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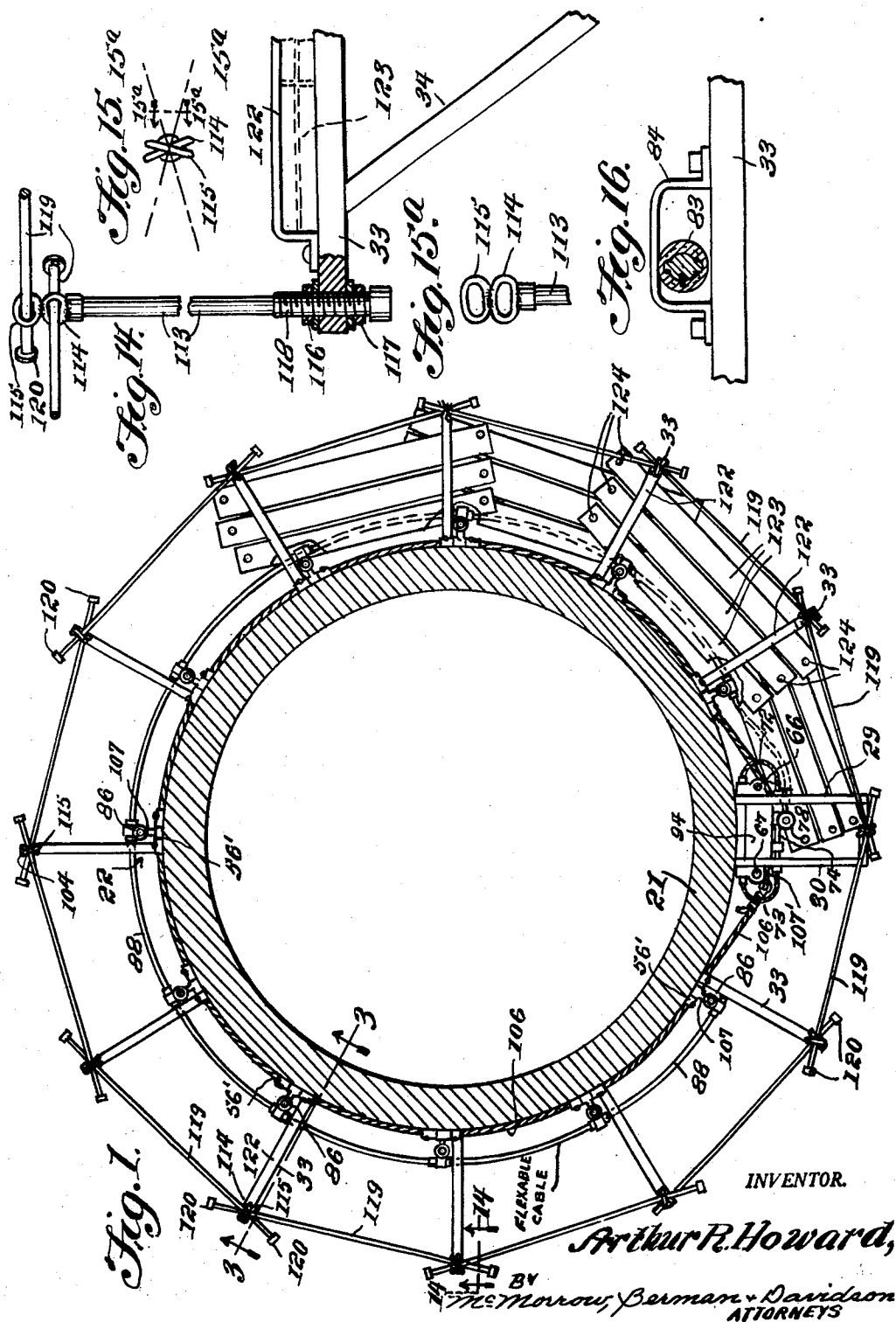
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2,906,365

