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J. H. HITCHCOCK ET AL

2,804,925

SHEARING APPARATUS

Filed March 28, 1955

4 Sheets-Sheet 1

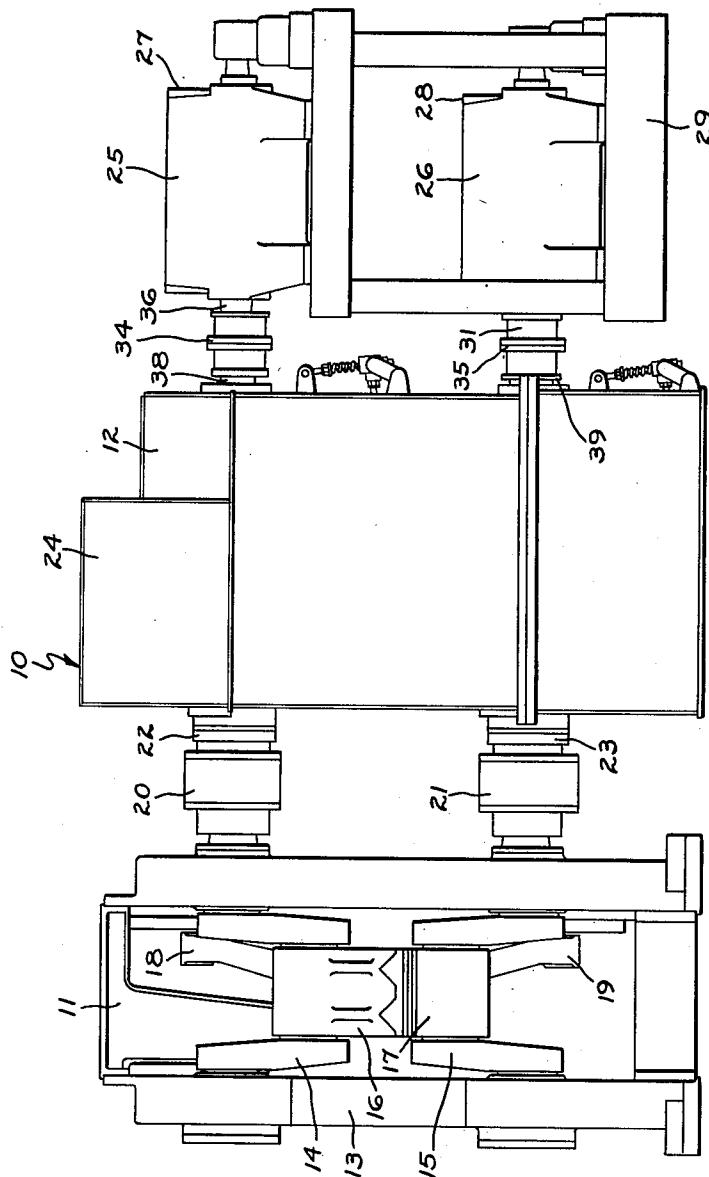


