United States Patent

Sarff et al.

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[54] POWER-DRIVEN WIRE TYING MECHANISM

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[52] **U.S. Cl.** .....**140/93.6,** 140/93 A, 140/119

[51] **Int. Cl.** **B21f 9/02,** B21f 15/04

[58] **Field of Search**.....140/93, 93.6, 115, 118, 119, 140/120, 122; 318/446; 72/2, 30

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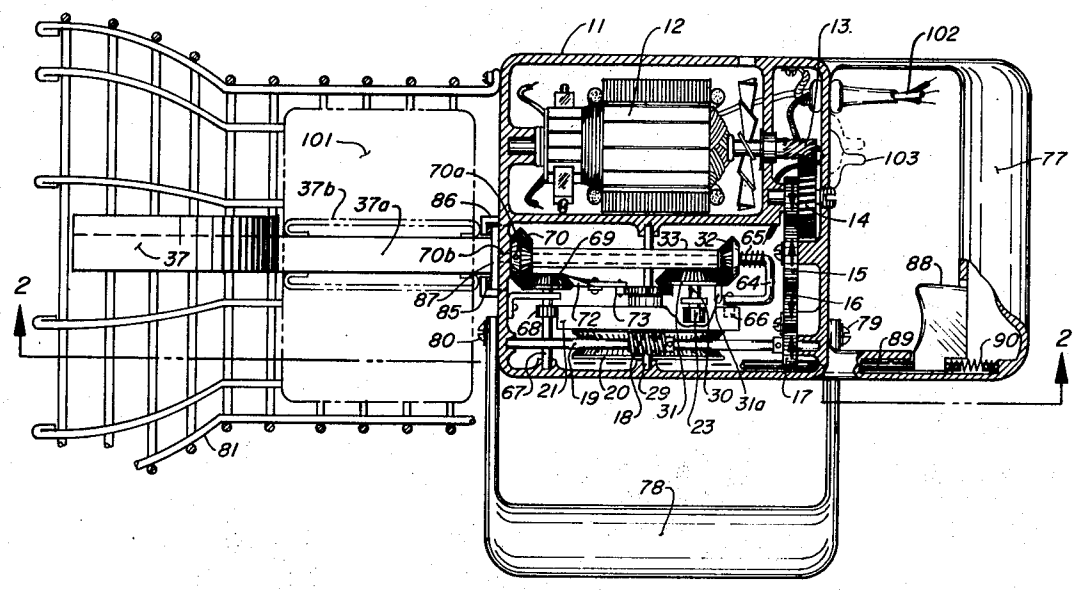
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[57] **ABSTRACT**

This invention relates to wire tying mechanisms, and more particularly to a power-driven mechanism for making wire ties for the purpose of bundling materials, tying the tops of sacked material, tying reinforcing steel together prior to placing concrete in reinforced concrete structures, for tying together such assemblies as garden stakes, fencing and similar packages or assemblies, or any assembly, the parts of which can be secured together by wire ties.

