March 27, 1951 E. R. MUDDIMAN 2,546,469

PUNCHING MACHINE FOR SAMPLING MOVING STRIPS

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FIG. 1.

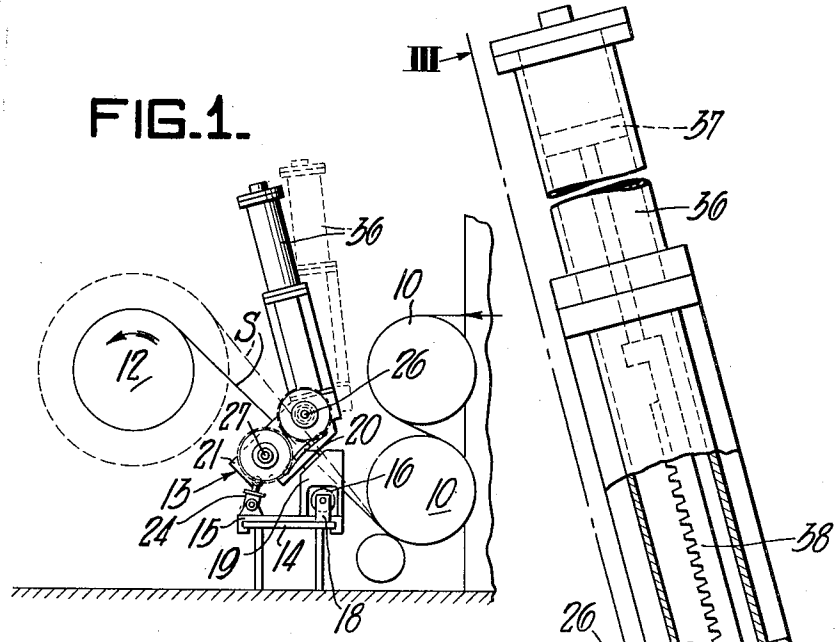


FIG. 2.

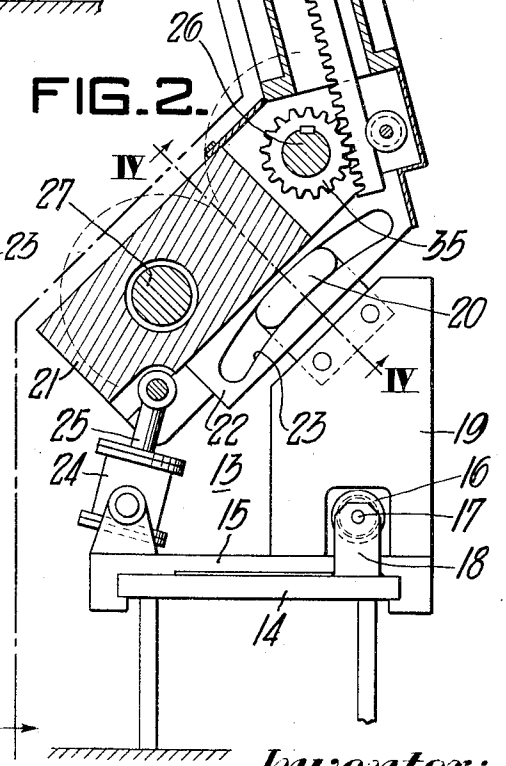
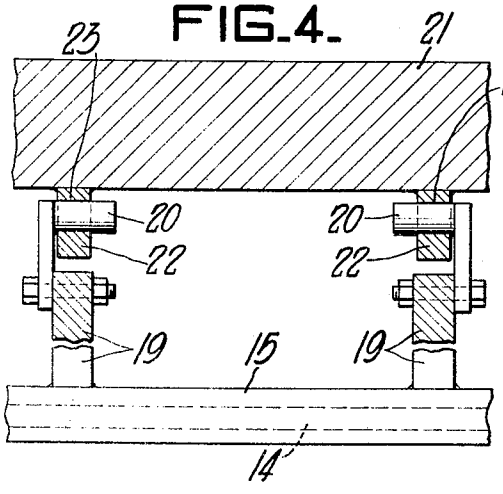


FIG. 4.



