June 20, 1967 J. A. LANGE 3,325,946

CUTOFF MACHINE

Filed Oct. 22, 1964 2 Sheets-Sheet 1

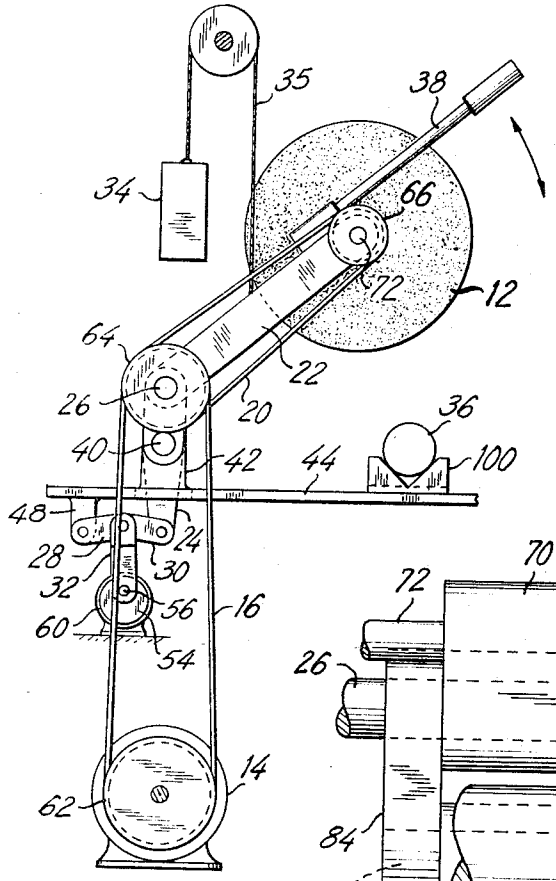


FIG. 1

