

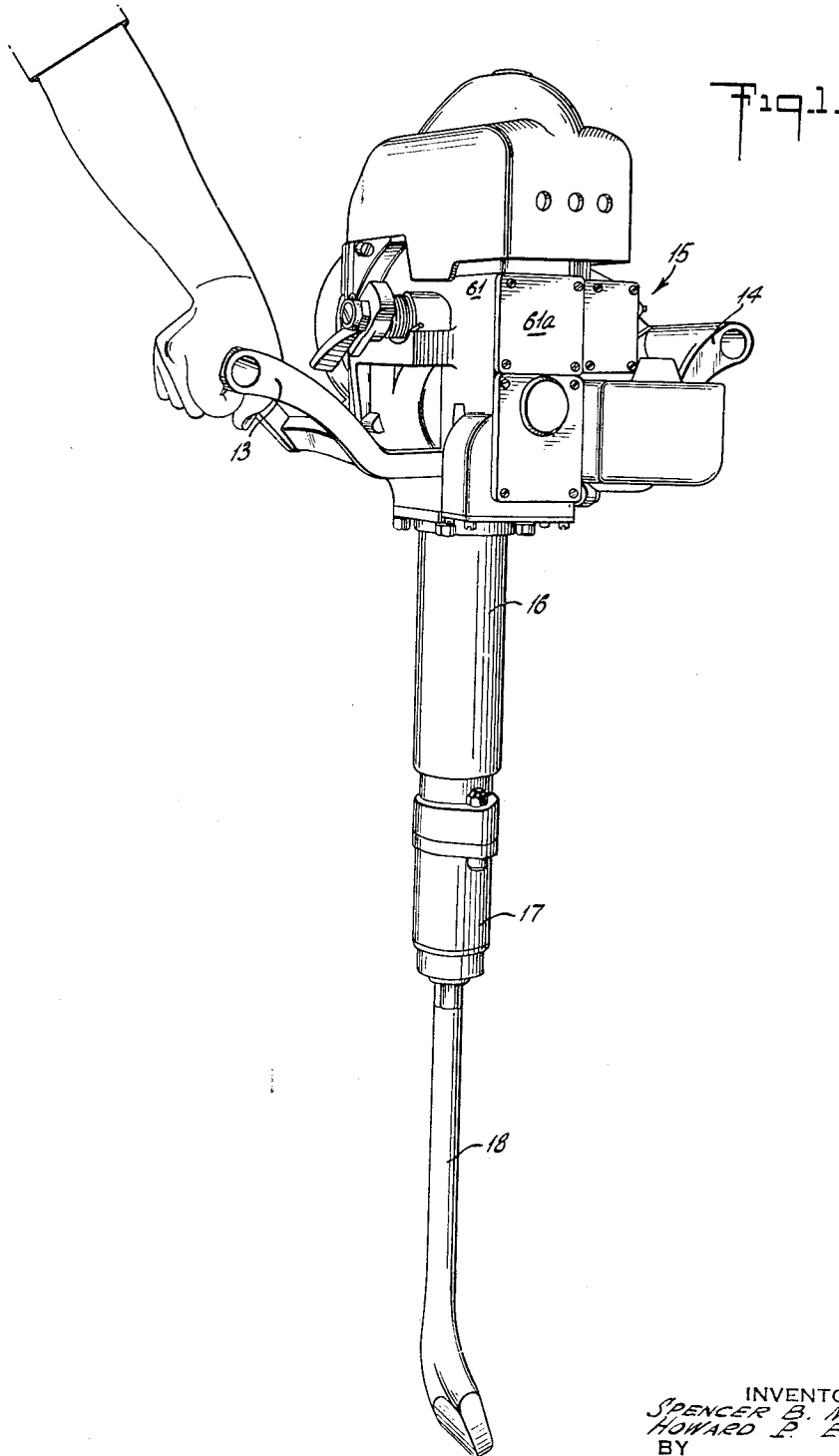
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S. B. MAURER ET AL
GAS HAMMER

