Sept. 8, 1959 A. G. BUTLER 2,903,553

CONTINUOUS CAGE-MAKING MACHINE

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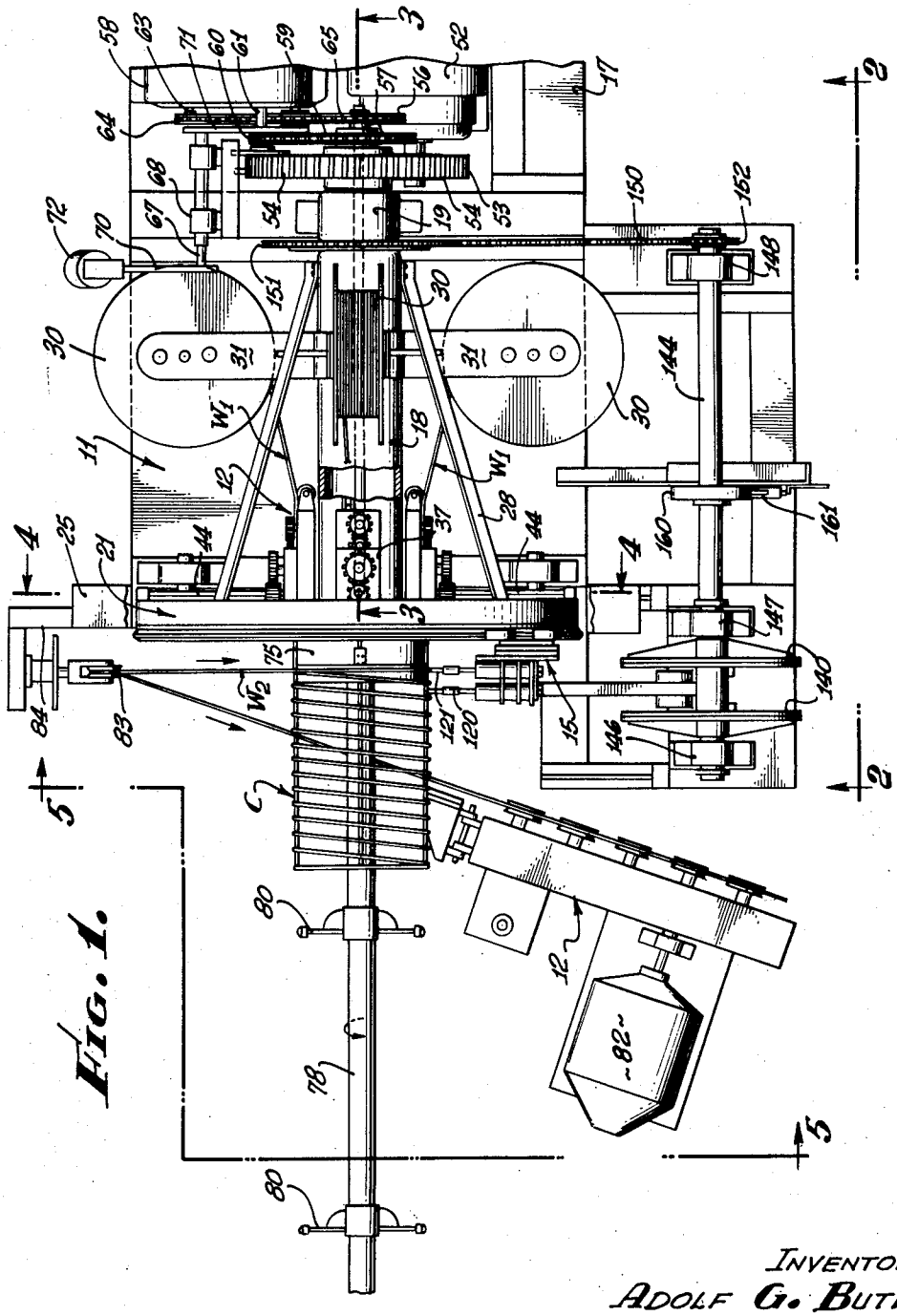


FIG. 1.

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CONTINUOUS CAGE-MAKING MACHINE

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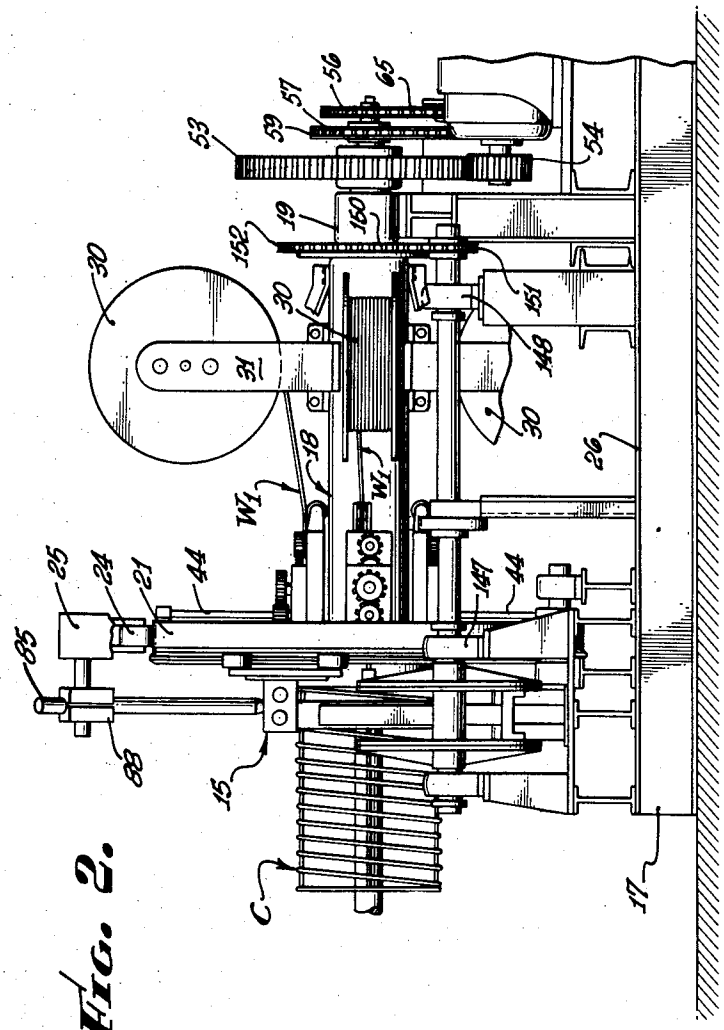


FIG. 2.