AUTOMATIC SCAFFOLDING MACHINE

Filed Jan. 11, 1957

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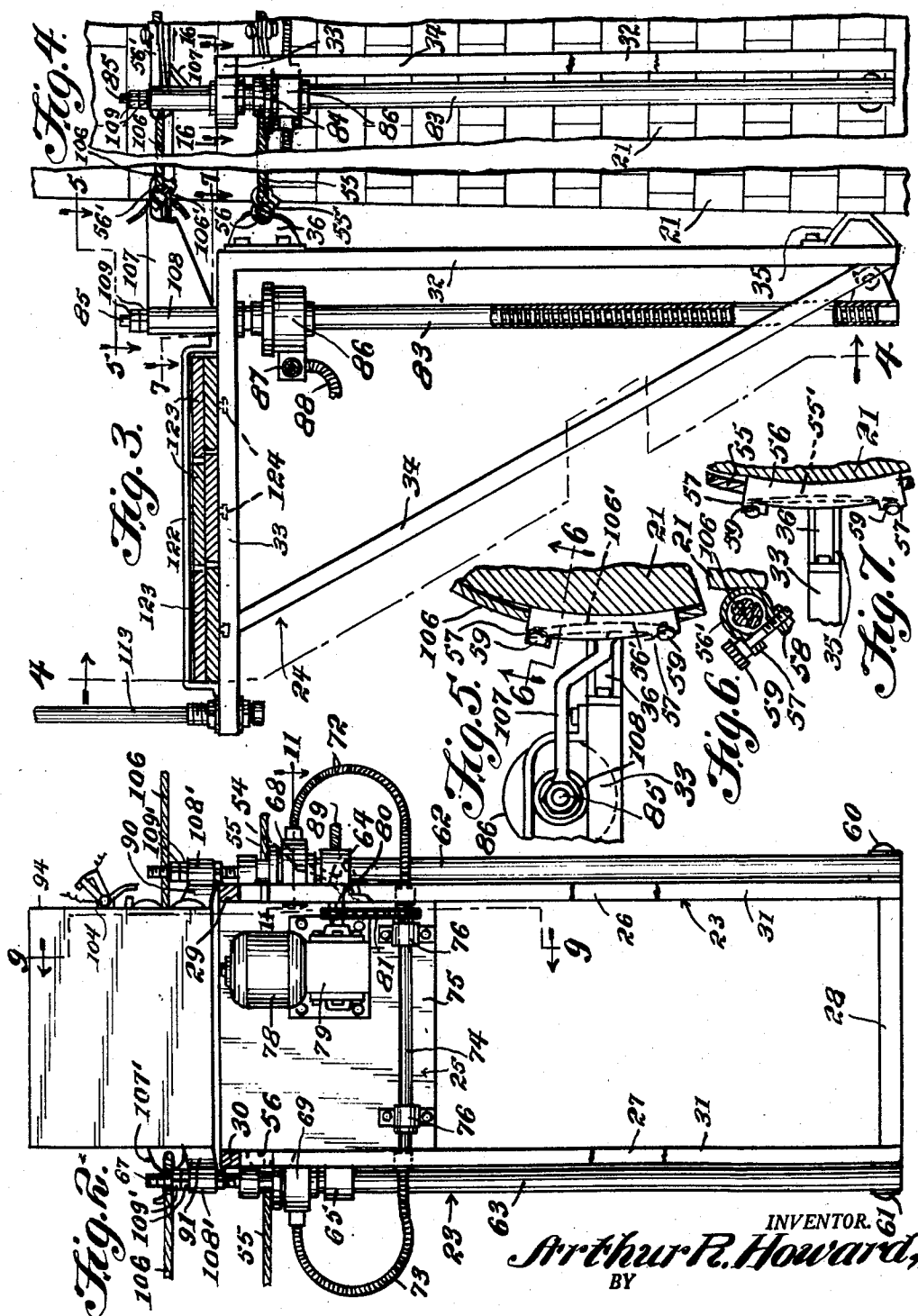
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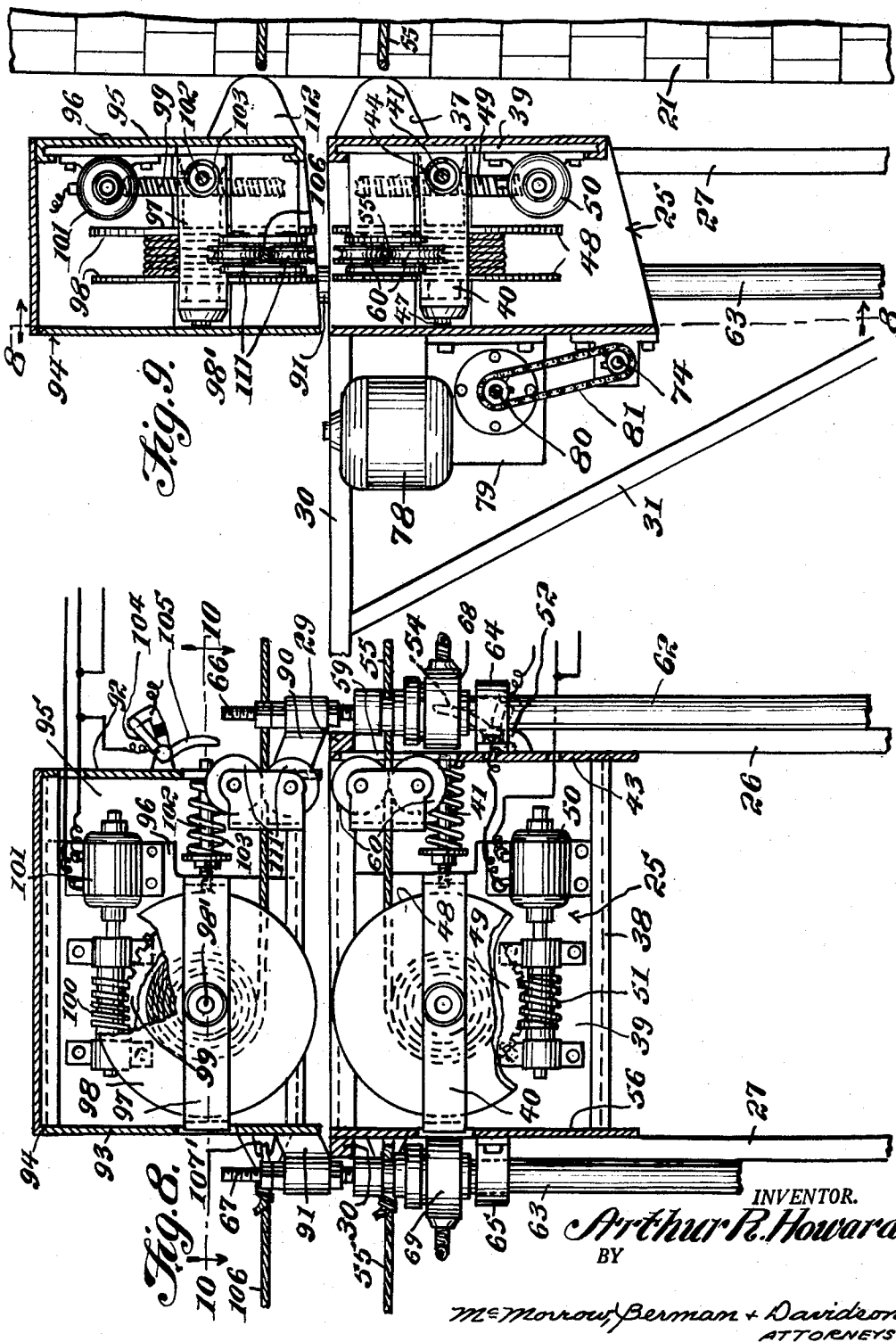
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AUTOMATIC SCAFFOLDING MACHINE

