

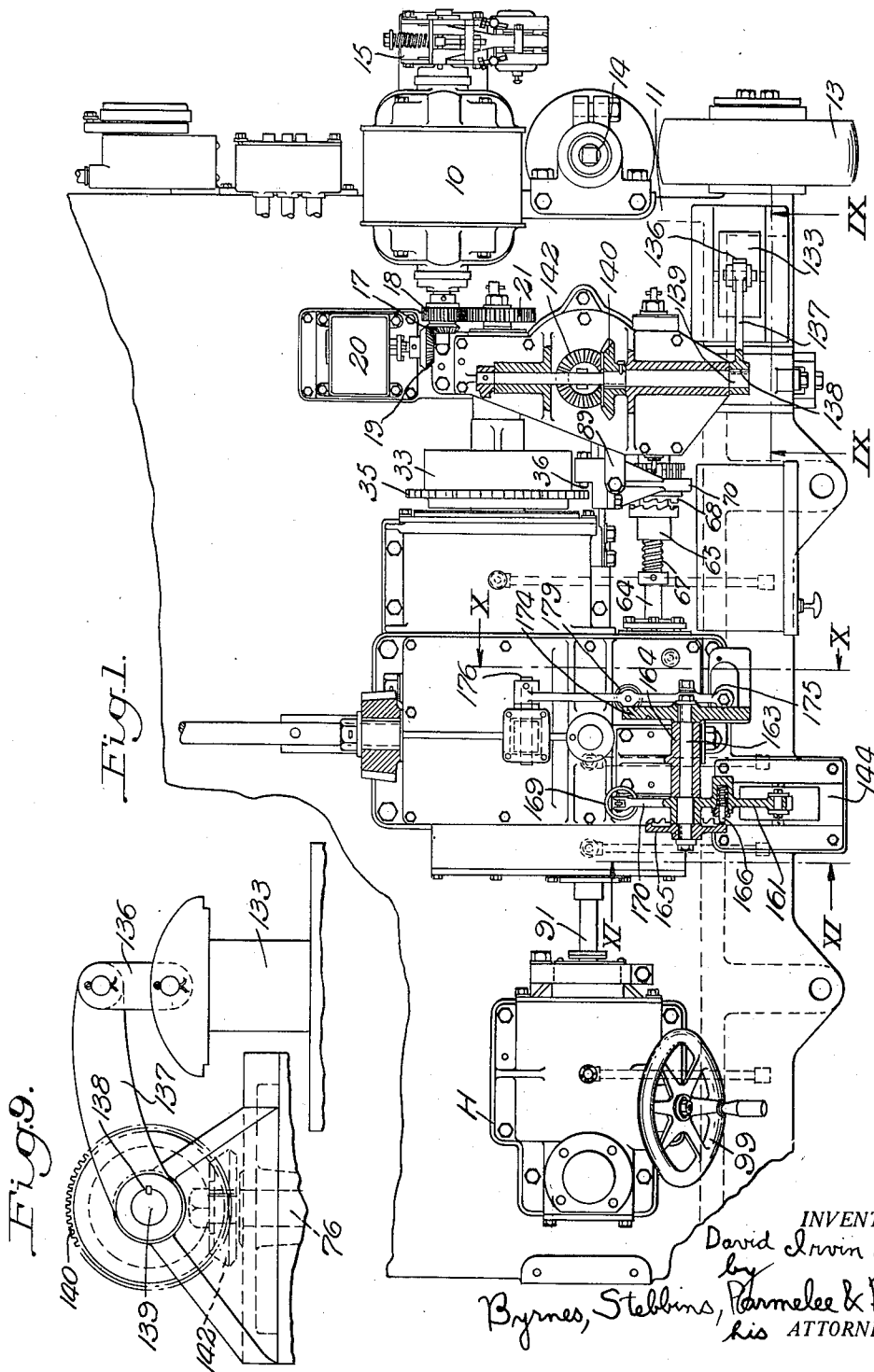
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2,026,023

DRIVING MECHANISM

Original Filed June 21, 1930 9 Sheets-Sheet 1



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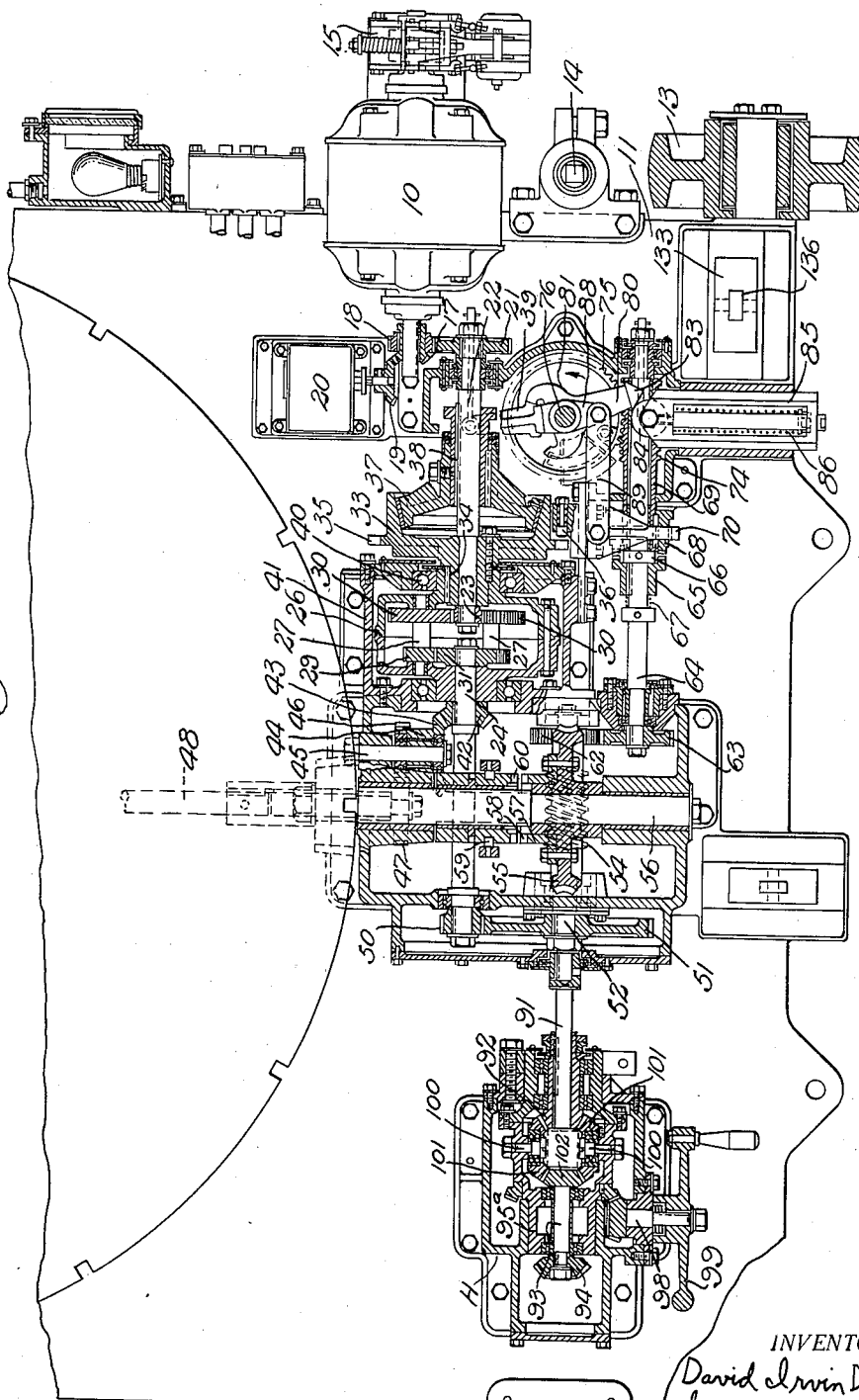
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DRIVING MECHANISM

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Fig. 2.