Fig. 1

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4 Sheets-Sheet 2

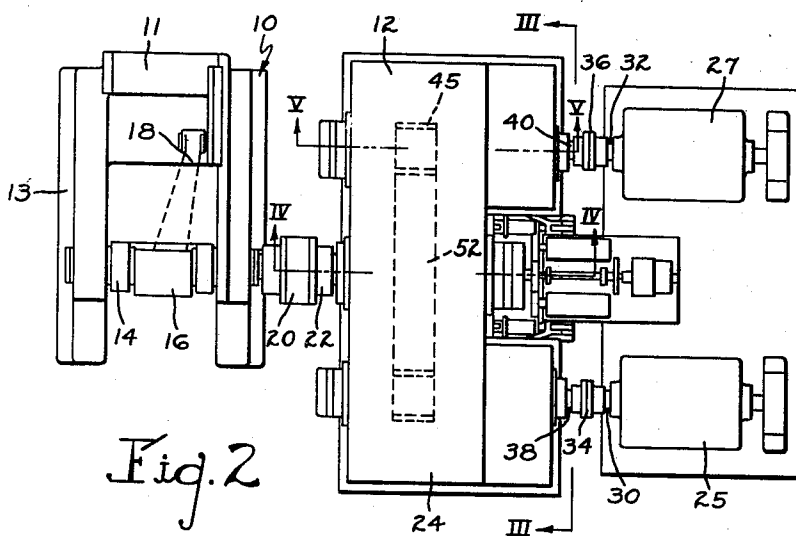
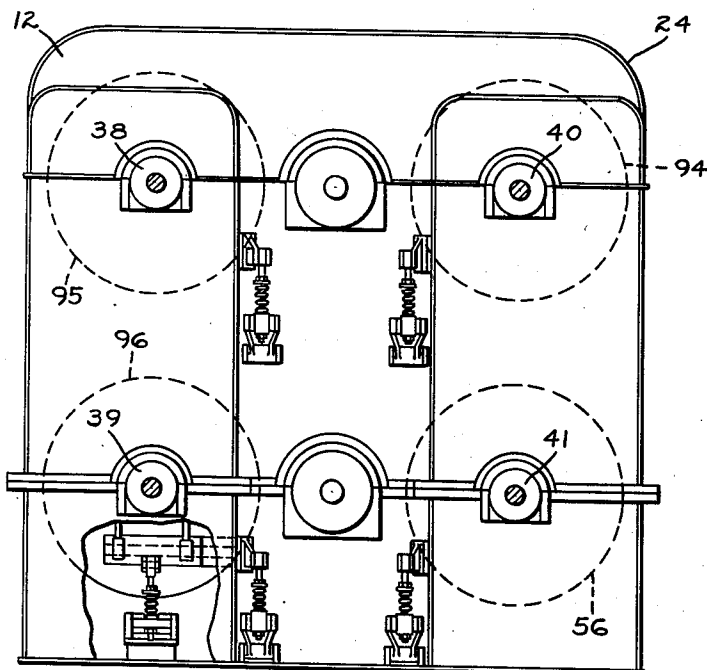