1 Claim, 14 Drawing Figures



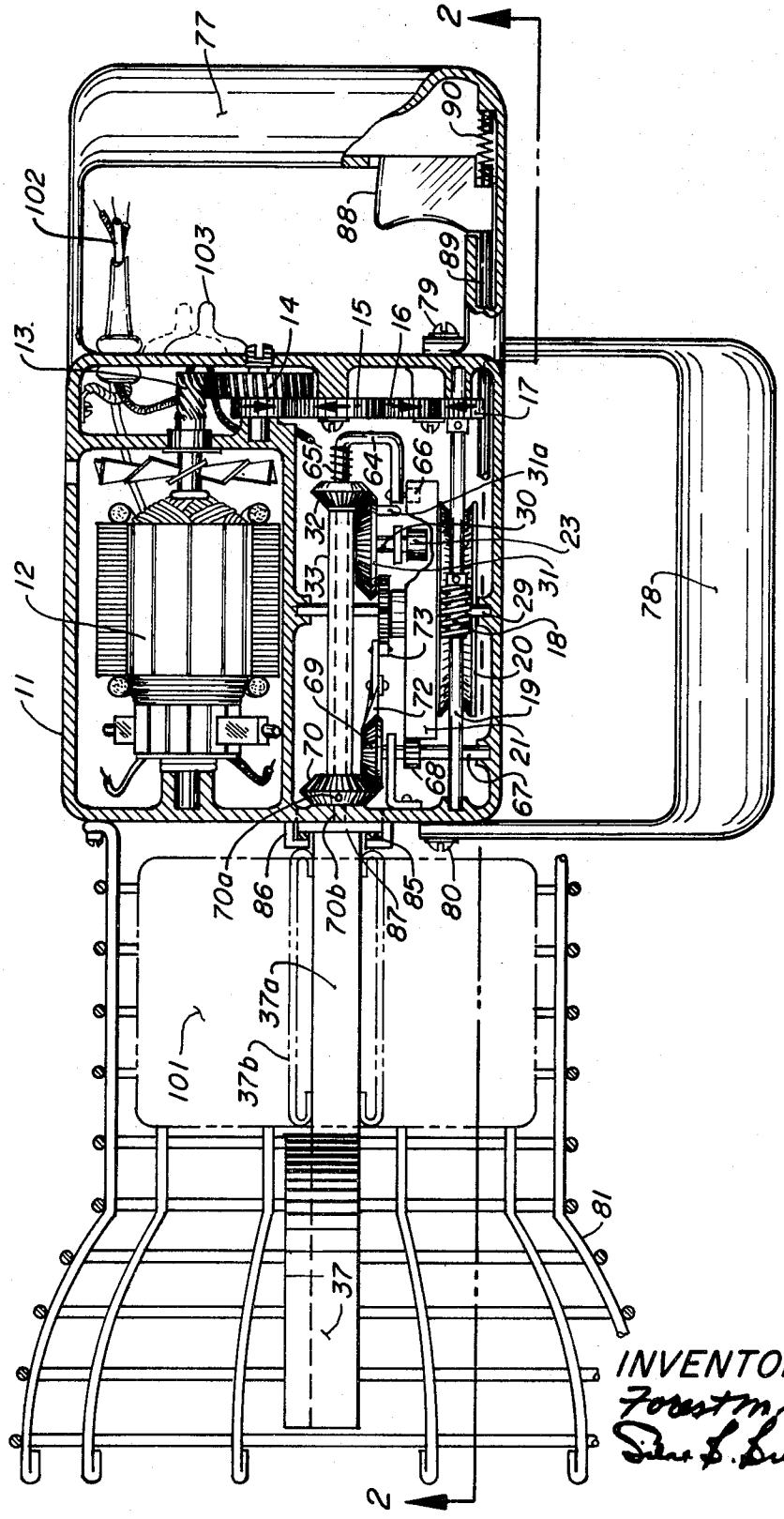

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FIG 1

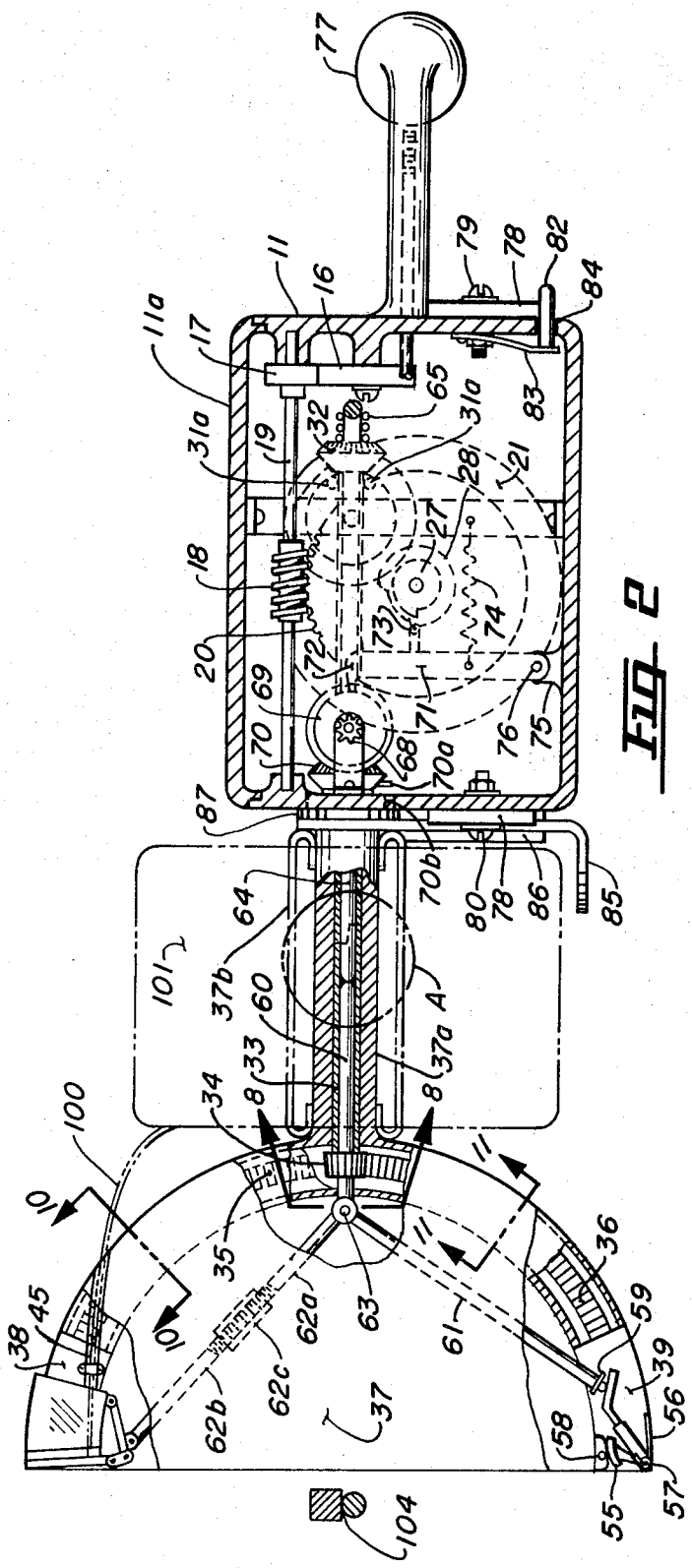


Fig 2

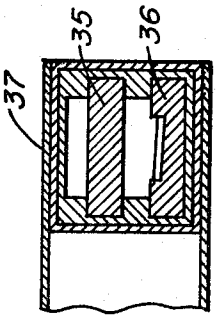


Fig 11