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CONTINUOUS CAGE-MAKING MACHINE

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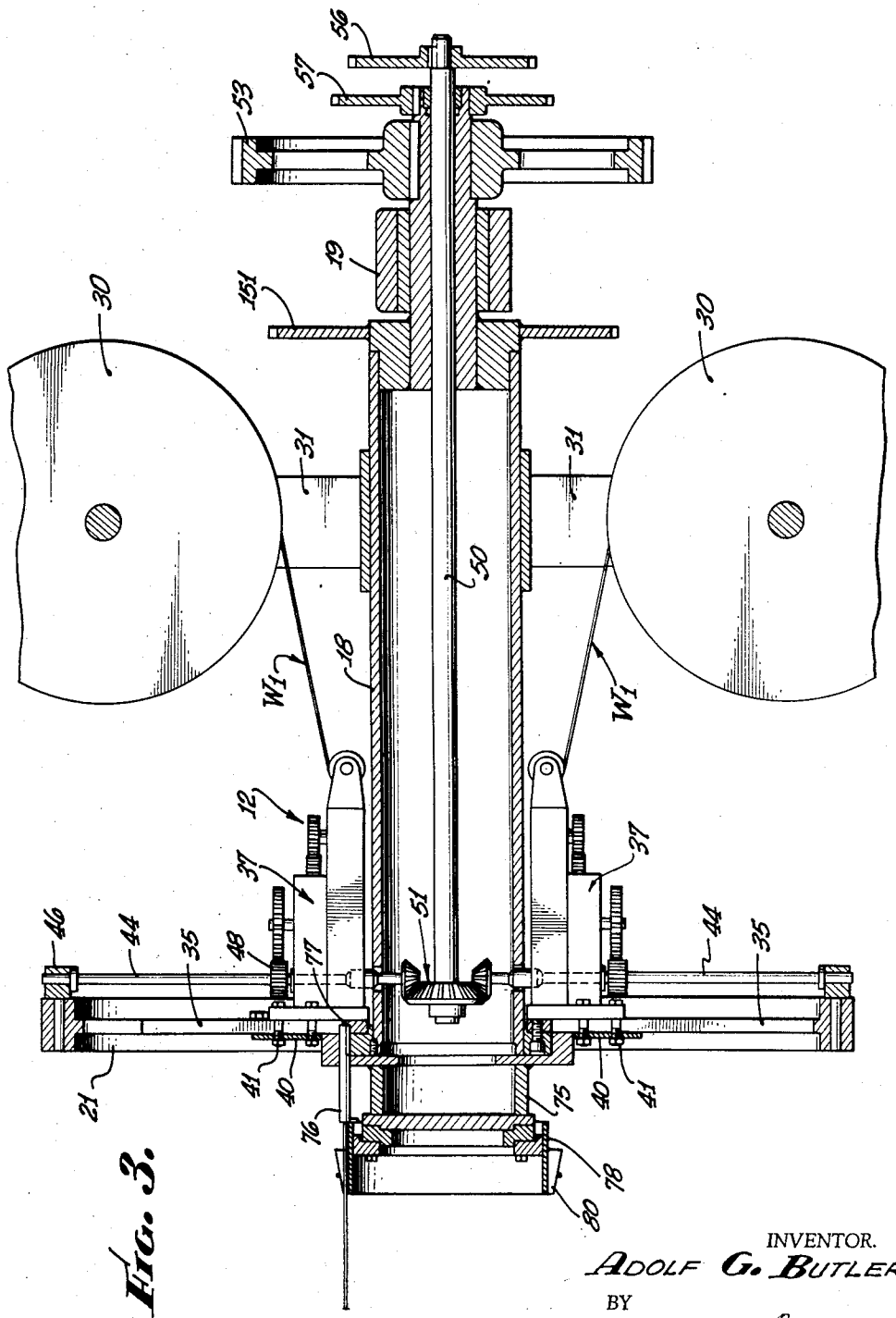


FIG. 3.

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CONTINUOUS CAGE-MAKING MACHINE

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FIG. 4.