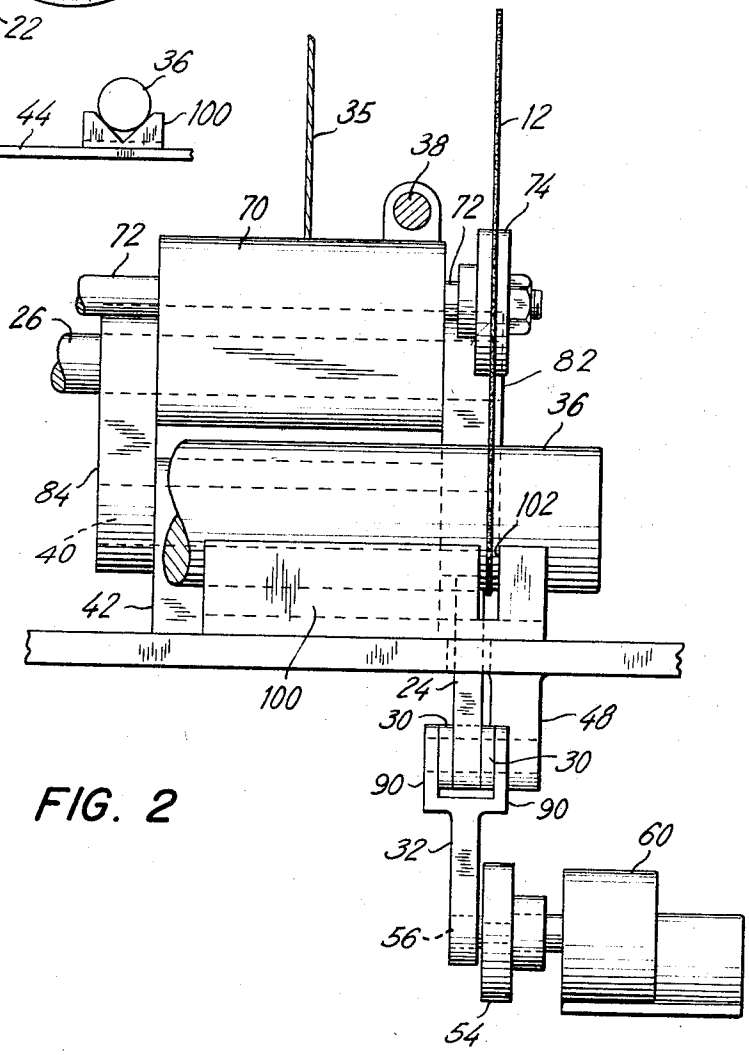


FIG. 2

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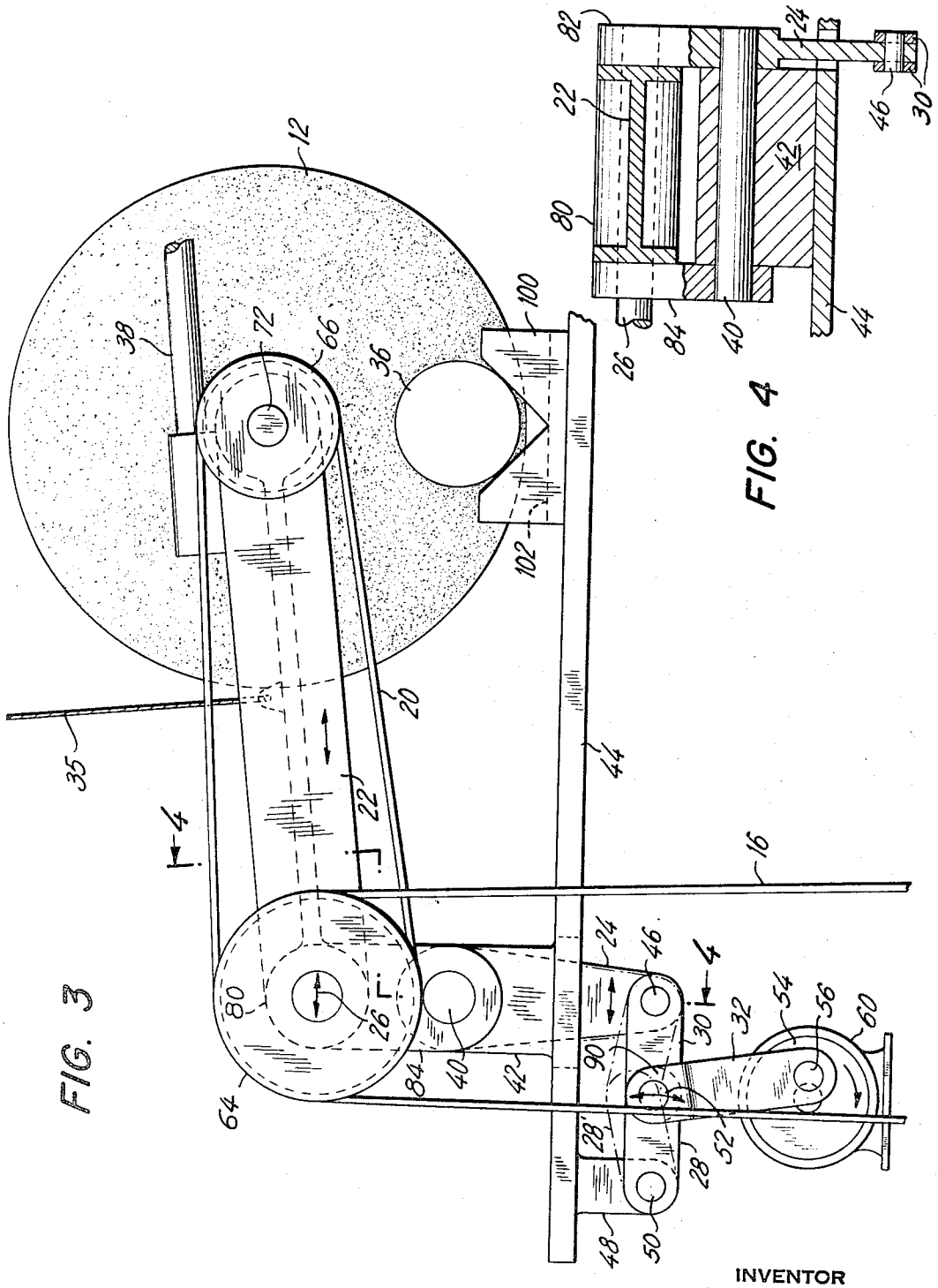


