May 31, 1966 E. R. BODNAR 3,253,490

DIE ACCELERATOR MECHANISM

Filed Feb. 19, 1965 3 Sheets-Sheet 1

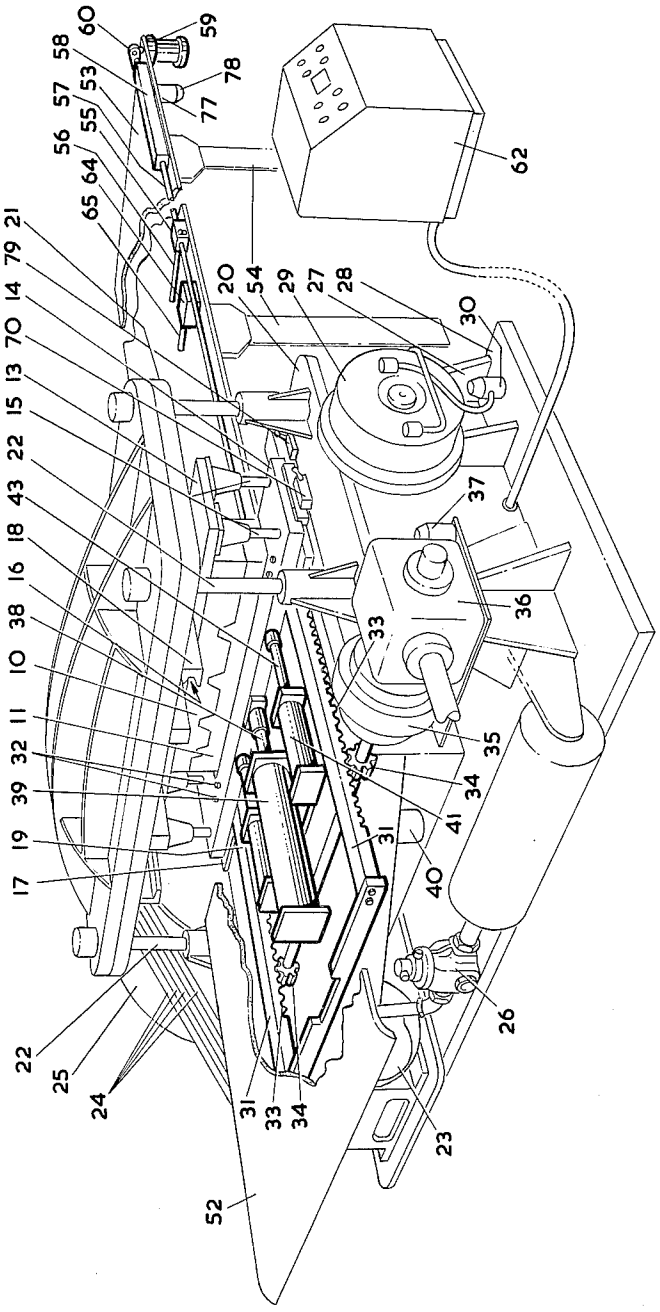


FIG. 1