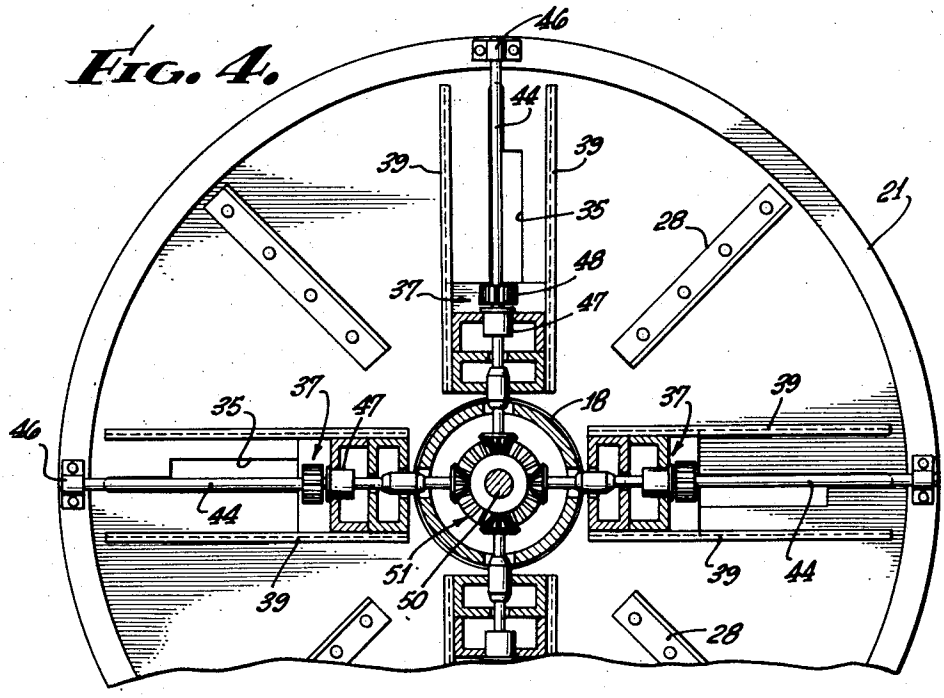
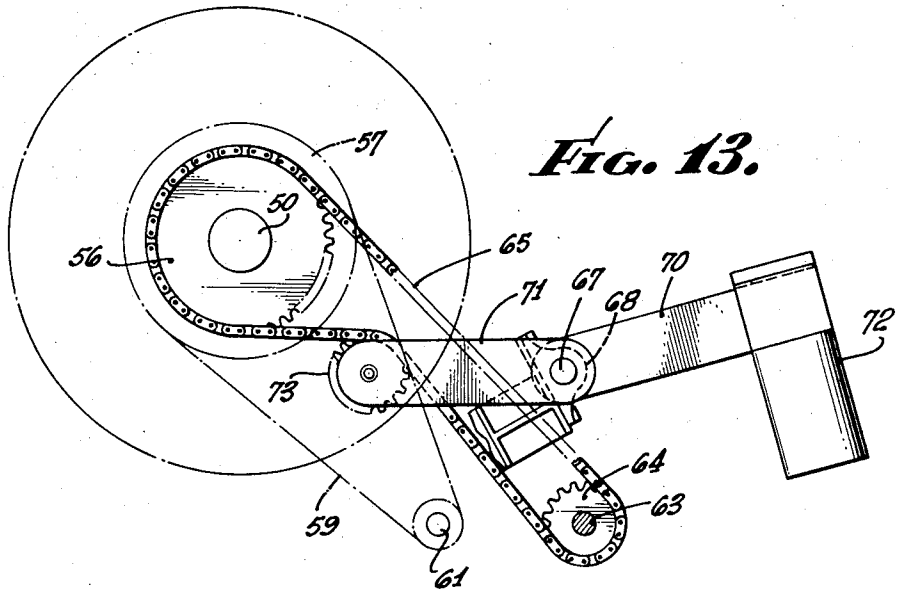


FIG. 13.



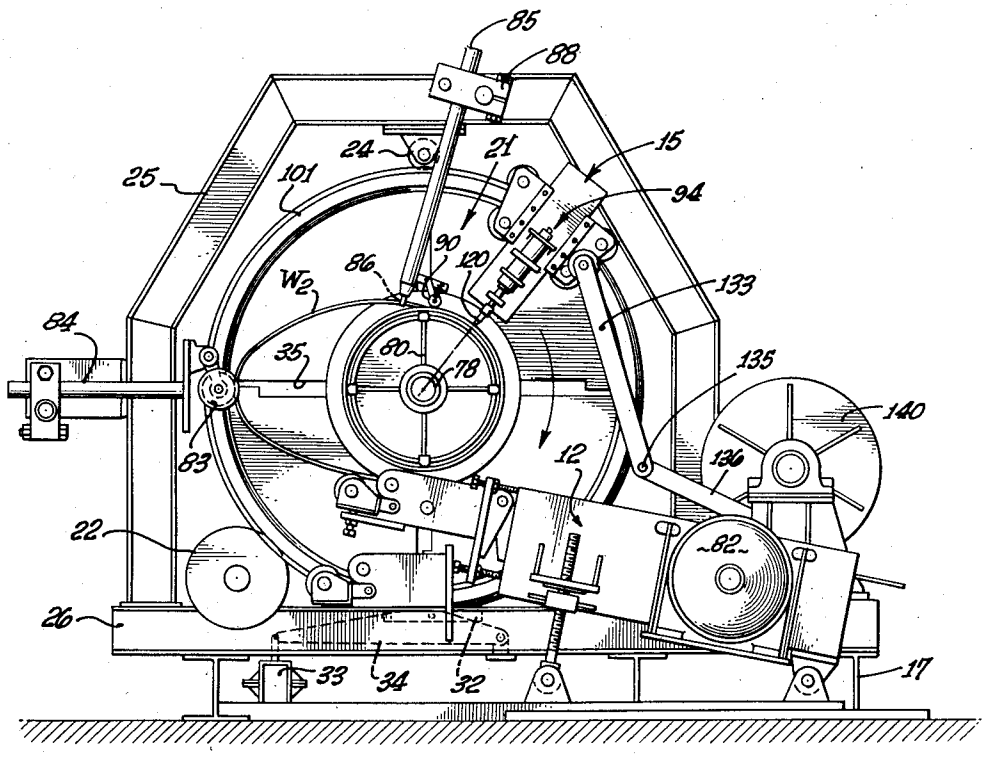
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Sept. 8, 1959 A. G. BUTLER 2,903,553

CONTINUOUS CAGE-MAKING MACHINE

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FIG. 5.



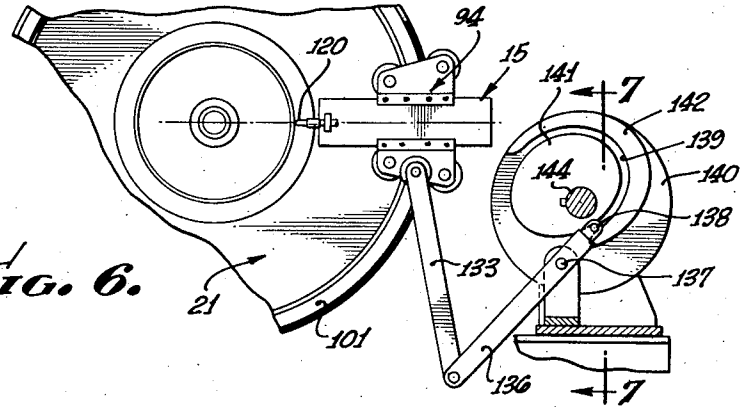


FIG. 6.

