Nov. 28, 1933. S. L. BATCHELOR 1,936,928

FLYING SHEARS

Filed April 30, 1932 4 Sheets-Sheet 1

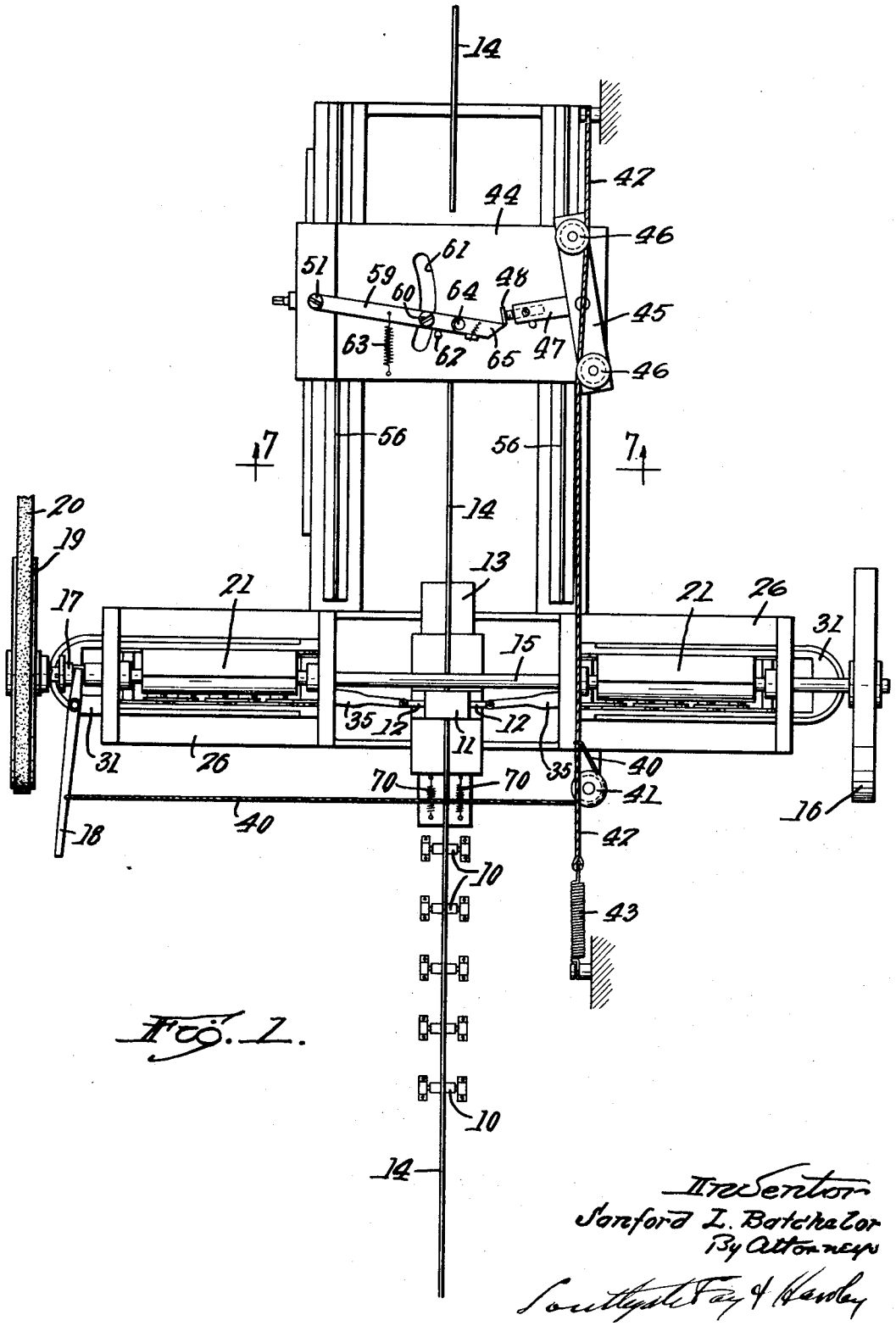


Fig. 1.