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6 Claims. (Cl. 182-136)

This invention relates to scaffolds, and more particularly to a scaffold raising and lowering mechanism for use on chimneys and similar structures.

The main object of the invention is to provide a novel and improved automatic self-elevating scaffold apparatus for use on chimneys or the like, said apparatus being simple in construction, being easy to install on a structure, and eliminating a great deal of the labor and hazard usually involved in the maintenance and repair of chimneys and similar structures.

A further object of the invention is to provide an improved automatic self-elevating scaffold apparatus for use on chimneys or the like, said apparatus involving inexpensive components, being reliable in operation, and providing access to tall structures, such as chimneys or the like, without requiring the use of expensive auxiliary equipment, such as cranes, ladders, or the like.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a horizontal cross sectional view taken through a chimney on which is mounted an improved automatic scaffold apparatus constructed in accordance with the present invention.

Figure 2 is an enlarged elevational view of the main support employed in the scaffold apparatus of Figure 1, and of parts of the scaffold cooperating with said main support.

Figure 3 is an enlarged transverse vertical cross sectional view taken on the line 3-3 of Figure 1.

Figure 4 is a vertical cross sectional view taken on the line 4-4 of Figure 3.

Figure 5 is an enlarged fragmentary plan detail view taken on the line 5-5 of Figure 3.

Figure 6 is an enlarged cross sectional detail view taken on the line 6-6 of Figure 5.

Figure 7 is an enlarged fragmentary plan view taken on the line 7-7 of Figure 3.

Figure 8 is a vertical cross sectional view taken through the main support of the scaffold apparatus of Figure 1 and through the upwardly adjacent member cooperating therewith, said view being taken on the line 8-8 of Figure 9.