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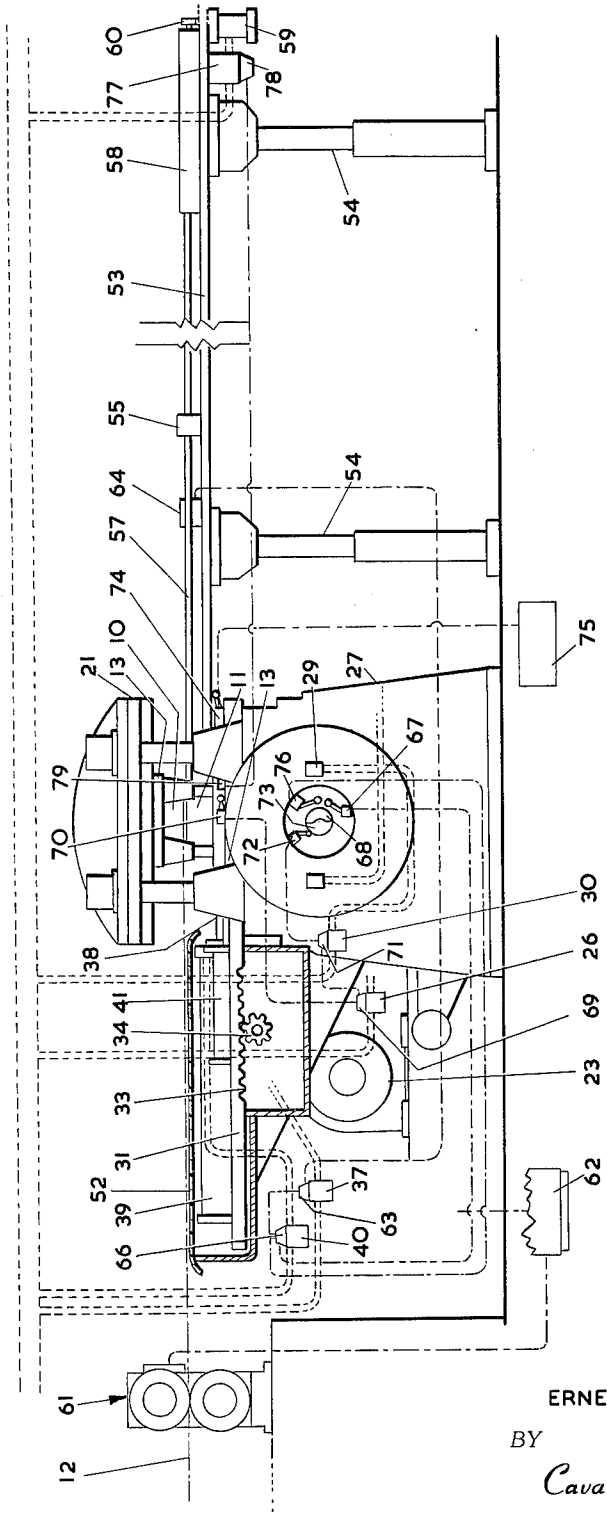


FIG. 2

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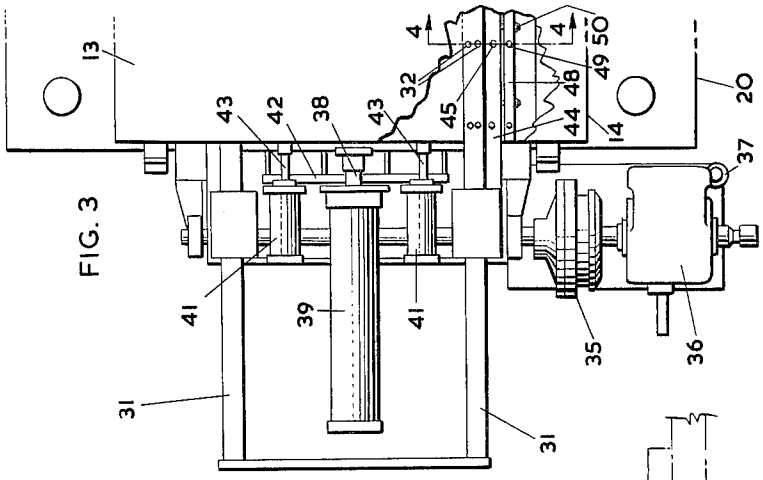