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Filed April 30, 1932 4 Sheets-Sheet 2

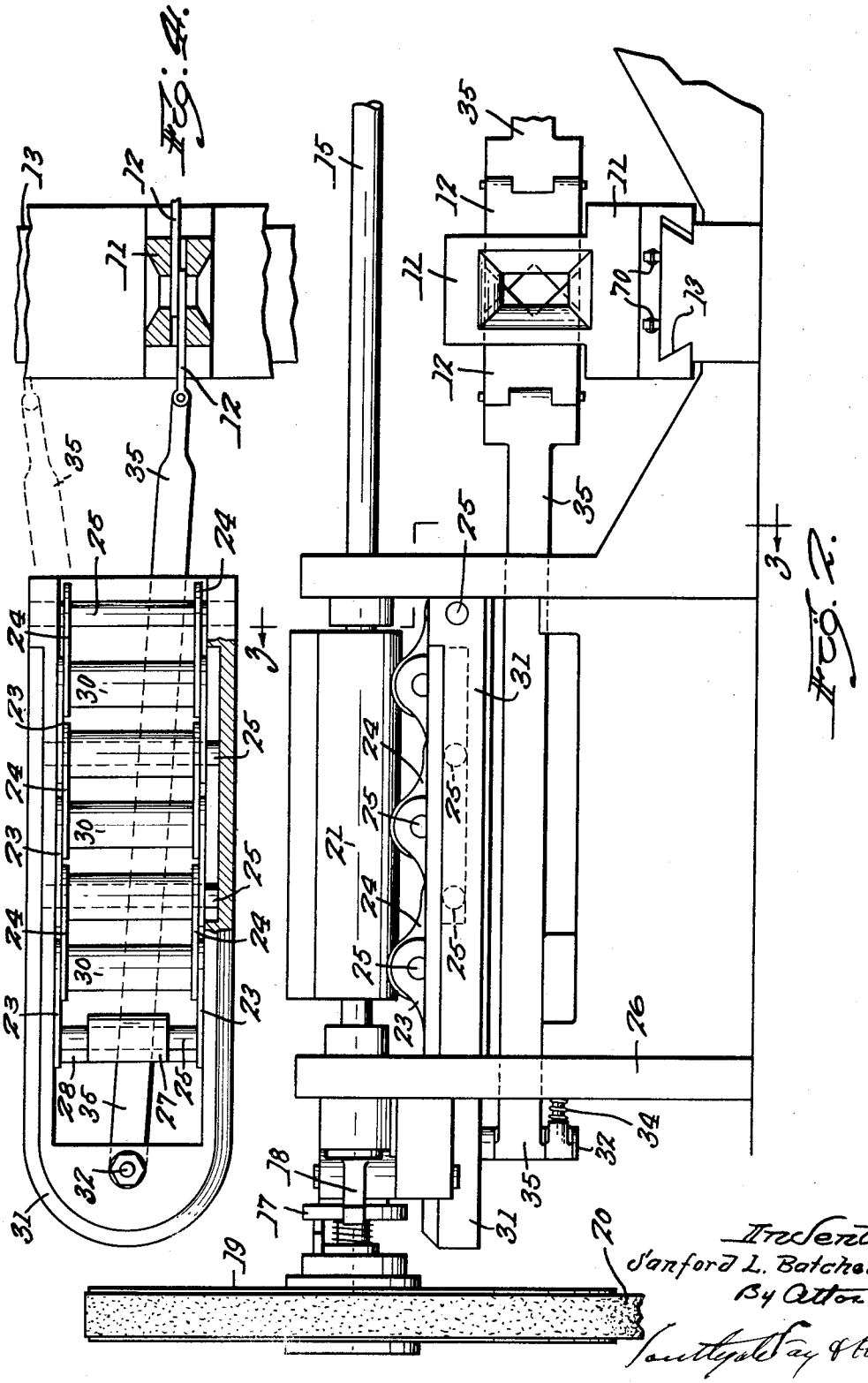


Fig. 4.

Fig. 2.

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Nov. 28, 1933. S. L. BATCHELOR 1,936,928