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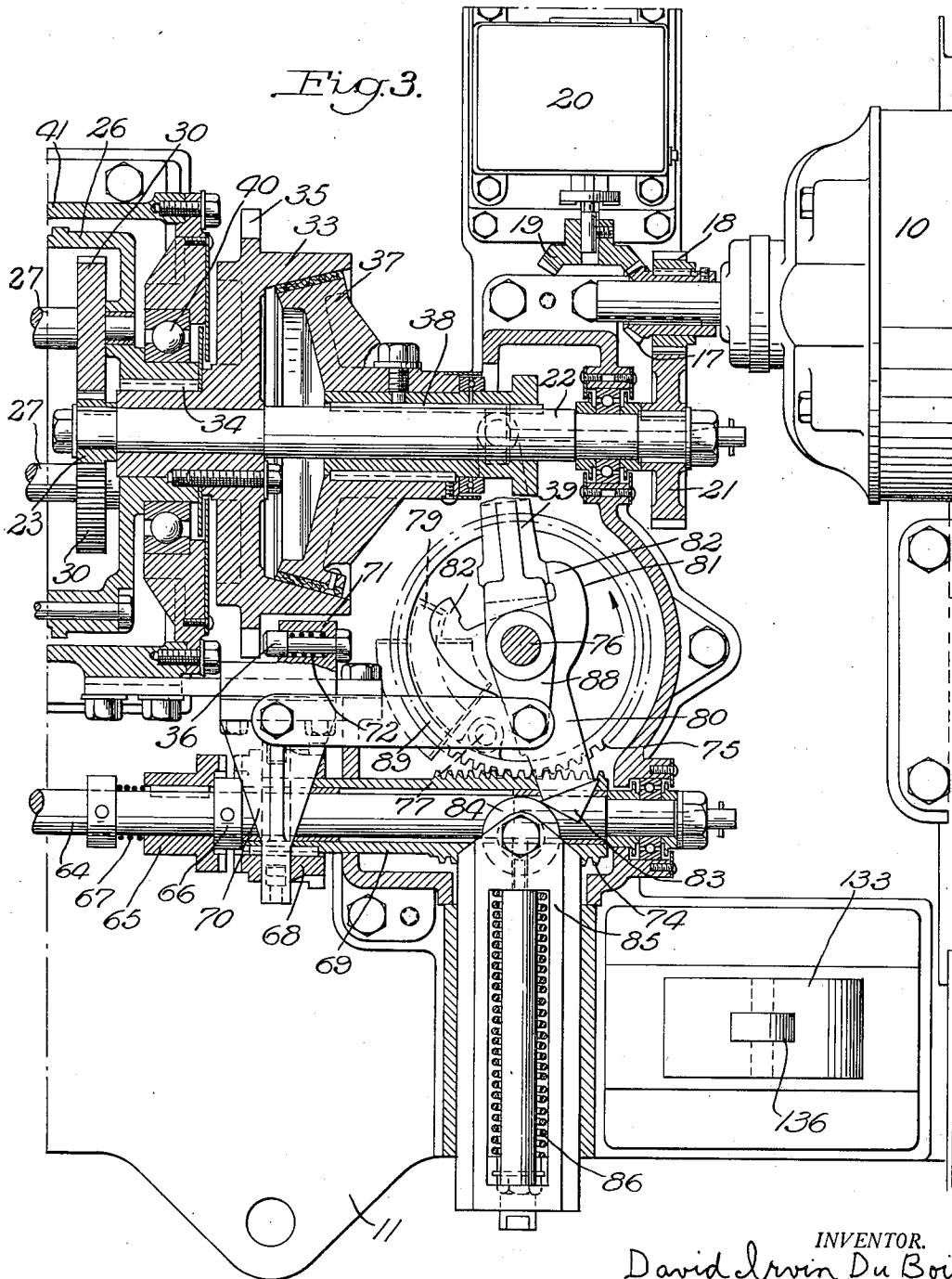
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DRIVING MECHANISM

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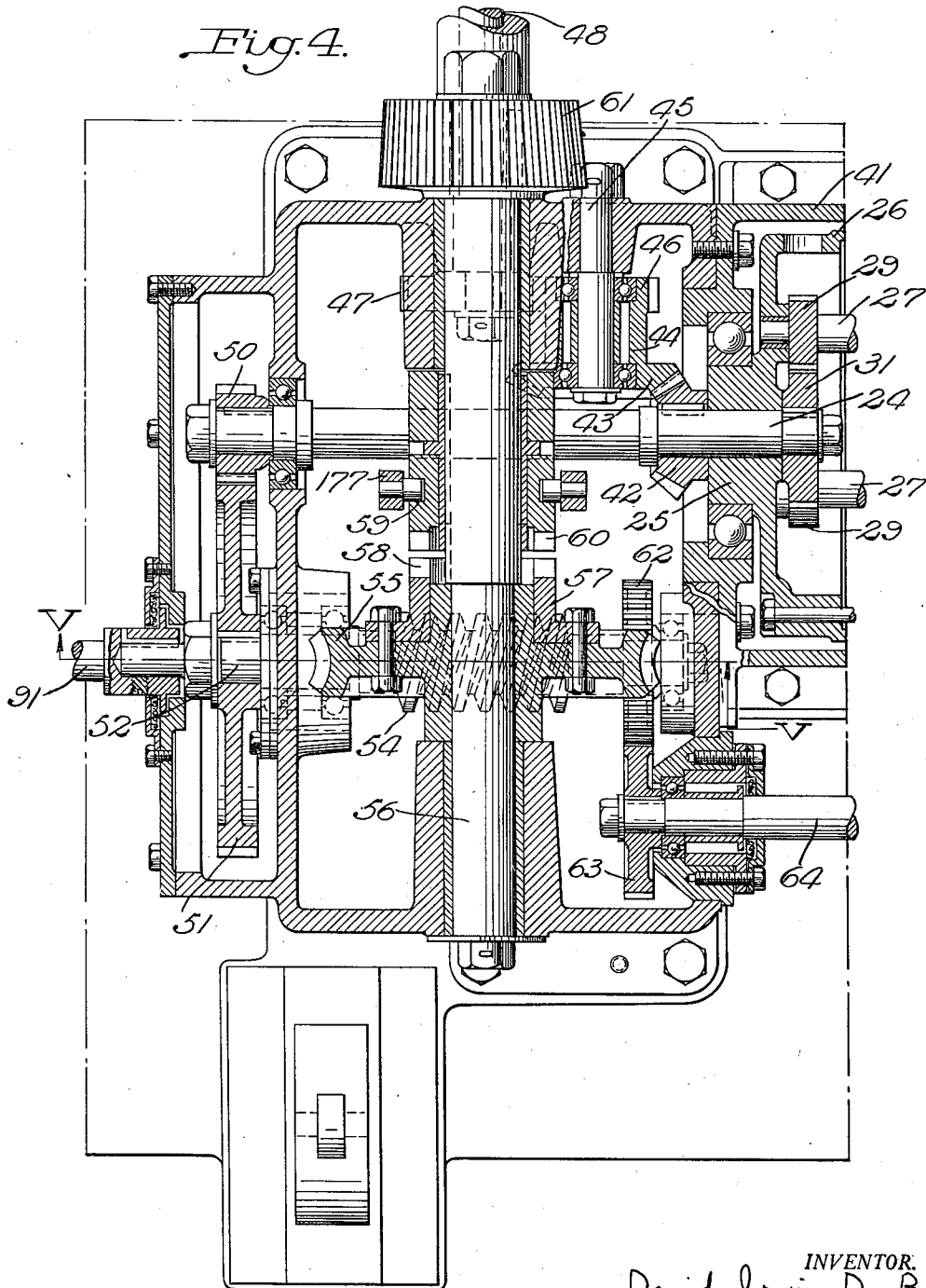
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DRIVING MECHANISM

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DRIVING MECHANISM

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Fig. 5.