FIG. 3

FIG. 4

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CUTOFF MACHINE

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6 Claims. (Cl. 51—33)

This invention relates to cutoff machines, and more particularly to such machines using an abrasive cutting wheel.

Cutoff machines using a thin abrasive disc of large diameter are already known. The disc is driven at high speed and is movable toward or away from the work, as by mounting the same rotatably at the free end of a pivoted arm. The arm may be provided with appropriate means, such as a counterweight or a spring to normally raise the wheel from the work, and the arm may be provided with a handle which is used to move the wheel against the work.

It is already known that the cutting action is speeded, and the power requirement reduced, by reciprocating the wheel in a direction transverse to the direction of the feed movement of the wheel. (Usually the wheel is fed downward and is reciprocated horizontally.) Heretofore a relatively long slow stroke has been employed, for example, a reciprocation of say two inches, at a rate of say forty-five per minute.

The object of the present invention is to generally improve cutoff machines of the specified character. More specific objects are to speed the cutting operation; to simplify the main drive mechanism; and to reduce vibration. I have discovered that these objects may be fulfilled by utilizing a rapid reciprocation and a short stroke. For example, in a cutoff machine using a cutting wheel of say sixteen to twenty inches in diameter, and cutting round steel bar having a diameter of say tow to four inches, the reciprocation preferably is approximately one-eighth inch at a rate of about two hundred and forty reciprocations per minute.

Another object of the invention is to provide an improved toggle linkage for reciprocating the cutting wheel.

To accomplish the foregoing general objects, and other more specific objects which will hereinafter appear, my invention resides in the cutoff machine elements and their relation one to another, as are hereinafter more particularly described in the following specification. The specification is accompanied by drawings, in which:

FIG. 1 illustrates somewhat schematically a cutoff machine embodying features of my invention, the wheel being shown in raised position;

FIG. 2 is a fragmentary end elevation with the wheel in down position;

FIG. 3 is an elevation corresponding to a part of FIG. 1, but with the cutting wheel in down position; and

FIG. 4 is a section taken approximately in the plane of the stepped line 4—4 of FIG. 3.

Referring to the drawing, and more particularly to FIG. 1, the cutoff machine comprises an abrasive cutoff wheel **12**, a motor **14**, and drive means, in this case the belts **16** and **20**, to rotate the wheel **12** at high speed. There is a pivoted arm **22** carrying the wheel **12** for feed movement toward or away from the work. A lever **24** carries the pivoted end of the arm **22**, as shown at **26**, to reciprocate the arm **22** and the wheel **12** in a direction transverse to the direction of feed. In the usual case and as here illustrated, the direction of feed is downward, and the reciprocation is horizontal. There is additional motor-driven linkage **28**, **30**, and **32** to reciprocate the lever **24** and arm **22**, and the linkage and its drive are so designed as to provide a rapid reciprocation of short stroke, the stroke being in a range of from one-sixteenth

inch to three-eights of an inch, and at a rate of from one hundred twenty to three hundred sixty reciprocations per minute. In preferred form, the stroke is one-eighth inch at a rate of two hundred forty per minute.

In FIG. 1 it will be seen that a counterweight **34** and cable **35** normally move the arm **22** and wheel **12** upward from the work or stock **36** which is to be cut. A handle **38** is mounted on arm **22** for moving the arm and wheel downward for the cutting feed movement.