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CONTINUOUS CAGE-MAKING MACHINE

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FIG. 8.

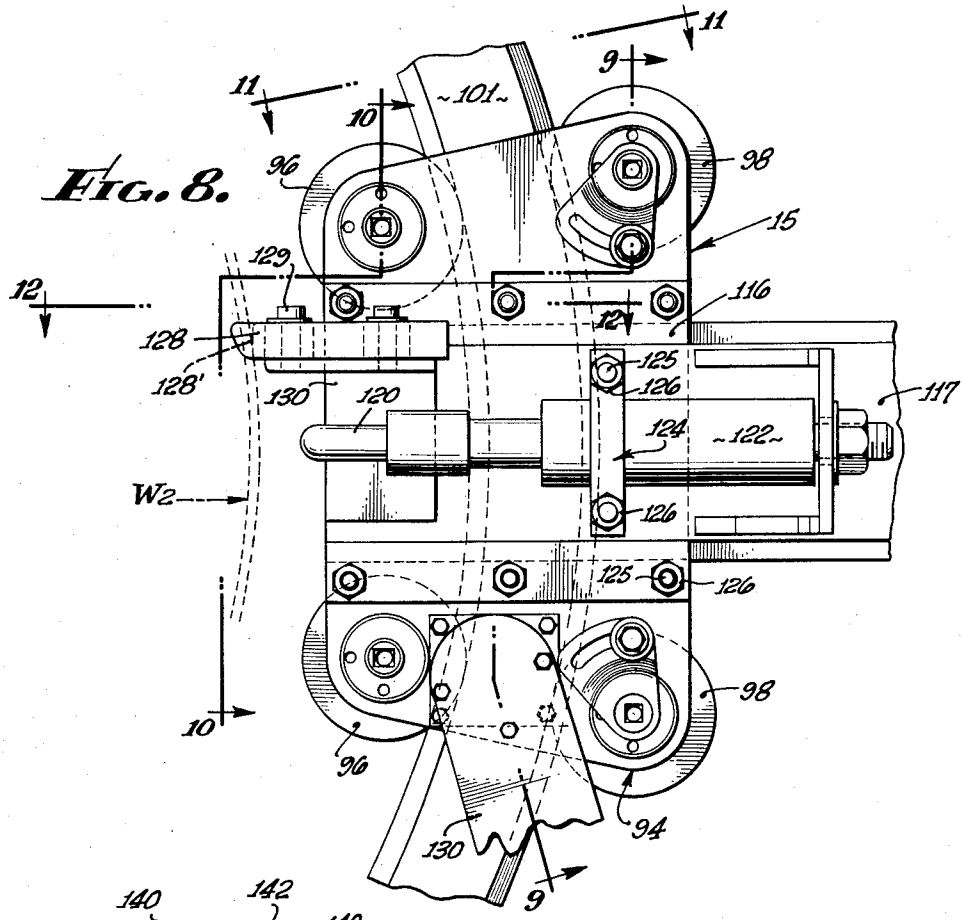
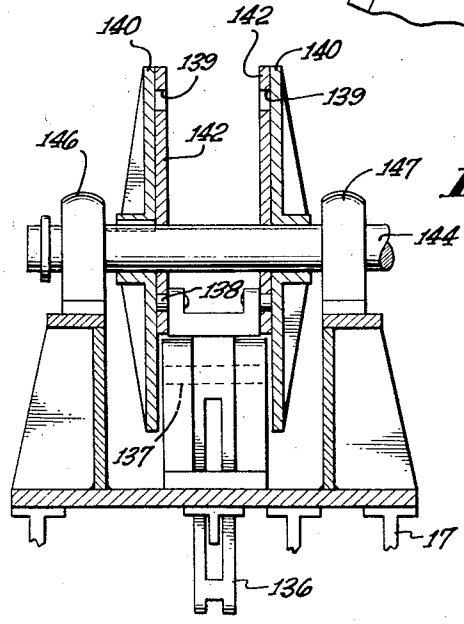


FIG. 7.



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FIG. 11.

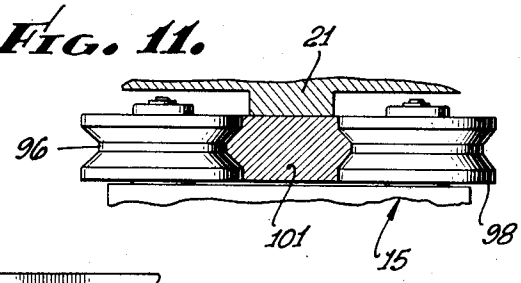


FIG. 12.

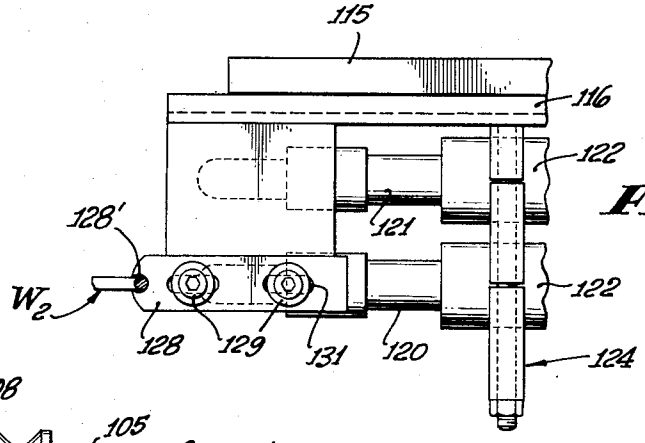


FIG. 9.