Figure 9 is an enlarged vertical cross sectional view taken on the line 9-9 of Figure 2.

Figure 10 is a horizontal cross sectional view taken on the line 10-10 of Figure 8.

Figure 11 is an enlarged horizontal cross sectional view taken on the line 11-11 of Figure 2.

Figure 12 is a vertical cross sectional view taken on the line 12-12 of Figure 11.

Figure 13 is a cross sectional detail view taken on the line 13-13 of Figure 12.

Figure 14 is an enlarged cross sectional view taken on the line 14-14 of Figure 1.

Figure 15 is an enlarged top view of the railing guides and the post member employed in the automatic scaffold apparatus of Figure 1, and shown in Figure 14.

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Figure 15a is a fragmentary elevational view taken on the line 15a-15a of Figure 15.

Figure 16 is an enlarged horizontal cross sectional view taken on the line 16-16 of Figure 4.

Figure 17 is a fragmentary horizontal cross sectional view similar to the upper portion of Figure 8, but showing a modified form of the automatic scaffold apparatus of the present invention.

Figure 18 is a vertical cross sectional view taken through one of the jack cylinders of the automatic scaffold apparatus of Figure 17.

Figure 19 is a vertical cross sectional view, partly in elevation, taken through one of the jack cylinders associated with an auxiliary support of the form of automatic scaffold apparatus of Figures 17 and 18.

Figure 20 is a schematic diagram illustrating a further modification of automatic scaffold apparatus according to the present invention, wherein each of the scaffold-elevating plungers is driven by a separate electric motor and wherein the motors are connected in a series circuit for energizing and simultaneously controlling same.

Referring to the drawings, and more particularly to Figures 1 through 16, 21 designates a relatively high structure, for example, a chimney, on which the automatic scaffold, designated generally at 22, is mounted.

The automatic scaffold apparatus 22 comprises a main support, designated at 23 in Figure 2, and a plurality of auxiliary supports 24 adapted to be spaced around the chimney 21 and being connected to the main support 23 in a manner presently to be described.

The main support 23 comprises a housing 25 having rigidly secured to its opposite sides respective vertical bars 26, 27 which are rigidly connected at their lower ends by a transverse bar 28. Rigidly secured to the top ends of the vertical bars 26 and 27 are the outwardly extending horizontal bars 29 and 30 which are braced to the vertical bars 26 and 27 by suitable diagonal struts 31.

Each of the auxiliary supports 24 comprises a vertical bar 32 having rigidly secured to its top end an outwardly extending horizontal bar 33 which is braced to the lower end of the vertical bar 32 by a diagonal strut 34, as shown in Figure 3. Secured to the inwardly facing portions of the lower ends of the vertical bars 32 are U-shaped spacer brackets 35 adapted to abut the outer surface of the chimney 21 in the manner shown in Figure 3. Secured to the top ends of the bars 32 and being inwardly directed therefrom are bracket members 36 adapted to abut the outer surface of the chimney 21 at locations above and vertically aligned with the associated brackets 35.

The vertical bars 26 and 27 of the main support 23 are provided at their lower ends with abutment brackets 35, similar to those of the auxiliary support 24. The housing 25 is provided at its opposite end portions and at its rear wall with the inwardly directed abutment lugs 37, as shown in Figure 9, adapted to abut the outer surface of the chimney 21 substantially in vertical alignment with and above the lower brackets 35.

Housing 25 is provided with the horizontally channelled rear wall 38 in which is slidably mounted a plate member 39. Secured on the plate member 39 is an arched bracket 40 having one side thereof engaged with the end of an abutment rod 41 slidably mounted in the side wall 43 of housing 25 and biased into engagement with the bracket member 40 by coiled springs 44 bearing between the wall 43 and a washer 45 disposed on the rod 41 and retained thereon by a nut 46. Journaled in the housing 25, for example, in the bracket 40 and in the rear wall 38 of the housing is a shaft 47 on which is mounted a reel 48 and a worm gear 49. A reversible electric motor 50 is mounted on the plate 38 and is drivingly coupled to a worm 51 meshing with worm gear 49, as shown in Figure 8. Designated at 52 is a limit switch which is

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mounted on the side wall 43 of the housing 25 and which is provided with a pivoted actuating member 54 having a top arm portion extending in the path of movement of the slidable rod member 41, the actuating member 54 being biased counterclockwise, as viewed in Figure 8, toward a normally elevated position wherein the limit switch 52 is closed. The actuating member 54 is engaged by the end of the rod 41 responsive to the movement of plate member 39 to the right, as viewed in Figure 8, so that when said plate member reaches a predetermined position, the actuating member 54 is rotated clockwise, as viewed in Figure 8, and opens the limit switch 52, deenergizing the motor 50.