2,677,355

Original Filed Aug. 15, 1946

3 Sheets-Sheet 1



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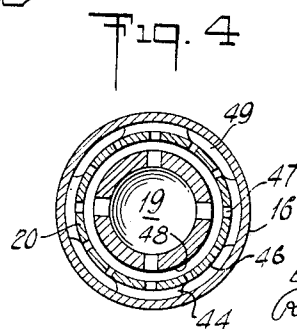
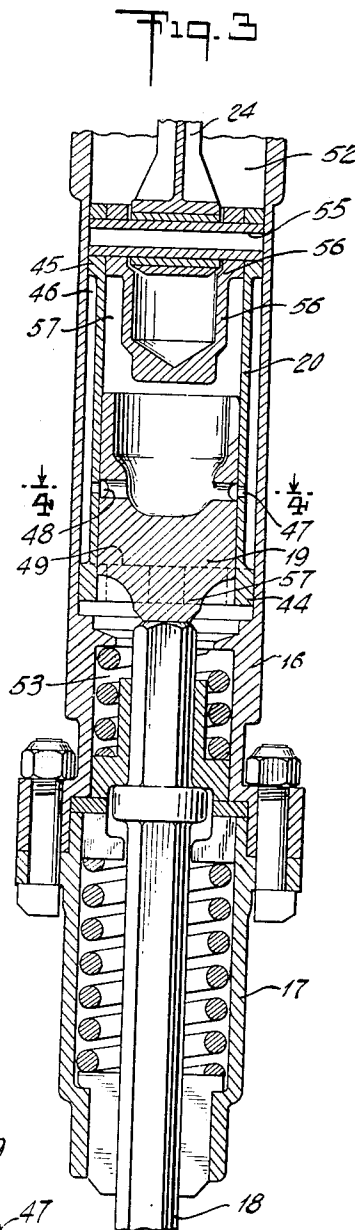