FLYING SHEARS

Filed April 30, 1932 4 Sheets-Sheet 3

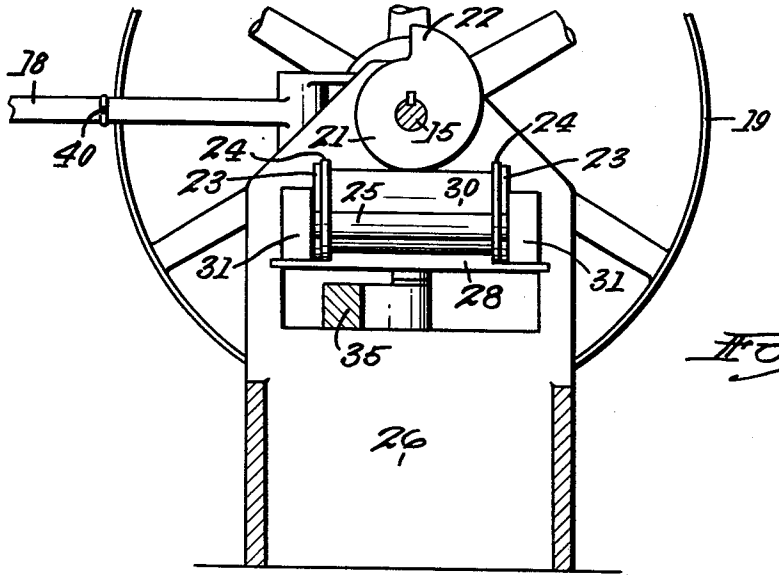


Fig. 3.

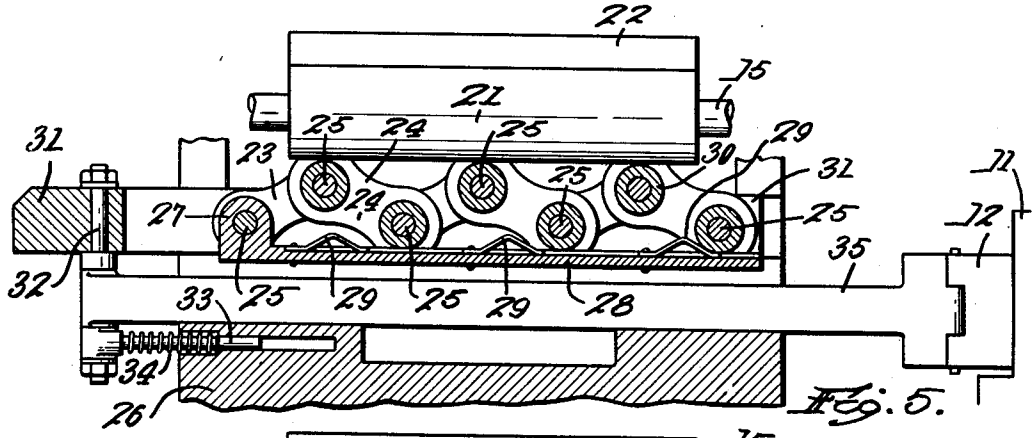


Fig. 5.

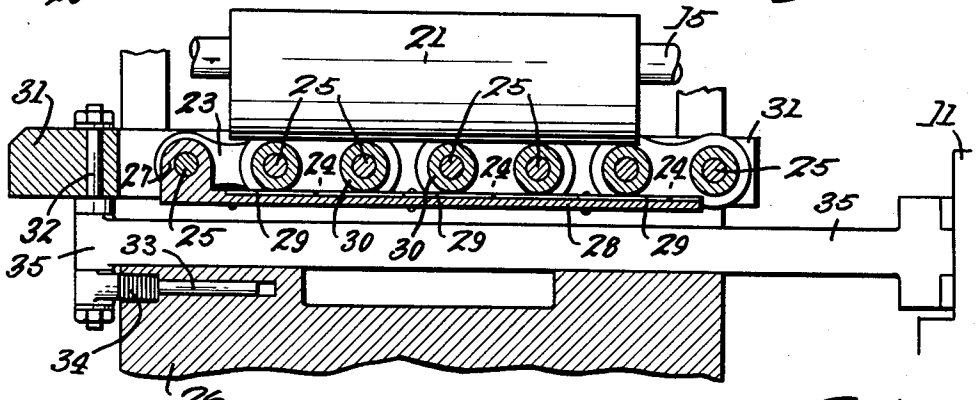


Fig. 6.

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Nov. 28, 1933. S. L. BATCHELOR 1,936,928