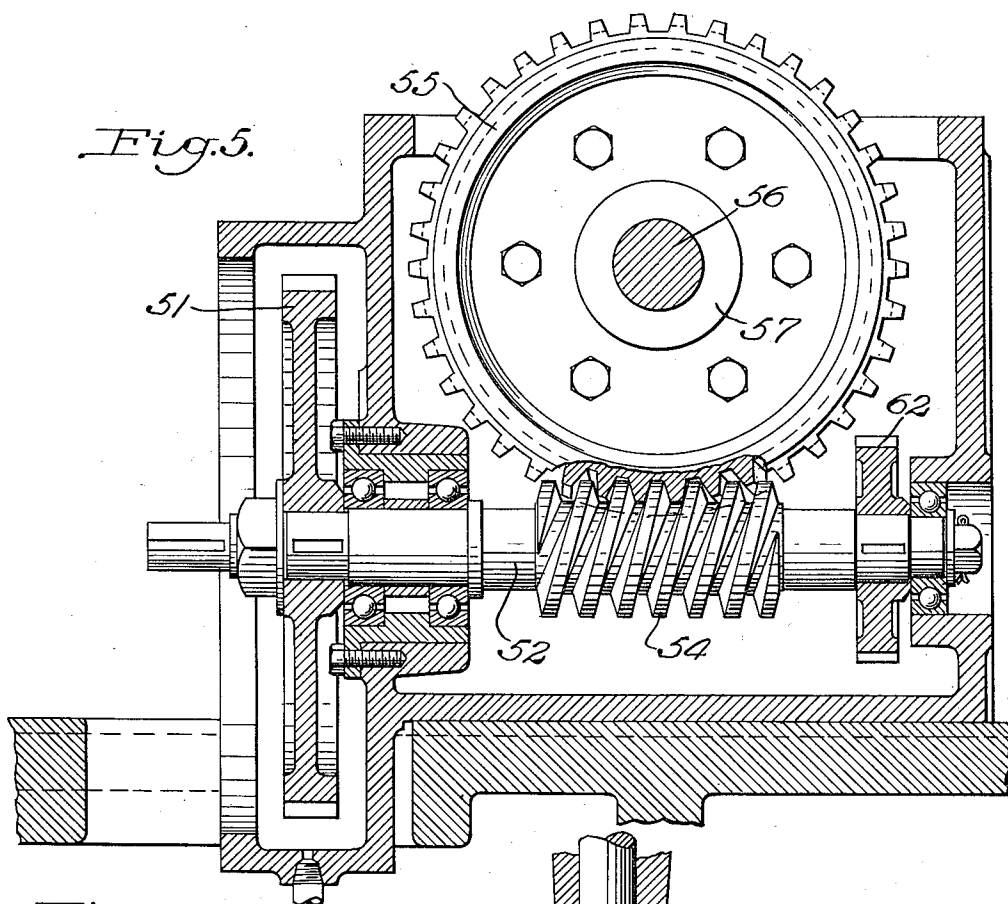
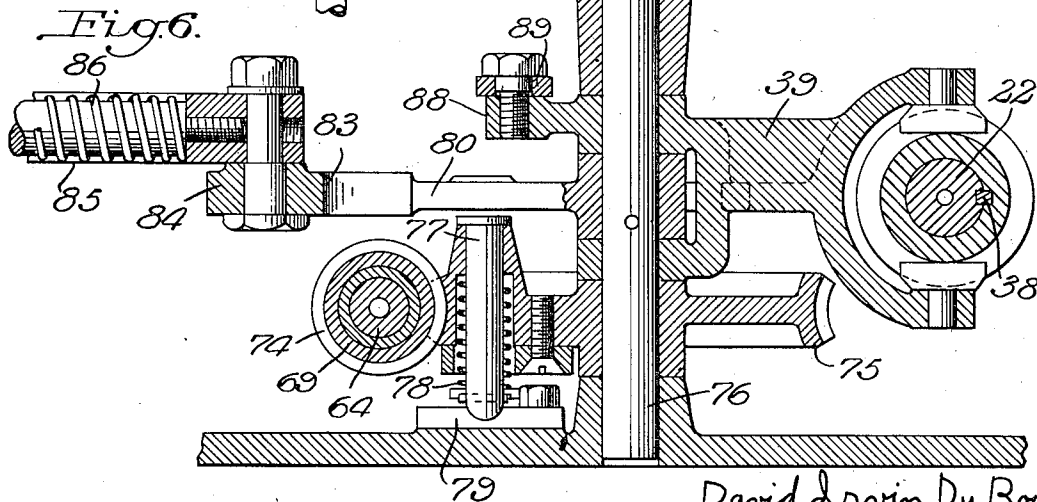


Fig. 6.



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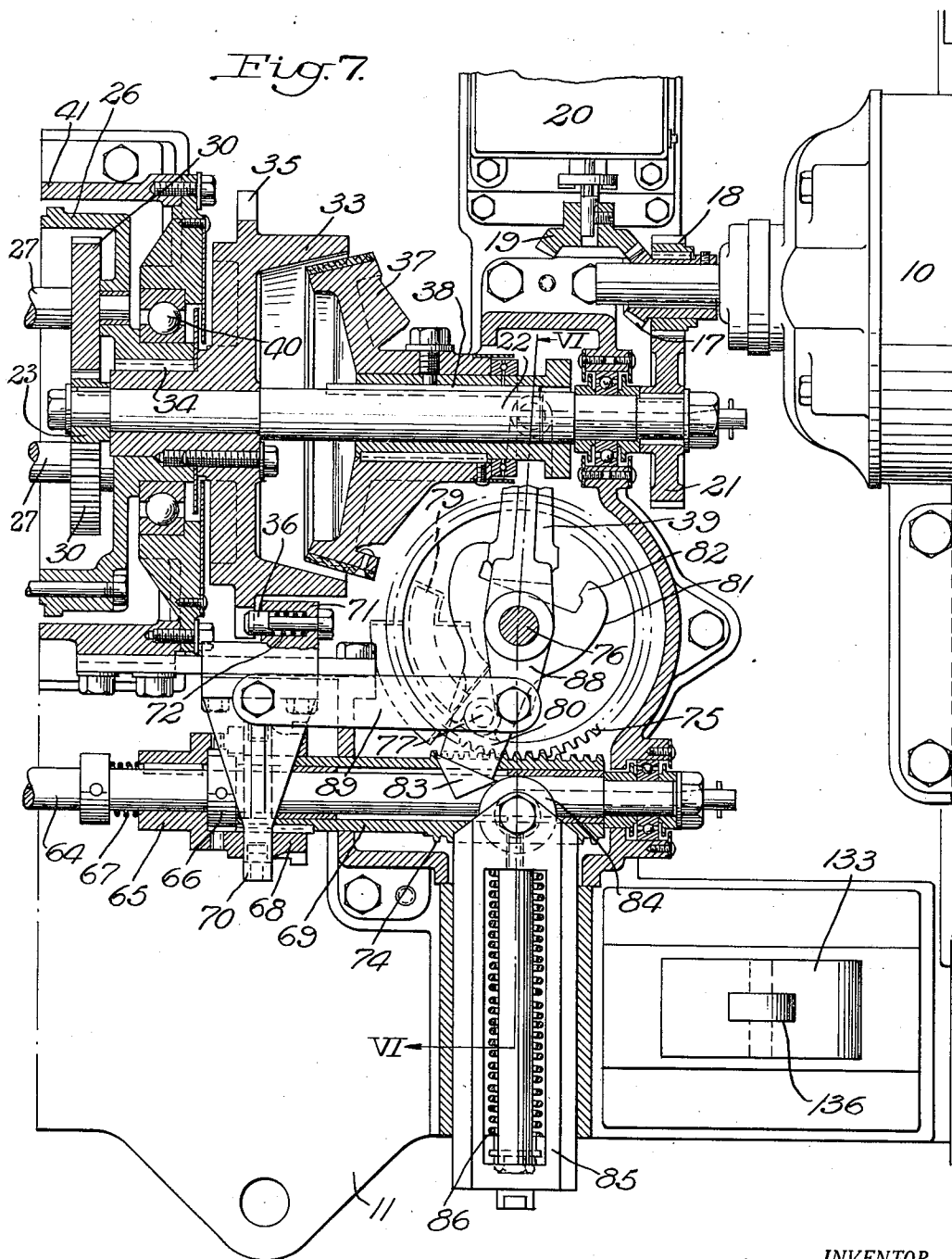
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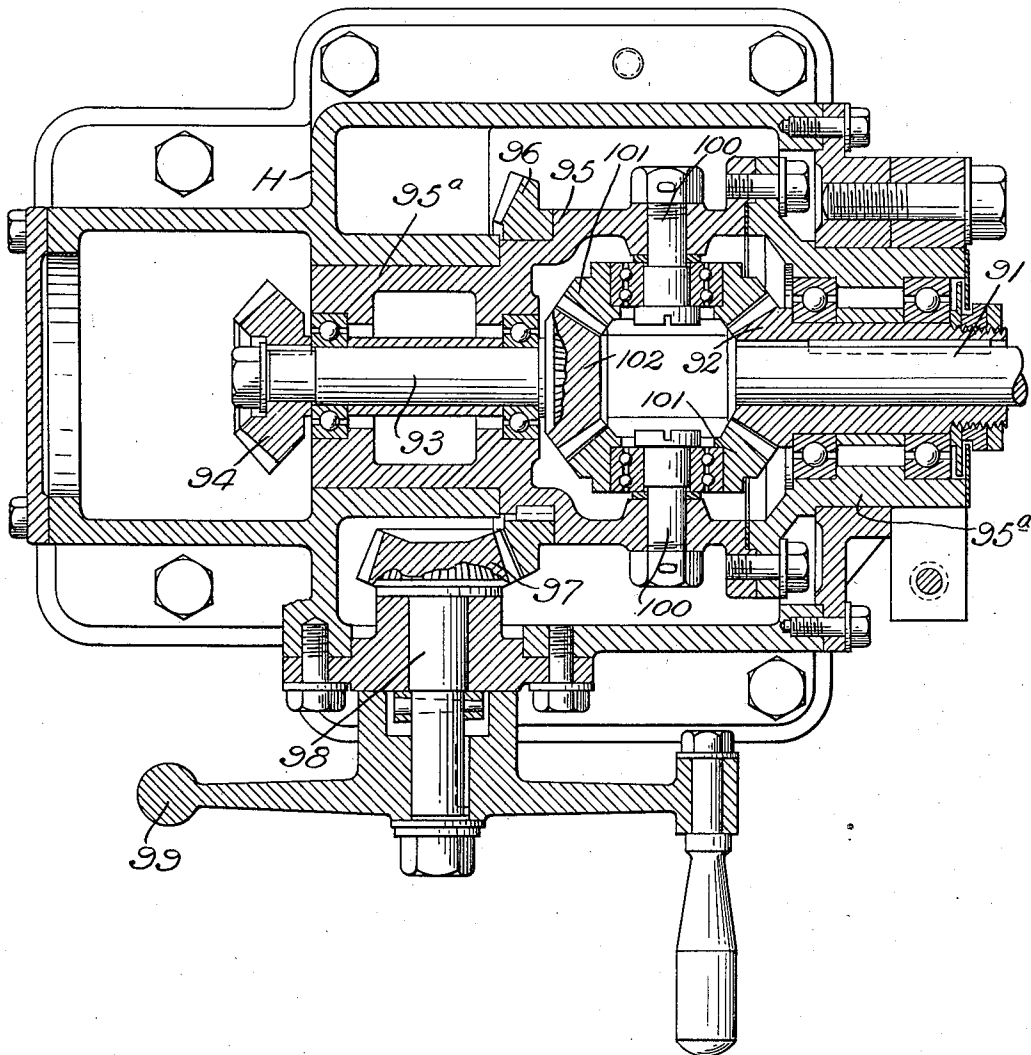
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Fig. 8.