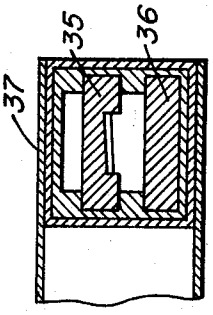


Fig 10

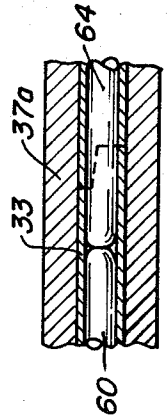


Fig 9

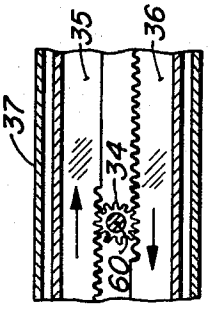


Fig 8

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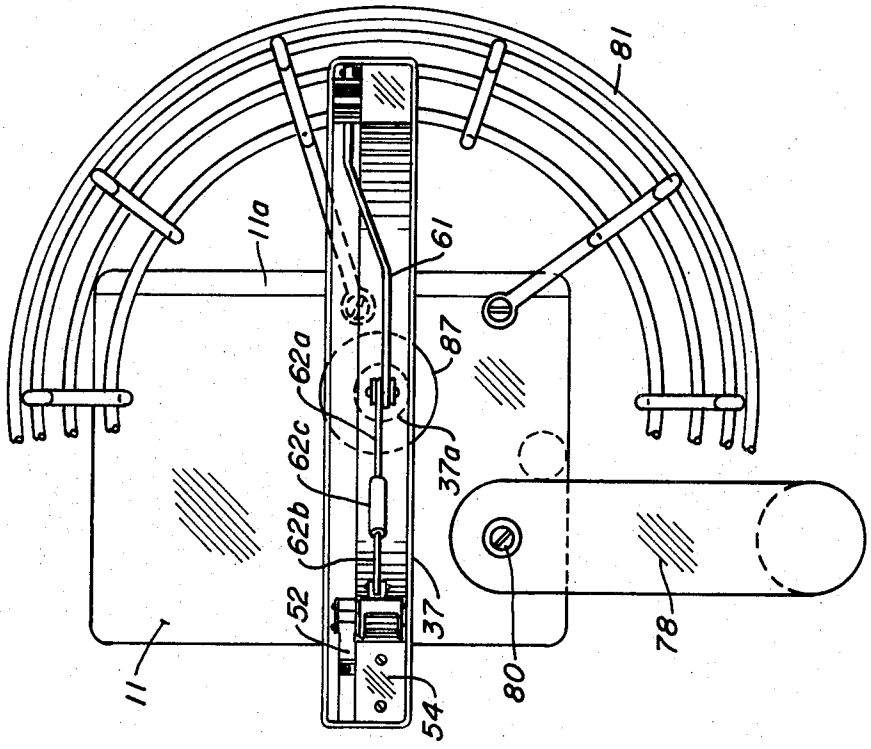