FIG. 3

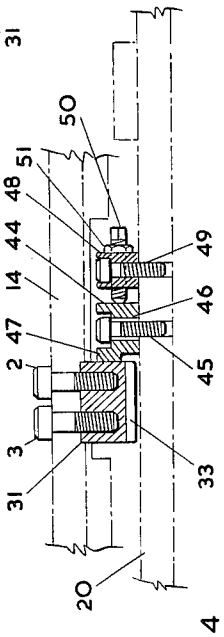


FIG. 4

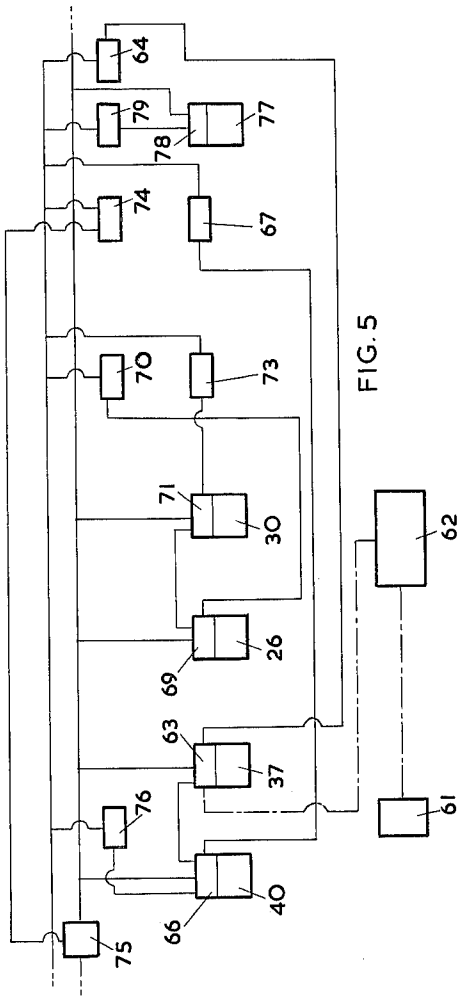


FIG. 5

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3,253,490

Patented May 31, 1966

3,253,490

DIE ACCELERATOR MECHANISM

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Filed Feb. 19, 1965, Ser. No. 433,924
7 Claims. (Cl. 83—287)

The invention relates to cut-off die apparatus for use in a sheet metal working line.

In a sheet metal working line it is desirable to maintain said sheet metal in continuous motion in order that the same may be continuously worked or shaped without a pause. At the end of such a line the sheet metal is generally severed into lengths for shipping or storage, and in order to achieve such cutting, a movable cut-off die is provided, which is reciprocable along the path of movement of said sheet metal and operable during such movement to sever the same without necessitating a pause in the movement thereof. Such prior cut-off die apparatus as has generally been available has suffered from a variety of difficulties. For example, the speed of movement of prior cut-off dies has sometimes been erratic or variable with the result that at the time of shearing of the sheet metal it was moving either faster or slower and thus damaging a portion thereof. Further, such prior apparatus has rendered it difficult to cut said sheet metal to precise lengths, resulting in wastage thereof, and sometimes involving a further trimming operation.

A greatly improved form of cut-off die is disclosed in my prior Canadian Letters Patent No. 667,957, issued Aug. 6, 1963, for Die Accelerator & Control Mechanism wherein greater accuracy of acceleration and cutting is achieved. My prior cut-off die incorporated a rack and pinion for driving of the die carriage on its forward stroke and air cylinder on its return stroke and it has been found that, particularly when operating at the upper limit of its speed of operation, or when applied to a very large installation, the large inertial forces tend to cause the die carriage to twist to and fro, with greatly increased power consumption and wear and further that such forces are difficult to control and reverse within the limits of the available path in the apparatus.

It is therefore an objective of the invention to provide cut-off die apparatus of the type described which is adapted to cut sheet metal while in motion in an economical and expeditious manner and with a minimum wastage of time and materials.

More specifically, it is an object of the invention to provide cut-off die apparatus having the foregoing advantages which is adapted to cut said sheet metal into precise lengths and without damaging the same or causing a pause or break in the movement thereof.

More specifically it is an objective of the invention to provide a cut-off die apparatus having the foregoing advantages in which cut-off die carriage is buffered to reduce its speed at each end of its stroke.

More specifically it is an objective of the invention to provide a cut-off die apparatus in which the cut-off die carriage is driven on the forward stroke by drive means spaced apart on each side of its path of movement.

More specifically it is an objective of the invention to provide a cut-off die apparatus in which the control system is operable to procure buffering of the movement of the cut-off die carriage.

It is a further objective to provide cut-off die apparatus having the foregoing advantages in which the speed of reciprocation may be varied during the operation thereof.

It is a further objective of the invention to provide cut-off die apparatus having the foregoing advantages which is fully automatic in operation and requires only a minimum of supervision.

The foregoing and other advantages will become apparent from the following description of a preferred embodiment of the invention which will be described with reference to the following drawings in which like reference devices refer to like parts thereof throughout the various views and diagrams, and in which:

FIGURE 1 is an isometric view of cut-off die apparatus according to the invention, showing portions thereof in phantom and from which the various control devices have been omitted for the sake of clarity;

FIGURE 2 is an elevation view partly in section of the apparatus shown in FIGURE 1 and also showing a portion of the sheet metal working line in association with which it is used and in addition, showing the various control devices superimposed thereon in phantom;

FIGURE 3 is a top plan view of the apparatus of FIGURE 1;

FIGURE 4 is an enlarged section along the line 4—4 of FIGURE 3, and

FIGURE 5 is a block circuit diagram of the electrical controls.