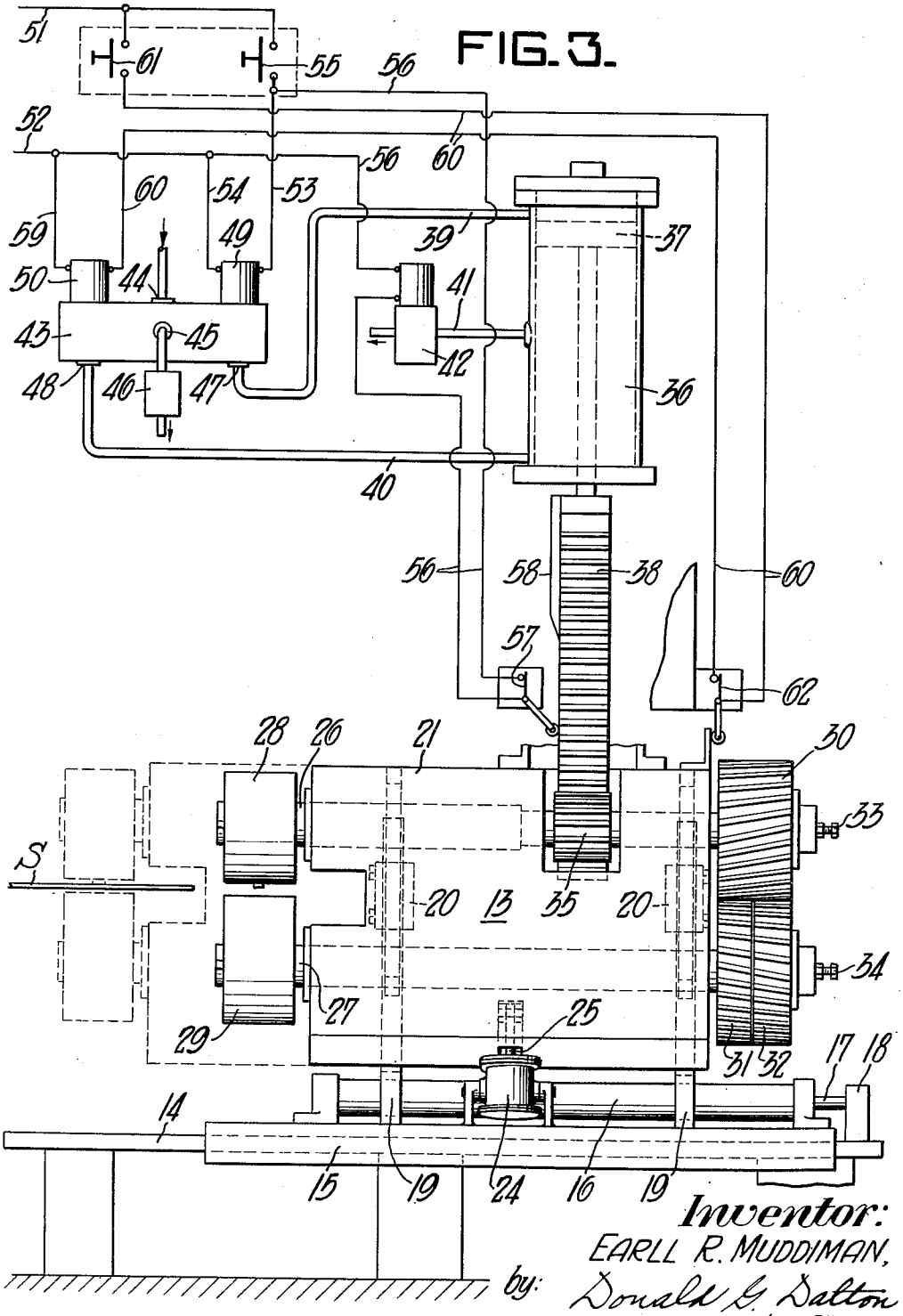
Inventor:
EARLL R. MUDDIMAN,
by: Donald G. Dalton
his Attorney

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PUNCHING MACHINE FOR SAMPLING MOVING STRIPS

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FIG. 3.



Inventor:
EARLL R. MUDDIMAN,
by: Donald G. Dalton
his Attorney.

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UNITED STATES PATENT OFFICE

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PUNCHING MACHINE FOR SAMPLING MOVING STRIP

Earll R. Muddiman, Wilkinsburg, Pa., assignor to United States Steel Company, a corporation of New Jersey

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3 Claims. (Cl. 164—95)

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This invention relates to punching machines for sampling strip moving in processing lines and particularly to improved actuating mechanisms for such machines.