Fig 3

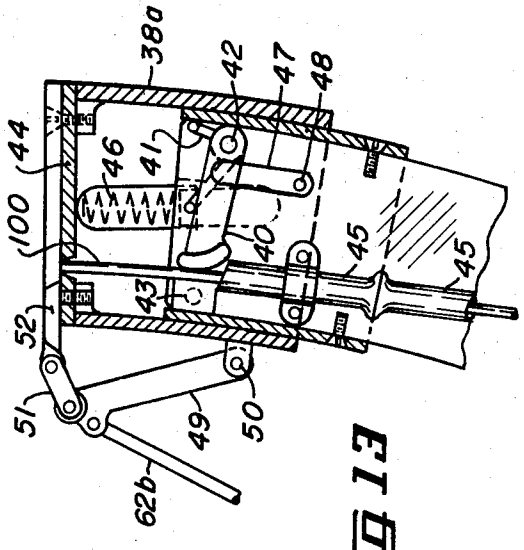


Fig 13

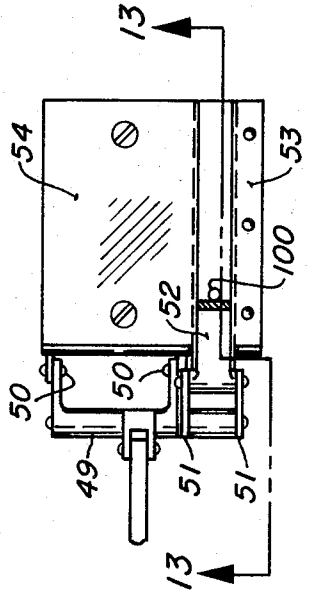


Fig 12

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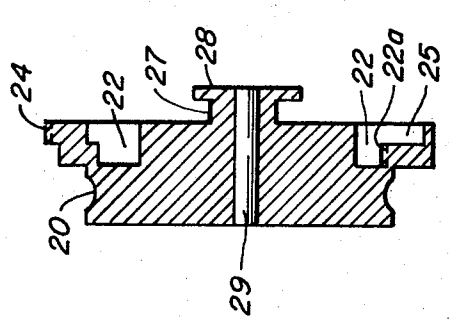