FLYING SHEARS

Filed April 30, 1932 4 Sheets-Sheet 4

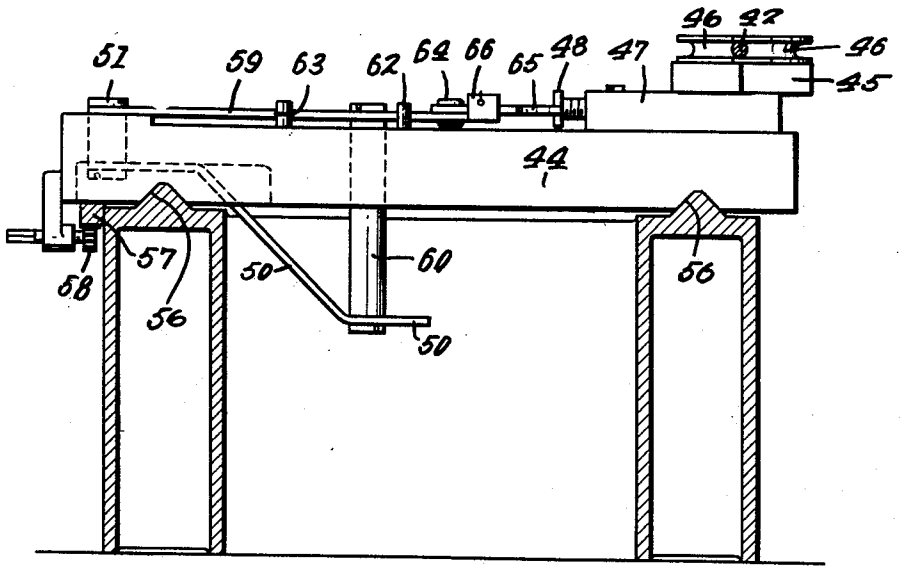


Fig. 7.

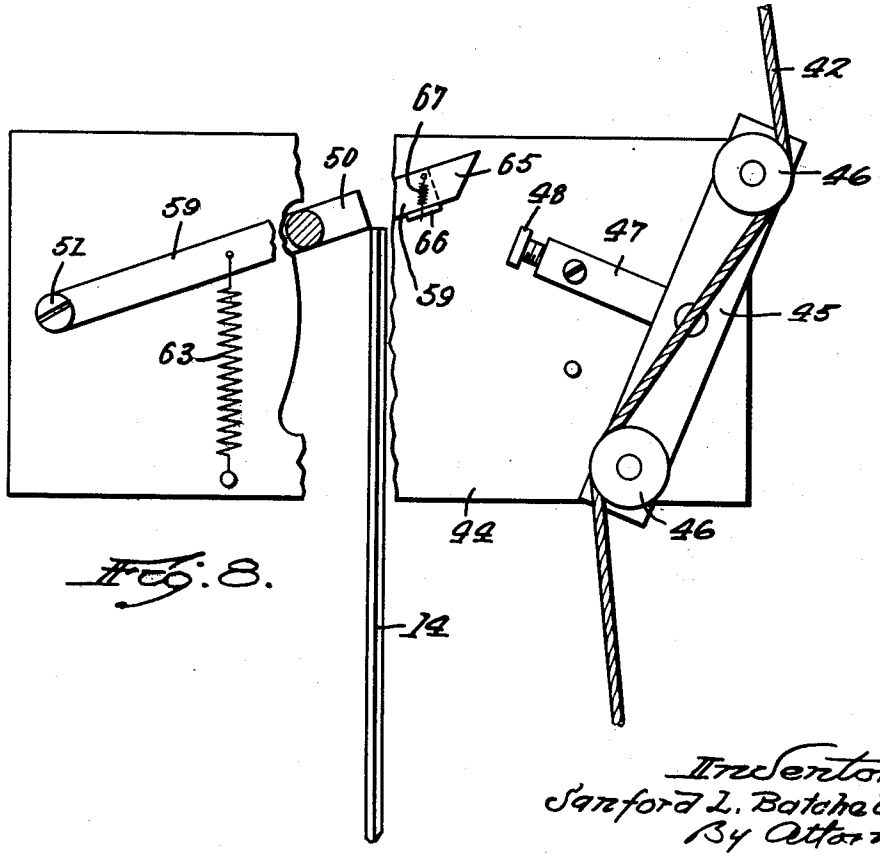


Fig. 8.

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UNITED STATES PATENT OFFICE

1,936,928

FLYING SHEARS

Sanford L. Batchelor, Farnumsville, Mass.

Application April 30, 1932. Serial No. 608,448

15 Claims. (Cl. 164—49)

This invention relates to a flying shear for cutting a moving rod, billet, or wire.