The present invention is an improvement over that disclosed and claimed in Brunner Patent No. 2,393,745, which issued January 29, 1946. That patent shows a punching machine which is mounted between the tension rolls and the delivery reel of a strip temper mill. The machine has a frame which is movable vertically and angularly to adjust its position in accordance with the size of coil on the delivery reel. This frame supports a carriage which is reciprocably movable toward and away from the strip. The frame and carriage are equipped with fluid pressure cylinders and pistons for effecting these movements. A punch and a cooperating die are rotatably mounted on the carriage and are actuated by a solenoid which rotates a gear segment that meshes with a pinion on the punch shaft.

An object of the present invention is to provide in punching machines of the foregoing type improved actuating mechanism which furnishes better control of acceleration and deceleration of the rotatable punching elements.

A further object of the invention is to provide in such punching machines a pneumatic actuating mechanism which rapidly accelerates the punching elements to approximately the normal linear speed of strip in the processing line, and after the sample has been punched, decelerates the punching elements to a smooth cushioned stop.

In accomplishing these and other objects of the invention, I have provided improved details of structure, a preferred form of which is shown in the accompanying drawings, in which:

Figure 1 is a side elevational view of a portion of a strip processing line equipped with an improved punching machine which embodies features of the present invention;

Figure 2 is an enlarged side elevational view of the punching machine, partly in section;

Figure 3 is an end elevational view of the machine taken substantially on line III—III of Figure 2 and showing schematically the actuating mechanism with which the present invention is particularly concerned; and

Figure 4 is a transverse sectional view taken substantially on line IV—IV of Figure 2.

In Figure 1 there are shown tension rolls 10 and a delivery reel 12 of a strip processing line, such as a temper mill. Strip S emerging from the line travels at a relatively high speed around said rolls and winds in a coil on said reel. As the

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coil builds up, the vertical and angular position of the strip approaching the reel progressively changes, two such positions being illustrated in Figure 1.

A punching machine 13 is mounted between rolls 10 and reel 12 for sampling the material of the strip for physical and chemical analysis. Except for the novel actuating mechanism hereinafter described, the punching machine may be essentially like that of the aforementioned Brunner patent. However, I have illustrated the mounting arrangement as somewhat altered in a fashion I have found convenient practically.

As illustrated, the punching machine comprises a supporting table 14 fixed to the floor and a carriage 15 mounted on said table for reciprocable movement toward and away from strip S. A double acting fluid pressure cylinder 16 is fixed to the top of carriage 15 and extends in a horizontal direction. The free end of its piston rod 17 is fixed to a lug 18 upstanding from the top of table 14. Thus actuation of this piston and cylinder moves the carriage toward or away from the strip. Carriage 15 has a plurality of upstanding plates 19, the upper forward edges of which carry fixed guide pieces 20, which furnish a mounting for a punch frame 21. The latter has depending flanges 22 which contain arcuate slots 23 in which said guide pieces are received. A double acting fluid pressure cylinder 24 and piston 25 are pivoted respectively to the top of carriage 15 and to punch frame 21 for adjusting the vertical and angular position of the punch frame in accordance with the size of the delivery reel.

Punch frame 21 carries rotatable shafts 26 and 27 which carry punching elements at their inner ends. Said elements include a punch 28 and a mating die 29 of any suitable construction, preferably embodying some positive means for ejecting punchings. The outer ends of these shafts carry motion transmitting means, illustrated as gears 30 and 31 which mesh so that rotation of one shaft rotates the other shaft in the opposite direction. Preferably these gears are of the anti-backlash type, having helical gear teeth and the driven gear 31 being thinner than the driving gear 30 and having an anti-backlash gear 32 mounted alongside. The end of shaft 26 carries an adjusting screw 33 for synchronizing the punching elements. The end of shaft 27 carries an adjusting screw 34 for setting the anti-backlash gear. Inasmuch as such anti-backlash gearing per se is not novel, no more detailed description is deemed necessary.