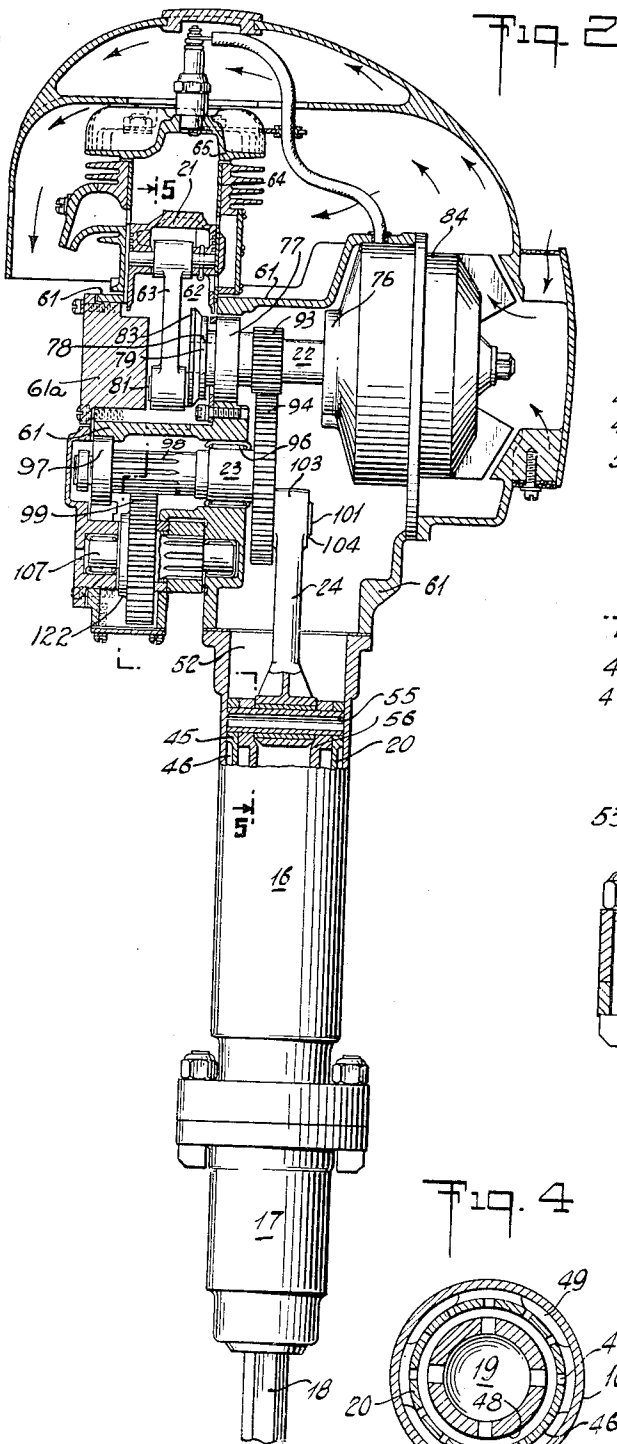
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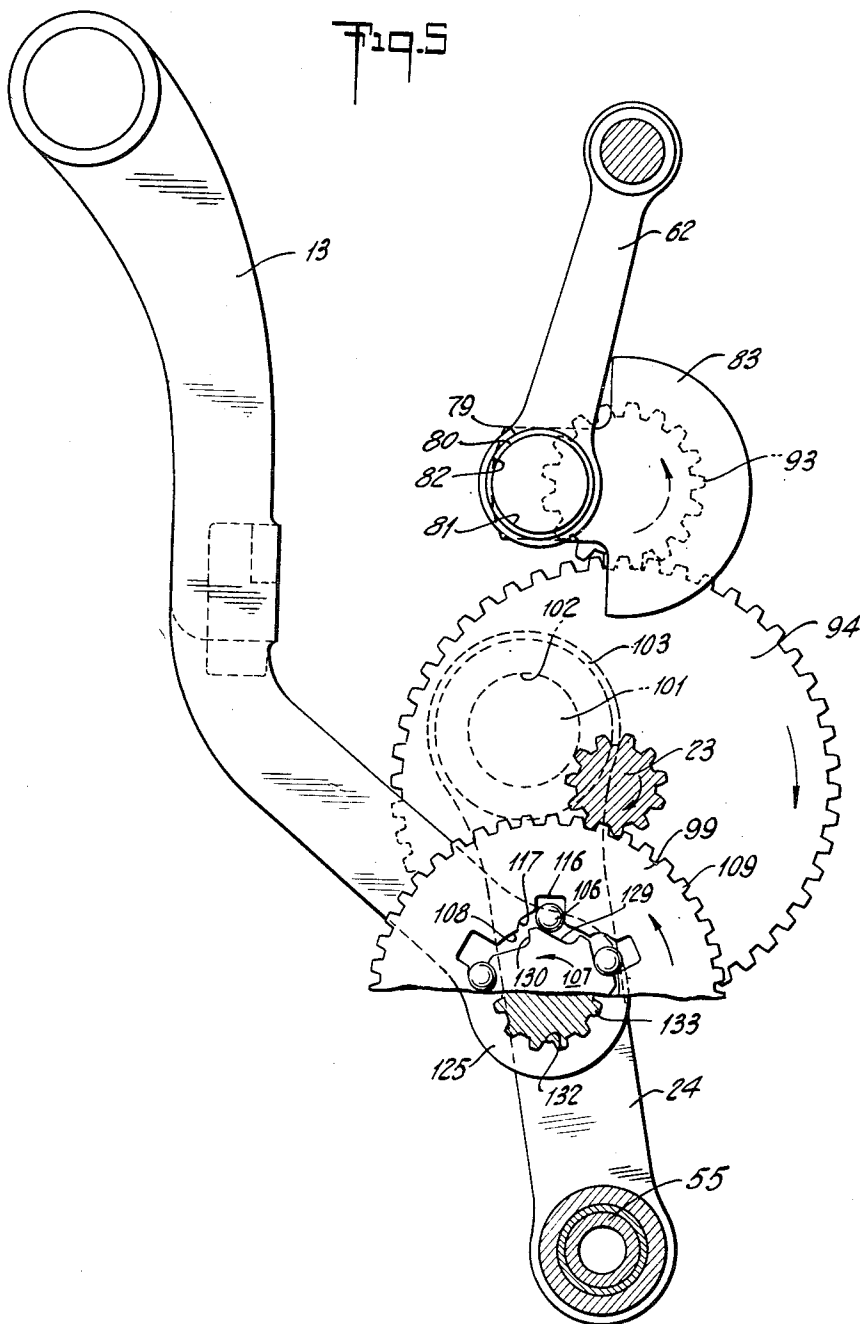
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UNITED STATES PATENT OFFICE