Referring now to FIG. 3, lever **25** is pivoted at **40** on a fixed bearing **42** mounted on or cast integrally with the machine table or frame **44**. The parts **28** and **30** form a toggle linkage which is connected at one end to the upright lever **24**, as shown at **46**. The toggle linkage is connected at its other end to a fixed bearing **48**, as shown at **50**. Bearing **48** is secured to or formed integrally with table **44**. The connecting rod **32** is connected at its upper end to the common or middle pivot **52** of the toggle linkage, and is connected at its lower end to a crank disc **54** having a crank pin **56**. The crank is driven by a gear reduction motor **60**. It will be seen that as the crank rotates it moves the toggle linkage above dead center as shown in broken lines at **28'** when the crank is at the top of its stroke. The toggle linkage is moved downward below dead center when the crank is at the bottom of its stroke. This causes a sideward oscillation at pivot **46** and a consequent horizontal reciprocation of the arm **22** and cutting wheel **12**. The toggle linkage causes two reciprocations (four excursions) for each rotation of the crank.

Reverting to FIG. 1, the main drive motor **14** carries a pulley **62** driving belt **16** which drives a pulley **64**. The latter is either secured to or is formed integrally with a companion pulley which drives belt **20**, and the latter extends along the arm **22** and is oscillatable and reciprocable with the arm. The belt **20** drives a pulley **66** which drives the cutting wheel **12**. Because pulley **64** has the same axis as the pivot for arm **22** (the shaft **26**), the drive of the cutting wheel **12** is unaffected by oscillation of arm **22** when moved toward or away from the work **36**. The drive of belt **20** also is unaffected by horizontal reciprocation of the arm **22**, because the belt and its pulleys simply move with the arm. The drive of belt **16** is not significantly affected by the horizontal reciprocation of the arm **22** because the belt is long relative to the horizontal stroke which is very short, say one-eighth inch. This constitutes an incidental extra advantage of the short stroke here employed. Moreover, the reciprocation of pulley **64** is tangential and does not noticeably change the distance between pulleys **62** and **64**.

Referring to FIG. 4, the arm **22** may have a "H" section, as indicated. This lightens the arm without loss of rigidity. At the ends of the arm the web is enlarged to form sturdy full-length bearings. Referring to FIG. 2, the end bearing **70** carries a short shaft **72**. The hub **74** of cutting wheel **12** is mounted at one end of shaft **72**, and a pulley (not shown) is mounted at the other end. The pulleys preferably have multiple V grooves, and the belts are preferably multiple V belts.

Referring again to FIG. 4, the bearing **80** at the other end of arm **22** is received between the upper end **82** of the upright lever **24**, and the upper end of a companion arm **84** which resembles the upper end of lever **24**. The parts **82** and **84** are secured to a common pin or pivot **40** so that they oscillate in unison. Pin **40** is carried in the fixed bearing **42** previously referred to.

Shaft **26** is carried at the upper ends of the parts **82** and **84**, and it also carries the bearing **80** of arm **22**. Shaft **26** further carries the two pulleys (not shown in FIG. 4) needed for the main belt drive of the cutting wheel. These pulleys are mounted immediately adjacent

one another on one end of shaft **26**, and the upright and horizontal belts **16** and **20** (FIG. 3) are adjacent one another. The pulleys may rotate freely on the shaft **26**, or may be secured to the shaft.

Referring to FIG. 4, there are two collateral toggle links **30** which straddle the lower end of lever **24**. Referring next to FIG. 3, the toggle link **28** is a single link having the same thickness as lever **24**, so that the two collateral links **30** straddle the end of link **28**. The other end of link **28** is pivoted on a fixed bearing **48** which is disposed alongside the link, as shown in FIG. 2. FIG. 2 also shows how the upper end of the connecting rod **32** is bifurcated at **90** to straddle all three links, of which the spaced links **30** are visible in FIG. 2, while the single link therebetween is concealed by the lever **24**.