Fig. 3

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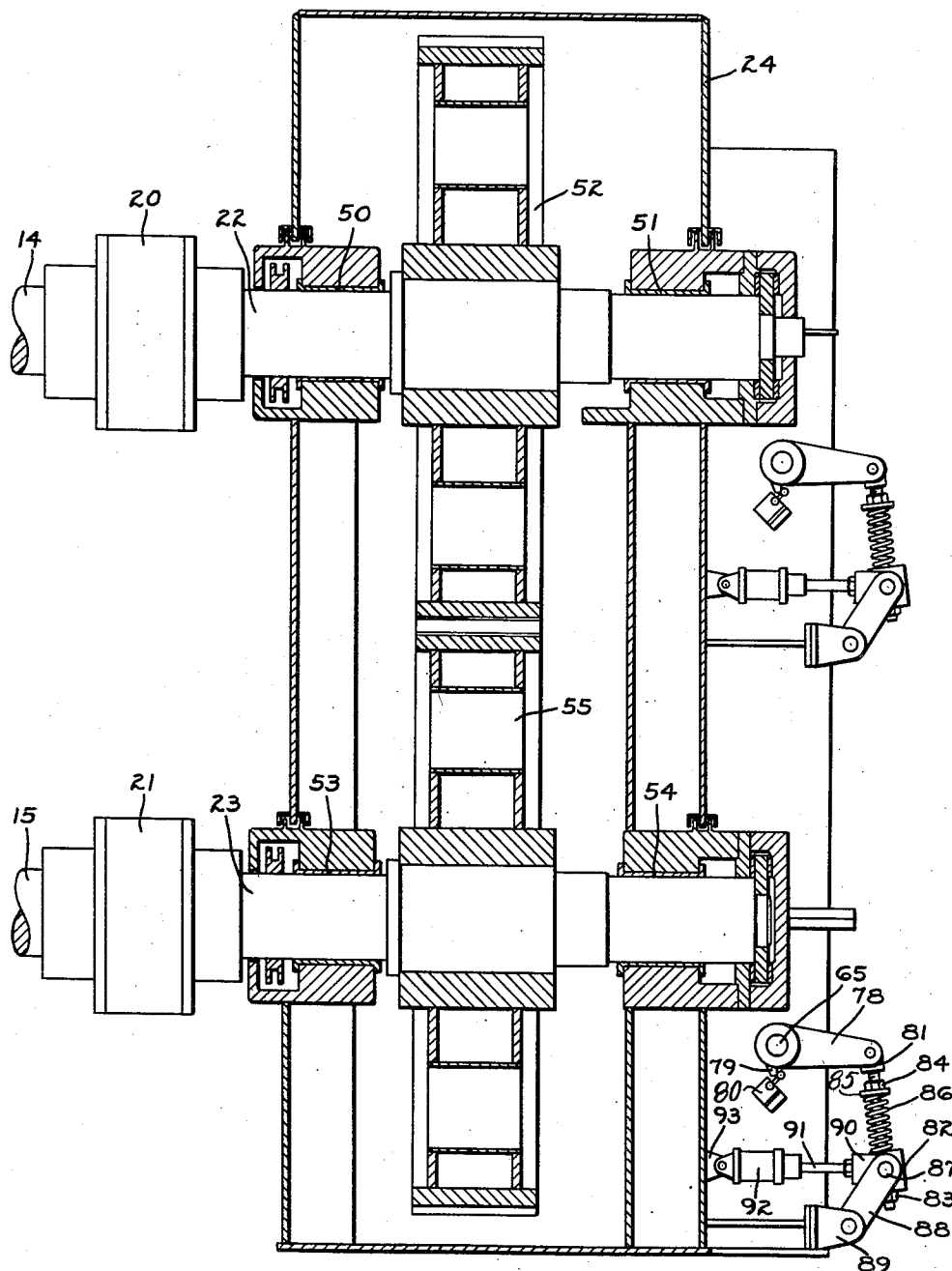
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## SHEARING APPARATUS

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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