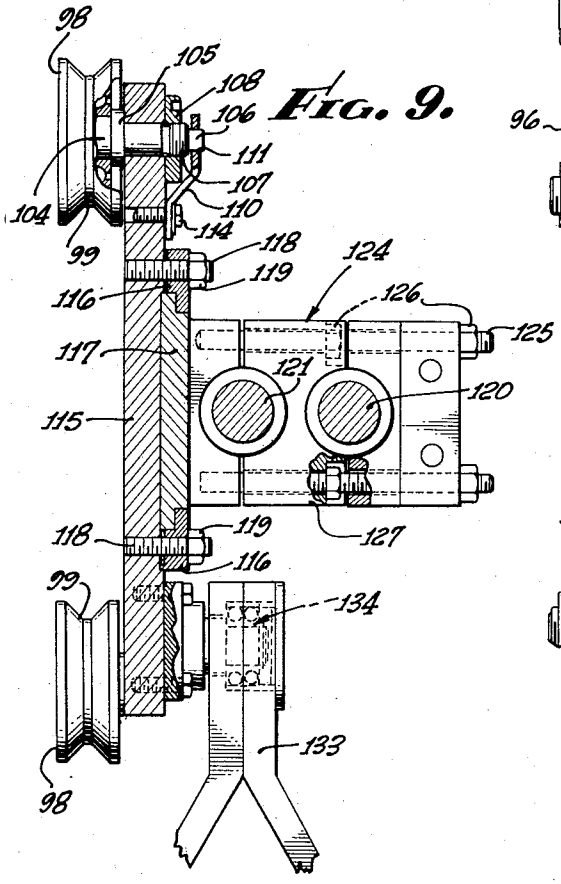
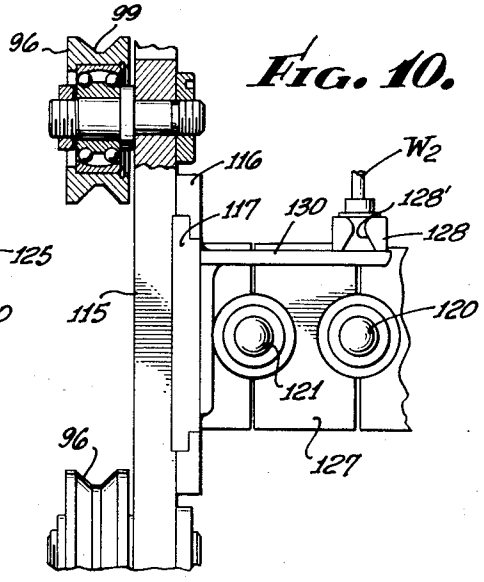


FIG. 10.



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United States Patent Office 2,903,553
Patented Sept. 8, 1959

2,903,553

CONTINUOUS CAGE-MAKING MACHINE

Adolf G. Butler, Downey, Calif., assignor to American Pipe and Construction Co., South Gate, Calif., a corporation of Delaware

Application February 3, 1958, Serial No. 712,893

20 Claims. (Cl. 219—56)

This invention has to do with machines for making reticulated wire structures such as cylindrical cages used as reinforcement in concrete pipe and other structures.

An object of the invention is to provide a novel and improved automatic machine capable of feeding a plurality of wires longitudinally, wrapping a wire therearound, and welding the wrapped wire to the longitudinally fed wires.

Another object is to provide such a machine for making various-sized cages which includes novel wire feed means for guiding and moving the longitudinally fed wires and novel means for adjustably varying the spacing of the wire feed means.

A further object is to provide novel automatic means for welding a spirally wrapped wire to the longitudinally fed wires. In this connection it is an object to provide novel means for supporting and moving a welding head assembly in a manner such that the assembly automatically periodically follows or travels with the wire cage being made throughout a portion of each revolution thereof.

A further object is to provide a wire cage-making machine of the type indicated which includes a large bull wheel through which the longitudinal wires of the cage are fed together with novel means for supporting a welding electrode assembly on the bull wheel for intermittent travel therewith in a manner to follow the wheel, and a cage being made, during a welding cycle.

Still another object is to provide, in apparatus of the type described, a radially slotted bull wheel and means mounted on the wheel adjustable along each slot for feeding the longitudinal wires of the cage through the slots.

A further object is to provide novel means for enabling interruption of the forward feeding of the longitudinally fed wires during the welding cycle.

These and other objects will be apparent from the drawings and the following description.

Referring to the drawings:

Fig. 1 is a plan view of apparatus embodying the invention;

Fig. 2 is a fragmentary side elevational view on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary sectional view on line 3—3 of Fig. 1, but on a larger scale;

Fig. 4 is a fragmentary sectional view on line 4—4 of Fig. 1, but on a larger scale;

Fig. 5 is a sectional elevational view on line 5—5 of Fig. 1;

Fig. 6 is a fragmentary sectional elevational view similar to Fig. 5 but showing the parts in a different position;

Fig. 7 is a sectional view on line 7—7 of Fig. 6, on a larger scale;

Fig. 8 is an enlarged face view of the welding carriage;

Figs. 9, 10, 11, and 12 are fragmentary sectional views on lines 9—9, 10—10, 11—11 and 12—12, respectively, of Fig. 8; and

Fig. 13 is a diagrammatic view of a flexible drive connection.

More particularly describing the invention, in general the apparatus comprises a rotatable assembly 11 which feeds a plurality of wires W1 longitudinally in laterally or circumferentially spaced relation and at the same time rotates the wires as a whole about a common axis to enable the wrapping therearound of a wire W2 which is fed by wire feed means designated 12. Welding means is provided which includes a carriage 15 mounted for movement on an arc concentric about the axis of rotation of the assembly 11 and wires W1 and means is provided for permitting the welding carriage intermittently to follow or travel with the reticulated wire structure being formed during a portion of its rotation for the purpose of welding the wire W2 to wires W1 where the former crosses the latter.

Referring in more detail to the apparatus, I show a base or foundation 17 of any suitable character upon which is rotatably supported the assembly 11. The latter includes a tube 18 which is journaled adjacent one end at 19 upon a frame 20. A bull wheel 21 is secured to the tube at its other end, being supported upon trunnions 22 and being held down by a roller 24. The latter is mounted on a frame 25 while the trunnions are supported on a frame member 26. Suitable braces 28 are provided between the bull wheel and the tube. A plurality of wire supply reels 30 are rotatably mounted upon the tube in brackets 31. A brake 32 (Fig. 5), operated by power means 33 through linkage 34, is shown associated with the bull wheel.