The principal objects of the invention are to provide a holder for the shear, mounted to move with the billet or rod which it is to cut; to provide automatic means for moving the shear transversely with respect to the billet or rod comprising a shaft located with its axis parallel with the direction of movement of the shear; to provide a shear-moving device made up of pivoted links connected with each other in such a way that with a comparatively small vertical motion the horizontal motion for operating the shear to perform its cutting action will be greatly multiplied; to provide an improvement in the means for operating the shear or other tool which consists in the employment of a series of toggle joints connected together in such a way as to multiply the movement of the joints from one position to another, whereas the motion of these joints in the other direction in the aggregate is the same as that of each one of them; to provide a construction for operating the same which consists of a cam on the operating shaft, preferably extending the length of the series of toggle joints and operating all of them at once; to provide a movable trough-shaped guide housing the main part of the series of toggles and pivotally connected with the one nearest the shear blade so that it is slidably mounted with respect to the rest of the toggle construction; to provide means operated by the end of the rod or billet to be cut off for controlling the operation of the machine and rendering this operation automatic after it has once been started; to provide means whereby, in case anything happens to prevent the proper cutting of the billet, the guide for the shears will simply be moved off its supporting track, and to provide a machine of this character in which all the parts are mounted on a self-contained frame that requires no foundation and that can be moved from place to place.

Other objects and advantages of the invention will appear hereinafter.

Reference is to be had to the accompanying drawings, in which

Fig. 1 is a plan of a flying shear for a rolling mill constructed in accordance with this invention;

Fig. 2 is a side view of the same;

Fig. 3 is a transverse sectional view on the line 3—3 of Fig. 2;

Fig. 4 is a plan of the parts for operating the shear, partly in section;

Fig. 5 is a central longitudinal sectional view showing the parts of the shear operating mechanism in the contracted non-operative position;

Fig. 6 is a view of the same parts showing them expanded and in a position to push the shear blade to its full limit;

Fig. 7 is a sectional view on the line 7—7 of Fig. 1 showing the automatic mechanism for stopping and starting the machine for automatic operation, and

Fig. 8 is a plan of the same.

In the employment of this invention for the purpose of cutting billets from a single rod coming from transferring rolls 10, the rod is passed through a holder and guide 11 for the shear blades 12. This guide is mounted on a dovetailed track 13 capable of sliding on that track exactly in parallelism with the direction of motion of the rod 14 which is to be cut. Normally the shear blades are open sufficiently to allow this rod to pass through and it is only when they grip the rod that this shear guide 11 moves with the rod on its track, at the speed, of course, of the rod while the shear blades are being forced in to sever the rod. The track 13 is only of short length so that if anything happens to prevent the rod being sheared off the guide 11 will have to continue to travel with the rod until it is dismounted from the end of its track. Then it will fall on the floor and the operators will have to switch the rod 14 on some other set of rolls or stop its progress.

The cutting knives or shears 12 are operated by a main shaft 15 extending across the machine. This shaft is provided with a fly wheel 16 for the usual purpose. It has a one-revolution clutch 17 at the other end which is controlled by an operating handle 18 to throw the clutch in and connect it with a wheel 19 which, by a belt 20, receives its motion from any desired source of power. Of course, any other connection for bringing the shaft 15 into operation and stopping it could be employed.

On the shaft 15 are two cams 21, if the machine is to be operated as a double shear. In case it is to be operated as a single shear with one blade fixed in the guide 11, only one of these cams and corresponding mechanism would be employed. Each one of these cams 21 is of a semi-cylindrical shape with a longitudinal projection 22 produced by a spiral curve from the edge of the semi-cylinder to the end of the projection 22. These two cams are keyed to the shaft 15 and located in exactly the same position circumferentially.

Underneath each cam 21 is a toggle joint construction comprising a series of links 23 and 24

with cross pins 25 for connecting them. The first cross pin 25 is fixed in stationary position to the frame 26 of the machine. The machine frame is provided with a vertical part constituting the end of the machine and this cross pin 25 is fixed at this point, to an ear 27 integral with a stationary plate 28. This stationary plate carries a series of springs 29 adapted to engage the sleeves 30 when they are depressed and tend to force them up. So normally the links are in the position shown in Fig. 5. When the cam projection 22 comes down on the sleeve 30 which surround the cross pins 25, this cam will force these several slides down. When brought to the flat straight position shown in Fig. 6 the end one of the cross pins 25 has been moved a distance which is determined by adding the distance of movement of all of the lower cross pins 25 together. The cross pin 25 at the free end of the series of toggle joints is connected freely with a trough-like guide 31 so that this guide has to move with this link. This guide has sides normally housing the toggles and extends back beyond the frame. There it is provided with a vertical rod 32 extending down and having a slidable pin 33 connected with it and located in a recess in the frame. A spring 34 surrounds this pin and normally acts at all times to push this frame back into the open position shown in Fig. 5. Also connected with this vertical pin 32 is a swinging link 35 to which is pivoted one of the shear blades 12. The same construction preferably is provided on the other side of the machine for operating the other shear blade.