Referring to the drawings it will be seen that this preferred embodiment of the invention comprises upper and lower cut-off die halves 10 and 11 which are shaped according to the configuration of the sheet metal 12 leaving the working line (the details of which have been omitted for the sake of clarity). Die halves 10 and 11 are mounted on a die carriage assembly comprising a respective upper and lower platens 13 and 14 which are reciprocable towards and away from one another on mounting posts 15 which are adapted to telescope one within the other to permit such reciprocation. Platens 13 and 14 are in turn fastened to respective upper and lower slides 16 and 17 which run on respective guide rails 18 and 19 to permit reciprocal movement to and fro on a predetermined path along the line of movement of sheet metal 12. Guide rails 19 are fastened to bed plate 20, and guide rails 18 are fastened to movable plate 21, which is itself mounted on adjustable pillars 22 which are slidably mounted in bed plate 20.

Any suitable die operating mechanism may be provided below bed plate 20 for procuring rapid reciprocation of movable plate 21 towards and away therefrom, and driven by a constant speed electric motor 23, through drive mechanism 24 and air clutch 25, air valve 26 being provided to procure intermittent operation thereof. Bed plate 20 is supported at an elevation by side walls 27 and fastened in position by base 28.

Brake mechanism 29 is provided, of any suitable design which, in this preferred embodiment is operated and controlled by air valve 30, such brake mechanism operating along the same axis as clutch 25 and acting on a crank shaft (not shown) extending therebetween and forming part of the die operating mechanism, the details of which have been omitted for clarity.

Mechanical means are provided to procure forward acceleration of platens 13 and 14, and cut-off die halves 10 and 11 fastened thereto, and comprising a pair of driving rods 31 are attached to platen 14 by bolts 32 along each side thereof, and extending rearwardly therefrom. On their underside is provided racking 33 for driving in the forward direction by pinions 34 meshing with racking 33, which are in turn driven through air operated clutch 35, and variable speed drive 36 by a constant speed electric motor (not shown). Manual control means (not shown) may be provided on variable drive 36 for regulating the speed thereof to procure forward acceleration of die halves 10 and 11 up to the same speed as that of the sheet metal. Clutch 35 is operated by electrically controlled air valve 37 to procure intermittent acceleration in a manner to be described hereinafter.

Pneumatic means are provided to return platens **14** and **15** and die halves **10** and **11** fastened thereto rearwardly, after the cutting of the sheet metal comprising cylinder rod **38** attached to platen **14** and extending therefrom into pneumatic cylinder **39** and fastened to the piston thereof (not shown) therewithin. Electrically controlled air valve **40** is provided for admitting air to cylinder **39** and procuring rearward movement of rod **38**, and for permitting escape of air therefrom during forward acceleration, and also to close the same to terminate escape of air and provide a pneumatic buffering action at the end of the forward acceleration stroke.

Shock absorber means comprising hydraulic cylinders **41** are provided mounted on support bar **42** adjacent to the rearward, at rest, position of platens **13** and **14** and aligned parallel with the path of movement thereof, and having buffer rods **43** extending therefrom into contact with, but unattached to the rearward edge of platen **14** for buffering the rearward stroke thereof. Cylinders **41** are provided with known spring means (not shown) causing extension of rods **43** therefrom when freed by forward acceleration of platen **14**.

Adjustable guide means are provided for limiting sideways movement or turning of platen **14** and for taking up wear which comprises the guide rail **44** fastened to bed plate **20** alongside rod **31** by means of bolts **45** passing through oversize holes **46** therein. Bearing edge **47** extends along the inner side of guide rail **44** for contacting rod **31** (see FIGURES 3 and 4). Guide rail **44** is itself located in precise position by means of reference rail **48** fastened to bed plate **20** parallel to guide rail **44** by means of bolts **49** so as to be incapable of adjustment. Spaced bolts **50** extend horizontally through reference rail **48** for moving and locating guide rail **44** and are locatable by means of lock nuts **51**. Shield **52** is provided to cover the foregoing members and to guide sheet metal directly between cut-off die halves **10** and **11**.