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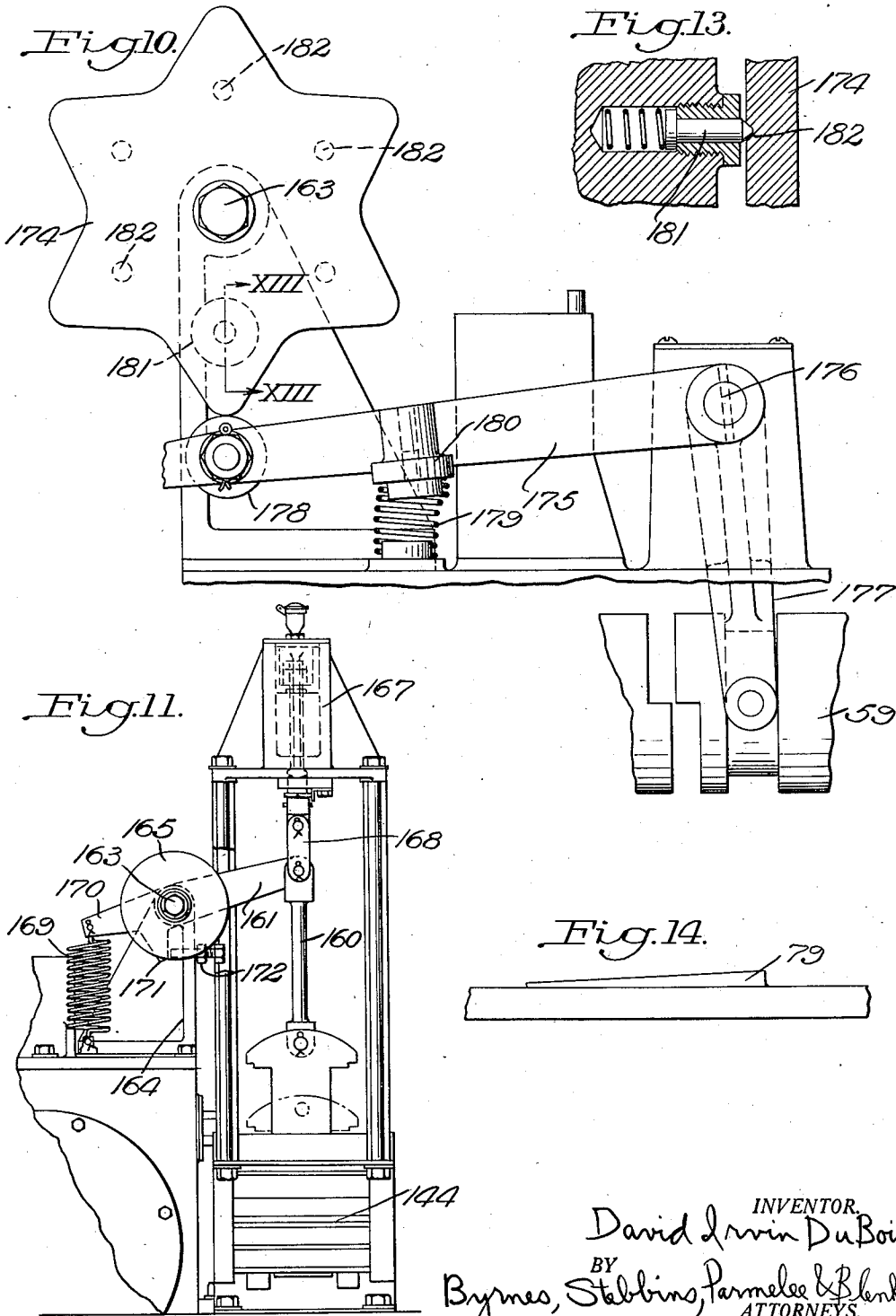
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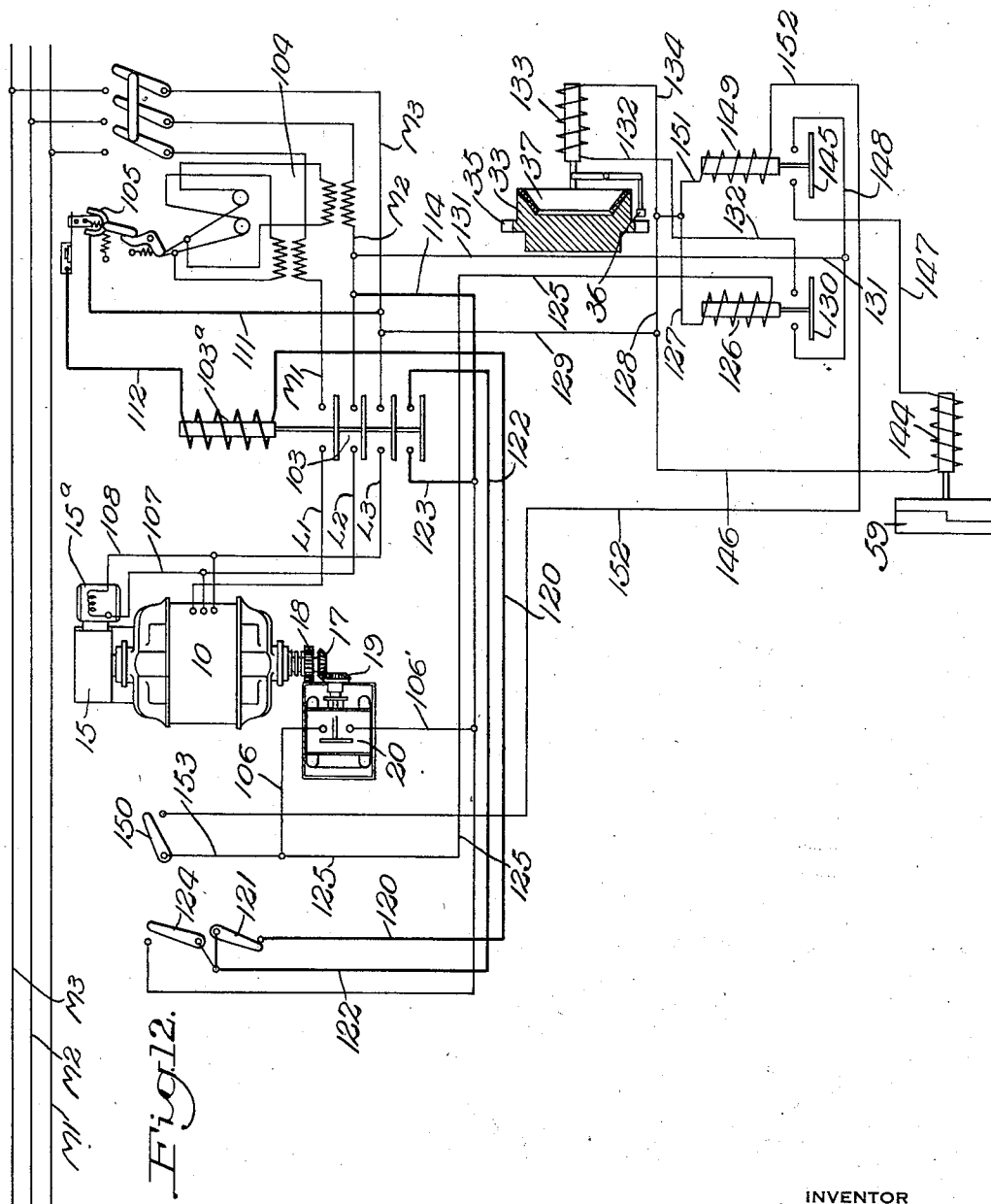
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UNITED STATES PATENT OFFICE