2,677,355

GAS HAMMER

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Original application August 15, 1946, Serial No. 690,654, now Patent No. 2,533,487, dated December 12, 1950. Divided and this application July 25, 1950, Serial No. 175,742

1 Claim. (Cl. 123-7)

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This invention relates generally to percussive tools in which the motive power is derived from an integrally formed internal combustion engine, and more particularly to improvements pertaining to the driving connection between the engine and a hammer assembly of such tools.

This application is a division of our parent application Serial No. 690,654, filed August 15, 1946, which issued as Patent No. 2,533,487, on December 12, 1950. Other divisional applications are as follows: Serial No. 103,662, filed July 8, 1949, now Patent 2,609,813, dated September 9, 1952; Serial No. 176,984, filed August 1, 1950 (now abandoned), containing claims to a cooling system for a percussive tool internal combustion engine; Serial No. 248,076, filed September 19, 1951, containing claims to a handle starter arrangement for a gas hammer.

In the illustrative embodiment of the present invention, a tie tamper is driven by a gasoline powered single cylinder, two cycle, air-cooled engine designed to impart rapid downward blows to a tamping bar mounted vertically in the lower end of the tool. The engine is mounted directly atop a cast aluminum housing, which is the main body of the tool, and is connected to a hammer assembly which imparts impact blows to the tamping bar. A prime feature of the invention resides in the manner of connecting the engine to the hammer assembly, so that in addition to the power transmission means afforded, a convenient arrangement is provided for the integration of a handle starter arrangement.

The main object of this invention is the provision of an improved arrangement for connecting an internal combustion engine with a hammer assembly in a portable tie tamper.

A further object is the provision of an arrangement whereby a handle starter means may be arranged in the connection between the engine and hammer assembly.

Other objects and structural details of the invention will be apparent from the description when read in conjunction with the accompanying drawings, wherein:

Fig. 1 is a view, in perspective, of the tool of the present invention, shown adapted for the tamping operations, with the starter handle in the lowered position;

Fig. 2 is a longitudinal section view, the lower part of the tool being shown in elevation; and

Fig. 3 is a longitudinal section in the same plane as Fig. 2, showing a striking hammer and cage in lowered or foremost position and in contact with the working implement. Fig. 4 is a

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cross section view as indicated by the arrows 4-4 in Fig. 3.

Fig. 5 is a view of the transmission mechanism shown in relation to the starter handle and shaft with an intervening clutch in position for starting operation. Figs. 2, 3 and 4 are drawn to a larger scale than Fig. 1, while Fig. 5 is further enlarged.

As shown in Fig. 1, the tool of the invention is a portable, unitary structure which may be manipulated by one or two men by means of properly and conveniently disposed handles 13 and 14. For purposes of description, the tool may be considered as divided into a plurality of cooperating sections or parts including an upper portion 15, a downwardly extending barrel 16, and a barrel extension or nose 17. Extension or nose 17 supports a working implement 18 which, in the present instance, is a tamping bar. Referring also to Fig. 3, the inner end of the bar 18 projects into the barrel 16 in position to receive blows of percussion from a hammer piston 19. The piston 19 forms part of a free piston type hammer assembly and moves within a cylindrical cage 20 slidably mounted within the barrel 16. The cage 20 is reciprocated by power transmission means connected to the driving piston 21 of the internal combustion engine. The transmission means, hereinafter more fully described, comprises an engine crankshaft 22 driven by the piston 21, a main crankshaft 23 actuated by the engine crankshaft 22 through pinion and gear means, and a connecting rod 24 between the main crankshaft 23 and the cage 20. The reciprocating action of cage 20 imparts repetitive hammering action to the hammer piston 19 as hereinafter described.