A suitable run-out table **53** supported in position on legs **54** is provided for supporting sheet metal passing between cut-off die halves **10** and **11** and to prevent damage thereto by bending or flexing thereof. Table **53** is preferably provided with an adjustable length indicator **55** having an indicator arm **56** normally oriented in the path of sheet metal advancing along run-out table **53**. Indicator member **55** is adjustably located on the sliding rod member **57** one end of which is fastened to the lower cut-off die half **11**, and the other end of which is slidably supported within the sleeve member **58**. Sleeve member **58** is rotatably mounted on table **53** and is provided with means for rotating the same through approximately 90 degrees of rotation comprising pneumatic cylinder **59** and lever arm **60** attached to sleeve **58** whereby rod **57** and indicator member **55** attached thereto may be rotated through approximately 90 degrees to bring arm member **56** out of the path of sheet metal on table **53** allowing the same to pass thereby after completion of the cutting stroke.

Measuring of lengths of sheet metal passing between cut-off die halves **10** and **11** may be achieved by means of a rotating measuring unit such as is indicated generally by reference **61** operable to deliver a predetermined number of electrical signals in response to passage of sheet metal in engagement therewith which signals may be utilized to operate any suitable digital counter such as is generally indicated by reference **62**, substantially in the manner described in my aforesaid Canadian Letters Patent No. 667,957. Counter **62** operates, as described in the aforesaid Letters Patent No. 667,957 to deliver a triggering impulse to electrical solenoid **63** associated with the pneumatic valve **37** thereby operating air clutch **35** and causing rotation of pinions **34** thereby driving cut-off die halves **10** and **11** forwardly. However, according to a further preferred form of the invention measuring device **61** and counter **62** are dispensed with and in place, a triggered impulse is supplied by means of limit switch **64** which is movably locatable along table **53** and is provided with contact arm **65** located in the path of sheet metal moving along table **53** for operation of switch **64**. Electrical solenoid **66** associated with pneumatic valve **40** is connected to switch **67** operated by cam **68** mounted on the crank shaft (not shown) of the cut-off die operating mechanism, electrical solenoid **69** is associated with pneumatic valve **26** for operation thereof and is connected to limit switch **70** located in the path of movement of lower platen **14**, and electrical solenoid **71** is associated with pneumatic valve **30** for operation thereof and is connected to switch **72** operated by cam **73** mounted concentrically with cam **68** aforesaid. In addition, as a safety measure, an over-run limit switch **74** may be provided in the path of movement of lower platen **14** and beyond the normal limit of travel thereof which is connected to any suitable relay **75** for immediately terminating supply of electrical power to the entire installation.

For providing early closing of pneumatic cylinder **39** to prevent further escape of air therefrom an additional switch **76** is provided for operation by cam **68** and connected to electrical solenoid **66** for operating pneumatic valve **40** to close the same. A further pneumatic valve **77** is provided for operation of air cylinder **59** and having electrical solenoid **78** associated therewith connected to and controlled by limit switch **79** located in the path of movement of platen **14**.

In operation, cut-off die halves **10** and **11** will be normally apart from one another and at the rearward end of their stroke. In this position, sheet metal will pass therebetween at a predetermined speed until the leading edge of the sheet metal strikes arm **65** of switch **64**. Switch **64** will thereupon deliver a triggering impulse to solenoid **63** which operates pneumatic valve **37** thereby operating clutch **35** and causing rotation of pinions **34** and driving rods **31** forwardly. Forward movement of rods **31** will carry with them upper and lower platens **13** and **14** and upper and lower die halves **10** and **11** and accelerate them up to the speed of the sheet metal passing therebetween at which point lower platen **14** will contact limit switch **70** and deliver an impulse to solenoid **69** thereby operating pneumatic valve **26**. Pneumatic valve **26** thereby operates air clutch **25** and applies power from motor **23** to the crank shaft (not shown) thereby causing immediate downward motion of upper plate **21** carrying with it upper platen **13** and upper die half **10** and severing the sheet metal. Simultaneously, with such severing motion, the further end of the sheet metal will have contacted arm **56** of member **55** which is moving along table **53** at the same speed as platens **13** and **14**, being fastened thereby by rod **58**, thereby giving a visual indication of the precise length of the sheet metal being severed by that particular operation. As the crank shaft (not shown) completes its revolution die half **10** and upper platen **13** and under plate **12** will be raised to their upper position permitting sheet metal to continue to pass between upper and lower die halves **10** and **11** and leaving the severed length of sheet metal lying freely on table **53**. As soon as cut-off die halves **10** and **11** begin to move apart from one another as aforesaid, it is necessary to begin deacceleration of their forward movement and for this purpose cam **68** is located so as to trip switch **76** and send an impulse to solenoid **66** which operates pneumatic valve **40** and closes pneumatic cylinder **39** against further escape of air thereby applying a cushioning or buffering effect rapidly slowly down forward movement of cut-off die halves **10** and **11** and platens **13** and **14**. As plate **21** reaches its highest position once more cam **68** trips switch **67** and sends a further signal to solenoid **66** operating pneumatic valve **40** and the same signal is also communicated to solenoid **63** operating valve **37** and releasing air clutch **35**. Operation of pneumatic valve **40** applies compressed air to the interior of cylinder **39** and procures movement of platens **13** and **14** and die halves **10** and **11** in the rearward direction