2,026,023

DRIVING MECHANISM

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Original application June 21, 1930, Serial No.
462,802. Divided and this application January
15, 1932, Serial No. 586,785

24 Claims. (Cl. 74—289)

The present invention relates broadly to a power transmission device, and more particularly to change speed mechanism whereby the load being driven by a prime mover may be set in motion, whereupon a shift is made to high speed driving connection.

It is well understood that a considerable problem is presented in bringing a load driven by a prime mover up to speed. If change speed mechanism under the control of the operator is provided, such as to permit a stepping up in the speed of the parts, the interval elapsing before the step up in speed occurs is entirely dependent upon the skill of the particular operator in charge of the machine.

In accordance with this invention, difficulties of this character are obviated; and there is provided a driving mechanism automatically controlled and effective for ensuring commencement of operation at some predetermined relatively low speed with a transition under predetermined conditions only, from this speed to a higher speed.

This application is a division of application Serial No. 462,802, filed June 21, 1930, for Plastic forming apparatus.

In the accompanying drawings in which, for purposes of illustration and not as limiting my invention, I have shown one embodiment which the same may assume.

Fig. 1 is a plan view of the driving mechanism, parts being shown in section;

Fig. 2 is a horizontal sectional view, parts being shown in plan, of the driving mechanism of Fig. 1;

Figs. 3, 4 and 8, taken together, are sectional views corresponding to Fig. 1, but on a much enlarged scale;

Fig. 5 is a vertical sectional view partly broken away and partly in elevation on line V—V of Fig. 4, the worm wheel being shown principally in elevation;

Fig. 6 is a central vertical section on line VI—VI of Fig. 7, partly broken away and partly in elevation showing the clutch driving mechanism;

Fig. 7 is a partial sectional view illustrating a portion of the driving mechanism in the position for slow speed driving;

Fig. 9 is a view in elevation from line IX—IX of Fig. 1, illustrating the automatic control mechanism for the change speed gearing;

Fig. 10 is a view in side elevation of the mechanism for shifting the main clutch of the machine and is taken on line X—X of Fig. 1;

Fig. 11 is a view in elevation of the solenoid

and related mechanism for shifting the main clutch of the machine, and is taken at XI—XI of Fig. 1;

Fig. 12 is a wiring diagram of the controlling circuits for the main driving motor;

Fig. 13 is a detail sectional view on line XIII—XIII of Fig. 10; and

Fig. 14 is a side elevational view of the trip cam for controlling the change speed clutch mechanism.

In the parent application, the driving mechanism is shown operatively connected to a glass working machine and to a glass feeding machine. In the arrangement there shown, the driving motor 10, together with the driving mechanism are carried by the base 11 of the machine. This base is wheel mounted, one of the wheels 13 being shown in Figs. 1 and 2. When the machine has been properly located in correct relation to other apparatus with which it is designed to cooperate, a device 14 is screwed down into engagement with the floor of the shop to securely hold the machine in position.

As disclosed in the parent application, the motor 10 is an electric motor, although it is to be understood that my invention is not limited to this type of motor, and that other suitable types of prime movers may be employed. The outer end of the motor shaft is provided with a solenoid brake 15 which is automatically applied when the current is cut off from the motor. Electrical equipment for controlling such a brake may be readily secured, since such equipment is well known. To the other or inner end of the motor shaft is secured a combination gear comprising a bevel gear 17 and a pinion 18, the pinion conveniently surrounding the hub of the bevel gear and being secured thereto for simultaneously rotating therewith. The bevel gear meshes with a bevel gear 19 secured to the shaft of a switch 20, which may be of any desired type and construction such, for example, as the well known Carpenter switch. In such a type of switch, starting of the motor opens the circuit through the same, and this circuit is closed when the motor is deenergized.

A spur gear 21 meshes with the pinion 18, this gear being secured to one end of a clutch shaft 22 (see Fig. 2). A pinion 23 is secured to the other end of this clutch shaft. A shaft 24 (see Figs. 2 and 4) is mounted co-axially with the clutch shaft 22. The shaft 24 is rotatably supported at one end in the hub 25 of a rotatable gear casing 26. Jack shafts 27 (preferably 3 in number) are rotatably supported in bearings pro-

vided by the casing 26, and extend lengthwise of the casing in substantially parallel relationship to the clutch shaft 22 and the shaft 24. The jack shafts are equidistantly spaced in concentric relation to the clutch shaft. To each of these jack shafts is secured a small gear 29 and a large gear 30. Meshing with the small gears 29 is a center gear 31 secured to the shaft 24 while the pinion 23 splined to the clutch shaft 22 functions as the second center pinion which meshes with the large gears 30.

With the construction just described, if the casing 26 is held stationary, the motor 10, through pinion 23 and the trains of gears 30, 29 and 31, drives the shaft 24 at a speed lower than the speed of the clutch shaft 22. This is obviously true, as during such a driving operation there is an initial speed reduction between the center pinion 23 and the large gears on the jack shafts 27, and a second speed reduction between the small gears on the jack shafts and the center pinion 31. If, however, the casing 26 is locked to rotate with the clutch shaft, the gears 23, 30, 29 and 31 are held against relative rotation, and the shaft 24 is accordingly driven by the motor 10 at the speed of the clutch shaft. For the purpose of thus locking the gear casing 26 to the clutch shaft, I provide a clutch shoe 33 keyed at 34 to the gear casing 26. In order to hold the clutch shoe 33 against rotation, slots 35 are formed in the periphery thereof in such position as to be engageable by a pin 36 actuated by mechanism later to be described. A cone clutch 37 is feathered at 38 to the clutch shaft. A shipper 39 cooperates with a groove in the outer end of the cone clutch to effect movement thereof axially of the clutch shaft. When the cone is forced inwardly its periphery engages a friction surface on the interior of the clutch shoe 33, and the gear casing 26 is accordingly locked for rotation with the clutch shaft, the pin 36 at this time being in the position illustrated in Fig. 3 out of engagement with any of the slots 35.

The casing 26 may be mounted for rotation on ball bearings 40 supported in the housing 41. Keyed to the shaft 24 adjacent the hub 25 of the casing 26 is a bevel gear 42 meshing with a similar gear 43 formed integrally with a sleeve 44, this sleeve being journaled on a stud 45. A spur gear 46 also formed integrally with the sleeve 44 meshes with a gear 47 secured to the drive shaft 48 which constitutes a continuously driven power take-off of the driving mechanism.

To the outer end of the shaft 24 (see Fig. 4) is secured a change speed pinion 50 meshing with a gear 51 keyed to a worm shaft 52 (see Fig. 5). The gears 50 and 51 are herein referred to as change speed gears for the reason that by effecting a proper substitution for the gears shown of different sizes, the speed of the shaft 52 may be varied at will.

On the worm shaft 52 is a worm 54 meshing with a worm wheel 55 rotatably supported on a drive shaft 56. The hub 57 of the worm wheel 55 is provided with a clutch tooth 58 (Fig. 4). A shiftable clutch member 59 is splined to the drive shaft 56, and is provided with a clutch tooth 60 which, when in engagement with the tooth 58, causes driving of the apparatus or machinery which is driven through the shaft 56. Thus, the main driving clutch just described controls the driving connections between the motor and this machinery or the like.