The tamping bar is driven in its working operations by blows percussively imparted by the striking or hammer piston 19 which is slidably mounted in cage 20. Cylindrical cage 20, which is made from a seamless steel tubing, is provided at its ends with annular enlargements or shoulders 44 and 45 which slidably engage the inner wall of barrel 16. The mid-portion of the cage 20 is of reduced external diameter to provide an annular space 46 between the cage and the barrel, and said portion of reduced diameter is formed with a series of circumferentially spaced ports or openings 47 to cooperate with a groove 48 in the piston as hereinafter more fully described. The shoulders 44 and 45 are formed with circumferentially arranged longitudinal recesses 49 which serve to connect the annular space 46 respectively with the chamber 52 of the main crankshaft and the barrel chamber 53. Continuous communica-

tion is thus established between the top and bottom of the cage to minimize pressure fluctuations. The chambers 52 and 53 may be vented by exhaust ports (not shown) or alternatively may be enclosed from the atmosphere and maintained at any suitable pressure. In any event, the pressure fluctuations in chambers 52 and 53 are slight, due to the equalizing effect of recesses 49 which transfer air from one chamber to the other and thereby inhibit compression in either chamber as a result of the movements of cage 20 and piston 19. Cage 20 is connected to the connecting rod 24 by means of a wrist pin 55 which is passed through aligned holes in the upper end of the cage and in the lower terminal of the connecting rod. An aluminum head 56 fits snugly within the upper end of cage 20 to form an air-tight closure for a chamber or air pocket 57 which lies above hammer piston 19. The head is transversely bored to receive the wrist pin 55 and is provided at its upper end with a square recess to receive the lower end of the connecting rod. The cage head 56 has a downwardly protruding portion which fills up a considerable part of the air pocket 57. Reciprocating movement is imparted to the cage by the connecting rod 24, and is transmitted through the air pocket 57 to the striking piston 19.

The upper portion 15 of the tool contains the internal combustion engine and controls therefor, including the starting mechanism and fly-wheel magneto. In the illustrative embodiment the engine is of the two-cycle type. The principal supporting element for the engine is a frame piece or crank case 61, to which is bolted a cover 61^a, the frame piece and cover being made of aluminum, and cooperating to form an air-tight crankcase chamber 62 through which the connecting rod 63 passes. The driving piston 21 reciprocates within a cylinder 64 in the cylinder head 65 secured to the frame in conventional manner.

Motion is transmitted from the piston 21 through the engine crankshaft 22 to the main shaft 23. The engine crankshaft 22 is rotatably supported in ball bearing assemblies 76 and 77, the latter being mounted in the frame 61. The left hand end of the engine crankshaft (as viewed in Fig. 2) extends into the crankcase chamber 62 and has keyed thereto, as at 78, a crank arm 79. Arm 79 has an outwardly projecting stud 81 extending into a cylindrical aperture 82 in the connecting rod 63 and is also formed with a fan-shaped counterweight 83. Needle bearings 80 are provided for the easy rotation of the stud 81 within the connecting rod receiving aperture 82.

For effecting return motion of the piston 21 and thereby of the piston hammer assembly, a fly-wheel 84 is mounted upon the outer end of the engine crankshaft. The kinetic energy stored in the fly-wheel 84 on the power stroke of the piston 21, in conjunction with the counterweight 83, is sufficient to continue the rotation of the crankshaft 22 and to transmit through the crank arm 79 and connecting rod 63 force for the return stroke of the piston 21. The connection between the rod 63 and the crankshaft 22 is such that they are constrained to move in unison, and operation of either element effects a simultaneous operation of the other. Their relationship as driven and driving elements is mutual and reversible.

The engine crankshaft 22 drives the main crankshaft 23 by means of pinion 93 on the engine crankshaft and the gear wheel 94 which is

integral with the main crankshaft. Main crankshaft 23 is rotatably mounted in the frame 61 by needle bearings 96 and ball thrust bearings 97, and is provided at its forward portion with splines which form a pinion 98 to cooperate with the toothed clutch ring 99, as hereinafter described. The inner face of gear wheel 94 is provided with a stud 101 which projects into the circular aperture 102 in the terminal portion 103 of the cage connecting rod 24, a bushing 104 being disposed between the stud and the rod terminal. Connecting rod 24 is connected at its lower end to the cage 20 by wrist pin 55, as hereinbefore described. It thus may be seen that the reciprocal motion of the engine or driving piston 21 is transmitted through the connecting rod 63 and the crankshaft arm 79 to impart rotary motion to the engine crankshaft 22 and that in operation the engine crankshaft 22 drives the main crankshaft 23. Crankshaft 23, through the cage connecting rod 24, acts as a reciprocating driver for the cage 20.