The bull wheel is provided with a plurality of radially extending slots 35, one for each of the reels, and the wires W1 are fed through these slots by individual wire feed units 37. One feature of the invention is the means for mounting several wire feed units so that they can be adjusted radially of the bull wheel to enable the making of wire cages of any given diameter within the limitations of the apparatus. To accomplish this, each wire feed unit 37 is mounted between a pair of guide rails 39 disposed, respectively, on each side of a slot 35. A plate 40 on the front side of the bull wheel in conjunction with one or more bolts 41 serves to secure a unit in adjusted position.

Each of the units 37 is driven by a shaft 44 (Fig. 4) which extends radially of the bull wheel, being journaled at 46 and 47. The shafts are positioned adjacent the slots 35 and extend parallel thereto. Any suitable drive connection may be employed between each drive shaft and the wire feed unit associated therewith so as to permit adjusted positioning of the unit to any point along the shaft. For example the drive connection may be a pinion 48 forming part of the unit 37 and keyed to shaft 44 but slidable therealong for purpose of adjustment.

The shafts 44 are driven by a main drive shaft 50, which is journaled in the tube 18, through the medium of intermeshing gears 51 upon the inner end of the drive shaft and the inner ends of shafts 44.

The tube and bull wheel assembly 11 is driven by a motor 52 through the medium of gears 53 and 54. The drive shaft 50 for the wire feed units 37 projects beyond the end of the tube and carries a sprocket 56. The tube itself is also provided with a sprocket, designated 57, which serves to drive a speed change unit 58 by means of a chain 59 passing around the sprocket 60 on the input shaft 61 of the unit. The output shaft 63 carries a sprocket 64 which drives a chain 65 passing around the sprocket 56 on drive shaft 50.

As will later appear, during the welding cycle the forward feed of the wires W1 is interrupted. This is accomplished by providing a flexible drive means between unit 58 and shaft 50. This comprises a rod 67 (Figs. 1

and 13) journalled at 68 and to which are secured oppositely extending arms 70 and 71. The first of these carries a weight 72 and the second carries an idler sprocket 73 which engages the drive or tension run of drive chain 65. The chain has considerable slack therein and in the normal operation the force of the weighted arm is sufficient to take up the slack. However, when there is an unduly large resistance or load operating to stop the forward travel of the wires W1, the driven sprocket 56 may stop while the shaft 63 takes up the slack in the chain 65 against the force of the weighted arm 70.

Upon the forward side of the bull wheel I mount a forming hub 75 which is provided with wire feed tubes 76 and grooves 77 through which the wires W1 are fed forwardly by the units 37. I also provide an axially extending cage-supporting tube 78 and on this, a plurality of cage-supporting spiders or brackets 80, to hold the cage or reticulated wire structure C as it is formed and progresses to the left as shown in Figure. 1.

As the longitudinal wires W1 are fed forwardly through the bull wheel the wire W2 is wrapped therearound, being fed by means 12 which also serves as a wire-straightening and wire-prebending means. The means 12 is driven by motor 82. The wire W2 is guided by a roller 83 carried on an adjustable bracket 84 mounted at the side of frame 25 and also guided by a rod 85 mounted at the upper part of the frame. The rod has an eye 86 at its lower end through which wire W2 passes before it is wound around the wires W1. Rod 85 is adjustably carried in a bracket 88 and is provided with a spring-biased roller 90 which assists in holding the wire against the cage being formed.

A particular feature of the invention is the mounting and operation of the means 15 for welding the "cross-overs" of the wire W2 with the wires W1. In general, this comprises a carriage 94 provided with one or more welding electrodes, means for advancing and retracting the electrodes, and means for mounting and moving the carriage so that it can travel with the cage during a portion of a revolution thereof.

The carriage 94 is shown as provided with two inner wheels 96 and two outer wheels 98, the wheels having a peripheral groove 99 to receive and ride upon a circular track 101 secured to the forward face of the bull wheel 21. The outer wheels 98 are so mounted as to be adjustable toward and away from the inner wheels. Thus each outer wheel is rotatably mounted upon the eccentric portion 104 of a stub shaft 105. The outer end 106 of the shaft is shown as rectangular and inwardly of this is a threaded section 107. A nut 108 secures the stub shaft. A plate 110 having a rectangular opening 111 receives end 106 of the stub shaft. The plate has an arcuate slot concentric with the opening 111 and this receives a bolt 114 which threads into the body 115 of the carriage.

The carriage includes a main body in the form of a plate, designated 115, and this is provided with a pair of undercut clamp bars 116 which serve to hold the base plate 117 of the welding electrode assembly for adjustment along the body toward and away from the axis of rotation of the bull wheel. Studs 118 and nuts 119 serve to secure the parts. On the base plate 117 I provide two welding electrodes, designated 120 and 121. These are carried on piston-cylinder units 122 of conventional type for axial movement toward and away from the cage being formed. The units 122 are mounted in a plate assembly 124 which is secured by appropriate studs 125 and nuts 126 in a plate 127. Both assembly 124 and plate 127 are carried on the base plate 117.

In the drawings of the welding means I have omitted the fluid or air connections to the units 122 and the electrical conductors to the welding electrodes; however, it will be understood that conventional electrical and fluid connections can be used and that conventional electronic control of the welding electrodes can be utilized. However, as will later become apparent, I only use electrode 120 for the purpose of welding the crossovers of the wire W2 with the wires W1, the electrode 121 being merely a return conductor for the electrical current. In the event of feeding two circumferential wires simultaneously these electrodes can each weld one crossover in a series type weld.

Immediately above electrode 120, I provide a wire guide finger 128 having a recess 128' at its end for slidably receiving the circumferential wire W2. Bolts 129 mounted in an L-shaped plate 130 on base 117 serve to secure the finger in adjusted position, the bolts passing through slots 131 in the finger.