On the worm shaft 52 adjacent the worm 54

is keyed a pinion 62 meshing with a pinion 63 keyed to a trip mechanism drive shaft 64. A clutch member 65 (Fig. 3) is splined to the trip mechanism drive shaft 64, and is urged against a collar 66 by a spring 67. A second shiftable clutch member 68 is splined to a hollow shaft 69. Cooperating with the clutch member 68 to move the same longitudinally of the hollow shaft is a clutch shifter 70 whereby engagement of the two clutch members may be effected for driving the hollow shaft. This clutch shifter is provided with an extension 71 formed with a bore in which is received the clutch locking pin 36 normally urged outwardly into the position illustrated in Fig. 3 by a spring 72. When the shifter 70 is moved to the left as viewed in this figure, the pin 36 will engage one of the slots 35 in the clutch shoe and hold the same against rotation, the clutch members 65 and 68 at this time being in engagement so that the hollow shaft 69 is rotated.

Formed on the hollow shaft 69 is a worm 74 (see Fig. 6), meshing with a worm wheel 75 rotatably mounted on a vertical shaft 76. A vertical trip pin 77 is slidably received within the worm wheel 75, a spring 78 pressing the trip pin toward its lowermost position. A trip cam 79 is formed on the base of the drive housing in such position that during rotation of the worm wheel 75 in the direction of the arrow in Fig. 3, the trip pin is caused to ride upwardly onto and over the trip cam. As the worm wheel nears the end of one complete revolution, the trip pin engages a lever arm 80 of a trip lever 81 secured to the vertical shaft 76. This trip lever is provided with forks 82 for engaging opposite sides of the clutch shifting member 39. The outer end of the lever arm 80 is sharpened or pointed, as indicated at 83, to cooperate with a roller 84 carried by a slide 85 pressed inwardly by a spring 86. Due to this construction, it will be apparent that movement of the trip lever brings the pointed end 83 into engagement with the roller 84, so that when the pin passes the center of the roller, the roller will snap to its extreme position, thereby forcing the trip lever into its extreme position in the opposite direction and producing a quick throw or snap action of the trip lever.

The clutch shifting member 39 has a rearwardly projecting arm 88 to which is pivoted a link 89. The other end of this link is pivotally connected to the clutch shifter 70. It will be apparent, therefore, that starting with the shafts 64 and 69 clutched together, as indicated in Fig. 7, the worm wheel 75 will be rotated for nearly a complete revolution, or until such time as the trip pin 77 has been moved upwardly by the trip cam 79 to bring its upper end into engagement with the lever arm 80. This will cause the right hand fork 82 to engage the clutch shifting member 39 and move the same to the left into the position shown in Fig. 3. This movement brings the cone 37 into engagement with the clutch shoe 33 to produce high speed driving of the machinery, and simultaneously moves the pin 36 out of contact with the teeth 35. Obviously, the shafts 64 and 69 are disconnected simultaneously with the withdrawal of the pin 36, the parts being interconnected for this purpose.

From the foregoing description, it will be apparent that starting with the parts in the position illustrated in Fig. 7, the shaft 24 will be driven at low speed through the reduction gearing provided for this purpose and located in the hous-

ing 26. After a predetermined period of such slow speed rotation, the automatic trip mechanism will be actuated, independently of any act on the part of the operator, for shifting the cone clutch, and thereby establish such a driving relationship of the parts that the shaft 24 will be rotated at high speed. There is thus secured a condition of slow speed drive for a predetermined period effective for overcoming the friction of rest of the machinery, which period of slow speed drive is followed without manual intervention by the normal high speed operating condition, the two conditions following each other in definite sequence and timed relation.

Through the shaft 24 is driven a shaft 48 which constitutes a continuously driven power take-off of the driving mechanism. Through this same shaft 24 is also driven the machinery or the like connected to the drive shaft 56. I have furthermore provided a third power take-off driven from the shaft 24, in which power take-off is embodied means for advancing or retarding the mechanism thus driven relative to the other mechanism driven through shaft 24. The driving arrangement thus provided makes it possible to bring up to speed a plurality of driven elements, the change in speed being brought about automatically upon movement of one of the elements through a predetermined distance; and then while the drive of the plurality of elements is continued, one of these elements may be advanced or retarded relative to the others.

This third power take-off is shown more particularly in Fig. 8. To the outer end of the worm shaft 52 to which the change speed gear 51 is keyed, is connected a drive shaft 91, this drive shaft in reality constituting an outward continuation of the worm shaft so as to rotate in unison therewith. To the outer end of the drive shaft 91 is secured a bevel gear 92. An intermediate shaft 93 is arranged co-axially with the shaft 91, and carries a bevel gear 94 constituting a third power take-off driven from the shaft 24.

An adjustable casing 95 is supported by trunnion bearings 95a journaled in the differential housing H. Secured to and extending around the adjustable casing 95 is a gear 96 adapted to be rotated by a pinion 97 secured to an adjusting shaft 98 extending through the differential housing H and carrying at its outer end a hand wheel 99 whereby the desired adjustment may be effected.

Extending radially of the casing 95 is a plurality of studs 100 disposed in a common plane, and each carrying at its inner end an intermediate gear 101 meshing respectively with the bevel gear 92 on the drive shaft 91 and with a second gear 102 on the shaft 93. If the casing 95 be held stationary, the drive shaft 91 rotates the shaft 93 through the bevel gears 101 in the opposite direction, but without speed change. If, during the rotation of these shafts, the hand wheel 99 be rotated, the shaft 93 will be retarded or advanced relative to the drive shaft 91, depending upon the direction in which the hand wheel is rotated. This mechanism, therefore, constitutes a differential of generally standard characteristics whereby the power take-off 94 may be speeded up or slowed down relative to the other elements, such as the shafts 48 and 56, driven through the shaft 24.

Automatic control

is conveniently of the alternating current induction type. In Fig. 12 there are shown main alternating current power lines M1, M2 and M3. An automatic over-load safety mechanism 104 is provided for preventing burning out of the motor or of the other devices supplied with current from the power lines. Any suitable type of overload mechanism may be employed, this mechanism herein being shown diagrammatically as including induction coils for supplying induced current to a circuit including heating elements. If sufficient expansion of the heating elements takes place, due to their being raised to too high a temperature, a switch 105 is opened. As will be later explained, this switch 105 is in series in a circuit which controls a main switch solenoid 103a arranged to open and close the main switch 103. The main switch 103 comprises four bars, of which three connect and disconnect the lines M1, M2 and M3 to the motor leads L1, L2 and L3, respectively.

The armature shaft of the motor projects at both ends, one end carrying the gears 17 and 18, as fully described in connection, more particularly, with Fig. 1 of the drawings, the gear 17 meshing with a bevel gear 19 which drives the mechanism 20 including a switch for making connection between lines 106 and 106'. At all times when the motor is running, this switch is opened, while as soon as the motor stops, the switch closes to connect line 106 to line 106'.

The other end of the armature shaft carries an automatic brake 15 for stopping the motor whenever the supply of current thereto is cut off. This brake is actuated by a brake solenoid 15a which, when energized, releases the brake so that the motor may run, a spring or equivalent device applying the brake when the solenoid is deenergized. A circuit including a wire 107 and a wire 108 supplies current to the brake solenoid whenever the switch 103 is closed, the wire 107 being connected to the current carrying line L2 and the wire 108 being connected to the current carrying line L3. Obviously, therefore, the brake solenoid is connected across one phase of the alternating current supply, but is energized whenever current is supplied to the motor 10. Current for actuating main switch solenoid 103a is supplied by a circuit including a wire 111 leading from the power line M3 to the switch 105, a line 112 leading from the switch 105 to the main switch solenoid 103a, and a circuit which will be further described and which returns by way of wire 114 connected to the power line M2.

Current flowing through line 111, switch 105, line 112 and the main switch solenoid 103a flows also through a line 120 leading to one terminal of a stop switch 121. The stop switch is biased to closed position, so that it normally bridges or connects its two terminals. Current, therefore, flowing through line 120 flows also through line 122, but will be interrupted if the switch 121 is opened. The line 122 is connected to the line 114 whenever current is flowing to the motor 10, the connection being completed by a fourth bar 65 on the switch 103 and a line 123. It will be apparent, therefore, that a circuit across one phase of the alternating current supply is completed through the switch 121 so long as current is flowing to the motor 10; and that whenever the switch 121 is opened, the solenoid 103a is deenergized, opening the main switch 103.