The toothed clutch ring 99 and rollers 106, as shown in Fig. 5, cooperate to form a clutch mechanism between the starter shaft 107 and the main crankshaft 23. Ring 99 is formed with an axial bore 108 and with a toothed periphery 109 to gear with the splined portion of the main crankshaft 23. The axial bore 108 of the clutch ring 99 is provided with a plurality of spaced slots 116 (Fig. 5) circumferentially arranged and extending axially from the body of the brazed ring to the outer wall of the clutch ring. Each slot is formed with an adjacent arcuate portion 117 the purpose of which will be explained.

The periphery of the central portion 122 of the starter shaft 107 is formed with a plurality of longitudinally extending spaced grooves 129 which serve, in conjunction with the cooperating slots 116 in the bore of the clutch ring 99, as seats for rollers 106 to form a clutch as previously stated. Each peripheral groove has an arcuate portion 130 throughout its length which has the same radius as a roller and forms a shoulder adapted to engage a roller to force it against the arcuate portion 117 of the slot 116 when shaft 107 is rotated counter-clockwise (as viewed in Fig. 5) by the rotary thrust of the starter handle 13. One of the rollers 106, which will be at rest upon the upper portion of the starter shaft when the tool is not in operation, will wedge between a shoulder 130 of the starter shaft 107 and an arcuate portion 117 of a slot 116 when the shaft is actuated. In Fig. 5 such engagement is shown in the "10 o'clock position," although in actual operations such engagement or clutching may take place at any point in the upper portion of the shaft. Clutching will not be effected in the lower regions since the rollers will drop by gravity into the slots 116 when the tool is at rest. Motion is imparted to the starter shaft by a sudden downward thrust by the operator of the starter arm 13 whose inner terminal 125 is provided with teeth 132 to engage splines 133 formed on the forward portion of the starter shaft 107. Such starting motion of the starter shaft is counterclockwise and the clutch ring 99 moves in the same direction at the speed of the starter shaft. Said clutch ring transmits motion at a higher speed to the main crankshaft, thence at a still higher speed to the engine or magneto crankshaft 22. As the engine picks up speed, the clutch ring will overrun the starter shaft and the rollers will be urged by centrifugal

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force into the slots 116 where they will remain throughout the normal operation of the tool.

In the illustrative embodiment the total gear ratio from the starter shaft 107 to the engine crankshaft 22 is 11.4 to 1. Thus a quarter turn of the starter shaft will turn the engine over approximately three times. A rapid downward thrust of the starter handle 13 through its normal ten inch stroke (approximately one-quarter turn of starter shaft) will produce more than three full revolutions of the engine at a fairly high speed.

The gear ratio between the engine crankshaft 22 and the main crankshaft 23 is about 2.85 to 1. The advantages of using a high speed motor with gear reduction are more power per cubic inch of motor, more cooling air with a smaller fan, better magneto operation (hotter spark) and smoother operation due to larger number of smaller motor impulses and accentuated fly-wheel effect of the rather heavy magneto rotor.

What is claimed is:

In a portable self-contained percussive tool of the class wherein power is transmitted from an

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internal combustion engine to a hammer assembly, in combination, a frame piece for the support of said engine, a rotatable crankshaft having a splined portion, a second rotatable crankshaft provided with a splined portion and a toothed flange with a stud projecting from the flange, said toothed flange being adapted to cooperate with the splined portion on the first crankshaft for the mutual transmission of motion, mounting means formed in said frame piece for the support of said rotatable crankshafts, and a connecting rod mounted upon the second crankshaft stud at one end and at the other end to the hammer assembly.

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