on their return stroke. Just before such return stroke commences, pneumatic cylinder **59** is operated by limit switch **79**, solenoid **78** and valve **77**, to rotate sleeve **58** and rod **57** through approximately 90 degrees to bring arm **56** of member **55** substantially vertical thereby freeing the same from the end of the piece of sheet metal lying on table **53** and permitting the same to move rearwardly once more in unison with platens **13** and **14**. Roughly simultaneously with the termination of the forward stroke of platens **13** and **14**, upper plate **21** and upper platen **13** and upper die half **10** will have reached their uppermost position once more and cam **73** is so located as to trip switch **72** at this point thereby operating solenoid **71** which in turn operates pneumatic valve **30** and causes brake **29** to check further rotation of the crank shaft (not shown). As the upper and lower platens **13** and **14** move rearwardly they will accelerate to a maximum speed after which they must be deaccelerated and halted in their rearward position ready for the next stroke. Such deacceleration and buffering is achieved by means of hydraulic cylinders **41** and rods **43** extending forwardly therefrom which are located in the path of rearward movement of lower platen **14** and function substantially as shock absorbers therefor, thereby avoiding the development of unnecessary shocks in the apparatus.

From the foregoing, it will be seen that precise control of the length of sheet metal being sheared can be maintained by means of moving limit switch **64** on table **53** either closer to or further away from cut-off die halves **10** and **11** and at the same time a close visual check can be kept on the accuracy of shearing during operation by means of the operator watching the movement of arm **56** and member **55**. Even in the case of very large installation, the tendency for upper and lower platens **13** and **14** to twist as they move forwardly is avoided by the use of twin rods **31** and pinions **34** driving the same from each side thereof and by the accurate control of wear developing in the apparatus by means of the adjustment provided in rail **44**. Excessive wear due to continual shocks developed in the apparatus in operation is avoided by means of the buffering of forward movement by early closure of the pneumatic cylinder and buffering in the reverse direction is achieved by means of hydraulic cylinders thereby smoothing out the deacceleration to a substantial degree.

The foregoing is a description of a preferred embodiment of the invention which is here made by way of example only. The invention is not to be taken as limited to the specific steps described but comprehends all such variations that come within the spirit and scope of the appended claims.

What I claim is:

1. Cut-off die apparatus for use in association with a sheet metal working line for shearing sheet metal to predetermined lengths while moving along said line, said apparatus comprising:
- a die press including a press operating mechanism;
- a cut-off die carriage means reciprocably mounted in said press for forward and return movement;
- at least two rack members connected to said carriage means in spaced apart parallel relation;
- pinion members engaging respective said rack members and having a power source connectable thereto;
- a length sensor located in the path of said sheet metal delivering a triggering signal to said power source;
- pneumatic cylinder means connected to said carriage means and having valve control means therefor;
- switch means responsive to acceleration of said die carriage means to trigger said die press operating mechanism;
- and switch means responsive to operation of said die press to trigger said pneumatic cylinder.

2. Cut-off die apparatus for use in association with a sheet metal working line for shearing sheet metal to predetermined lengths while moving along said line, said apparatus comprising:
- a die press including a press operating mechanism;
- a cut-off die carriage means reciprocably mounted in said press for forward and return movement;
- rack and pinion means coupled to a power source and connected to said die carriage means;
- a length sensor located in the path of said sheet metal delivering a triggering signal to said power source;
- switch means responsive to acceleration of said die carriage means to trigger said die press operating mechanism;
- pneumatic cylinder means connected to said carriage means and having valve control means therefor;
- switch means responsive to operation of said die press to trigger said pneumatic cylinder;
- and switch means responsive to partial operation of said die press to close said pneumatic cylinder.