A start switch 124 is provided for closing the circuit to the main switch solenoid 103a after the flow of such current has been interrupted. The

The motor 10, where an electric motor is used,

start switch 124, which is normally in open position, is adapted to close the connection between the line 114 and the line 120. In such case, the circuit across the main power line M2 and line M3 is completed through the line 114, switch 124, switch 121, line 120, main switch solenoid 103a, line 112, switch 105 and line 111. A spring or equivalent device (not shown) is arranged to open the main switch 103 whenever the main switch solenoid 103a is de-energized. The closing of the start switch 124 energizes the main switch solenoid for closing the main switch, as described. It is unnecessary to hold the starting switch closed, once the main switch solenoid has been energized, since the fourth bar of the main switch 103 completes the circuit through the lines 114, 123, 122 and 120, this circuit being unbroken so long as the stop switch 121 remains closed. Since the main switch 103 immediately opens if current ceases to flow through the main switch solenoid 103a, the latter is de-energized and the motor is stopped if the stop switch 121 is opened. It will furthermore be noted that the driving mechanism may be stopped due to an overload, causing opening of the switch 105.

The line 106' above mentioned connects the line 114 to the automatic switch in the mechanism 20. When this automatic switch closes, a circuit is completed through the wire 106, wire 125, a contactor solenoid 126, line 127, line 128 and line 129 connected to the main power line M3. This completes the circuit across the lines M2 and M3 and energizes the contactor solenoid 126 to close a switch 130. The closing of this switch completes a circuit through line 131 connected to the main power line M2, switch 130, line 132, a trip solenoid 133, line 134, line 128 and line 129. A circuit is, therefore, completed across lines M2 and M3 to energize such trip solenoid 133.

As is shown in Fig. 9, the trip solenoid 133 is connected by a link 136 to a lever arm 137 keyed at 138 to the shaft 139. To this shaft is also keyed a bevel gear 140 meshing with a similar gear 142 keyed to the vertical shaft 76. It will be obvious, therefore, that when the trip solenoid 133 is energized, the shaft 76 will be rotated in the opposite direction to that effected by the worm wheel 75, this rotation swinging the lever 80 in a clockwise direction as viewed in Fig. 3, to bring the left-hand fork 82 into engagement with the clutch shifting member 39 for swinging it in a clockwise direction and disengage the cone clutch 37 from its shoe 33. At the same time, the pin 36 is moved into engagement with one of the slots 35 in the clutch shoe. Since the automatic switch 20 is opened while the motor is running and closed when the motor stops, the trip solenoid 133 is energized each time the motor stops and de-energized when the motor starts. Due to this construction, each time the motor stops the cone clutch is automatically moved into its slow speed driving position, so that when the motor is again energized, driving of the shaft 24 and the various power take-offs must be initiated with the parts in a previously determined slow speed relation.

In convenient relationship to the starting switch 124, I provide a switch for controlling movement of the main clutch 59 and connecting and disconnecting the main driving gear 61 to or from the driving mechanism. This clutch is controlled by a clutch solenoid 144 (Fig. 11), included in a circuit which may be connected across the lines M2 and M3 by a switch 145. This circuit includes wire 129, a wire 146, the clutch solenoid

144, wire 147, the switch 145, wire 148 and wire 131. The switch 145 is controlled by a contactor solenoid which may be energized by the closing of the switch 150 which is conveniently located with relation to the starting switch 124. Upon closing of this switch 150, a circuit is completed across the main power lines M2 and M3 by way of wire 129, wire 128, wire 151, contactor solenoid 149, a wire 152, the switch 150, wire 153, wire 106, the automatic switch in mechanism 20, wire 106' and wire 114.

It will be noted that upon starting of the motor, the connection between wires 106 and 106' is broken. The closing of the switch 150 will, therefore, have no effect upon the clutch solenoid 144 if the motor is running, due to the break between the lines 106 and 106'. This precaution is taken to prevent any possibility of shifting of the main clutch during operation of the motor itself. The clutch solenoid 144 (Fig. 11) is connected by a link 160 to an arm 161 of a lever freely rotatably mounted on a shaft 163 in turn rotatably mounted in a support 164 (Fig. 1). A ratchet wheel 165 is keyed to the shaft 163. As the arm 161 is swung downwardly, a spring 25 pressed pawl 166 carried by the arm engages a tooth of the ratchet wheel 165 and effects a partial rotation thereof. A dash pot 167 is connected by a link 168 to the solenoid link 160. A spring 169 is connected to the opposite arm 170 of the lever from the arm 161. This is a coil spring tending to pull the arm 170 downwardly when the clutch solenoid is de-energized. A lug 171 projects downwardly from the lever arm 170 and is engaged by an adjustable abutment screw 172 for limiting the downward movement of the lever arm.

To the shaft 163 (see Figs. 1 and 10) is secured a star wheel 174. Beneath the star wheel is the outer end of a clutch shifting lever 175 secured to shaft 176 of a main clutch shifting member 177. A roller 178 is carried by the outer end of the lever arm 175 in position to be engaged by the teeth of the star wheel 174. A compression spring 179 disposed below an abutment 180 on the lower side of the lever arm 175 tends to swing the lever arm upwardly to maintain the roller 178 in engagement with the teeth of the star wheel, rotation of the star wheel therefore being effective for moving the lever through the medium of the roller 178 against the action of the spring 179. A spring pressed pawl 181 is adapted to cooperate with depressions 182 in one side of the star wheel 174 to maintain the star wheel in the position to which it is moved by the ratchet wheel 165 with the roller 178 in engagement with one of the high points of the star wheel. No latch mechanism is required to maintain the lever arm 175 in its raised position because at this time the roller 178 is intermediate two of the points of the star wheel and is held upwardly in this position by the spring 179.

The driving mechanism just described is connected to apparatus, machinery or other load to be driven through a main clutch 59. This main clutch 59 may be moved by the solenoid 144 into engaging position only when the motor 10 is at rest, since at other times the source of current for the solenoid 144 is cut off by the automatic switch mechanism 20. It is accordingly apparent that the mechanism for shifting the main clutch 59 is inoperative except at such time as the driving mechanism is stationary.

It will furthermore be noted that the solenoid 133 is supplied with current which flows through the automatic switch mechanism 20. As has

been previously explained, the solenoid 133 pulls the lever arm 137 downwardly as soon as the flow of current through the automatic switch mechanism 20 is interrupted by stopping of the motor 10. This movement of the lever arm 137 withdraws the cone clutch from engagement with the clutch shoe; and accordingly the driving mechanism is left in condition for driving at slow speed whenever the motor is again supplied with current to start driving of the mechanism again. There is accordingly no need for the operator to take precautions to insure that the driving mechanism be so related as to drive at low speed when the motor 10 is started, since such arrangement of the driving mechanism is automatically ensured. While the machinery is coming up to speed, the operator can give his attention to other duties, since the shift from low speed to high speed driving relation is automatically effected without the necessity of intervention on the part of the operator. It will be accordingly apparent that the starting and driving of the machinery is as nearly automatic as safety permits; and it is merely necessary that the operator determine that the machinery is ready for starting, and then to supply current to the motor 10.

While I have illustrated and described one specific form of driving mechanism, it will be understood that the invention is not restricted to the particular construction and arrangement shown, but may be variously modified within the contemplation of the invention and under the scope of the following claims, not only with respect to the mechanism itself, but also with respect to the uses or purposes to which it is placed.

I claim:

1. Driving mechanism comprising a prime mover, change speed mechanism operatively connected to said prime mover, an element driven through said change speed mechanism, and means for automatically effecting a change in the speed of said driven element through said change speed mechanism comprising timing mechanism driven by said prime mover for causing said change in the change speed mechanism; said timing mechanism setting itself to start with starting of the prime mover and to cause said change when driving through not more than a predetermined extent has been completed by said prime mover after starting.

2. In combination, a driven element, driving means therefor, operative driving connections between said driving means and said driven element including change speed gearing adapted to have the ratio of the gearing changed, and timing means timed by the extent of driving by said driving means for automatically effecting a change in the speed of said driven element by changing the gear ratio of the gearing, said timing means basing its timing period upon the starting of said driving means and causing said change in the gear ratio of the gearing, upon rotation of said gearing through not more than a predetermined extent after starting.

3. In combination, a driven element, driving means therefor, and operative driving connections between said driving means and said driven element, said driving connections comprising change speed gearing cooperating when in one relation to drive said element at one speed for a predetermined extent of movement only and cooperating when in another relation to drive said element at another speed indefinitely, and means timed by the rotation of said gearing for auto-

matically changing from the first relation of said gearing to the second relation thereof.

4. In combination, a rotatable driven element, driving means therefor, operative driving connections between said driving means and said driven element including change speed gearing and means movable to different positions to hold certain gears of said gearing against relative rotation whereby a change in the speed of said driven element is produced, and means for automatically moving said movable means to produce a change in the speed of said driven element upon rotation of said driven element through not more than a predetermined angle, while continuing movement of said driven element.