As previously indicated, the carriage is actuated in timed relation to the rotation of the bull wheel and cage being formed so that the carriage follows the work through a portion of its rotation and then returns to its initial point. In order to accomplish this, I provide a lever 133 which is pivotally mounted at 134 upon the lower end of the carriage body 115. The lower end of lever 133 is pivotally connected at 135 to a second lever, designated 136. The latter is pivotally mounted adjacent its outer end at 137. The outer end of the second lever carries a pair of oppositely extending cam follower rollers 138 which engage cam tracks 139, respectively, formed in a pair of cam wheels 140 between which the lever extends. The inner faces of the cam wheels have an inner cam 141, and an outer cam 142 providing the cam track referred to.

The cam wheels 140 are fixed to a shaft 144 which is journaled at 146, 147, and 148. The shaft is driven in timed relation to the assembly 11 by chain 150 which passes around a sprocket 151 fixed to shaft 144 and around a sprocket 152 fixed to tube 18.

As previously indicated, the welding means 15 is caused to move with the bull wheel during a portion of its rotation and thereafter is returned to its original position, the welding cycle taking place during the movement of the welding means with the bull wheel and cage being formed. In Fig. 5 the parts are shown with the welding carriage in its original or upper position, while in Fig. 6 it is shown in its lower position at the end of the welding cycle. During the welding cycle the welding electrodes are automatically moved inwardly, causing electrode 120 to engage and firmly press wire W2 against one of the wires W1 where the former crosses the latter. The particular wire W1 in turn is pressed tightly against the hub 75, stopping its forward motion and that of the other wires W1 as permitted by the flexible drive for shaft 50 previously described.

It should be noted that the wire guide finger 128 is directly above electrode 120 so that registration of that electrode with wire W2 at all times is insured. Registration of the same electrode with the point or region of W2 where it crosses one of the wires W1 is insured by the fact that shaft 144 is driven directly by the tube 18 as previously described, so that the welding carriage operates in timed relation to the bull wheel.

The lateral spacing of electrodes 120 and 121 is such that electrode 121 does not engage the wires of the cage but engages hub 75 on the bull wheel. The electrode 121 thus merely serves as a return for the electrical current. However, as previously indicated, if it is desired to feed two circumferential wires simultaneously, each electrode can be used to weld a crossover with suitable guide means provided to cause electrode 121 to follow one of the circumferential wires.

Conventional control and actuating means may be provided for the electric welding and for the fluid-operated piston-cylinder units 122 which move the electrodes into engagement with the work and subsequently return them to their original position. However, for the purpose of initiating such welding cycle control means, I provide a cam disk 160 on the shaft 144 and this is shaped ap-

propriately to actuate a microswitch **161** at the proper time to initiate the welding cycle through the conventional type of welding control means (not shown) to which switch **161** may be connected.

Although I have illustrated and described a preferred form of my invention, I contemplate that various changes and modifications can be made therein without departing from the invention, the scope of which is indicated by the following claims.

I claim:

1. In apparatus for making reticulated wire structures, a rotatable wire feed and support assembly for feeding a plurality of wires in circumferentially spaced relation axially of said assembly and simultaneously rotating said wires as a whole about the axis of rotation of said assembly to wind another wire therearound, welding means supported for limited movement on an arc concentric with the axis of rotation of said assembly, and means for causing said welding means to travel with said assembly for a limited distance.

2. In apparatus for making reticulated wire structures, a rotatable wire feed and support assembly for feeding a plurality of wires in circumferentially spaced relation axially of said assembly and simultaneously rotating said wires as a whole about the axis of rotation of said assembly to wind another wire therearound, welding means carried on said assembly for movement relative thereto in a given arc concentric with the axis of rotation of said assembly, and means for causing said welding means to move with said assembly from a given point during a portion of a revolution thereof and for causing the same subsequently to move oppositely to said assembly and return to said given point.

3. Apparatus as set forth in claim 2 in which said wire feed and support assembly includes means providing a circular track concentric about the axis of rotation of said assembly and in which said welding means is mounted to ride on said track.

4. In apparatus for making reticulated wire structures, a rotatable wire feed and support assembly for feeding a plurality of wires in circumferentially spaced relation axially of said assembly and simultaneously rotating said wires as a whole about the axis of rotation of said assembly to wind another wire therearound, welding means supported for movement about an arc concentric with the axis of rotation of said assembly, means for causing said welding means to travel with said assembly for a limited distance and subsequently to travel oppositely thereto, said last-mentioned means comprising a movable cam, lever means operatively connecting said cam and said welding means, and means for driving said cam in timed relation with said wire feed and support assembly.

5. In apparatus for making reticulated wire structures, a rotatable wire feed and support assembly for feeding a plurality of wires in circumferentially spaced relation axially of said assembly and simultaneously rotating said wires as a whole about the axis of rotation of said assembly to wind another wire therearound, said assembly providing a circular track concentric about its axis of rotation, a carriage mounted for movement on said track, welding means carried by said carriage adapted to engage the wire structure being formed, and means for causing said carriage to move with said assembly from a given point during a portion of a revolution of the wheel and subsequently causing the carriage to move oppositely to said wheel and return to said given point.

6. Apparatus as set forth in claim 5 in which said wire feed and support assembly includes yieldable drive means for feeding said first-mentioned wires and for permitting said wires to momentarily pause in their forward movement when engaged by said welding means.

7. In apparatus for making reticulated wires structures, a rotatable wire feed and support assembly for feeding a plurality of wires in circumferentially spaced relation axially of said assembly and simultaneously rotating said wires as a whole about the axis of rotation of said assembly to wind another wire therearound, said assembly including a circular track disposed concentrically about the axis of rotation of the assembly, welding means mounted for movement on said track, and means for causing said welding means intermittently to travel with said track, comprising a lever pivotally mounted intermediate its ends, a link connecting one end of said lever to said welding means, a roller carried at the other end of said lever, a cam wheel engaged by said roller, and means for driving said cam wheel in synchronism with said assembly.