The table **44** is provided with a means or rest to hold the work begin cut. The work typically is round bar stock as shown at **36**, and the rest or support then is preferably V-shaped, as shown at **100**. The support **100** is cut away to clear the cutting wheel, as shown at **102** in FIG. 2.

In a typical case, the abrasive wheel **12** may be from sixteen to twenty inches in diameter, and one-eighth inch thick. It may be made of silicon carbide, or aluminum oxide, or other such abrasive, depending on the material to be cut. The main drive motor **14** may be a seven and one-half horsepower motor for a sixteen-inch wheel, or a ten horsepower motor for a twenty-inch wheel. The motor drives the cutting wheel at a peripheral speed of, say, ten to fifteen thousand feet per minute.

The auxiliary motor **60** is preferably a small, say one-quarter horsepower, gear reduction motor for slow-speed output. It preferably drives the crank at one hundred twenty r.p.m., which because of the toggle linkage, causes reciprocation of the cutting wheel at two hundred forty per minute. If the motor speed is adjustable, it preferably provides a range of from sixty to one hundred eighty r.p.m. for the crank disc, with a corresponding range of one hundred twenty to three hundred sixty reciprocations per minute. The horizontal stroke caused by the illustrated linkage may range from one sixteenth inch to three eighths inch, or better from three sixteenths inch to five sixteenths inch, and most preferably is one eighth inch.

Working on machine steel bar having a diameter of three and one-half inches, and using a sixteen inch cutting wheel of Grade 430 made by Raybestos-Manhattan, Inc., of Passaic, N.J., the bar was cut in forty-eight seconds when using a stroke of three thirty-second inch at a rate of two-hundred-forty per minute. When the stroke was increased to five-sixteenths inch, the rate of reciprocation was reduced to one hundred twenty per minute to avoid excessive vibration. The longer stroke and slower reciprocation increased the cutting time for the same material to seventy-eight seconds. The wheel was a rubber bonded wheel, used for a "wet cut," and the liquid used was water.

As another example, machine steel having a diameter of four one-eighth inches was cut with a dry cut, using a Raybestos-Manhattan, Inc. resin-bonded sixteen inch wheel of Grade 225. The cutting time with a stroke of five-sixteenths inch, at one hundred twenty reciprocations per minute, was sixty-seven seconds. By reducing the stroke to one-eighth inch and increasing the rate to two hundred forty per minute, the cutting time was reduced to forty-six seconds. A higher speed of, say three hundred sixty reciprocations per minute caused vibration and did not reduce the cutting time. The speed of two hundred forty per minute was not desirable with the five-sixteenth inch stroke because it caused vibration.

The two hundred forty and even a three hundred sixty rate was used with a shorter stroke than one-eighth inch, but the cutting time increased slightly (two to four seconds longer).

However, it is believed that in all cases the cutting time was reduced and the operation improved compared to the more conventional practice of using, say, a two-inch reciprocation at a rate of forty-five per minute. With no reciprocation at all the power requirements is so great that the motor is stalled.

It is believed that the construction and operation of my improved cutoff machine, as well as the advantages thereof, will be apparent from the foregoing detailed description. Although quantitative values have been given in the foregoing description, such as the wheel diameter and wheel speed, etc., it will be understood that many of these values have been given solely by way of exemplification and are not intended to be in limitation of the invention. It will also be understood that while I have shown and described the invention in a specific form, changes may be made without departing from the scope of the invention, as sought to be defined in the following claims.

I claim:

1. A cutoff machine for cutting a work piece, said machine comprising an abrasive cutoff wheel, a pivoted arm carrying the wheel for feed movement toward or away from the work piece which is to be cut, a generally upright lever carrying the pivot of the arm, toggle linkage having a common or middle pivot and connected at one end to the lever and connected at the other end to a fixed bearing, a crank and connecting rod connected to the common or middle pivot of the toggle linkage, motor means for driving the crank and for driving the wheel, and means including a belt extending along and oscillatable with the arm for connecting the motor means to the cutoff wheel.