Designated at 55 is a cable which is connected at one end thereof to housing 25 adjacent the side wall 56 thereof, opposite side wall 43. The cable 55 is secured to the respective lug members 36 of the auxiliary supports 24, which are spaced around the chimney 21, and the end of the cable is secured to the reel 48, so that when the cable is wound up on the reel, said cable is tightened by said reel and clampingly engages the outer surface of chimney 21.

As shown in Figure 7, the cable 55 extends slidably through arcuate sleeve members 56 rigidly secured to and projecting horizontally from the inner end portions of the respective abutment lugs 36, said sleeve members 56 being provided with flanges 57 and 58. Retaining screws 59 extend through the flanges 57 and are threadedly engaged in the flanges 58, whereby the cable 55 cannot disengage from the sleeves.

Cable 55 passes through an aperture 59 in side wall 43 and between a pair of guide rollers 60, 60 journaled in the housing 25 adjacent aperture 59, as shown in Figure 8. As will be readily apparent, when motor 50 is energized, the worm 51 drives worm gear 49 and shaft 47. In one direction of rotation of shaft 47 the cable 55 is wound up on the reel 48, causing the cable to be tightened. The tension in the cable moves the plate member 39 to the right, as viewed in Figure 8, until finally the bracket 40 engages abutment rod 41 and causes the limit switch 52 to open, which deenergizes the motor 50. Worm gear 49 meshing with worm 51 holds the reel 48 against reverse rotation, whereby the cable 55 is maintained in tension and secures the main support 23 and the auxiliary supports 24 to the chimney 21. However, by reversing the motor 50 by means of a suitable reverse energizing circuit, the cable may be loosened, as required.

Pivoted at 60 and 61 to the lower ends of the vertical bars 26 and 27 are respective sleeve members 62 and 63 which extend upwardly through suitable guide brackets 64 and 65 secured to the side walls 43 and 56 of housing 25. Slidably and non-rotatably disposed in the sleeve members 62 and 63 are respective externally threaded plungers 66 and 67. Secured to the top ends of the sleeves 62 and 63 are respective gear housings 68 and 69 in which are rotatably mounted worm gears 70 threadedly engaged on the respective threaded plungers 66 and 67, as shown in Figure 12. The nut members 70 are rotatably supported in the housings 68 and 69 and are meshingly engaged by respective worms 71 journaled horizontally in said housings, as shown in Figure 11. The worms 71 are respectively coupled by flexible shaft units 72 and 73 to the opposite ends of a drive shaft 74 rotatably mounted on the front wall 75 of the housing 25, as shown in Figure 2, for example, on bearing assemblies 76, 76.

A reversible electric motor 78 is mounted on the front wall 75 of housing 25 and is drivingly connected through a gear unit 79 to an output shaft 80. Shaft 80 is coupled by a belt 81 and suitable pulleys to the shaft 76, so as to be drivingly connected to the respective worms 71 to drive said worm simultaneously in the proper directions to either simultaneously raise or lower the respective threaded plunger members 66 and 67, said plunger members being raised or lowered by the rotation of the as-

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sociated nut members 70, which are in turn meshingly engaged by the respective worms 71.

As shown in Figure 13 a longitudinal key 82 is provided internally in each sleeve member 62 and 63 engaging slidably in a keyway in the associated plunger member to prevent rotation of the plunger member but to allow the plunger member to move axially in the sleeve.

Additional sleeve members 83 are pivotally connected to the lower end portions of the respective vertical bars 32 of the auxiliary supports 24 and extend through U-shaped guide brackets 84 secured to the horizontal bar members 33 of the supports 24, as shown in Figures 4 and 16. Threaded plungers 85 are slidably but non-rotatably disposed within the sleeve members 83, in the same manner as explained in connection with the plungers 66 and 67, the auxiliary plungers 85 being threadedly engaged by worm gears rotatably mounted in gear housings 86 secured to the top ends of the sleeves 83. Respective worms meshingly engage said worm gears and are journaled horizontally in the gear housings 86, the worm shafts, shown at 87 in Figure 3, being interconnected by a flexible shaft 88 and being drivingly connected to a flexible shaft 89, shown in Figure 2, which is coupled to the output shaft 80 of gear unit 79. Thus, the threaded plungers 66, 67 and 85 are simultaneously driven by the motor 78, said plungers being simultaneously raised or lowered, depending upon the direction of rotation of motor 78.