Fig 6

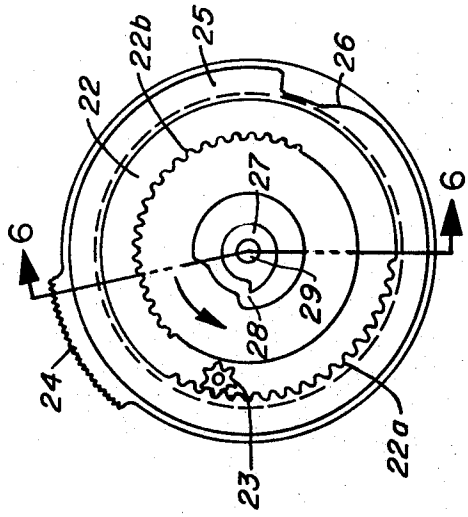


Fig 5

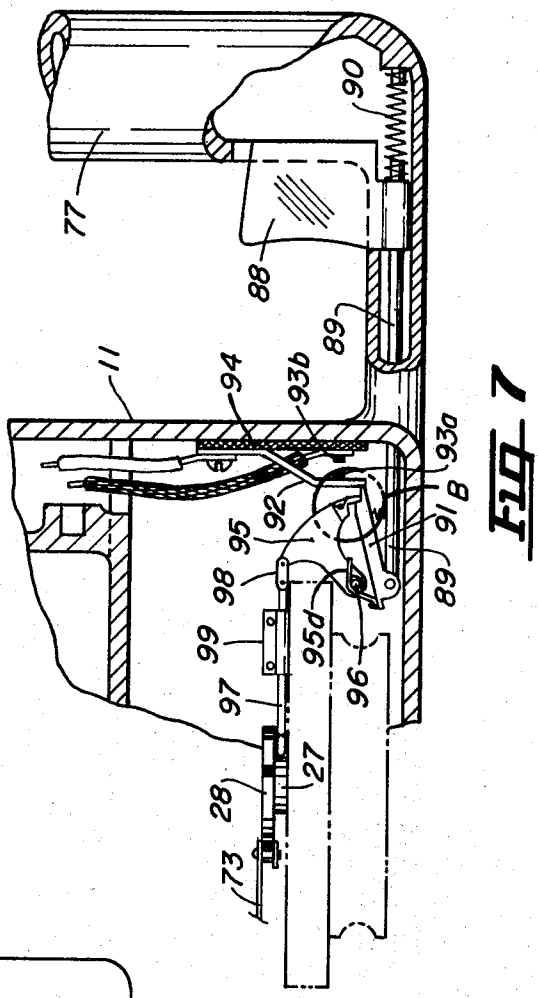


Fig 7

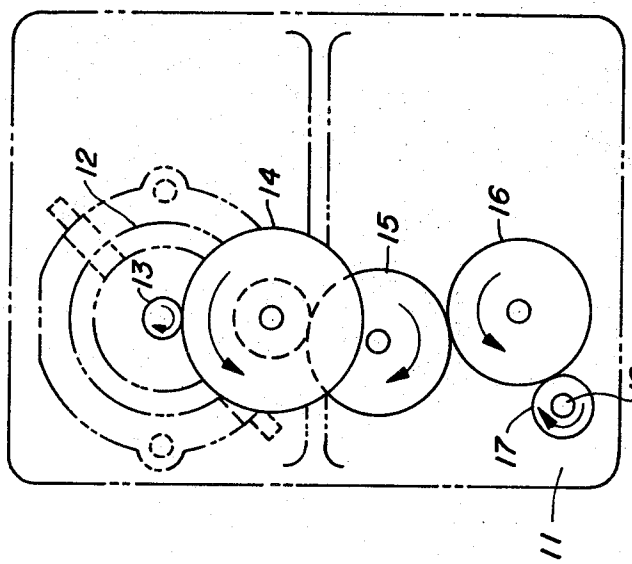


Fig 4

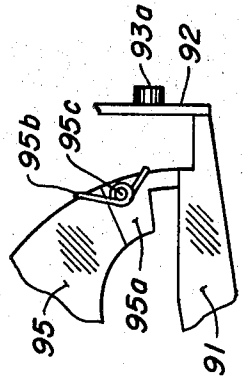


Fig 14

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POWER-DRIVEN WIRE TYING MECHANISM

By utilizing principles which will significantly increase the speed and efficiency in making wire ties, the present invention is in the nature of an improvement over previous devices such as were intended to make wire ties. In addition, the present invention can be a portable mechanism which would provide for its use in any position as well as in confined spaces.

Where a wire tie is involved, this invention will automatically provide a rapid wire tie by feeding the tie wire, twisting the wire tight, cutting the wire off, and stopping after each wire tying cycle.

The need for the improvements provided in the present invention is apparent to all who are involved in making wire ties. The present invention provides for a safe means to make a wire tie mechanically for a wide variety of purposes and will make such ties at a very rapid rate, thereby increasing efficiency over previous methods. The present invention satisfies the need for a mechanism which will permit wire ties to be made, even where such ties are at various attitudes or in confined spaces.

This invention relates to wire tying mechanisms, and more particularly to a power-driven mechanism for making wire ties to secure two or more parts of an assembly together or for bundling or packaging materials.

It is an object of the present invention to provide a mechanism, or series of mechanisms, for securing together by wire ties, two or more parts of an assembly.

Another object of the present invention is to operate by power means a mechanism for making wire ties.

A still further object of the present invention is to provide a mechanism which is adaptable for use with an extension handle and which can be portable and lightweight to permit its use in any position or attitude as well as in confined spaces.

A still further object of the present invention is to provide a mechanism which is fully automatic in its operation and can be operated easily by depressing a single switch.

Still additional objects, benefits, and advantages of the present invention will become evident from a study of the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a top view of the mechanism taken with the cover removed, showing the relative location and arrangement of its component parts.

FIG. 2 is a cross-section of a side view of the mechanism taken on the line 2—2 of FIG. 1.

FIG. 3 is a front view of the mechanism showing a portion of the basket guard.

FIG. 4 is a diagram showing the relative location and arrangement of the power gear train.

FIG. 5 is a view of the worm driven cam-gear assembly.

FIG. 6 is a cross-sectional view of the cam-gear assembly taken on the line 6—6 of FIG. 5.

FIG. 7 is a cut-away view of the trigger switch mechanism.

FIG. 8 is a sectional view of the arrangement of the racks and pinion in the yoke case taken on the line 8—8 of FIG. 2.

FIG. 9 is a longitudinal sectional view of the spindle encircled by A, on FIG. 2, showing in detail how this assembly separates.

FIG. 10 is a cross-sectional view of a portion of the yoke case showing the arrangement of the racks in the case, and is taken on the line 10—10 of FIG. 2.

FIG. 11 is a different cross-sectional view of a portion of the yoke case showing the arrangement of the racks in the case, and is taken on the line 11—11 of FIG. 2.

FIG. 12 is an end view of the yoke head that carries the tie wire and wire cut-off mechanism.

FIG. 13 is a top sectional view of the yoke head showing the wire gripping mechanism and the wire cut-off mechanism taken on line 13—13 of FIG. 12.

FIG. 14 is a detail of a portion of the switch mechanism encircled by B on FIG. 7.

Referring now specifically to the drawings, the power-driven wire tying mechanism shown in FIGS. 1 and 2, consists of a case 11 and cover 11*a* housing a motor 12 which rotates

helical gear 13 which in turn rotates change gear 14. As change gear 14 rotates, it causes gears 15, 16, and 17 to rotate. Gear 17 and worm 18 are fixed on shaft 19, so that in rotating, worm 18 engages worm gear 20 and drives cam-gear assembly 21. Cam-gear assembly 21 shown in FIGS. 5 and 6, is provided with a worm gear 20, a groove 22 having internal gear teeth 22*a* and external gear teeth 22*b*, a spur gear 23 tracking in groove 22, an external rack 24, groove 25, cam 26, switch cut-off cam 27, and dog operating cam 28. Cam-gear assembly 21 rotates on shaft 29 completing one operating cycle of the mechanism in one revolution.