3. Cut-off die apparatus for use in association with a sheet metal working line for shearing sheet metal to predetermined lengths while moving along said line, said apparatus comprising:
- a die press including a press operating mechanism;
- a cut-off die carriage means reciprocably mounted in said press for forward and return movement;
- at least two rack members connected to said carriage means in spaced apart parallel relation;
- pinion members engaging respective said rack members and having a power source connectable thereto;
- a length sensor located in the path of said sheet metal delivering a triggering signal to said power source;
- switch means responsive to acceleration of said die carriage means to trigger said die press operating mechanism;
- pneumatic cylinder means connected to said carriage means and having valve control means therefor;
- switch means responsive to operation of said die press to trigger said pneumatic cylinder;
- and buffer means operable on said carriage means to deaccelerate movement thereof.

4. Cut-off die apparatus for use in association with a sheet metal working line for shearing sheet metal to predetermined lengths while moving along said line, said apparatus comprising:
- a die press including a press operating mechanism;
- a cut-off die carriage means reciprocably mounted in said press for forward and return movement;
- rack and pinion means coupled to a power source and connected to said die carriage means;
- a length sensor located in the path of said sheet metal delivering a triggering signal to said power source;
- switch means responsive to acceleration of said die carriage means to trigger said die press operating mechanism;
- pneumatic cylinder means connected to said carriage means and having valve control means therefor;
- switch means responsive to operation of said die press to trigger said pneumatic cylinder;
- visual length indicator means coupled to said die carriage means in the path of said sheet metal and movable in unison therewith;
- and indicator release means connected to said indicator means for moving same out of the path of said sheet metal.

5. Cut-off die apparatus for use in association with a sheet metal working line for shearing sheet metal to predetermined lengths while moving along said line, said apparatus comprising:
- a die press including a press operating mechanism;
- a cut-off die carriage means reciprocably mounted in said press for forward and return movement;
- at least two rack members connected to said carriage means in spaced apart parallel relation;
- pinion members engaging respective said rack members and having a power source connectable thereto;

a length sensor located in the path of said sheet metal delivering a triggering signal to said power source;

switch means responsive to acceleration of said die carriage means to trigger said die press operating mechanism;

pneumatic cylinder means connected to said carriage means and having valve control means therefor;

switch means responsive to operation of said die press to trigger said pneumatic cylinder;

and hydraulic buffer members mounted adjacent said die carriage means in the return path thereof.

6. Cut-off die apparatus for use in association with a sheet metal working line for shearing sheet metal to predetermined lengths while moving along said line, said apparatus comprising:

a die press including a press operating mechanism;

a cut-off die carriage means reciprocably mounted in said press for forward and return movement;

at least two rack members connected to said carriage means in spaced apart parallel relation;

pinion members engaging respective said rack members and having a power source connectable thereto;

a length sensor located in the path of said sheet metal delivering a triggering signal to said power source;

switch means responsive to acceleration of said die carriage means to trigger said die press operating mechanism;

pneumatic cylinder means connected to said carriage means and having valve control means therefor;

switch means responsive to operation of said die press to trigger said pneumatic cylinder;

and guide rail means mounted adjacent at least one said rack member and having means for adjustably re-locating same to maintain substantially constant spacing therebetween.

7. Cut-off die apparatus for use in association with a sheet metal working line for shearing sheet metal to predetermined lengths while moving along said line, said apparatus comprising:

a die press including a press operating mechanism;

a cut-off die carriage means reciprocably mounted in said press for forward and return movement;

at least two rack members connected to said carriage means in spaced apart parallel relation;

pinion members engaging respective said rack members and having a power source connectable thereto;

a length sensor located in the path of said sheet metal delivering a triggering signal to said power source;

switch means responsive to acceleration of said die carriage means to trigger said die press operating mechanism;

pneumatic cylinder means connected to said carriage means and having valve control means therefor;

switch means responsive to operation of said die press to trigger said pneumatic cylinder;

switch means responsive to partial operation of said die press to close said pneumatic cylinder;

hydraulic buffer members mountde adjacent said die carriage means in the return path thereof;

guide rail means mounted adjacent at least one said rack member and having means for adjustably relocating same to maintain substantially constant spacing therebetween;

visual length indicator means coupled to said die carriage means in the path of said sheet metal and movable in unison therewith;

and indicator release means connected to said indicator means for moving same out of the path of said sheet metal.

No references cited.

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