Secured to the top ends of the plungers 66 and 67 are respective bracket members 90 and 91, said bracket members being rigidly secured to the respective side walls 92 and 93 of an auxiliary reel housing 94 located above the main reel housing 25. The reel housing 94 is provided with the channeled rear wall 95 in which is slidably mounted the plate member 96 on which is secured the arched bracket 97. A shaft 98' is journaled between the bracket 97 and the plate member 96 and has secured thereon the reel 98 and the gear 99. The gear 99 is meshingly engaged by a worm 100 coupled to the shaft of a reversible electric motor 101 mounted on plate 96. A push rod 102 is slidably mounted in the wall 92 and is biased into engagement with the bracket 97 by a coiled spring encircling the same, as shown in Figure 8, similar to the spring 44 associated with the rod 41. A limit switch 104 is mounted on the side wall 92 and has an arm 105 engageable by the end of the push rod 102 to deenergize the motor 101 when plate member 96 is moved to the right a predetermined amount, as in the case of plate member 39 previously described.

Designated at 106 is a cable member having one end thereof connected to wall 93 at a lug 107 provided on said wall. Intermediate points on cable 106 slidably engage through sleeve members 56', which in turn are rigidly connected by bracket arms 107 to the top ends of the respective threaded plunger members 85. As shown in Figure 3, each arm 107 may be integrally formed with a sleeve portion 108 receiving the upper portion of the associated plunger 85 and may be clampingly secured to upper portion of the plunger by nuts 109. The arms 90, previously mentioned, are likewise formed with sleeve portions 108' which are clampingly secured to the top portions of the threaded plungers 66 and 67 by nuts 109', as is clearly shown in Figure 8.

The outer edges of the sleeve members 56 and 56' are parallel and are arcuate in shape, whereby said outer edges define arcuate slots 106' and 55' shown in dotted view in Figures 5 and 7. Said slots curve downwardly from the outer ends of the sleeves toward the mid-portion thereof, whereby the mid-portions of the slots are substantially at the bottoms of the sleeves. Thus, in order to insert the cables in the sleeves, the cables must be loose and must be arcuately bent to pass through said slots. Similarly, the cables may be removed from the sleeves by disengaging them through said slots without requiring the cables to be pulled entirely through

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the sleeves. The slots 106' and 55' are preferably of just sufficient width to allow the cables to pass therethrough, for example, are approximately 5/8 inch wide.

The end of cable 106 extends through an aperture 110 in side wall 92 and between guide rollers 111 journaled in the housing 94 adjacent said aperture. The cable 106 is secured to and wound on the reel 98, whereby said cable is tensioned by the rotation of the reel to wind the cable up thereon, in the same manner as described in connection with the cable 55. Thus, when the motor 101 is energized in its forward direction, the cable 106 is wound up on the reel 98 until a limiting tension is developed in the cable, at which point the limit switch 104 opens the energizing circuit of the motor, leaving the cable sufficiently tight to clamp the top portions of the plungers 66, 67 and 85 to the chimney 21 above the cable 55. Motor 101 is provided with a suitable reverse energizing circuit which may be employed to reverse the direction of reel 98 and to loosen the cable 106, when desired.

As shown, the rear wall 95 of the upper housing 94 is provided with the inwardly directed abutment lugs 112 engageable with the outer surface of the chimney 21. The arcuate sleeve members 56' are integrally formed with the arms 107, as above explained, so that tightening of the cable 106 clamps the sleeves 56' to the chimney surface, thus clampingly securing the top ends of the associated plungers 85 to said chimney surface.

Rigidly secured to the outer ends of the respective outwardly extending horizontal bar members 29, 30 and 33 are respective vertical post members 113, said post members having rigidly secured to their top ends the successive horizontally elongated loop members 114 and 115, shown in Figures 14, 15 and 15a.

As shown in Figure 14, the post members 113 are adjustably secured by means of top and bottom nuts 116 and 117 engaged on threaded lower portions 118 provided on the post members and clampingly securing the post members to the associated outwardly extending horizontal bars 29, 30 and 33.

The loops 114 and 115 are welded together in angularly spaced vertical planes which intersect substantially coaxially with the associated post members 113, so as to slidably receive railing rods 119 therethrough in the manner clearly illustrated in Figure 1. The railing rods 119 are provided at their opposite ends with enlarged head portions 120 so that the rods cannot become disengaged from the loops 114 and 115, but may slidably adjust themselves in said loops in accordance with changes in the diameter of the chimney 21 as the scaffold is raised or lowered thereon.