Referring back to FIGS. 1 and 2, spur gear 23 is secured to one end of shaft 30, and bevel gear 31 is attached to the other end. Bevel gear 31, equipped with a pair of stop pins 31*a*, mates with bevel gear 32 which is fixed to hollow shaft 33. Pinion 34 is also fixed to hollow shaft 33 and engages racks 35 and 36 which are enclosed in yoke case 37. Yoke case 37 also encloses yoke head 38, and yoke head 39. Yoke head 38, shown in FIGS. 12 and 13, consists of dog 40, spring 41, pin 42, knurled lug 43, hardened steel shear plate 44, wire guide 45, tube and spring assembly 46, slot 47, stop pin 48, shear lever 49, pins 50, links 51, blade 52, and end plates 53 and 54. Yoke head 39 consists of dog 55, spring 56, pin 57, knurled lug 58, and rod guide 59.

Pusher rod 60, attached to rods 61 and 62*a* by pin 63, moves axially inside hollow shaft 33 with one end in contact with the end of pusher rod 64. Rod 62*b* is attached to shear lever 49 on one end and connected to rod 62*a* by turnbuckle 62*c*. Pusher rod 64 operates against spring 65 and is equipped with a roller 66 which tracks in groove 25 in cam-gear assembly 21. Shaft 67 is equipped with a pinion 68 which intermittently meshes with external rack 24. Shaft 67 also has mounted on it, bevel gear 69 which meshes with bevel gear 70. Bevel gear 70 is attached to spindle 37*a* of yoke case 37, and is equipped with a pin 70*a* which must be aligned with slot 70*b* to pass through case 11. Spool adapter 37*b* is mounted on spindle 37*a*.

A dog assembly consisting of a lever arm 71, dog 72, dog operating cam follower 73, and spring 74 is secured to lug 75 on case 11 by pin 76.

Case 11 is provided with fixed handle 77, hinged handle 78 mounted on pins 79 and 80, and a wire basket guard 81. Locking pin 82, attached to spring 83, projects through hole 84 in case 11. Thumb lock 85, slides in track 86 and holds yoke case 37 to case 11 by collar 87 on the end of spindle 37*a*.

Referring to FIG. 7, the trigger switch mechanism consists of a trigger 88 fixed to rod 89 which operates against spring 90 on one end and has on the other end a spring loaded hinged dog 91 at an attitude to engage insulated spring 92 on which electric contact 93*a* is mounted. Electric contact 93*b* is mounted on insulating strip 94. Crank 95, which has a pawl 95*a*, pawl spring 95*b*, pin 95*c* and crank spring 95*d* rotates on pin 96 and is connected to push rod 97 by links 98. Push rod 97 is maintained in alignment by guide 99 as that its end is in constant contact with switch cut-off cam 27.

Tie wire 100 is fed through the power-driven wire tying mechanism from tie wire spool 101 equipped with spool adapter 37*b* mounted on spindle 37*a*. Power is furnished to motor 12 through a three-wire conductor 102. A safety switch 103 is mounted on case 11 near fixed handle 77. The objects to be tied are shown as objects 104 in FIG. 2.

The operation of the power-driven wire tying mechanism is as follows: when trigger 88 is depressed, the mechanism will start and it is designed to complete one wire tying cycle with one complete revolution of cam-gear assembly 21 and stop automatically, even when the trigger remains depressed. By depressing trigger 88 against spring 90, rod 89 is moved axially carrying spring loaded hinged dog 91 into contact with insulated spring 92, moving it in turn in the same direction to complete an electrical circuit between electric contact points 93*a* and 93*b*.

Motor 12 is thereby energized and rotates helical gear 13 which in turn rotates change gear 14 and gears 15, 16, and 17.

Gear 17 is fixed to shaft 19 which also turns worm 18. Worm 18 is mated to worm gear 20 causing cam-gear assembly 21 to be rotated.

As cam-gear assembly 21 begins to rotate, internal gear teeth 22*a* will engage spur gear 23 which will be rotated counterclockwise, thereby rotating shaft 30 and bevel gear 31. Bevel gear 32, mated to bevel gear 31, will be thus rotated which will rotate hollow shaft 33 and pinion 34, thereby moving racks 35 and 36 outward in yoke case 37. This movement causes yoke heads 38 and 39 to extend out from yoke case 37 in arcs until they meet.