8. In apparatus of the type described, a rotatable member providing a circular track, means for rotating said member, a carriage mounted for movement on said track, and means for causing said carriage to travel with said rotatable member a given distance and for causing said carriage subsequently to move oppositely to said member for a distance equal to the distance previously traveled with said member.

9. Apparatus as set forth in claim 8 in which said last-mentioned means comprises a lever pivotally mounted intermediate its ends, a link connecting one end of said lever to said carriage, a roller carried at the other end of said lever, a cam wheel engaged by said roller, and means for driving said cam wheel in synchronism with said rotatable member.

10. In apparatus for making reticulated wire structures, a rotatable wire feed and support assembly for feeding a plurality of wires in circumferentially spaced relation axially of said assembly and simultaneously rotating said wires as a whole about the axis of rotation of said assembly to wind another wire therearound, means for rotating said assembly, a movably mounted welding assembly, and means for causing said welding assembly to follow and move with said first-mentioned assembly for a given period.

11. In apparatus for making reticulated wire structures, a rotatably mounted assembly adapted to carry a plurality of wire supply reels, a wire feed support structure extending generally normal to the axis of rotation of said assembly, a plurality of wire feed mechanisms, and means for adjustably securing and positioning said wire feed mechanisms radially of said support structure.

12. In apparatus for making reticulated wire structures, a rotatably mounted structure adapted to carry a plurality of wire supply reels, a plurality of drive shafts journaled on said structure and extending radially of the axis of rotation thereof, means for driving said shafts, a wire feed mechanism associated with each shaft and mounted on said structure for adjusted positioning along the shaft, and a driving connection between each shaft and its associated wire feed mechanism.

13. In apparatus for making reticulated wire structures, a rotatably mounted assembly including a tube and a bull wheel attached thereto, means for rotating said assembly, a plurality of wire supply reels carried on said tube, said bull wheel having a plurality of radial slots, a secondary drive shaft mounted on said wheel adjacent each slot, a wire feed mechanism mounted on said wheel adjacent each slot for feeding a wire generally axially of the axis of rotation of said assembly, each of said wire feed mechanisms being adjustable along its associated slot and shaft, a driving connection between each said shaft and its associated wire feed mechanism, and means for driving said secondary drive shafts including a main shaft extending axially within said tube and a driving connection between each secondary drive shaft and said main shaft.

14. In apparatus for making reticulated wire structures, a rotatable wire feed and support assembly for feeding a plurality of wires in circumferentially spaced relation axially of said assembly and simultaneously rotating said wires as a whole about the axis of rotation of said assembly to wind another wire therearound, said assembly including a circular track disposed concentrically about the axis of rotation of the assembly, a car-

riage mounted on said track for movement relative thereto, welding means mounted on said carriage including a welding electrode mounted for movement toward the axis of rotation of said assembly and means for moving the electrode to engage the work, a shaft, a driving connection between said assembly and said shaft, a cam wheel fixed to said shaft, lever means operatively connecting said cam wheel and said carriage for causing said carriage periodically to travel with said assembly during a portion of a revolution thereof and subsequently to return to its original position, and means controlled by rotation of said shaft for operating said welding means.

15. In apparatus for making reticulated wire structures, a rotatably mounted assembly including a tube and a bull wheel attached thereto, means for rotating said assembly, a plurality of wire supply reels carried on said tube, said bull wheel having a plurality of radial slots, a secondary drive shaft mounted on said wheel adjacent each slot, a wire feed mechanism mounted on said wheel adjacent each slot for feeding a wire generally axially of the axis of rotation of said assembly, each of said wire feed mechanisms being adjustable along its associated slot and shaft, a driving connection between each said shaft and its associated wire feed mechanism, a main drive shaft journaled in said tube, a driving connection between said main shaft and each of said secondary shafts, and drive train means between said tube and said main shaft for driving the latter at a predetermined speed with reference to said tube, said drive train means including flexible means enabling said main shaft to be stopped by excess load thereon for a limited period of time while said tube continues rotating.

16. In apparatus for making reticulated wire structures, a rotatably mounted assembly including a tube and a bull wheel attached thereto, means for rotating said assembly, a plurality of wire supply reels carried on said tube, said bull wheel having a plurality of radial slots, a secondary drive shaft mounted on said wheel adjacent each slot, a wire feed mechanism mounted on said wheel adjacent each slot for feeding a wire generally axially of the axis of rotation of said assembly, each of said wire feed mechanisms being adjustable along its associated slot and shaft, a driving connection between each said shaft and its associated wire feed mechanism, a circular track

on said bull wheel concentric about the axis of rotation of said assembly, a carriage adapted to carry welding means mounted for movement on said track, means operably connected to said assembly for causing said carriage to move with said bull wheel for a limited distance and subsequently to return to its original position, flexible means for driving said secondary drive shafts, said flexible means enabling said secondary drive shafts to be stopped by excess load thereon.

17. In apparatus for making reticulated wire structures, a support, a rotatable assembly rotatably mounted on said support, said assembly including a bull wheel and a tube attached thereto concentric with the axis of rotation of the assembly, means for rotating said assembly, a plurality of wire feed mechanisms carried on said assembly for feeding a plurality of wires parallel to the axis of rotation of the assembly, a first shaft journaled in said tube, a driving connection between said first shaft and said wire feed mechanisms, means for driving said first shaft in timed relation with the rotation of said assembly, a second shaft, means for driving said second shaft in timed relation with said assembly, a carriage mounted on said bull wheel for movement relative thereto about the axis of rotation of the assembly, and a driving connection between said carriage and said second shaft for causing said carriage to move with said bull wheel for a limited distance and subsequently to return to its original position.

18. Apparatus as set forth in claim 17 in which the means for driving said first shaft is connected between said assembly and said first shaft and in which said means is sufficiently flexible to permit of the stoppage of said first shaft for a limited period of time irrespective of the continued rotation of said assembly.

19. Apparatus as set forth in claim 17 in which said second shaft is driven by said assembly.

20. Apparatus as set forth in claim 17 in which both said first and said second shafts are driven by said assembly.

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