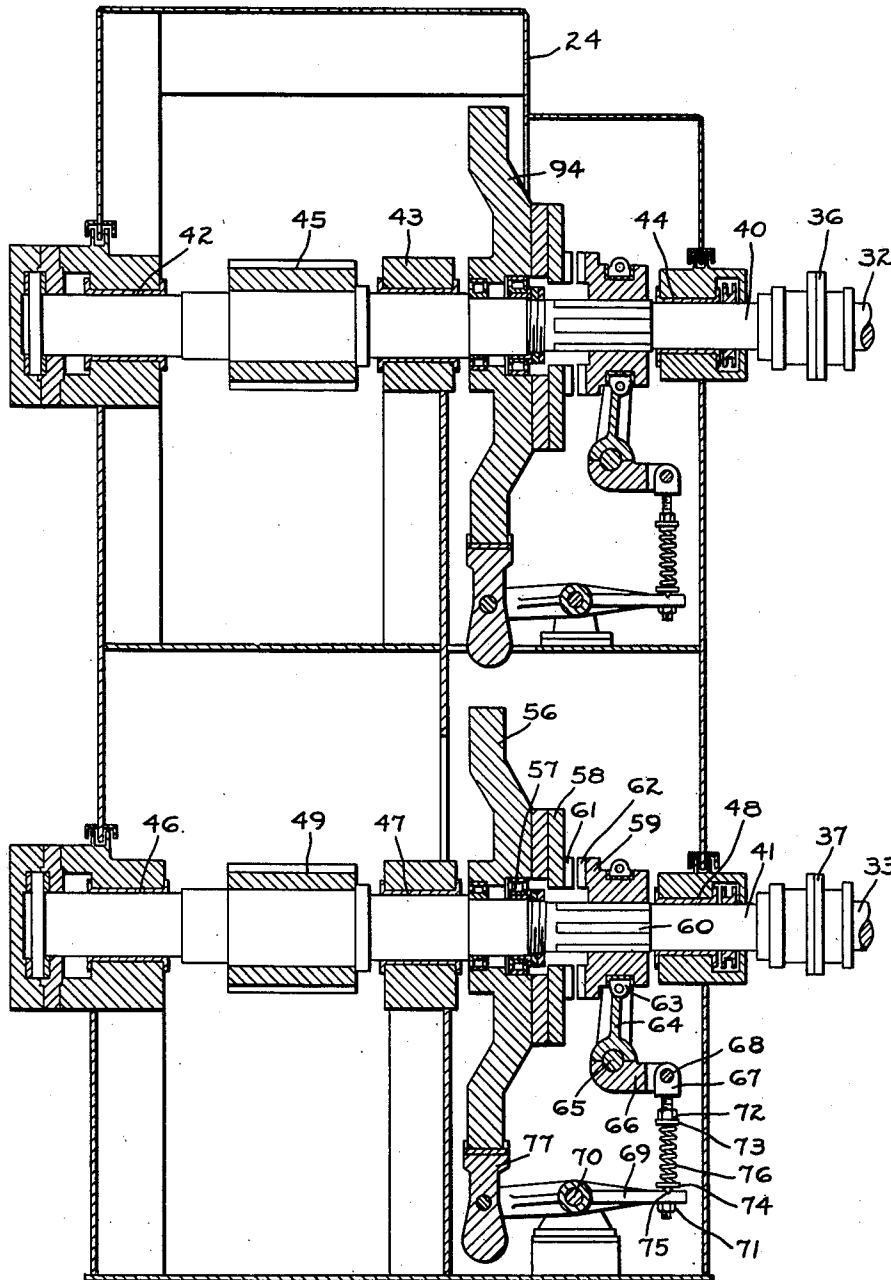


Fig. 5

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2,804,925

## SHEARING APPARATUS

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Application March 28, 1955, Serial No. 496,998

2 Claims. (Cl. 164—66)

This invention relates to a shear and, more particularly, to an electric shear for use in a rolling mill.

In the operation of a high-speed rolling mill, it is customary to use a so-called "flying shear" whose blades, at the instant of cutting, are traveling at the same speed as the material to be cut. Although flying shears were originally driven by steam, use of electric motors as the propulsion power has increased over the last few years. The difficulties experienced with most flying shears and, particularly, those which are electrically driven is that a shear which is designed particularly for cutting material travelling at high speeds and having a small cross-sectional area has difficulty in cutting material of larger cross-sectional area travelling at a slower speed. In some installations, however, it is necessary that a flying shear, which may be used to cut crops and cobbles or which may be used to cut to length, be capable of cutting properly regardless of the speed of delivery of the mill and irrespective of the cross-sectional area of the material being rolled. Furthermore, it is possible in present-day rolling mills that the material rolled may vary from a soft, easily-cut material to a tough metal, such as an alloy of steel, which is considerably more difficult to cut. These and other difficulties experienced with the prior art devices are obviated by the present invention in a novel manner.

It is, therefore, an outstanding object of the present invention to provide a shear capable of cutting material travelling at a wide range of speeds having a wide range of cross-sectional area and having a wide range of toughness.

A further object of this invention is the provision of a flying shear which is capable of cutting with equal facility material in a rolling mill travelling at high speed and having a low cross-sectional area or material travelling at low speed and having a large cross-sectional area.

It is a still further object of this invention to provide a flying shear having an inherent inertia which may be selectively changed.

Another object of the instant invention is the provision of a flying shear having flywheels which may or may not be introduced into the inertia system of the shear at the option of the operator.