As yoke head 38 is compressed against yoke head 39, the end assembly 38*a* will telescope along yoke head 38 against tube and spring assembly 46, causing tie wire 100 to project beyond end plate 54 and enter and be gripped between dog 55 and knurled lug 58 in yoke head 39. Telescoping movement of end assembly 38*a* is limited in both directions by stop pin 48 in slot 47.

As cam-gear assembly 21 continues to rotate, external gear teeth 22*b* will engage spur gear 23 and rotate it clockwise, thereby rotating shaft 30 and causing bevel gears 31 and 32 to rotate in opposite directions. This causes hollow shaft 33 and pinion 34 to rotate, moving racks 35 and 36 inward, thereby retracting yoke heads 38 and 39 to their original positions.

Dog 55, under tension from spring 56, will grip and hold tie wire 100 from retracting as yoke head 38 retracts. Dog 40 will be automatically and simultaneously released from its gripping action against knurled lug 43 as it retracts with yoke head 38 along tie wire 100. Tie wire 100 will then span from yoke head 39 to yoke head 38, with the wire on the opposite side of objects 104 with respect to the wire tying mechanism.

As cam-gear assembly 21 continues to rotate, external rack 24 will engage pinion 68 which is fixed on shaft 67 and will rotate bevel gears 69 and 70 in opposite directions. Bevel gear 70 will in turn rotate spindle 37*a* which is an integral part of yoke case 37. The entire yoke case 37, while carrying tie wire spool 101, will rapidly rotate several times, twisting tie wire 100 tight and securely binding objects 104 together. This twisting operation will cease when cam-gear assembly 21 rotates to the point that pinion 68 passes off the end of external rack 24.

As cam-gear assembly 21 continues to rotate, roller 66 tracking in groove 25 will follow the cam surface of cam 26 thereby moving pusher rod 64 axially compressing spring 65. Pusher rod 64 being thus pushed axially inside hollow shaft 33, transmits this linear motion to pusher rod 60 which moves toward yoke case 37, thereby transmitting this outward motion through pin 63 to rod 61 and rod 62*a*. As rod 62*a* moves axially, through turn-buckle 62*c* and rod 62*b*, it pushes shear lever 49 which rotates about pins 50 causing blade 52 to shear off tie wire 100 at the point where it projects through the hole in shear plate 44. Rod 61, which is restrained laterally on its outboard end by rod guide 59, moves simultaneously with rod 62*a*. The end of rod 61 will press on the lever arm of dog 55, thereby releasing the grip on tie wire 100. The extended cam face of cam 26 will hold pusher rods 60 and 64, and rod 61 extended so that dog 55 will remain in a wire-releasing position until cam-gear assembly 21 begins a new cycle. Also, while pusher rod 64 is in this cut-off cycle, the end of pusher rod 64 carrying roller 66 will pass between stop pins 31*a* in bevel 31, thereby preventing any rotation and simultaneously maintaining the proper orientation of yoke case 37. As cam-gear assembly 21 rotates, it also rotates switch cut-off cam 27 and at this end of the operating cycle, switch cut-off cam 27 moves push rod 97 axially. This motion is transmitted through links 98 causing crank 95 to rotate about pin 96 and to depress crank spring 95*d* and spring loaded hinged dog 91. This disengages the end of spring loaded hinged dog 91 from insulated spring 92 permitting the latter to relax, thereby instantly breaking electrical contact between electric contacts 93*a* and 93*b*, even while the trigger 88 is still depressed.

One end of crank 95 is equipped with a pawl 95*a* which is held snugly against crank 95 by pawl spring 95*b*. When the switch mechanism is in a power-off condition, trigger 88 can be released momentarily then again depressed causing pawl 95*a* to catch in the notch in the top of spring loaded hinged dog 91. Pawl 95*a* will rotate about pin 95*c* against pawl spring 95*b*, thereby permitting spring loaded hinged dog 91 to move and contact insulated spring 92 and close the electrical circuit between electric contacts 93*a* and 93*b*. This mechanism will permit re-energizing the wire tying mechanism at any instant, even when the attitude of switch cut-off cam 27 is holding push rod 97 and crank 95 in a power-off condition. This completes one wire tie and the mechanism will automatically stop.

Simply by depressing the trigger switch of the power-driven wire tying mechanism, the mechanism will start and will automatically shut the power off after completing one cycle, even when trigger 88 remains depressed. The wire tying mechanism can be stopped at any part of the cycle by releasing trigger 88. The cycle can be completed by again depressing trigger 88 without affecting the interrelationship of the various components of the mechanism.

The power-driven wire tying mechanism is equipped with an emergency safety switch 103 which can be easily utilized to shut off power if any part of the switch mechanism fails to operate properly.