5. In combination, a driven element, driving means therefor, operative driving connections between said driving means and said driven element including change speed gearing operable for effecting a low speed and a high speed movement of said driven element and means movable to different positions to vary the operative relation between gears of said gearing whereby a change in the speed of said driven element from one speed to the other is produced, and means for automatically moving said movable means to produce a change from a low speed movement to a higher speed movement on the part of said driven element upon completion of not more than a predetermined movement of said element.

6. In combination, a driven element, driving means therefor, operative driving connections between said driving means and said driven element including change speed gearing, and means movable to different positions to change the gear ratio of said gearing whereby a change in the speed of said driven element is produced, means operable independently of the speed of the driving means and timed by the extent of driving after starting for automatically moving said movable means to produce an increase in the speed of said driven element, and means inoperative so long as said driving means is in motion but operative upon stopping of said driving means for automatically adjusting said change speed gearing for low speed driving.

7. In combination, a driven element, driving means therefor, operative driving connections between said driving means and said driven element including change speed mechanism having a clutch, said change speed mechanism being adaptable upon shifting of the clutch to produce high and low speed driving of said element, and means inoperative so long as said driving means is in motion to relate said change speed mechanism for low speed driving but operative upon stopping of said driving means for automatically shifting said clutch to relate said change speed mechanism for low speed driving.

8. In combination, a driven element, driving means therefor, operative driving connections between said driving means and said driven element including change speed gearing, and means movable to different positions to vary the gear ratio of said gearing whereby high or low speed of said driven element is produced, and means inoperative so long as said driving means is in motion to move said movable means into low speed driving position but operative upon stopping of said driving means for automatically moving said movable means into low speed driving position.

9. In combination, a driven element, driving means therefor, operative driving connections

between said driving means and said driven element including change speed gearing, and means movable to different positions to vary the relation between gears of said gearing whereby high or low speed of said driven element is produced, means for normally moving said movable means into high speed driving position only upon completion of a predetermined movement of said element, and means for automatically moving said movable means into low speed driving position upon stopping of said driving means.

10. In combination, a rotatable driven element, driving means therefor, operative driving connections between said driving means and said driven element including change speed gearing and means movable to different positions to hold certain gears of said gearing for movement together whereby a certain speed of said driven element is produced, or to release the gears whereby another speed of said driven element is produced, means for normally moving said movable means to hold said gears to produce said certain speed of said driven element only upon rotation thereof through a predetermined angle, and means for automatically moving said movable means to release said gears to produce said other speed of said driven element upon stopping of said driving means.

11. In combination, a driven element, actuating means therefor, operative driving connections between said actuating means and said driven element including change speed mechanism adjustable to produce high and low speed driving of said element, electrically actuated means for adjusting said change speed mechanism for low speed driving, and a switch automatically actuated upon stopping of the actuating means for supplying current to said adjusting means.

12. In combination, a driven element, actuating means therefor, operative driving connections between said actuating means and said driven element including change speed gearing, means movable to different positions to vary the operative relation between gears of said gearing whereby high or low speed of said driven element is produced, electrically actuated means for moving said movable means into low speed driving position, and a switch automatically closed upon stopping of the actuating means for supplying current to said electrically actuated means.

13. In combination, a plurality of driven elements, common driving means for said elements, operative driving connections between said driving means and one of said elements including change speed mechanism, operative driving connections between said driving means and the other of said elements including said change speed mechanism, said change speed mechanism comprising means for automatically effecting a simultaneous speed change in both of said elements upon movement of one of the elements through a predetermined distance, and means in said second mentioned driving connection for advancing or retarding the other element relative to the first element.

14. In combination, a plurality of driven elements, common driving means for said elements comprising a rotatable member, a prime mover, and operative driving connections including change speed mechanism between said prime mover and said rotatable member, said change speed mechanism comprising means for automatically effecting a speed change in said rotatable member upon rotation thereof through not more than a predetermined angle, and opera-

tive driving connections between said rotatable member and each of said driven elements, the driving connection to one of said driven elements including means for advancing or retarding the said element relative to said rotatable member.

15. In combination, a prime mover, a rotatable member driven thereby through change speed mechanism, said change speed mechanism comprising means for automatically effecting a speed change in said rotatable member upon rotation thereof through not more than a predetermined angle, a plurality of power take-offs, and operative driving connections between each of said power take-offs and said rotatable member, the driving connection to one of said power take-offs embodying differential gearing for advancing or retarding the said power take-off relative to said rotatable member.

16. In combination, a prime mover, a rotatable member driven thereby through change speed mechanism, said change speed mechanism comprising means for automatically effecting a speed change in said rotatable member upon rotation thereof through not more than a predetermined angle, a plurality of power take-offs, and operative driving connections between each of said power take-offs and said rotatable member, the driving connection to one of said power take-offs embodying differential gearing for advancing or retarding the said power take-off relative to said rotatable member and the driving connection to another of said power take-offs being controlled by a clutch.

17. In combination, a driven element, driving means therefor, operative driving connections between said driving means and said driven element including change speed gearing, and means movable to different positions to change the gear ratio of said gearing whereby a change in the speed of said driven element is produced, means operable independently of the speed of the driving means and timed by the extent of rotation of said gearing after starting for automatically moving said movable means to produce an increase in the speed of said driven element, a solenoid for restoring said movable means to lower speed position, and a switch for supplying current to said solenoid only when said driving means has stopped.

18. Driving mechanism comprising driving means, automatic change speed mechanism operatively connected to said driving means, and an element driven through said change speed mechanism by said driving means, said change speed mechanism being provided with a timing gear for timing an increase in the speed of said driven element automatically effected by said change speed mechanism, said timing gear being driven by said driving means and basing its predetermined timing period upon the starting of said driving means.

19. Driving mechanism comprising driving means, change speed gearing operatively connected to said driving means, an element driven through said change speed gearing by said driving means, means movable to different positions to change the gear ratio of said gearing whereby a change in the speed of said driven element is produced, and means for automatically moving said movable means to produce at a predetermined interval after starting an increase in the speed of said driven element including a timing gear driven by said driving means during said predetermined interval but normally stationary during high speed driving.

20. Driving mechanism comprising driving means, change speed gearing operatively connected to said driving means, an element driven through said change speed gearing by said driving means, means movable to different positions to change the gear ratio of said gearing whereby a change in the speed of said driven element is produced, and means for tripping said movable means to effect an increase in the speed of said driven element including a timing gear for determining the time of the tripping by said tripping means, said timing gear being driven by said driving means and automatically reset upon stopping of said driving means so as to measure its timing period from the starting of said driving means.

21. Driving mechanism comprising driving means, change speed gearing operatively connected to said driving means, an element driven through said change speed gearing by said driving means, means shiftable to different positions to change the gear ratio of said gearing whereby a change in the speed of said driven element is produced, a trip for quickly shifting said movable means to effect an increase in the speed of said driven element, a timing gear having a portion engageable with said trip to actuate the same, and operative driving connections between said driving means and said timing gear including a clutch disengaged upon actuation of said trip by said timing gear.

22. In combination, a motor, change speed gearing operatively connected to said motor to be driven thereby continuously so long as said motor is in operation, said change speed gearing including a friction clutch operable to change the gear ratio of said gearing, and means timed by the rotation of said gearing after starting of said motor for automatically shifting said friction

clutch to produce a higher ratio of said change speed gearing.

23. In driving mechanism, change speed gearing comprising a driving element and a driven element mounted for rotation on the same axis, sun gears secured to the adjacent ends of said elements, a gear couple rotatably mounted in a carrier and meshing respectively with said sun gears, said carrier being rotatably mounted on said axis to carry said gear couple orbitally about said axis, a friction clutch for connecting said driving element and carrier for rotation together, and means for holding said carrier stationary; said last-mentioned means being releasable upon actuation of said friction clutch to connect said driving element and carrier.

24. In combination, driving means, planetary gearing operatively connected to said driving means, an element driven through said planetary gearing by said driving means, said planetary gearing including a planetary gear carrier for controlling the gear ratio of said planetary gearing, means for holding said carrier stationary whereby low speed driving of said element is effected, a clutch for connecting said carrier to said driving means for rotation therewith whereby high speed driving of said element is effected, and means for automatically changing the gear ratio of said gearing a predetermined interval after starting including a device for shifting said clutch, a timing gear having a portion engageable with said device for simultaneously actuating said device and said carrier holding means so as to permit rotation of said carrier when said clutch is moved into engaged position, and means operatively connecting said driving means to said timing gear to drive the same including a clutch disengaged by said clutch shifting device.

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