Secured on the horizontally extending, outwardly projecting bar members 29, 30 and 33 are arched brackets 122 beneath which are disposed floor boards 123, said floor boards being thus supported on the horizontal bar members. The end portions of the floor boards are provided with depending stop pins 124 which are engageable with the supporting horizontal bar members 29, 30 and 33 to prevent the floor boards from slipping out from between the associated arched retaining brackets 122 and the subjacent horizontal supporting bars.

In operation, the scaffold is raised on the chimney 21 by first tightening the lower cable 55 to clampingly secure the main support and the auxiliary support to the outer surface of the chimney. The motor 78 is then energized to raise the plunger members 66, 67 and 85 to a substantial height. Thereafter, motor 78 is deenergized and the upper cable 106 is tightened. The lower cable 55 is then loosened and motor 78 is then operated in a reverse direction, causing the sleeve members 62, 63 and 83 to be elevated on the plunger members 66, 67 and 85. After said sleeve members 62, 63 and 83 have been elevated for a substantial height, motor 78 is deenergized and cable 55 is tightened. Cable 106 is then loosened and motor 78 is energized in its forward

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direction to elevate the plunger members 66, 67 and 85, thereafter repeating the previously described cycle of operation, until the apparatus has been raised to the desired height on the chimney.

The scaffold is lowered on the chimney by following a procedure reverse to that above described.

Figures 17, 18 and 19 illustrate a modification of the invention wherein pneumatic means is employed in place of electric motors previously, as the driving means for the scaffold apparatus. Thus, reversible air motors 120 may be employed to drive the respective cable reels, for example, to drive the cable reel 98 in Figure 17, the motors 120 operating the worms in the same manner as the reversible electric motors 50 and 101 in the previously described form of the invention. The main support, shown at 23', corresponding to the main support 23 in the previously described form of the invention, is provided with elevating fluid pressure cylinders 62' containing pistons 63' having piston rods 64' whose top end portions are connected by brackets 90' to the side walls of the upper reel housing, shown at 94'. The auxiliary supports are provided with similar fluid pressure elevating cylinders shown at 83' containing pistons 84' having piston rods 85'. The top ends of the piston rods 85' are connected by arms 107' to the cable sleeves receiving the cable 106, similar to the previously described form of the invention. A suitable fluid pressure supply means is provided, connected by suitable control valves to the respective cylinders 62' and 83' for simultaneously raising or lowering the pistons 63' and 84'. Said fluid pressure means may also be employed by the use of suitable reversing valves to operate the fluid pressure motors 120.

In the form of the invention illustrated in Figure 20, instead of employing the flexible shafts 72, 73, 88 and 89 to drivingly connect the respective nut members 70 to a single electric motor 78, a separate electric motor 130 is employed to drive each of the nut members individually. Thus, as shown in Figure 20, the motors 130 comprise reversible electric motors which are connected in a series circuit to a common current source, the circuit being provided with suitable reversing switches for reversibly applying current to the series-connected motors. As shown, each motor 130 is supported by a suitable bracket 131 associated with and rigidly connected to a gear housing, for example the gear housing 68 of the main support and the gear housings 86 of the auxiliary supports, whereby the motors 130 are movable with said main support and auxiliary supports.

While certain specific embodiments of an improved automatic, self-elevating scaffold apparatus have been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. In an automatic self-elevating scaffold apparatus for use on chimneys or the like, a main support, a plurality of auxiliary supports adapted to be spaced around a chimney, a first cable connected at both ends to said main support and connected at intermediate portions thereof to said auxiliary supports so as to completely surround the chimney, first cable-tightening means connected to said first cable, respective vertically movable plungers slidably mounted on said main support and said auxiliary supports, a second cable located above the first cable and connected at both ends to said main support and connected at intermediate portions thereof to the top ends of the plungers so as to also surround the chimney, second cable-tightening means connected to said second cable, reversible drive means, means drivingly connecting said drive means to said plungers and being formed and arranged to at times elevate said

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plungers and second cable relative to the supports when the drive means operates in one direction and to lower the plungers and second cable relative to the supports at other times when the drive means operates in a reverse direction, and scaffold-supporting means on said supports.

