved from the position shown in solid lines in that figure wherein the bar is out of the path of movement of the sleeve 94 and does not engage said sleeve. In the latter position, the spring 12 holds the punches in a retracted position throughout rotation of the crank shaft 91, there being no actuation of the punches. The ball bearings 93 permit the sleeve 94 to rotate freely relative to the sleeve 92 so as to minimize friction between the sleeve 94 and the bar 22b when the sleeve engages the bar as shown in Fig. 10. It will be apparent from the drawings and the above description how the machine of Figs. 10 and 11 functions. It will be understood that the bars 22b may be controlled either as shown in Fig. 8 or as shown in Fig. 9.

It will be understood that, in accordance with the provisions of the patent statutes, variations and modifications of the specific devices disclosed herein may be made without departing from the spirit of the present invention.

Having described my invention, I claim:

1. In a punching machine having a frame, a punch mounted for reciprocation on said frame, means for reciprocating said punch including an impact wheel mounted for rotation on said frame and having one or more impact members spaced about its periphery, and feeding means for supplying a strip of material to said punch in timed relation to rotation of said wheel to be acted upon by said punch, the improvement which comprises: a bar projecting between said punch and said wheel for transmitting hammer blows from said impact members to said punch, said bar being mounted for movement between a first position in which hammer blows are transmitted to said punch and a second position wherein it is ineffective, motor means for effecting movement of said bar between said first and second positions to initiate and discontinue actuation of said punch by said impact members, and means for controlling the operation of said motor means including cam means driven in timed relation to said wheel and said feeding means and follower means responsive to movement of said cam means for starting and stopping said motor means.

2. A punching machine comprising a frame, a rotatable flywheel having one or more impact rollers spaced about its periphery and occupying less than about ten percent of said periphery, means for rotating said flywheel

to impart to said impact members a velocity of at least about 15 feet per second, a punch mounted on said frame, a bar for transmitting hammer blows from said impact rollers to said punch and mounted for movement between a first position wherein a portion of the bar is in the path of movement of said impact rollers and a second position wherein the bar is out of the path of movement of said rollers, means for causing movement of said bar between said first and second positions including a motor, and cam-operated means for controlling the operation of said motor in timed relation to the rotation of said flywheel.

3. In a punching machine having a frame, a punch mounted for reciprocation on said frame, and means for imparting hammer blows to said punch including an impact wheel having at least one impact member thereon, the improvement which comprises: a cam mounted for rotation on said frame and having a raised portion thereon, means for rotating said cam in timed relation to rotation of said impact wheel, a motor, electrical means for energizing and deenergizing said motor including a switch and follower means in the path of movement of said raised portion of said cam for operating said switch, a bar carried by said frame and having an anvil portion for receiving hammer blows from said impact member, said bar being adapted to transmit the hammer blows to said punch to reciprocate the punch and being movable from a first operative position in which said anvil portion is in the path of movement of said impact member to a second inoperative position in which the bar is out of the path of movement of said impact member, and means operated by said motor for causing movement of said bar between said first and second positions whereby the reciprocation of the punch may be started and stopped during rotation of the impact wheel and in accordance with the shape of said cam.

4. A punching apparatus as defined in claim 3 wherein said bar is reciprocated by said motor in a direction generally perpendicular to the direction of movement of said punch.

5. A punching apparatus as defined in claim 3 wherein said bar is mounted for swinging movement on said frame toward and away from said impact wheel and a finger is mounted for movement between said bar and said punch to transmit hammer blows from the bar to the punch, said finger being operably connected to said motor and being engageable with said bar to move the bar between said first and second positions.

6. A punching apparatus as defined in claim 3 wherein said bar comprises a resilient leaf spring operably connected to said motor and having an anvil thereon, said spring being supported at its opposite ends and being mounted for reciprocation in a direction generally perpendicular to the direction of movement of said punch so that the anvil may be moved by said motor into and out of the path of movement of said impact member.

7. A punching machine comprising a punch mounted for reciprocation vertically toward and away from a strip of sheet material, means for feeding said strip horizontally including a pair of feed rollers, an impact wheel above said punch having at least one impact member thereon for imparting hammer blows to said punch, an anvil interposed between said punch and said impact wheel for receiving the hammer blows from said impact member and for transmitting the blows to said punch, said anvil being mounted for movement between a first position wherein the anvil is in the path of movement of said impact member and a second position wherein the anvil is out of the path of movement of said impact member, motor means for effecting movement of said anvil between said first and second positions, and control means for automatically starting and stopping the operation of said motor means in timed relation to rotation of said impact wheel and said feed rollers.

8. A perforating machine comprising a frame, a cy-

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lindrical flywheel mounted on said frame for rotation about a horizontal axis, a series of aligned longitudinally spaced dies arranged parallel to said axis, a series of aligned longitudinally spaced punches mounted between said flywheel and dies for reciprocation into and out of said dies to perforate a strip of sheet material, means including a pair of feed rolls for feeding a strip of sheet material between said punches and dies in a direction generally perpendicular to said axis so that said punches may cut parallel rows of perforations in said strip, one or more impact rollers on said flywheel for imparting hammer blows to each of said punches, a plurality of independently movable bars carried by said frame for engaging the impact rollers on said flywheel to transmit hammer blows from the rollers to the punches, each bar being mounted for movement between a first position wherein an anvil portion of the bar is in the path of movement of an impact member on the flywheel and a second position wherein the bar is out of the path of movement of said impact member so that each punch associated with said bar stops reciprocating each time said bar moves to said second position, means including a plurality of motors for effecting movement of said bars between their first and second positions, and means for controlling said motors to cause movement of the bars at different times including a plurality of rotary cams rotatable in synchronism with said flywheel and a plurality of control means for starting and stopping operation of said motors, each cam controlling one motor to cause movement of one of said bars between its first and second positions.

9. A punching machine comprising a punch mounted for reciprocation vertically toward and away from a strip of sheet material, means for feeding said strip horizontally including a pair of feed rolls, a punch-actuating member mounted for rotation about a horizontal axis above said punch and having peripheral surfaces spaced different distances from said axis to provide means for actuating said punch in response to rotation of said member, a movement-transmitting bar interposed between said punch and said rotating member for engaging

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said punch and said actuating means to transmit movement to said punch from said rotating member, said bar being mounted for movement between a first position wherein the bar is in the path of movement of said rotating member and a second position wherein the bar is out of the path of movement of said rotating member, means for holding said punch in a position to permit feeding of said strip while said bar is in said second position, motor means for effecting movement of said bar between said first and second positions, and control means for automatically starting and stopping operation of said motor means in timed relation to rotation of said member and said feed rolls.

10. A punching machine comprising a punch mounted for reciprocation vertically toward and away from a strip of sheet material, means for feeding said strip horizontally including a pair of feed rolls, a punch-actuating member mounted for rotation about a horizontal axis above said punch and having peripheral surfaces spaced different distances from said axis to provide means for actuating said punch in response to rotation of said member, a movement-transmitting bar interposed between said punch and said rotating member for engaging said punch and said actuating means to transmit movement to said punch from said rotating member, said bar being mounted for movement between a first position wherein the bar is in the path of movement of said rotating member and a second position wherein the bar is out of the path of movement of said rotating member, means for holding said punch in a position to permit feeding of said strip while said bar is in said second position, and means for effecting movement of said bar between said first and second positions.

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