With these and other objects in view, as will be apparent to those skilled in the art, the invention results in the combination of parts set forth in the specification and covered by the claims appended hereto.

The character of the invention, however, may be best understood by reference to certain of its structural forms as illustrated by the accompanying drawings in which:

Figure 1 is an elevational view of a shearing apparatus constructed according to the present invention looking in the direction of the pass line,

Figure 2 is a plan view somewhat reduced of the apparatus shown in Figure 1,

Figure 3 is an elevational view of a portion of the apparatus of the invention taken on the line III—III of Figure 2,

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Figure 4 is a sectional view of a portion of the invention taken on the line IV—IV of Figure 2, and

Figure 5 is a sectional view of the invention taken on the line V—V of Figure 2.

Referring first to Figures 1 and 2, wherein is best shown the general feature of the invention, the shearing apparatus, indicated generally by the reference numeral 10, is shown as comprising a shear 11 and a drive 12. A shear 11 is of the type shown and described in the patent to Myles Morgan No. 2,157,000 and consists of a housing 13 in which are mounted two crankshafts 14 and 15 on which are supported cutting blades 16 and 17, respectively. To the blades 16 and 17 are connected tail rods 18 and 19, respectively, the outer ends of which are guided in cams, not shown, and which serve to maintain the blades 16 and 17 in the proper aspect during the cutting portion of the cycle. The crankshafts 14 and 15 are driven through couplings 20 and 21, respectively, by shafts 22 and 23 extending from the drive apparatus 12.

The drive 12 comprises a gear housing 24 driven by four electric motors 25, 26, 27 and 28 mounted on a suitable support 29. The electric motors 25, 26, 27 and 28 have their shafts 30, 31, 32 and 33 connected by means of couplings 34, 35, 36 and 37 to shafts 38, 39, 40 and 41, respectively.

As is evident in Figure 5, a shaft 40 is mounted in three bearings 42, 43 and 44 fixed in the housing 24, and has keyed thereto a pinion gear 45 located between the bearings 42 and 43; in a similar manner, the shaft 41 is mounted in bearings 46, 47 and 48 mounted in the housing 24 and is provided with a pinion gear 49 keyed to the portion thereof lying between the bearings 46 and 47. Referring to Figure 4, it can be seen that the shaft 22 is mounted in bearings 50 and 51 fixed to the housing 24 and has keyed thereto between the bearings a bull gear 52; in a similar manner, the shaft 23 is mounted in bearings 53 and 54 fixed to the housing 24 and between these bearings on the shaft 23 is keyed a bull gear 55. It is to be noted that the shafts 38 and 39 are mounted in a manner similar to the shafts 40 and 41 and are provided with similar pinion gears. It can be seen from Figure 4 that the bull gears 52 and 55 mesh with each other and, as is indicated in Figure 2, two of the pinion gears mesh with each bull gear; for instance, a pinion gear 45 associated with the shaft 40 meshes with the bull gear 52 while the pinion gear 49 associated with the shaft 41 meshes with the bull gear 55. The pinion gears associated with the shafts 38 and 39 also mesh with bull gears 52 and 55 respectively.

Referring next to Figure 5, a heavy flywheel 56 is rotatably mounted on the shaft 41. A roller bearing 57 is situated between these two elements, the outer race being attached to the flywheel 56 while the inner race is attached to the shaft 41. A driven portion 58 of the clutch is welded or otherwise fastened to the flywheel coaxially with the shaft 41 and the driving portion 59 of the clutch is slidably mounted on the shaft 41. The shaft is provided with splines 60 whereby the driving portion 59 of the clutch can be keyed to the shaft 41 so that it may slide longitudinally thereof without rotation relative thereto. The driven portion 58 of the clutch is provided with teeth 61 adapted to engage with teeth 62 on the driving portion 59 of the clutch. A collar 63 is fastened around the driving portion 59 of the clutch and is pivotally attached to one end of a yoke 64. The other end of the yoke 64 is securely fastened to a shaft 65. Also secured to the shaft 65 is a lever 66 which with the yoke 64 acts in the manner of a bell crank. The outer end of the lever 66 is pivotally connected to a clevis 67 by means of a pin 68. The clevis has a long shank which extends downwardly to one end of a lever 69. The central portion of lever 69 is hori-