In accordance with the present invention, shaft

20 carries a pinion 35 intermediate its length. A double acting pneumatic cylinder 36 is fixed to the punch frame 21 and contains a reciprocable piston 37. A rack gear 38 is fixed to the piston rod of piston 37 and meshes with pinion 35 for driving the punching elements. When the piston rod and rack gear are lowered, the punching elements rotate to punch the strip. When the piston and rack gear are raised, the punching elements return to their starting position. Cylinder 36 has an air line 39 connected to its upper end, an air line 40 connected to its lower end, and an exhaust line 41 connected to its mid-portion. When air is admitted to the cylinder through line 39, the piston is lowered, and when air is admitted to the cylinder through line 40, the piston is raised. Exhaust line 41 contains a solenoid operated valve 42 which opens when it is energized and closes when it is de-energized.

A four-way solenoid valve 43 controls admittance of air to cylinder 36. Inasmuch as such valves per se are known and do not form a part of the present invention, no detailed showing of the mechanism is deemed necessary. Said valve has a port 44 connected to a source of compressed air and an exhaust port 45 connected to a restrictive valve 46 and then exhausting into the atmosphere. Valve 43 also has ports 47 and 48 connected to air lines 39 and 40 extending to the top and bottom respectively of cylinder 36. Valve 43 has a solenoid 49 for controlling admittance of air to line 39 for lowering the piston and punching strip S and a second solenoid 50 for controlling admittance of air to line 40 and raising the piston and returning the parts to their starting position.

The preferred circuit for operating the solenoid valves includes conductors 51 and 52 connected to an outside power source. These conductors are connected to solenoid 49 via conductors 53 and 54, respectively. Conductor 53 contains an actuating switch 55, the closing of which completes the circuit to solenoid 49. Energization of this solenoid connects ports 44 and 47 of valve 43 to admit air to the upper end of the cylinder and simultaneously connects ports 45 and 48 of this valve to permit air to discharge from the lower end of the cylinder through restrictive valve 46. The solenoid of valve 42 in exhaust line 41 is connected to conductor 52 and to conductor 53 via a conductor 56 that contains a normally closed limit switch 57 mounted on punch frame 21 adjacent rack gear 38. Said rack gear carries a cam 58 for operating said limit switch. The cam engages and opens the limit switch as piston 37 passes the port in cylinder 36 connected to line 41. Closing of actuating switch 55 thus also energizes the solenoid of valve 42 to open this valve as long as limit switch 57 is in its normally closed position.

Initially while air is forcing piston 37 down, the air in the cylinder below the piston escapes freely through valve 42 and a minor part through line 40 and restrictive valve 46. Therefore the piston and the punching elements accelerate very rapidly until the piston passes the port to line 41. The parts are adjusted so that the linear speed of these elements reaches approximately that of the strip at this point and they engage the strip to remove a sample. As soon as the piston crosses the port to line 41, air can escape from below the piston only via line 40 and restrictive valve 46. Thus the air below the piston offers considerable resistance to additional travel of the piston. This air cushions the piston which thus decelerates to a smooth stop. At the same time cam 58 opens limit switch 57 and breaks the circuit to the solenoid of valve 42, thus closing this valve against the escape of air from the upper portion of the cylinder.

Conductor 52 is connected to solenoid 50 of valve 43 via a conductor 59. Conductor 51 is connected to solenoid 50 via conductor 60 that contains an actuating switch 61 and a limit switch 62 fixed to the mill housing adjacent the punch frame. Said limit switch opens when the punch frame moves away from its outer-most position and closes only when the punch frame is fully retracted from the strip. After the piston is in its lowered position following a punching operation and the carriage is fully retracted, switch 61 may be actuated to return the punching elements to their starting position. Closing of switch 61 energizes solenoid 50 to connect ports 44 and 48 and thus to admit air to the lower end of the cylinder via line 40. Energizing this solenoid also connects ports 45 and 47 so that air escapes from above the piston via line 39 and restrictive valve 46.

In operation when a sample is to be taken from the strip, cylinder 24 and its piston are actuated to adjust the punching elements 28 and 29 to the proper vertical and angular position with respect to the angle of approach of strip S to the coil. Cylinder 16 and its piston are actuated to move carriage 15 toward the strip, which enters the machine between the punching elements. Actuating switch 55 is closed to admit air to the top of cylinder 36. Piston 37 and rack gear 38 are thereby lowered and rotate the punching elements to punch the strip.

Cylinder 16 is actuated in the opposite direction to retract the carriage and remove the machine from the strip. After punch frame 21 engages and closes limit switch 62, actuating switch 61 is closed. The piston and rack gear are thereby raised and return the punching elements to their usual starting position.