2. In an automatic self-elevating scaffold apparatus for use on chimneys or the like, a main support, a plurality of auxiliary supports adapted to be spaced around a chimney, a first cable connected at both ends to said main support and connected at intermediate portions thereof to said auxiliary supports so as to completely surround the chimney, first cable-tightening means on said main support connected to the end of said first cable, respective vertically movable plungers slidably mounted on said main support and said auxiliary supports, second cable-tightening means on the plunger associated with said main support, a second cable located above the first cable and connected at both ends to said main support and at intermediate portions thereof to the top ends of the plungers so as to also surround the chimney and connected to said second cable-tightening means, reversible drive means on said main support, means drivingly connecting said drive means to said plungers and being formed and arranged to at times elevate said plungers and second cable relative to the supports when the drive means operates in one direction and to at other times lower the plungers and second cable relative to the supports when the drive means operates in a reverse direction, and respective outwardly extending platform-supporting arms rigidly secured to said supports.

3. In an automatic self-elevating scaffold apparatus for use on chimneys or the like, a main support, a plurality of auxiliary supports adapted to be spaced around a chimney, a first cable connected at both ends to said main support and connected at intermediate portions thereof to said auxiliary supports so as to completely surround the chimney, first cable-tightening means on said main support connected to the end of said first cable, respective vertically movable plungers slidably mounted on said main support and said auxiliary supports, second cable-tightening means on the plunger associated with said main support, a second cable located above the first cable and connected at both ends to said main support and at intermediate portions thereof to the top ends of the plungers so as to also surround the chimney and connected to said second cable-tightening means, reversible drive means on said main support, means drivingly connecting said drive means to said plungers and being formed and arranged to at times elevate said plungers and second cable relative to the supports when the drive means operates in one direction and to at other times lower the plungers and second cable relative to the supports when the drive means operates in a reverse direction, respective outwardly extending platform-supporting arms rigidly secured to said supports, and respective platform elements disposed on said arms.

4. In an automatic self-elevating scaffold apparatus for use on chimneys or the like, a main support, a plurality of auxiliary supports adapted to be spaced around a chimney, a cable reel mounted on said main support, first drive means operatively connected to said reel, a first cable connected at one end to said main support and at intermediate points thereon to said auxiliary supports so as to completely surround the chimney, the other end of said cable being connected to said reel, vertical plungers slidably engaged with said supports, a second reel, means mounting said second reel on the top end of the plunger associated with said main support, second drive means operatively connected to said second reel, a second cable connected at one end to the top end of said last-named plunger and at its intermediate points

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thereon to the top ends of the remaining plungers so as to also surround the chimney, the other end of said second cable being connected to said second reel, third drive means on said main support, and means drivingly connecting said third drive means to said plungers and being formed and arranged to at times reversibly raise and lower said plungers and second cable relative to said supports.

5. In an automatic self-elevating scaffold apparatus for use on chimneys or the like, a main support, a plurality of auxiliary supports adapted to be spaced around a chimney, a cable reel mounted on said main support, first drive means operatively connected to said reel, a first cable connected at one end to said main support and at intermediate points thereon to said auxiliary supports so as to completely surround the chimney, the other end of said cable being connected to said reel, respective threaded vertical plungers slidably and non-rotatably engaged with said supports, a second reel, means mounting said second reel on the top end of the plunger associated with said main support, second drive means operatively connected to said second reel, a second cable connected at one end to said last-named plunger and at intermediate points thereon to the top ends of the remaining plungers so as to also surround the chimney, the other end of said second cable being connected to said second reel, third drive means on said main support, respective nut members threadably engaged on the plungers and drivingly engaging said supports, and means drivingly connecting said third drive means to said nut members and being formed and arranged to at times reversibly raise and lower said plungers and second cable relative to said supports.

6. In an automatic self-elevating scaffold apparatus for use on chimneys or the like, a main support, a plurality of auxiliary supports adapted to be spaced around a chimney, a cable reel mounted on said main support, first drive means operatively connected to said reel, a first cable connected at one end to said main support and at intermediate points thereon to said auxiliary supports so as to completely surround the chimney, the other end of said cable being connected to said reel, respective threaded vertical plungers slidably and non-rotatably engaged with said supports, a second reel, means mounting said second reel on the top end of the plunger associated with said main support, second drive means operatively connected to said second reel, a second cable connected at one end to the top end of said last-named plunger and at intermediate points thereon to the top ends of the remaining plungers so as to also surround the chimney, the other end of said second cable being connected to said second reel, third drive means on said main support, respective nut members threadably engaged on the plungers and drivingly engaging said supports, means drivingly connecting said third drive means to said nut members and being formed and arranged to at times reversibly raise and lower said plungers and second cable relative to said supports, respective outwardly extending arms on said supports, and respective platform elements disposed on said arms.

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