zontally pivotally supported on a shaft 70. The shank of the clevis extends through the outer end of the lever 69 and is threaded to receive a nut 71 to hold the clevis and lever together. The upper end of the shank of the clevis is also threaded to receive a nut 72 which presses against a washer 73. A washer 74 is also located on the shank of the clevis and is provided with a knife-edge 75 which engages a notch in the lever 69. A coil spring 76 extends between the washer 73 and the washer 74 and is normally under compression. The other end of the lever 69 has pivotally attached thereto a brake 77 which is adapted to engage the rim of the flywheel 56. This portion of the actuating mechanism associated with the flywheel 56 is enclosed within the housing 24.

Figure 4 shows a portion of the actuating mechanism associated with the flywheel 56, which portion is mounted externally of the housing 24. It can be seen that the shaft 65 extends outwardly of the housing 24 and has attached thereto a crank arm 78. The hub of the crank arm which is attached and keyed to the shaft 65 is provided with a protuberance 79 which is adapted to engage an adjustable stop member 80 which serves to limit the counter-clockwise motion of the crank arm 78. The outer end of the crank arm 78 is pivotally connected to a clevis 81 having a shank which extends through a pivot block 82. The outer end of the shank is threaded and is provided with a nut 83 on the underside of the block 82. The upper end of the shank of the clevis is also threaded and is provided with a nut 84 which presses against a washer 85. A coil spring 86 extends between the washer 85 and the block 82. A pin 87 extends through the block 82 and has pivotally attached thereto one end of a link 88. The other end of the link 88 is pivotally connected to an abutment 89 fastened to the housing 24. Also pivoted on the pin 87 is a clevis 90 having a rod 91 fastened thereto. The rod 91 is the piston rod of a hydraulic cylinder 92, the other end of which is pivotally connected to an abutment 93 fastened to the housing 24. The clevis 81 and its shank constitute with the link 88 a toggle which is actuatable by means of the cylinder 92 to move the crank arm 78 upwardly and downwardly.

It is to be noted that, whereas the shaft 41 is provided with the flywheel 56 and associated apparatus, the shafts 40, 38 and 39 are provided with similar flywheels 94, 95 and 96, respectively, and each of these flywheels is provided with similar associated apparatus. It is to be understood that the cylinder 92 finds its counterpart in apparatus associated with the other flywheels of the invention and that all of the hydraulic cylinders are provided with control means, not shown, but which are under the control of an operator.

The operation of the apparatus will now be clearly understood in view of the above description. Electric motors 25, 26, 27 and 28 are under the control of an operator or of flag switches in the path of the moving material to be sheared. The motor shafts drive through their couplings to the shafts which are mounted in the gear housing 24 and which bear the pinion gears. The pinion gears actuate their respective bull gears and they, in turn, act through the shafts 22 and 23 and the couplings 20 and 21 to rotate the crankshafts 14 and 15. In the preferred embodiment of the invention, a shear will make a cut by starting from rest and accelerating to attain the proper cutting speed at the instant that the blades sever the material. This manner of shear operation is shown and described in the patent of Edmund S. Murrah No. 2,500,999. Because of the inter-engagement of the pinion gears and bull gears, it can be seen that the four motors will bear the load in equal proportions. When it is desired to cut material of small cross section travelling at a high rate of speed, it can be seen that it will be necessary to accelerate all the parts of the shearing apparatus from zero speed to a high peripheral speed at the moment of cutting. For that