To prevent yoke case 37 from moving or coasting while other systems of the mechanism are operating, dog 72 on the end of lever arm 71 is held engaged in the gear teeth of bevel gear 69 by dog operating cam follower 73 riding on the surface of dog operating cam 28. For that portion of the operating cycle when yoke case 37 is twisting a tie, the dog operating cam follower 73 is pulled into the recessed portion of dog operating cam 28 by spring 74 and dog 72 is disengaged from the gear teeth of bevel gear 69, thereby permitting the free rotation of bevel gear 69.

The wire tying mechanism is equipped with a fixed handle 77 and a hinged handle 78 which rotates on pins 79 and 80. Hinged handle 78 will fold under case 11 or rotate to contact the handle frame of fixed handle 77 at which position locking pin 82 attached to spring 83 will automatically pass through hole 84 and lock hinged handle 78 securely in position. The wire tying mechanism can be equipped with an extension handle attached to fixed handle 78.

A wire basket guard 81 is bolted to case 11 as safety guard and as a spacer to prevent yoke case 37 from coming in contact with any object. The ends of the shaped wires of wire basket guard 81 project beyond the outboard concentric wire ring. These projections help the operator of the mechanism to hold the device in place while the mechaniSm is operating, thereby resisting rotation of the wire tying mechanism from torque or from movement from other causes.

Referring back to FIGS. 1 and 2, the wire tying mechanism is provided with a means to separate yoke case 37 from case 11 for the purpose of inserting a tie wire spool 101 into the wire tying mechanism. Thumb lock 85 is retracted in track 86 to clear collar 87 on splndle 37*a*, thereby permitting the entire yOke case 37 and bevel gear 70 to be removed from the wire tying mechanism as a sub-assembly. In replacing yoke case 37, pin 70*a* in bevel gear 70 must pass through slot 70*b* in case 11 so that bevel gears 70 and 69 will be properly oriented with respect to each other, and yoke case 37 will be properly oriented with respect to case 11. Hollow shaft 33 and pusher rods 60 and 64 separate as shown in FIG. 9. At the point where hollow shaft 33 separates, the contact ends are shaped to permit them to be engaged in one position only, thereby assuring proper orientation of certain components of the wire tying mechanism.

Spool adapter 37*b* is inserted in tie wire spool 101 which is then placed on spindle 37*a*, and yoke case 37 is replaced in the wire tying mechanism. Thumb lock 85 is pushed in, engaging collar 87 on spindle 37*a* to secure yoke case 37 to case 11.

Referring now to FIG. 2, the end of the tie wire 100 is unwound from tie wire spool 101 and threaded into wire guide 45 so that the end of tie wire 100 will be gripped between dog

40 and knurled lug 43 and extend through the hole in shear plate 44 to prepare the wire tying mechanism for operation.

Thus the power-driven wire tying mechanism will wrap and tie a wire around any object that can be encircled by yoke heads 38 and 39.

Having thus described an electric motor powered mechanical gear and linkage system as a preferred example, various changes may be made such as utilizing an air motor, or other means of power, mechanical linkages, electronic mechanisms, or combinations of such mechanisms to accomplish the same results.

While the invention has been described with particular reference to the construction shown in the drawings and while various changes may be made in the detail construction, it shall be understood that such changes shall be within the spirit and scope of the present invention as described in the appended claim.

Having thus completely and fully described the invention, what is now claimed as new and desired to be protected by Letters Patent of the United States is:

1. In a power-driven wire tying mechanism, the combination comprising: a housing, handles or means to hold said housing, means to hold a coil or source of tie wire consisting of a spool adapter to secure a coil of tie wire in such a manner as to cause it to rotate axially as required by the mechanism, means to separate certain component parts of said wire tying mechanism to accommodate the insertion of the coil of wire, means to insure the proper orientation of these component parts upon reassembly, power means consisting of an arrangement of cams and gears to cause extensible arms to move circumferentially and meet, means to give said extensible arms the capability for gripping and pulling the tie wire thereby encircling an object or objects with said tie wire, means to securely hold the ends of said tie wire after it has encircled said object or objects, power means consisting of an arrangement of cams and gears to twist or otherwise bind together both ends of said tie wire that is encircling said object or objects, power means consisting of a system of levers and links to mechanically sever that end of said tie wire which is still attached to said coil of tie wire, power means through an arrangement of cams and levers to release both ends of said tie wire that is encircling said object or objects, means to manually start or stop the operation of said wire tying mechanism at any instant during the operating cycle, means to maintain the component parts of the wire tying mechanism in the proper orientation at all times during the cycle even when the cycle is interrupted at any instant, means to automatically stop the operation of said wire tying mechanism at the end of a completed operating cycle to prevent recycling, and means to safeguard the operator and to protect the exposed moving parts of said wire tying mechanism from damage.

* * * * *