For the purpose of making the operation of the machine automatic after it is once started, the starting lever 18 is connected by a cable 40 extending transversely with respect to the motion of the rod being cut, passing over a pulley 41 and connected with a strong cable 42 which is located parallel with the direction of motion of the rod that is being cut. One end of this cable 42 is fixed and the other end is connected at a fixed point by a spring 43. Located in stationary position at a distance at the side of the machine frame 26 is a frame 44. Pivotally mounted on this frame is a lever 45 having two pulleys 46 one located on each side of the cable 42. The point at which this lever is pivoted is in line with the two ends of the cable. This lever 45 has another arm 47 which is provided with an adjustable end 48, preferably a screw or bolt head.

The end of the rod 14 that has been severed previously engages a lever 50. Obviously this lever constitutes a measuring means to measure the length of the billets cut off so that they will all be uniform. This lever is pivotally mounted on a stud 51 and is located on the bottom of the sliding frame 44 which is made adjustable along a couple of tracks 56 by means of a rack 57 and a pinion 58. On the top of the frame 44 is a lever 59 which is connected with the lever 50 through the stud 51 and a second stud 60. There is an arcuate slot 61 in the frame for permitting the necessary motion of the stud 60 about the stud 51 as a center. This lever 59 is limited in its motion in one direction by a stop 62 and is provided with a spring 63 for drawing it back against that stop.

At a distance from the end of this lever is a vertical pivot stud 64 on which an operating tooth 65 is mounted pivotally. The end of the lever 59 is provided with a projection 66 which constitutes a back-stop for this tooth 65 and is connected with the tooth by a spring 67.

In the operation of this machine, of course, it will be understood that while the shear is at rest the rod to be operated upon which, of course, has an irregular end, is put into the shear and the irregular end is sheared off by simply connecting the clutch 17, by the use of the handle 18. This is done, of course, as this rod passes from the place where it was last rolled or otherwise operated upon through the rolls 10 into the slide and holder 11. Now this rod, sheared off squarely at the end, passes along until it engages the lever 50. This forces the lever 59 from the position shown in Fig. 1 to that shown in Fig. 8. On account of the construction shown, this lever with its tooth 65 is rigid for operation in this direction and engages the end 48 of the arm 47 of the lever 45. This lever 45 is turned to the position shown in Fig. 8 which shortens the cable 42 and stretches the spring 43. The effect of this is to pull the cable 40 and thus operate the handle 18 and close the clutch 17.

The closing of the clutch 17 starts into operation the shaft 15 and the two cams 21 are rotated from the neutral position in which they stop and in which they are shown in Figs. 1, 3 and 5. These cams move in the direction of the arrow shown in Fig. 3, bringing the toggle arrangement into the position shown in Fig. 6. The end cross pin 25 being attached to the slide 31, moves that a distance equal to the sum of the distances gained by each set of toggles. Each toggle moves a distance equal to the length of the link 24 between centers minus the cosine of the angle which the link makes with the horizontal when the cams 21 are in inoperative position, as shown in Fig. 5. Thus each toggle causes only a small but powerful motion and these motions are added together. In this case it is three times the amount above specified so that it may be called a multiplying motion. This motion is applied without diminution to the pin 32 and then through the link 35 to the shear blade 12. In the present case the two shear blades are operated at the same time and moved together to shear the bar. It is to be understood that a stationary blade could be mounted on the guide 11 on one side and the shearing done by a single blade coming in on the other side, but the motion of that blade would have to be twice as much as the motion of each blade is in the present instance.

The fly wheel, being in motion at a suitable speed for the work to be done, and the material to be operated upon passing through the knife head at a uniform speed, the motion of the cams on the cutting action is made smooth and uniform. When the cut has been made, the severed bar is taken care of in any of the ordinary ways by any desired machinery and the spring 63 will bring the lever 59 back to the starting point while the spring 67 will yield so that the tooth 65 can pass back over the head 48 to the position shown in Fig. 1. The spring 43 acting on the cable 42 straightens it out and returns the lever 45 to the position shown in Fig. 1. The cable 40 therefore is allowed to move back and the lever 18, which is operated upon by the spring in the clutch for opening it, will move back to normal position allowing the clutch to open and stop the shaft 15, until it is time for the next operation to be performed.