reason, it will be best to use a shearing apparatus of small inertia which can be easily accelerated. Because of the small cross sectional area, the apparatus need not possess the capability of doing a large amount of work during the cutting operation. For that reason, the flywheel 56 and its counterpart flywheels 94, 95 and 96 are not connected to their respective shafts and take no part in the shearing operation. If, however, it is desired to cut material of large cross sectional area or of relatively tough material, the shearing apparatus must have sufficient inertia so that the cutting operation may be performed with the inherent work of the moving apparatus. If the shearing apparatus is of insufficient inertia to perform the cutting operation, the load of the cutting operation will have to be carried by the motors and this they are not capable of doing. With the present apparatus, therefore, the operator causes the actuating mechanism to connect each of the flywheels to its shaft. For instance, in the case of the cylinder 92, hydraulic fluid will be introduced into the cylinder in such a way that the piston rod 91 will move inwardly thus acting upon the toggle formed by the clevis 81 and the lever 88. The inward movement of the piston rod 91 will straighten the toggle, that is to say, it will tend to place the shank of the clevis 81 and the link 88 more nearly in line, thus moving the crank arm 78 counterclockwise as it is shown in Figure 4 and moving the shafts 65 in the same direction. Moving the shaft 65 in a counterclockwise direction first serves to move the driving portion 59 of the clutch toward the driven portion 58, thus causing the teeth 61 and 62 to engage. The flywheel 56 is then connected to the shaft 41 and moves with it. The counterclockwise movement of the shaft 65 also serves to lift the clevis 67 and its shank carrying the end of the lever 64 with it and causing the brake 77 to move downwardly away from the flywheel 56 to release it. The flywheel 56 and the similar flywheels 94, 95 and 96 then move with their respective shafts and add to the inertia of the shearing apparatus. Although the shearing apparatus will not accelerate as rapidly because of this inertia, it is not necessary that acceleration be rapid because the cutting speed with a larger cross section is presumably much less. A large inertia, however, does serve to provide sufficient energy for the more difficult cutting operation, as is evident. When it is desired to release the flywheel 56 from its shaft 41, the operator will cause the cylinder 92 to operate in such a manner that the piston 91 moves outwardly, thus causing the clevis 81 and the link 88 to move more out of line and thus move the crank arm 78 in a clockwise direction. This clockwise movement of the crank arm causes a similar movement of the shaft 65 bringing about the disengagement of the teeth 61 and 62 of the clutch and at the same time, causing the brake 77 to move upwardly against the flywheel 56 bringing to rest.

It is obvious that minor changes may be made in the form and construction of the invention without departing from the material spirit thereof. It is not, however, desired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having thus been described, what is claimed as new and desired to secure by Letters Patent is:

1. A shearing apparatus comprising a flying shear, electric motors, a drive connecting the motors to the shear for the operation thereof, a shaft mounted in the drive and connected to the shear, a bull gear keyed to the shaft, a second shaft mounted in the drive and connected with the bull gear, a flywheel rotatably mounted on the second shaft, a brake for the flywheel, a clutch having one portion fixed to the flywheel and the other portion attached to the shaft, and an actuating mechanism for causing the two portions of the clutch to inter-engage to connect the flywheel to the shaft to increase the inertia of the driving apparatus and for releasing the brake from

the flywheel, the said mechanism including a hydraulic motor acting through a lever system to actuate the clutch and to actuate the brake.

2. A shearing apparatus comprising a flying shear, electric motors, a drive connecting the motors to the shear 5 for the operation thereof, a shaft mounted in the drive and connected to the shear, a bull gear keyed to the shaft, a second shaft mounted in the drive and connected with the bull gear, a flywheel rotatably mounted on the second shaft, a brake for the flywheel, a positively- 10 engaging clutch having one portion fixed to the flywheel and the other portion attached to the shaft, and an actuating mechanism for causing the two portions of the clutch to inter-engage to connect the flywheel to the shaft to increase the inertia of the driving apparatus and for re- 15 leasing the brake from the flywheel, the said mechanism including a hydraulic motor acting through a lever system simultaneously to actuate the clutch and deactivate the brake.

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