The improved construction just described enables the punching elements to rotate through a sufficiently large arc to enable them to accelerate to the same linear speed as the strip before they engage the strip and to enable them to decelerate smoothly to their final position. Therefore the line need not be slowed for taking the sample. The port in the mid-portion of cylinder 36 enables the accelerating portion of the stroke of piston 37 to be rapid and free of air resistance. The closing of this valve provides an air cushion in the lower portion of the cylinder that furnishes a cushioned deceleration during the remainder of the piston stroke.

While I have shown and described only a single embodiment of the invention, it is apparent that modifications may arise. Therefore, I do not wish to be limited to the disclosure set forth but only by the scope of the appended claims.

I claim:

1. In a punching machine for sampling strip moving in a processing line, a carriage supported for reciprocable movement toward and away from the strip, support means on said carriage, a pair of mating punching elements rotatably mounted in said support means, motion transmitting means interconnecting said punching elements for rotating them together in opposite directions, and actuating mechanism for said punching elements comprising a pneumatic cylinder and piston, rack and pinion means connecting said piston with one of said punching elements, a sole-

noid four-way control valve having ports connected to a source of compressed air, to a respective discharge and to opposite ends of said cylinder, said valve thereby selectively admitting air to said cylinder for moving said piston in either direction and restricting the discharge of air from said cylinder ahead of said piston for punching a sample from the strip and returning said punching elements to their starting position, a solenoid valve connected to the mid-portion of said cylinder, an electric circuit interconnecting said valves opening said second named valve when said first named valve admits air to said cylinder to move said piston in the punching direction, said second named valve allowing free exhaust of air from said cylinder ahead of said piston during the initial part of such movement, and means in said circuit for closing said second named valve after said piston passes the point at which this valve is connected to said cylinder.

2. In a punching machine for sampling strip which is moving in a processing line, a carriage supported for reciprocable movement toward and away from the strip, support means on said carriage, a pair of mating punching elements rotatably mounted in said support means, motion transmitting means interconnecting said punching elements for rotating them together but in opposite directions, and actuating mechanism for said punching elements comprising a double acting pneumatic cylinder and piston, rack and pinion means connecting said piston with one of said punching elements, a solenoid operated four-way control valve having ports which are connected respectively with a source of compressed air, a restrictive discharge and the opposite ends of said cylinder, said valve selectively admitting air to either end of said cylinder for moving said piston in either direction and restricting discharge of air from the other end of the cylinder ahead of said piston, said punching elements punching a sample from the strip when said piston moves in one direction and returning to their starting position when the piston moves in the other direction, a normally closed solenoid operated valve connected to said cylinder intermediate its ends, and an electric circuit connecting the solenoids of said valves and opening said second named valve when said first named valve admits air to said cylinder to move said piston in the punching direction, said second named valve thus allowing free exhaust of air from said cylinder during the initial part of such piston movement, said circuit including cam operated switch means for opening the circuit to the solenoid of said second named valve after said piston passes the point at which his valve is connected to said cylinder.

3. In a punching machine for sampling strip which is moving in a processing line, a carriage supported for reciprocable movement toward and away from the strip, support means on said carriage, a pair of mating punching elements rotatably mounted in said support means, motion transmitting means interconnecting said punching elements for rotating them together but in opposite directions, and actuating mechanism for said punching elements comprising a double acting pneumatic cylinder and piston, rack and pinion means connecting said piston with one of said punching elements, a four-way control valve having two operating solenoids and having ports which are connected respectively with a source of compressed air, a restrictive discharge and the opposite ends of said cylinder, said valve on energization of one of its solenoids admitting air to the end of said cylinder which moves said piston in a direction to rotate said punching elements for punching a sample from the strip and restricting discharge of air from the other end of said cylinder and on energization of its other solenoid admitting air to the other end of said cylinder for returning said piston and said punching elements to their starting positions, a normally closed solenoid operated valve connected to said cylinder intermediate its ends, an electric circuit connecting the solenoids of said valves and opening said second named valve when said first named valve admits air to said cylinder to move said piston in the punching direction, said second named valve thus allowing free exhaust of air from said cylinder during the initial part of such piston movement, the circuit to the solenoid of said second named valve including a cam operated switch, and a cam carried by said rack means for opening said switch and thus closing said second named valve after said piston passes the point at which this valve is connected to said cylinder.

EARLL R. MUDDIMAN.

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