It will be seen therefore that after the lever 18 is operated to close the clutch for the cutting off of the irregular front end of the rod or bar 14, the entire operation of stopping and starting is automatic. Also if for any reason the shears

fail to sever the rod 14 the whole structure, comprising the shears and holder 11, will be dismantled off the end of the guide 14 and the shaft 15 will remain disconnected from the power until the difficulty is remedied.

This constitutes an entirely automatic machine consisting of comparatively few parts, all mounted on a self-contained frame requiring no foundation and capable of being moved from one place to another as may be desired. The cutting action is very powerful because it is made up of a plurality of small motions, each made at an effective angle so that a powerful cutting action is secured and one of sufficient length. This has been a problem in machines for this general purpose because with ordinary mechanism it is difficult to get the power required for cutting and the length of motion necessary at the same time without employing a very powerful and quick-acting machine. The parts of the motion for securing this shear action are housed in a sliding frame which also constitutes a link to transmit the power and thus it is easy to provide a very strong construction for this purpose.

The connection of the flying shear with the power is made through a link which is pivoted on a stationary pivot at one end and of course has to travel with the shear at the other end with the entire width of the machine utilized for this purpose. This link is longer than the machine frame is wide and therefore very little of the motion produced by the toggle joint construction is lost through this link.

The movable head 11 furnishes the support for the knives and this support is moved by the motion of the rod being cut, taking advantage of the fact that the knife blades cut into the stock and furnish the connection between the stock and the head. The head is returned to its original position as soon as the cutting operation is performed by springs 70 so that it is always ready to commence the next operation. The cams are formed so as to operate only during the first part of one revolution of the shaft. The motion of the knife blades is controlled by the shape of the cam and the cams can be varied in shape for the purpose, in view of the kind of material being operated on and its size. As many of these toggle joints may be used in one shear as may be necessary to get the required motion of the blade within the radius of action of the cam which is practical.

Although I have illustrated and described only one form of the invention, I am aware of the fact that modifications can be made therein by any person skilled in the art without departing from the scope of the invention as expressed in the claims. Therefore I do not wish to be limited in this respect but what I do claim is:—

1. In a shear, the combination with a movable shear blade, of a shaft, a cam on said shaft, a plurality of members adjacent to the cam adapted to be engaged and pushed by the cam simultaneously, connections between said members for translating that motion into a longitudinal motion, and means connecting the end one of said members with the shear blade for operating it in a direction parallel to the axis of the shaft.

2. In a shear, the combination of a shaft, and cam means on said shaft, a series of toggle joints under the cam means in position to be moved from an angle to the straight line position by the cam means, one end of the series of toggle joints being pivoted at a stationary point, and means connected with the other end for moving the shear blade.

3. In a shear, the combination with a reciprocable shear blade of a series of toggle joints connected together, the one at one end being pivoted at a fixed point and the one at the other end being movable, means for connecting the last named end of the series of joints with the blade for operating it, and means for simultaneously moving the toggle joints from a position in which they are at an angle to each other toward a position in which they are in alignment for operating the shear blade.

4. In a shear, the combination with a reciprocable shear blade, of a series of links having cross pins connecting them in such a manner as to constitute a series of toggle joints, yielding means for moving the toggle joints normally to a position in which the links make an angle with each other, means for pressing on the joints thus elevated and thus pressing them into a plane parallel with the direction of motion of the shear blade, means for pivoting the link at one end of the series at a stationary point, and means for connecting the link at the other end of the series with the shear blade, whereby the motion produced by one toggle joint will be multiplied to move the shear blade.

5. In a shear, the combination of a shaft, cam means on said shaft, a series of toggle joints under the cam means in position to be moved from an angle to the straight line position by the cam means, one end of the series of toggle joints being pivoted at a stationary point, means connected with the other end for moving the shear blade, and yielding means for returning the toggle joints to the contracted or broken position when the pressure of the cam is removed from them, said yielding means being under compression at all times.

6. In a shear, the combination of a series of toggle joints, each consisting of two links and cross pins pivotally connecting said links together in a series, the link at one end of the series being pivoted at a stationary point, a guide for said toggle joints, the cross pin at the other end of the series of toggle joints being connected with said guide, means for connecting the guide with a shear blade to move it in proportion to the extended motion of the last named cross pin, and means for simultaneously moving the links from a position in which they are at an angle to each other to one in which they are in the same plane, said guide having three sides, on one of which the lower end of each link rests at all times and the other two sides housing the toggle joints.