2. A cutoff machine for cutting a work piece, said machine comprising an abrasive cutoff wheel, a pivoted arm carrying the wheel for feed movement toward or away from the work piece which is to be cut, a generally upright lever carrying the pivot of the arm, toggle linkage having a common or middle pivot and connected at one end to the lever and connected at the other end to a fixed bearing, a crank and connecting rod connected to the common or middle pivot of the toggle linkage, a reduction gear motor for driving the crank, a main motor for driving the wheel, means including a belt extending along and oscillatable with the arm for connecting the main motor to the wheel, means to raise the arm to lift the wheel from the work, and a handle on the arm for urging the wheel downward against the work.

3. A cutoff machine for cutting a work piece, said machine comprising an abrasive cutoff wheel, a pivoted arm carrying the wheel for feed movement toward or away from the work piece which is to be cut, a generally upright lever carrying the pivot of the arm, toggle linkage having a common or middle pivot and connected at one end to the lever and connected at the other end to a fixed bearing, a crank and connecting rod connected to the common or middle pivot of the toggle linkage, a reduction gear motor for driving the crank, a main motor for driving the wheel, and means including a belt extending along and oscillatable with the arm for connecting the main motor to the wheel, the linkage and reduction gear motor being so dimensioned and designed as to provide a rapid reciprocation of short stroke.

4. A cutoff machine for cutting a work piece, said machine comprising an abrasive cutoff wheel, a pivoted arm carrying the wheel for feed movement toward or away from the work piece which is to be cut, a generally upright lever carrying the pivot of the arm, toggle linkage having a common or middle pivot and connected at one end to the lever and connected at the other end to a fixed bearing, a crank and connecting rod connected to the common or middle pivot of the toggle linkage, a reduction gear motor for driving the crank, a main motor for driving the wheel, and means including a belt extending along and oscillatable with the arm for connecting the main motor to the wheel, the linkage and reduction gear motor being so dimensioned and designed as to provide a rapid reciprocation of short stroke, the stroke being in a range of from one-sixteenth inch to three-eighth inch at a rate of

from one hundred twenty to three hundred sixty reciprocations per minute.

5. A cutoff machine for cutting a work piece, said machine comprising an abrasive cutoff wheel, a pivoted arm carrying the wheel for feed movement toward or away from the work piece which is to be cut, a generally upright lever carrying the pivot of the arm, toggle linkage having a common or middle pivot and connected at one end to the lever and connected at the other end to a fixed bearing, a crank and connecting rod connected to the common or middle pivot of the toggle linkage, a reduction gear motor for driving the crank, a main motor for driving the wheel, and means including a belt extending along and oscillatable with the arm for connecting the main motor to the wheel, the linkage and reduction gear motor being so dimensioned and designed as to provide a rapid reciprocation of short stroke, the stroke being approximately one-eighth inch long at a rate of approximately two hundred forty reciprocations per minute.

6. A cutoff machine for cutting a work piece, said machine comprising an abrasive cutoff wheel, a pivoted arm carrying the wheel for feed movement toward or away from the work piece which is to be cut, a generally upright lever carrying the pivot of the arm, toggle linkage having

a common or middle pivot and connected at one end to the lever and connected at the other end to a fixed bearing, a crank and connecting rod connected to the common or middle pivot of the toggle linkage, a reduction gear motor for driving the crank, a main motor for driving the wheel, means including a belt extending along and oscillatable with the arm for connecting the main motor to the wheel, means to raise the arm to left the wheel from the work, and a handle on the arm for urging the wheel downward against the work, the linkage and reduction gear motor being so dimensioned and designed as to provide a rapid reciprocation of short stroke, the stroke being approximately one-eigth inch long at a rate of approximately two hundred forty reciprocations per minute.

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LESTER M. SWINGLE, *Primary Examiner.*