7. In a shear, the combination of a reciprocable shear blade, a series of toggle joints connected together, one at one end being pivoted at a fixed point and one at the other end being movable, means for connecting the last named end of the series of joints with the blade for operating it, means for simultaneously moving the toggle joints from a position in which they are at an angle to each other toward a position in which they are in a plane for operating the shear blade, a guide for said toggle joints pivoted to the movable end of the series, and a link pivoted to the guide at a point further away from the shear blade than the fixed pivot of the toggles and connected with said shear blade to transmit the motion of the guide thereto.

8. In a flying shear, the combination of a shear blade mounted to reciprocate endwise, a guide for the shear blade mounted to reciprocate in a

transverse direction and having an opening therethrough for receiving the rod to be cut, a series of toggle joints connected together, the toggle joints normally making an angle with each other, means for simultaneously straightening out the entire series of toggles, one end of the series being stationary and the other movable, and a link pivoted beyond the toggles and pivotally connected with the movable end of the series and with the shear blade, whereby, when the toggles are operated, the shear blade will engage the rod passing through the guide and move with it while the knife blade cuts the rod.

9. In a flying shear, the combination of a shear blade mounted to reciprocate edgewise, a guide for the shear blade mounted to reciprocate in a transverse direction and having an opening therethrough for receiving the rod to be cut, a series of toggle joints connected together, a guide for the toggle joints, yielding means for normally moving the toggle joints to a position in which they make an angle with each other, means for simultaneously straightening out the entire series of toggles, one end of the series being stationary and the other movable, and a laterally swinging link pivoted beyond the toggles and pivotally connected with the movable end of the series and with the shear blade, whereby, when the toggles are operated, the shear blade will engage the rod passing through the guide and move with it while the knife blade cuts the rod.

10. In a flying shear, the combination of a guide through which the rod to be sheared is adapted to pass, a shear blade reciprocably mounted in said guide for the purpose of shearing the rod, a shaft having a cam thereon, a toggle arrangement in position to be engaged by the cam and straightened out, means connected with the toggle for reciprocating the shear to cut off the rod, a stop lever in position to be engaged by the end of the rod passing through the guide, a clutch for connecting said shaft with a source of power normally held in open position, and means connected with said stop lever for closing the clutch and connecting the shaft with the source of power when the rod operates the stop lever.

11. In a flying shear, the combination with a movable shear blade, of a shaft, a cam on said shaft, a plurality of members adjacent to the cam adapted to be engaged and pushed by the cam simultaneously, means connecting the end of one of said members with the shear blade for operating it, a stop lever in position to be engaged and moved by the end of a rod passing by the shear blade, a cable having one end fixed and the other yieldingly connected with a fixed point, means operated by the said stop for flexing said cable so as to pull its yieldingly mounted end toward the stationary end, and means connected with the yieldingly mounted end of the cable for connecting said shaft with a source of power to start the shearing operation.

12. In a flying shear, the combination of a shear blade, a guide for the shear blade mounted to move freely in the direction of motion of the rod to be sheared, means for operating the shear blade which is normally disconnected from its source of power, a movable stop lever in position to be engaged by the end of the rod after it has been fed far enough from the shears to provide the desired length, a second lever connected with and operated by the stop lever having a pivoted finger thereon, yielding means for moving said lever back to inoperative position, a cable extending parallel with the direction of the rod fixed at one end and yieldingly mounted at the other, a third lever having means for engaging the cable on opposite sides and having an arm in position to be engaged by the finger and moved so that the cable will be taken up by said third lever and the other end of it pulled forward, a second cable attached near the end of the first cable, and means operated by the second cable for connecting the shear blade moving mechanism with its source of power.

13. The combination with a reciprocable blade, of a cam rotatable about an axis, a movable member located adjacent to the cam in a position to be pushed radially by the cam as it rotates, and means for translating the motion of said member into a lateral motion of the blade in a line parallel with the axis of the cam.

14. The combination with a tool, of a shaft, a long faced cam on said shaft, a plurality of inclined links adjacent to the cam adapted to be engaged and pushed by the cam simultaneously, connections between said links for translating that motion into a longitudinal motion, and means connecting the end of one of said links with the tool for operating it in a direction parallel to the axis of the shaft.

15. The combination of a shaft, and a member on said shaft, a series of toggle joints under the member in position to be moved from an angular nearly to the straight line position by the member, one end of the series of toggle joints being pivoted at a stationary point, and means connected with the other end for moving a tool.

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